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The Behavior Change Workbook and the laboratory activities are also found in an interactive format in Connect (connect.mheducation.com).
McGraw-Hill Connect® is a digital teaching and learning environment that improves performance over a variety of critical outcomes; it is easy to use; and it is proven effective. Connect® empowers students by continually adapting to deliver precisely what they need, when they need it, and how they need it, so your class time is more engaging and effective. Connect for Fit & Well offers a wealth of interactive online content, including fitness labs and self-assessments, video activities on timely health topics and exercise technique, a behavior-change workbook, and practice quizzes with immediate feedback.

Connect Insight® is Connect’s new one-of-a-kind visual analytics dashboard—now available for both instructors and students—that provides at-a-glance information regarding student performance, which is immediately actionable. By presenting assignment, assessment, and topical performance results together with a time metric that is easily visible for aggregate or individual results, Connect Insight gives the user the capability to take a just-in-time approach to teaching and learning, which was never before available. Connect Insight presents data that empowers students and helps instructors improve class performance in a way that is efficient and effective.

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The digital teaching and learning tools within Connect are built on the solid foundation of *Fit & Well*’s authoritative, science-based content. *Fit & Well* is written by experts who work and teach in the fields of exercise science, physical education, and health education. *Fit & Well* provides accurate, reliable current information on key health and fitness topics while also addressing issues related to mind-body health, diversity, gender, research, and consumer health.

**Wellness in the Digital Age** sections focus on the many fitness- and wellness-related devices and applications that are appearing every day.

**Evidence for Exercise** sections demonstrate that physical activity and exercise recommendations are based on solid scientific evidence.

**Critical Consumer** boxes help students navigate the numerous and diverse set of health-related products currently available.

**Take Charge** features provide a wealth of practical advice for students on how to apply concepts from the text to their own lives.

**Diversity Matters** features address the ways that our biological and cultural differences influence our health strengths, risks, and behaviors.

**Fitness Tips** and **Wellness Tips** catch students’ attention and get them thinking about—and acting to improve—their fitness and wellness.

**Hands-on lab activities** give students the opportunity to assess their current level of fitness and wellness and to create their own individualized programs for improvement.

**Exercise photos and online videos** demonstrate exactly how to correctly perform exercises described in the text.
Changes to the twelfth edition reflect new research findings, updated statistics, and current hot topics that impact students’ fitness and wellness behaviors. Revisions were also guided by student performance data anonymously collected from the tens of thousands of students who have used LearnSmart with *Fit & Well*. Because virtually every text paragraph is tied to several questions that students answer while using LearnSmart, the specific concepts that students are having the most difficulty with can be pinpointed through empirical data.

Chapter 1: Introduction to Wellness, Fitness, and Lifestyle Management

- Discussions of dimensions of wellness expanded to include cultural and occupational wellness
- All statistics updated to reflect the latest information on causes of death, life expectancy, and measures of quality of life
- New section on the Affordable Care Act

Chapter 2: Principles of Physical Fitness

- New Take Charge feature on reducing sedentary behaviors
- Updated information on medical clearance and risks from exercise

Chapter 3: Cardiorespiratory Endurance

- New Take Charge feature on high-intensity conditioning programs
- Updated coverage of warm-up and cool-down, high-intensity interval training, and cross-training

Chapter 4: Muscular Strength and Endurance

- New table summarizing pros and cons of stability balls
- Updated coverage of core training

Chapter 5: Flexibility and Low-Back Health

- Updated coverage of static and dynamic stretching and exercise safety for back pain
- New illustration of core musculature

Chapter 6: Body Composition

- Updated statistics on overweight and obesity in U.S. adults
- Updated and expanded coverage of diabetes

Chapter 7: Putting Together a Complete Fitness Program

- New Evidence for Exercise feature on the importance of reducing sedentary time
- Updated coverage of apps for tracking and motivation during a fitness program

Chapter 8: Nutrition

- Incorporation of information from the Scientific Report of the 2015 Dietary Guidelines Advisory Committee
- New tables summarizing recommended healthy dietary patterns, including vegetarian and Mediterranean patterns
- New Take Charge feature on making positive dietary changes
- Discussion of new FDA requirements for labels on food packaging, in restaurants, and for vending machines
- Expanded coverage of added sugars and updated discussion of dietary fats, including the FDA ban on trans fats

Chapter 9: Weight Management

- Expanded sections on environmental and cultural factors contributing to overweight and obesity
- Updated coverage of prescription medications and dietary supplements marketed for weight loss
- New illustration highlighting the change in restaurant portion sizes over time
- Updated statistics and information on eating disorders, including a new version of the eating disorder assessment in Lab 9.3

Chapter 10: Stress

- Updated statistics on stress and stress management techniques
- New sections on Type D personality and enhanced discussion of how gender and cultural factors influence stress
- New Wellness in the Digital Age feature on apps for improving and tracking sleep

Chapter 11: Cardiovascular Health

- Updated statistics on cardiovascular disease incidence, prevalence, and deaths
- Updated coverage of CVD prevention strategies, cholesterol guidelines, metabolic syndrome, and drugs and other CVD risk factors
Chapter 12: Cancer
• Updated statistics on new cancer cases and deaths
• New Health in the Digital Age feature on cancer screening reminders
• New section on cancer staging
• Updated coverage of characteristics of melanoma, cancer prevention strategies, and cancer screening tests

Chapter 13: Substance Use and Misuse
• New sections on misuse of prescription and over-the-counter medications and on current illicit drugs of concern, including synthetic marijuana and bath salts
• Updated statistics on use of illicit drugs, tobacco, and alcohol; updated information on the legal status of tobacco and marijuana
• Updated and expanded coverage of e-cigarettes and hookas

Chapter 14: Sexually Transmitted Infections
• Updated statistics on HIV and other STDs
• New information on home HIV testing and HPV vaccination

Chapter 15: Environmental Health
• New Take Charge features on energy-efficient lighting and endocrine disrupting chemicals
• New illustration highlighting climate change effects on human health
• New section on unconventional energy sources, including deepwater oil rigs, tar sands, and hydrofracking of natural gas
• Updated statistics on population growth, energy use, the hole in the ozone layer, and trash and recycling
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INSTRUCTOR RESOURCES

Instructor resources available through Connect for Fit & Well include a Course Integrator Guide, Test Bank, and PowerPoint presentations for each chapter.

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LOOKING AHEAD…

After reading this chapter, you should be able to

■ Describe the dimensions of wellness.
■ Identify the major health problems in the United States today and discuss their causes.
■ Describe the behaviors that are part of a wellness lifestyle.
■ Explain the steps in creating a behavior management plan to change a wellness-related behavior.
■ List some of the available sources of wellness information and explain how to think critically about them.

TEST YOUR KNOWLEDGE

1. Which of the following lifestyle factors is the leading preventable cause of death for Americans?
   a. excess alcohol consumption
   b. cigarette smoking
   c. obesity

2. The terms health and wellness mean the same thing. True or false?

3. A person’s genetic makeup determines whether he or she will develop certain diseases (such as breast cancer), regardless of that person’s health habits. True or false?

See answers on the next page.
A college sophomore sets the following goals for herself:
- Join new social circles and make new friends whenever possible.
- Exercise every day.
- Clean up trash and plant trees in blighted neighborhoods in her community.

These goals may differ, but they have one thing in common. Each contributes, in its own way, to this student’s health and well-being. Not satisfied merely to be free of illness, she wants more. She has decided to live actively and fully—not just to be healthy, but to pursue a state of overall wellness.

**WELLNESS: NEW HEALTH GOALS**

Generations of people have viewed health simply as the absence of disease, and that view largely prevails today. The word health typically refers to the overall condition of a person’s body or mind and to the presence or absence of illness or injury. Wellness expands this idea of health to include our ability to achieve optimal health. Beyond the simple presence or absence of disease, wellness refers to optimal health and vitality—to living life to its fullest. Although we use the terms health and wellness interchangeably, there are two important differences between them:
- Health—or some aspects of it—can be determined or influenced by factors beyond your control, such as your genes, age, and family history. For example, a man with a strong family history of prostate cancer will have a higher-than-average risk for developing prostate cancer himself.
- Wellness is largely determined by the decisions you make about how you live. That same man can reduce his risk of cancer by eating sensibly, exercising, and having regular screening tests. Even if he develops the disease, he may still rise above its effects to live a rich, meaningful life. This means not only caring for himself physically, but also maintaining a positive outlook, keeping up his relationships with others, challenging himself intellectually, and nurturing other aspects of his life.

Enhanced wellness, therefore, involves making conscious decisions to control risk factors that contribute to disease or injury. Age and family history are risk factors you cannot control. Behaviors such as choosing not to smoke, exercising, and eating a healthy diet are well within your control.

**The Dimensions of Wellness**

Here are nine dimensions of wellness:
- Physical
- Emotional
- Intellectual
- Interpersonal
- Cultural
- Spiritual
- Environmental
- Financial
- Occupational

Each dimension of wellness affects the others. Further, the process of achieving wellness is constant and dynamic (Figure 1.1), involving change and growth. Ignoring any dimension of wellness can have harmful effects on your life.

**Answers (Test Your Knowledge)**

1. **b.** Smoking causes about 481,000 deaths per year. Obesity is responsible for about 216,000 premature deaths, and alcohol is a factor in as many as 87,000 deaths.
2. **False.** Although the words are used interchangeably, they have different meanings. The term health refers to the overall condition of the body or mind and to the presence or absence of illness or injury. The term wellness refers to optimal health and vitality, encompassing all the dimensions of well-being.
3. **False.** In many cases, behavior can tip the balance toward good health even when heredity or environment is a negative factor.

**FIGURE 1.1  The wellness continuum.**

The concept of wellness includes vitality in nine interrelated dimensions, all of which contribute to overall wellness.
The following sections briefly introduce the dimensions of wellness. Figure 1.2 lists some of the specific qualities and behaviors associated with each dimension. Lab 1.1 will help you learn what wellness means to you and where you fall on the wellness continuum.

**Physical Wellness** Your physical wellness includes not just your body’s overall condition and the absence of disease, but your fitness level and your ability to care for yourself. The higher your fitness level (which is discussed throughout this book), the higher your level of physical wellness will be. Similarly, as you take better care of your own physical needs, you ensure greater physical wellness. To achieve optimum physical wellness, you need to make choices that help you avoid illnesses and injuries. The decisions you make now—and the habits you develop over your lifetime—will largely determine the length and quality of your life.

**Emotional Wellness** Your emotional wellness reflects your ability to understand and deal with your feelings. Emotional wellness involves attending to your own thoughts and feelings, monitoring your reactions, and identifying obstacles to emotional stability. **Self-acceptance** is your personal satisfaction with yourself, which might exclude society’s expectations, whereas **self-esteem** relates to the way you think others perceive you. **Self-confidence** can be a part of both acceptance and esteem. Achieving this type of wellness means finding solutions to emotional problems, with professional help if necessary.

**Intellectual Wellness** Those who enjoy intellectual wellness constantly challenge their minds. An active mind is essential to wellness because it detects problems, finds solutions, and directs behavior. People who enjoy intellectual wellness never stop learning. They seek out and relish new experiences and challenges.

**Interpersonal Wellness** Satisfying and supportive relationships are important to physical and emotional wellness. Learning good communication skills, developing the capacity for intimacy, and cultivating a supportive network are all important to interpersonal (or social) wellness. Social wellness requires participating in and contributing to your community and to society.

**Cultural Wellness** Cultural wellness refers to the way you interact with others who are different from you in terms of ethnicity, religion, gender, sexual orientation, age, and customs (practices). It involves creating relationships with others and suspending judgment on others’ behavior until you have lived.
Environmental Wellness  Your environmental wellness is defined by the livability of your surroundings. Personal health depends on the health of the planet—from the safety of the food supply to the degree of violence in society. To improve your environmental wellness, you can learn about and protect yourself against hazards in your surroundings and work to make your world a cleaner and safer place.

Financial Wellness  Financial wellness refers to your ability to live within your means and manage your money in a way that gives you peace of mind. It includes balancing your income and expenses, staying out of debt, saving for the future, and understanding your emotions about money. For more on this topic, see the box “Financial Wellness”.

Occupational Wellness  Occupational wellness refers to the level of happiness and fulfillment you gain through your work. Although high salaries and prestigious titles are gratifying, they alone generally do not bring about occupational wellness. An occupationally well person truly likes his or her work, feels a connection with others in the workplace, and takes advantage of opportunities to learn and be challenged. Another important aspect of occupational wellness is recognition from managers and colleagues. An ideal job draws on your interests and passions, as well as your vocational skills, and allows you to feel that you are making a contribution in your everyday work.

New Opportunities for Taking Charge

A century ago, Americans considered themselves lucky just to survive to adulthood (Figure 1.3). A child born in 1900, for example, could expect to live only about 47 years. Many people died from common infectious diseases (such as pneumonia, tuberculosis, or diarrhea) and poor environmental conditions (such as water pollution and poor sanitation).

Wellness Tip  Enhancing one dimension of wellness can have positive effects on others. For example, joining a meditation group can help you enhance your spiritual well-being, but it can also affect the emotional and interpersonal dimensions of wellness by enabling you to meet new people and develop new friendships.

Chapter 1  Introduction to Wellness, Fitness, and Lifestyle Management
Get Out of Debt

A 2011 study indicated that graduating college students often had debts of $25,250 and that this number would likely increase by several thousand dollars over the next several years. If you have credit card debt, stop using your cards and start paying them off. If you can’t pay the whole balance, at least try to pay more than the minimum payment each month. It can take a very long time to pay off a loan by making only the minimum payments. For example, to pay off a credit card balance of $2,000 at 10% interest with monthly payments of $20 would take 203 months—17 years. Check out an online credit card calculator like http://www.bankrate.com/calculators/credit-cards/balance-debt-payoff-calculator.aspx. Note that by carrying a balance and incurring finance charges, you are also paying back much more than your initial loan.

Start Saving

The same miracle of compound interest that locks you into years of credit card debt can work to your benefit if you start saving early (for an online compound interest calculator, visit http://www.moneychimp.com/calculator/compound_interest_calculator.htm). Experts recommend “paying yourself first” every month—that is, putting some money into savings before you start paying your bills, depending on what your budget allows. You may want to save for a large purchase, or you may even be looking ahead to retirement. If you work for a company with a 401(k) retirement plan, contribute as much as you can every pay period.

Become Financially Literate

How well do you manage your money? Most Americans have not received basic financial training. For this reason, the U.S. government has established the Financial Literacy and Education Commission (MyMoney.gov) to help Americans learn how to save, invest, and manage money better, a skill called financial literacy. Developing lifelong financial skills should begin in early adulthood, during the college years, if not earlier.

Today, a different set of diseases has emerged as our major health threat: heart disease, cancer, and chronic lower respiratory diseases are now the three leading causes of death for Americans (Table 1.1). Treating such chronic diseases is costly and difficult.

The good news is that people have some control over whether they develop chronic diseases. People make choices every day that increase or decrease their risks for such diseases. These lifestyle choices include behaviors such as smoking, diet, exercise, and alcohol use. As Table 1.2 makes clear, lifestyle factors contribute to many deaths in the United States, and people can influence their own health risks. The need to make good choices is especially true for teens and young adults. For Americans age 15–24, for example, the top three causes of death are accidents, suicide, and homicide (Table 1.3).

### National Health

Wellness is a personal concern, but the U.S. government has financial and humanitarian interests in it, too. A healthy population is the nation’s source of vitality, creativity, and wealth. Poor health drains the nation’s resources and raises health care costs for all.

---

**Table 1.1 Leading Causes of Death in the United States, 2012**

<table>
<thead>
<tr>
<th>RANK</th>
<th>CAUSE OF DEATH</th>
<th>NUMBER OF DEATHS</th>
<th>PERCENTAGE OF TOTAL DEATHS</th>
<th>LIFESTYLE FACTORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Heart disease</td>
<td>611,105</td>
<td>23.5</td>
<td>D I S A</td>
</tr>
<tr>
<td>2</td>
<td>Cancer</td>
<td>584,881</td>
<td>22.5</td>
<td>D I S A</td>
</tr>
<tr>
<td>3</td>
<td>Chronic lower respiratory diseases</td>
<td>149,205</td>
<td>5.7</td>
<td>D I S A</td>
</tr>
<tr>
<td>4</td>
<td>Unintentional injuries (accidents)</td>
<td>130,557</td>
<td>5.0</td>
<td>D I S A</td>
</tr>
<tr>
<td>5</td>
<td>Stroke</td>
<td>128,978</td>
<td>5.0</td>
<td>D I S A</td>
</tr>
<tr>
<td>6</td>
<td>Alzheimer’s disease</td>
<td>84,767</td>
<td>3.3</td>
<td>D I S A</td>
</tr>
<tr>
<td>7</td>
<td>Diabetes</td>
<td>75,578</td>
<td>2.9</td>
<td>D I S A</td>
</tr>
<tr>
<td>8</td>
<td>Influenza and pneumonia</td>
<td>56,979</td>
<td>2.2</td>
<td>D I S A</td>
</tr>
<tr>
<td>9</td>
<td>Kidney disease</td>
<td>47,112</td>
<td>1.8</td>
<td>D I S A</td>
</tr>
<tr>
<td>10</td>
<td>Intentional self-harm (suicide)</td>
<td>41,149</td>
<td>1.6</td>
<td>D I S A</td>
</tr>
<tr>
<td>11</td>
<td>Septicemia</td>
<td>38,156</td>
<td>1.5</td>
<td>D I S A</td>
</tr>
<tr>
<td>12</td>
<td>Chronic liver disease and cirrhosis</td>
<td>36,427</td>
<td>1.4</td>
<td>D I S A</td>
</tr>
<tr>
<td>13</td>
<td>Hypertension (high blood pressure)</td>
<td>30,770</td>
<td>1.2</td>
<td>D I S A</td>
</tr>
<tr>
<td>14</td>
<td>Parkinson’s disease</td>
<td>25,196</td>
<td>1.0</td>
<td>D I S A</td>
</tr>
<tr>
<td>15</td>
<td>Lung inflammation due to inhaling solids and liquids</td>
<td>18,579</td>
<td>0.7</td>
<td>D I S A</td>
</tr>
<tr>
<td></td>
<td>All other causes</td>
<td>537,554</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>All causes</td>
<td>2,596,993</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

**Key**
- **D**: Diet plays a part
- **I**: Inactive lifestyle plays a part
- **S**: Smoking plays a part
- **A**: Excessive alcohol use plays a part

**Note**: Although not among the overall top 15 causes of death, HIV/AIDS is a major killer, responsible for 6,955 deaths in 2013. HIV/AIDS was the 13th leading cause of death for Americans aged 15–24 years and the 8th leading cause of death for those aged 25–44 years.

Wellness Tip In Table 1.1, notice how many causes of death are related to lifestyle. This is an excellent motivator for adopting healthy habits and staying in good condition. Maintaining physical fitness and a healthy diet can lead to a longer life. It’s a fact!

The Affordable Care Act The Affordable Care Act (ACA), also called “Obamacare,” was signed into law on March 23, 2010, and upheld by the Supreme Court in 2012 and 2015. The new law requires most people to obtain health insurance or pay a federal penalty. Here is a brief summary of the new law.

**Coverage**

- Health plans can no longer deny or limit benefits due to a pre-existing condition.
- If you are under 26, you may be eligible to be covered under your parent’s health plan.

**TERMS**

- **chronic disease** A disease that develops and continues over a long period of time, such as heart disease or cancer.
- **lifestyle choice** A conscious behavior that can increase or decrease a person’s risk of disease or injury, such behaviors include smoking, exercising, and eating a healthy diet.

---

### Table 1.2

<table>
<thead>
<tr>
<th>Cause of Death</th>
<th>Number of Deaths per Year</th>
<th>Percentage of Total Deaths per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tobacco</td>
<td>481,000</td>
<td>18.5</td>
</tr>
<tr>
<td>Obesity-related deaths*</td>
<td>216,000</td>
<td>8.3</td>
</tr>
<tr>
<td>Alcohol</td>
<td>87,798</td>
<td>3.4</td>
</tr>
<tr>
<td>Microbial agents**</td>
<td>56,979</td>
<td>2.2</td>
</tr>
<tr>
<td>Illicit drug use</td>
<td>43,819</td>
<td>1.7</td>
</tr>
<tr>
<td>Unintentional poisonings</td>
<td>38,851</td>
<td>1.5</td>
</tr>
<tr>
<td>Motor vehicles</td>
<td>34,935</td>
<td>1.4</td>
</tr>
<tr>
<td>Firearms</td>
<td>33,636</td>
<td>1.3</td>
</tr>
<tr>
<td>Sexual behavior***</td>
<td>32,296</td>
<td>1.3</td>
</tr>
</tbody>
</table>

*The number of deaths due to obesity is an area of ongoing controversy and research. Recent estimates have ranged from 112,000 to 365,000.

**Microbial agents include bacterial and viral infections, such as influenza and pneumonia.

***The number of deaths due to sexual behavior includes deaths from HIV/AIDS, cervical cancer, and hepatitis B and C infections.


### Table 1.3

<table>
<thead>
<tr>
<th>Rank</th>
<th>Cause of Death</th>
<th>Number of Deaths</th>
<th>Percentage of Total Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Accidents</td>
<td>11,619</td>
<td>40.8</td>
</tr>
<tr>
<td></td>
<td>Motor vehicle</td>
<td>6,692</td>
<td>23.5</td>
</tr>
<tr>
<td></td>
<td>All other accidents</td>
<td>4,927</td>
<td>17.3</td>
</tr>
<tr>
<td>2</td>
<td>Suicide</td>
<td>4,874</td>
<td>17.1</td>
</tr>
<tr>
<td>3</td>
<td>Homicide</td>
<td>4,329</td>
<td>15.2</td>
</tr>
<tr>
<td>4</td>
<td>Cancer</td>
<td>1,496</td>
<td>5.3</td>
</tr>
<tr>
<td>5</td>
<td>Heart disease</td>
<td>941</td>
<td>3.3</td>
</tr>
<tr>
<td></td>
<td>All causes</td>
<td>28,486</td>
<td>100.0</td>
</tr>
</tbody>
</table>

• Insurers can no longer cancel your coverage because of honest mistakes in your application.
• If your plan denies payment, you are guaranteed the right to appeal.

**COSTS**

• Lifetime dollar limits on most benefits you receive are not permitted.
• Insurance companies must now publicly justify rate hikes.
• Your premium dollars must be spent primarily on health care—not administrative costs.

**CARE**

• Recommended preventive health services are covered with no copayment.
• From your plan’s network, you can choose the primary care doctor you want.
• You can seek emergency care at a hospital outside your health plan’s network.

**FINDING A PLAN** Under the ACA, a health insurance marketplace, also called health exchanges, facilitates the purchase of health insurance in every state. The health exchanges provide a selection of government-regulated health care plans that students and others may choose from. Those who are below income requirements are eligible for federal help with the premiums.

**BENEFITS TO COLLEGE STUDENTS** The ACA permits students to stay on their parents’ health insurance plan until age 26—even if they are married or have coverage through an employer. Students not on their parents’ plan who do not want to purchase insurance through their school can do so through the health insurance marketplace.

If you’re under 30, you have the option of buying a “catastrophic” health plan. Such plans tend to have low premiums but require you to pay all medical costs up to a certain amount, usually several thousand dollars. The insurance company would pay for essential health benefits over that amount.

Students whose income is below a certain level may qualify for Medicaid. Check with your state. Individuals with non-immigrant status, which includes worker visas and student visas, qualify for insurance coverage through the exchanges.

You can browse plans and apply for coverage at HealthCare.gov.

**The Healthy People Initiative** The national Healthy People initiative aims to prevent disease and improve Americans’ quality of life. Healthy People reports, published each decade since 1980, set national health goals based on 10-year agendas. The initiative’s most recent iteration, *Healthy People 2020*, was developed in 2008–2009 and released to the public in 2010. *Healthy People 2020* envisions “a society in which all people live long, healthy lives” and proposes the eventual achievement of the following broad national health objectives:

• Eliminate preventable disease, disability, injury, and premature death. This objective involves taking more concrete steps to prevent diseases and injuries, promoting healthy lifestyle choices, improving the nation’s preparedness for emergencies, and strengthening the public health infrastructure.
• Achieve health equity, eliminate disparities, and improve the health of all groups. This objective involves identifying, measuring, and addressing health differences between individuals or groups that result from social or economic disadvantage. (See the box “Wellness Issues for Diverse Populations.”)
• Create social and physical environments that promote good health for all. This objective involves the use of health interventions at many levels (such as anti-smoking campaigns by schools, workplaces, and local agencies), providing a broader array of educational and job opportunities for undereducated and poor Americans, and actively developing healthier living and natural environments for everyone.
• Promote healthy development and healthy behaviors across every stage of life. This goal involves taking a cradle-to-grave approach to health promotion by encouraging disease prevention and healthy behaviors in Americans of all ages.

In a shift from the past, *Healthy People 2020* emphasizes the importance of health determinants—factors that affect the health of individuals, demographic groups, or entire populations. Health determinants are social (including factors such as ethnicity, education level, and economic status) and environmental (including natural and human-made environments). Thus, one goal is to improve living conditions in ways that reduce the impact of negative health determinants.

Table 1.4 shows examples of individual health promotion goals from *Healthy People 2020*, as well as estimates of how well Americans are achieving those goals.

**Behaviors That Contribute to Wellness**

A lifestyle based on good choices and healthy behaviors maximizes quality of life. It helps people avoid disease, remain strong and fit, and maintain their physical and mental health as long as they live.

**Be Physically Active** The human body is designed to be active. It readily adapts to nearly any level of activity and exertion. Physical fitness is a set of physical attributes that allows the body to respond or adapt to the demands and stress of physical effort. The more we ask of our bodies, the stronger and

physical fitness A set of physical attributes that allows the body to respond or adapt to the demands and stress of physical effort.
DIVERSITY MATTERS
Wellness Issues for Diverse Populations

We all need to exercise, eat well, manage stress, and cultivate positive relationships. We all need to know how to protect ourselves from disease and injuries. But some of our differences—both as individuals and as members of groups—have important implications for wellness. These differences can be biological (determined genetically) or cultural (acquired as patterns of behavior through daily interactions with family, community, and society); many health conditions are a function of biology and culture combined. You share patterns of influences with others; and information about groups can be useful in identifying areas that may be of concern to you and your family. Wellness-related differences among groups can be described in terms of different characteristics, including the following:

**Sex and Gender.** Sex represents the biological and physiological characteristics that define men, women, and intersex people. Gender refers to the roles, behaviors, activities, and attributes that a given society considers appropriate for men and women. A person’s gender is rooted in biology and physiology, but it is shaped by experience and environment—how society responds to individuals based on their sex. Examples of gender-related characteristics that affect wellness include higher rates of smoking and drinking among men and lower earnings among women compared with men doing similar work. Although men are more biologically likely than women to suffer from certain diseases (a sex issue), men are less likely to visit their physicians for regular exams (a gender issue). Men have higher rates of death from injuries, suicide, and homicide, whereas women are at greater risk for Alzheimer’s disease and depression. Men and women also differ in body composition and certain aspects of physical performance.

**Ethnicity.** Compared with the U.S. population as a whole, American ethnic minorities have higher rates of death and disability from many causes. These disparities result from a complex mix of genetic variations, environmental factors, and health behaviors. Some diseases are concentrated in certain gene pools, the result of each ethnic group’s relatively distinct history. Diabetes is more prevalent among individuals of Native American or Latino heritage, for example, and African Americans have higher rates of hypertension. Ethnic groups may vary in their traditional diets; their family and interpersonal relationships; their attitudes toward tobacco, alcohol, and other drugs; and their health beliefs and practices.

**Income and Education.** Of all the variables contributing to health status, inequalities in income and education are the most important. Income and education are closely related, and groups with the highest poverty rates and least education have the worst health status. These Americans have higher rates of infant mortality, traumatic injury, violent death, and many diseases. They are more likely to eat poorly, be overweight, smoke, drink, and use drugs. They are exposed to more day-to-day stressors and have less access to health care services.

### Table 1.4 Selected Healthy People 2020 Objectives

<table>
<thead>
<tr>
<th>OBJECTIVE</th>
<th>BASELINE (% MEETING GOAL IN 2008)</th>
<th>MOST RECENT PROGRESS (% MEETING GOAL IN 2012)</th>
<th>TARGET (% BY 2020)</th>
<th>PROGRESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase proportion of people with health insurance</td>
<td>83.2</td>
<td>83.1</td>
<td>100.0</td>
<td>◡</td>
</tr>
<tr>
<td>Help adults with hypertension get blood pressure under control</td>
<td>43.7</td>
<td>48.9</td>
<td>61.2</td>
<td>◡</td>
</tr>
<tr>
<td>Reduce proportion of obese adults</td>
<td>33.9</td>
<td>35.3</td>
<td>30.5</td>
<td>◘</td>
</tr>
<tr>
<td>Reduce proportion of adults who drank excessively in past 30 days</td>
<td>27.1</td>
<td>27.1</td>
<td>24.4</td>
<td>◡</td>
</tr>
<tr>
<td>Increase proportion of adults who meet federal guidelines for aerobic physical activity and muscle strengthening</td>
<td>18.2</td>
<td>20.6</td>
<td>20.1</td>
<td>✓</td>
</tr>
<tr>
<td>Reduce proportion of adults who use cigarettes</td>
<td>20.6</td>
<td>18.2</td>
<td>12.0</td>
<td>◡</td>
</tr>
</tbody>
</table>

✓ Target met  ◡ Improving  ◘ Insignificant or no change  ◐ Getting worse

**SOURCE:** Healthy People 2020 Leading Health Indicators: Progress Update, March 2014 (http://www.healthypeople.gov/sites/default/files/LHI-ProgressReport-ExecSum_0.pdf)
more fit they become. When our bodies are not kept active, they deteriorate: Bones lose density, joints stiffen, muscles become weak, and cellular energy systems degenerate. To be truly well, human beings must be active.

Unfortunately, a sedentary lifestyle is common among Americans. According to a 2013 survey, only about half of adult Americans met the federal physical activity guidelines in 2013 (150 minutes or more per week of moderate aerobic exercise or 75 minutes per week of vigorous aerobic exercise). The older the adults, the less likely they met the guidelines.

The benefits of physical activity are both physical and mental, immediate and long term (Figure 1.5). In the short term, being physically fit makes it easier to do everyday tasks, such as lifting; it provides reserve strength for emergencies; and it helps people look and feel good. In the long term, being physically fit confers protection against chronic diseases and lowers the risk of dying prematurely. (See the box “Does Being Physically Active Make a Difference in How Long You Live?”) Physically active people are less likely to develop or die from heart disease, respiratory disease, high blood pressure, cancer, osteoporosis, and type 2 diabetes (the most common form of diabetes). As they get older, they may be able to avoid weight gain, muscle and bone loss, fatigue, and other problems associated with aging.

Choose a Healthy Diet In addition to being sedentary, many Americans have a diet that is too high in calories, unhealthy fats, and added sugars, as well as too low in fiber, complex carbohydrates, fruits, and vegetables. Like physical inactivity, this diet is linked to a number of chronic diseases. A healthy diet provides necessary nutrients and sufficient energy without also providing too much of the dietary substances linked to diseases.

Maintain a Healthy Body Weight Overweight and obesity are associated with a number of disabling and potentially fatal conditions and diseases, including heart disease, cancer, and type 2 diabetes. The Centers for Disease Control and Prevention (CDC) estimates that obesity kills 112,000 Americans each year. Healthy body weight is an important part of wellness—but short-term dieting is not part of fitness or wellness. Maintaining a healthy body weight requires a lifelong commitment to regular exercise, a healthy diet, and effective stress management.

Manage Stress Effectively Many people cope with stress by eating, drinking, or smoking too much. Others don’t deal with it at all. In the short term, inappropriate stress management can lead to fatigue, sleep disturbances, and other symptoms. Over longer periods of time, poor stress management can lead to less efficient functioning of the immune system and increased susceptibility to disease. Learning to incorporate effective stress management techniques into daily life is an important part of a fit and well lifestyle.

Avoid Tobacco and Drug Use and Limit Alcohol Consumption Tobacco use is associated with 8 of the top 10 causes of death in the United States; personal tobacco use and secondhand smoke kill nearly 500,000 Americans each year, more than any other behavioral or environmental factor. In 2012, 18% of adult Americans described themselves as current smokers. Lung cancer is the most common cause of cancer death among both men and women and one of the leading causes of death overall. On average, the direct health care costs associated with smoking exceed $133 billion per year. If the cost of lost productivity from sickness, disability, and premature death is included, the total is closer to $295 billion.

Excessive alcohol consumption is linked to 6 of the top 10 causes of death and results in about 88,000 deaths a year in the United States. The social, economic, and medical costs of alcohol abuse are estimated at more than $224 billion per year. Alcohol or drug intoxication is an especially notable factor in the death and disability of young people, particularly through unintentional injuries (such as drownings and car crashes caused by drunken driving) and violence.

Protect Yourself from Disease and Injury The most effective way of dealing with disease and injury is to prevent them. Many of the lifestyle strategies discussed here help protect you against chronic illnesses. In addition, you can take specific steps to avoid infectious diseases, particularly those that are sexually transmitted.

Take Other Steps toward Wellness Other important behaviors contribute to wellness, including these:

- Developing meaningful relationships
- Planning for successful aging
- Learning about the health care system
- Acting responsibly toward the environment

FIGURE 1.5 Benefits of regular physical activity.

TERMS

sedentary Physically inactive; literally, “sitting.”

unintentional injury An injury that occurs without harm being intended.
THE EVIDENCE FOR EXERCISE

Does Being Physically Active Make a Difference in How Long You Live?

How can we be sure that physical activity and exercise are good for our health? To answer this question, the U.S. Department of Health and Human Services asked a committee to review scientific literature. The committee’s mission was to determine if enough evidence exists to warrant the government making physical activity recommendations to the public. The committee’s report, the Physical Activity Guidelines Advisory Committee Report, 2008, summarizes the scientific evidence for the health benefits of regular physical activity and the risks of sedentary behavior. The report provides the rationale for the federal government’s physical activity guidelines, and its findings were confirmed in the Scientific Report of the 2015 Dietary Guidelines Committee.

The Physical Activity Guidelines Advisory committee started by asking whether physical activity actually helps people live longer. The committee investigated the link between physical activity and all-cause mortality—deaths from all causes—by looking at 73 studies dating from 1995 to 2008. The studies included men and women from all age groups (16 to 65+) and from different racial and ethnic groups.

The data from these studies strongly support an inverse relation between physical activity and all-cause mortality; that is, physically active people were less likely to die during a study’s follow-up period (ranging from 10 months to 28 years). The review found that active people have about a 30% lower risk of dying compared with inactive people. These inverse associations were found not just for healthy adults but also for older adults (age 65 and older), for people with coronary artery disease, diabetes, or impaired mobility, and for people who were overweight or obese. Poor fitness and low physical activity levels were found to be better predictors of premature death than smoking, diabetes, or obesity. Based on the evidence, the committee determined that about 150 minutes (2.5 hours) of physical activity per week is enough to reduce all-cause mortality (see Chapter 2 for more details). It appears that it is the overall volume of energy expended, no matter which kinds of activities are done, that makes a difference in risk of premature death.

The committee also looked at whether there is a dose-response relation between physical activity and all-cause mortality—that is, whether more activity reduces death rates even further. Again, the studies showed an inverse relation between these two variables. So, more activity above and beyond 150 minutes per week produces greater benefits. Surprisingly, for inactive people, benefits are seen at levels below 150 minutes per week. In fact, any increase in physical activity resulted in reduced risk of death. The committee refers to this as the “some is good; more is better” message. A target of 150 minutes per week is recommended, but any level of activity below the target is encouraged for inactive people.

Looking more closely at this relationship, the committee found that the greatest risk reduction is seen at the lower end of the physical activity spectrum (30 to 90 minutes per week). In fact, sedentary people who become more active have the greatest potential for improving health and reducing the risk of premature death. Additional risk reduction occurs as physical activity increases, but at a slower rate. For example, people who engaged in physical activity 90 minutes per week had a 20% reduction in mortality risk compared with inactive people, and those who were active 150 minutes per week, as noted earlier, had a 30% reduction in risk. But to achieve a 40% reduction in mortality risk, study participants had to be physically active 420 minutes per week (7 hours).

The message from the research is clear: It doesn’t matter what activity you choose or even how much time you can devote to it per week, as long as you get moving!


The Role of Other Factors in Wellness

Heredity, the environment, and adequate health care are other important influences on health and wellness. These factors can interact in ways that raise or lower the quality of a person’s life and the risk of developing particular diseases. For example, a sedentary lifestyle combined with a genetic predisposition for diabetes can greatly increase a person’s risk of developing the disease. If this sedentary, genetically predisposed person also lacks adequate health care, he or she is much more likely to suffer dangerous complications from diabetes.

Ask Yourself

QUESTIONS FOR CRITICAL THINKING AND REFLECTION

How often do you feel exuberant? Vital? Joyful? What makes you feel that way? Conversely, how often do you feel downhearted, de-energized, or depressed? What makes you feel that way? Have you ever thought about how you might increase experiences of vitality and decrease experiences of discouragement?
But in many cases, behavior can tip the balance toward health even if heredity or environment is a negative factor. Breast cancer, for example, can run in families, but it is also associated with overweight and a sedentary lifestyle. A woman with a family history of breast cancer is less likely to die from the disease if she controls her weight, exercises, performs regular breast self-exams, and consults with her physician about mammograms.

**College Students and Wellness**

Most college students appear to be healthy, but appearances can be deceiving. Each year, thousands of students lose productive academic time to physical and emotional health problems—some of which can continue for a lifetime. According to the Spring 2014 American College Health Association National College Health Assessment, the following were commonly reported factors affecting academic performance:

- Stress (30.3% of students affected)
- Anxiety (21.8%)
- Sleep difficulties (21.0%)
- Cold/flu/sore throat (15.1%)
- Depression (13.5%)
- Excessive use of Internet/computer games (11.6%)

Each of these factors is related to one or more dimensions of wellness, and most can be influenced by choices students make daily. For example, there are many ways to manage stress: By reducing unhealthy choices, such as using alcohol to relax, and by increasing healthy choices, such as using time management techniques, even busy students can reduce the impact of stress.

Getting Serious about Your Health

Before you can start changing a wellness-related behavior, you have to know that the behavior is problematic and that you can change it. To make good decisions, you need information about relevant topics and issues, including what resources are available to help you change.

Moving in the direction of wellness means cultivating healthy behaviors and working to overcome unhealthy ones. This approach to lifestyle management is called **behavior change**. As you may already know from experience, changing an unhealthy habit can be harder than it sounds. When you embark on a behavior change plan, it may seem like too much work at first. But as you make progress, you will gain confidence in your ability to take charge of your life. You will also experience the benefits of wellness—more energy, greater vitality, deeper feelings of appreciation and curiosity, and a higher quality of life.

The rest of this chapter outlines a general process for changing unhealthy behaviors that is backed by research and has worked for many people. You will also find many specific strategies and tips for change. For additional support, work through the activities in the Behavior Change Workbook at the end of the text.

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**Wellness Tip**

Look for behavior change support if you need it. Certain health behaviors are exceptionally difficult to change. Some people can quit smoking on their own; others get help from a smoking cessation program or a nicotine replacement product.

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**Behavior change** A lifestyle management process that involves cultivating healthy behaviors and working to overcome unhealthy ones.

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**Terms**
Surveys indicate that college students are smart about evaluating health information. They trust the health information they receive from health professionals and educators and are skeptical about popular information sources, such as magazine articles and websites.

How smart are you about evaluating health information? Here are some tips.

General Strategies

Whenever you encounter health-related information, take the following steps to make sure it is credible:

- **Go to the original source.** Media reports often simplify the results of medical research. Find out for yourself what a study really reported, and determine whether it was based on good science. What type of study was it? Was it published in a recognized medical journal? Was it an animal study, or did it involve people? Did the study include a large number of people? What did the study’s authors actually report?

- **Watch for misleading language.** Reports that tout “breakthroughs” or “dramatic proof” are probably hype. A study may state that a behavior “contributes to” or is “associated with” an outcome, but this does not prove a cause-and-effect relationship.

- **Distinguish between research reports and public health advice.** Do not change your behavior based on the results of a single report or study. If an agency such as the National Cancer Institute urges a behavior change, however, you should follow its advice. Large, publicly funded organizations issue such advice based on many studies, not a single report.

- **Remember that anecdotes are not facts.** A friend may tell you he lost weight on some new diet, but individual success stories do not mean the plan is truly safe or effective. Check with your doctor before making any serious lifestyle changes.

- **Be skeptical.** If a report seems too good to be true, it probably is. Be wary of information contained in advertisements. An ad’s goal is to sell a product, even if there is no need for it, and sometimes even if the product has not been proven to be safe or effective.

- **Make choices that are right for you.** Friends and family members can be a great source of ideas and inspiration, but you need to make health-related choices that work best for you.

Internet Resources

Online information sources pose special challenges. When reviewing a health-related website, ask these questions:

- **What is the source of the information?** Websites maintained by government agencies, professional associations, or established academic or medical institutions are likely to present trustworthy information. Many other groups and individuals post accurate information, but it is important to look at the qualifications of the people who are behind the site. (Check the home page or click the “About Us” link.)

- **How often is the site updated?** Look for sites that are updated frequently. Check the “last modified” date of any web page.

- **Is the site promotional?** Be wary of information from sites that sell specific products, use testimonials as evidence, appear to have a social or political agenda, or ask for money.

- **What do other sources say about a topic?** Be wary of claims and information that appear at only one site or come from a chat room, bulletin board, or blog.

- **Does the site conform to any set of guidelines or criteria for quality and accuracy?** Look for sites that identify themselves as conforming to some code or set of principles, such as those set forth by the Health on the Net Foundation or the American Medical Association. These codes include criteria such as use of information from respected sources and disclosure of the site’s sponsors.

Examine Your Current Health Habits

Have you considered how your current lifestyle is affecting your health today and how it will affect your health in the future? Do you know which of your current habits enhance your health and which ones may be harmful? Begin your journey toward wellness with self-assessment: Think about your own behavior, complete the self-assessment in Lab 1.2, and talk with friends and family members about what they’ve noticed about your lifestyle and your health.

Choose a Target Behavior

Changing any behavior can be demanding. This is why it’s a good idea to start small, by choosing one behavior you want to change—called a **target behavior**—and working on it until you succeed. Your chances of success will be greater if your first goal is simple, such as resisting the urge to snack between classes. As you change one behavior, make your next goal a little more significant, and build on your success over time.

Learn about Your Target Behavior

After you’ve chosen a target behavior, you need to learn its risks and benefits for you—both now and in the future. As a starting point, use this text and the resources listed in the For Further Exploration section at
the end of each chapter; see the box “Evaluating Sources of Health Information” for additional guidelines. Ask these questions:

- How is your target behavior affecting your level of wellness today?
- Which diseases or conditions does this behavior place you at risk for?
- What effect would changing your behavior have on your health?

**Find Help** Have you identified a particularly challenging target behavior or mood—something like alcohol addiction, binge eating, or depression—that interferes with your ability to function or places you at a serious health risk? Help may be needed to change behaviors or conditions that are too deeply rooted or too serious for self-management. Don’t be discouraged by the seriousness or extent of the problem; many resources are available to help you solve it. On campus, the student health center or campus counseling center can provide assistance. To locate community resources, consult yellowpages.com, your physician, or the Internet.

**Building Motivation to Change**

Knowledge is necessary for behavior change, but it isn’t usually enough to make people act. Millions of people have sedentary lifestyles, for example, even though they know it’s bad for their health. To succeed at behavior change, you need strong motivation.

**Examine the Pros and Cons of Change** Health behaviors have short-term and long-term benefits and costs. Consider the benefits and costs of an inactive lifestyle:

- **Short-term.** Such a lifestyle allows you more time to watch TV and hang out with friends, but it leaves you less fit and less able to participate in recreational activities.
- **Long-term.** This lifestyle increases the risk of heart disease, cancer, stroke, and premature death.

To successfully change your behavior, you must believe that the benefits of change outweigh the costs.

Carefully examine the pros and cons of continuing your current behavior and of changing to a healthier one. Focus on the effects that are most meaningful to you, including those tied to your personal identity and values. For example, engaging in regular physical activity and adequate sleep can support an image of yourself as an active person who is a good role model for others. To work toward being independent and taking control over your life, quitting smoking can be one way to eliminate a dependency. To complete your analysis, ask friends and family members about the effects of your behavior on them.

For example, a younger sister may tell you that your smoking habit influenced her decision to take up smoking.

The short-term benefits of behavior change can be an important motivating force. Although some people are motivated by long-term goals, such as avoiding a disease that may hit them in 30 years, most are more likely to be moved to action by shorter-term, more personal goals. Feeling better, doing better in school, improving at a sport, reducing stress, and increasing self-esteem are common short-term benefits of health behavior change. Many wellness behaviors are associated with immediate improvements in quality of life. For example, surveys of Americans have found that nonsmokers feel healthy and full of energy more days each month than do smokers, and they report fewer days of sadness and troubled sleep. The same is true when physically active people are compared with sedentary people. Over time, these types of differences add up to a substantially higher quality of life for people who engage in healthy behaviors.

**Boost Self-Efficacy** When you start thinking about changing a health behavior, a big factor in your eventual success is whether you have confidence in yourself and in your ability to change. **Self-efficacy** refers to your belief in your ability to successfully take action and perform a specific task. Strategies for boosting self-efficacy include developing an internal locus of control, using visualization and self-talk, and getting encouragement from supportive people.

**Locus of Control** Who do you believe is controlling your life? Is it your parents, friends, or school? Is it “fate”? Or is it you? **Locus of control** refers to the figurative place a person designates as the source of responsibility for the events in his or her life. People who believe they are in control of their own lives are said to have an **internal locus of control**. Those who believe that factors beyond their control determine the course of their lives are said to have an **external locus of control**.

For lifestyle management, an internal locus of control is an advantage because it reinforces motivation and commitment. An external locus of control can sabotage efforts to change.
behavior. For example, if you believe that you are destined to die of breast cancer because your mother died from the disease, you may view monthly breast self-exams and regular checkups as a waste of time. In contrast, if you believe that you can take action to reduce your risk of breast cancer in spite of hereditary factors, you will be motivated to follow guidelines for early detection of the disease.

If you find yourself attributing too much influence to outside forces, gather more information about your wellness-related behaviors. List all the ways that making lifestyle changes will improve your health. If you believe you'll succeed, and if you recognize that you are in charge of your life, you're on your way to wellness.

**Visualization and Self-Talk** One of the best ways to boost your confidence and self-efficacy is to visualize yourself successfully engaging in a new, healthier behavior. Imagine yourself going for an afternoon run three days a week or no longer smoking cigarettes. Also visualize yourself enjoying all the short-term and long-term benefits that your lifestyle change will bring. Create a new self-image: What will you and your life be like when you become a regular exerciser or a nonsmoker?

You can also use self-talk, the internal dialogue you carry on with yourself, to increase your confidence in your ability to change. Counter any self-defeating patterns of thought with more positive or realistic thoughts: “I am a strong, capable person, and I can maintain my commitment to change.” See Chapter 10 for more on self-talk.

**Role Models and Other Supportive Individuals** Social support can make a big difference in your level of motivation and your chances of success. Perhaps you know people who have reached the goal you are striving for; they could be role models or mentors, providing information and support for your efforts. Gain strength from their experiences, and tell yourself, “If they can do it, so can I.” In addition, find a buddy who wants to make the same changes you do and who can take an active role in your behavior change program. For example, an exercise partner can provide companionship and encouragement when you might be tempted to skip your workout.

**Identify and Overcome Barriers to Change** Don’t let past failures at behavior change discourage you; they can be a great source of information you can use to boost your chances of future success. Make a list of the problems and challenges you faced in any previous behavior change attempts. To this list, add the short-term costs of behavior change that you identified in your analysis of the pros and cons of change. After you’ve listed these key barriers to change, develop a practical plan for overcoming each one. For example, if you always smoke when you’re with certain friends, decide in advance how you will turn down the next cigarette you are offered.

**Enhancing Your Readiness to Change**

The transtheoretical, or “stages-of-change,” model is an effective approach to lifestyle self-management. According to this model, you move through distinct stages as you work to change your target behavior. It is important to determine what stage you are in now so that you can choose appropriate strategies for progressing through the cycle of change. (Figure 1.6) This approach can help you enhance your readiness and intention to change. Read the following sections to determine what stage you are in for your target behavior.

**Precontemplation** People at this stage do not think they have a problem and do not intend to change their behavior. They may be unaware of the risks associated with their behavior or may deny them. They may have tried unsuccessfully to change in the past and may now think the situation is hopeless. They may also blame other people or external factors for their problems. People in the precontemplation stage believe that there are more reasons or more important reasons not to change than there are reasons to change.

**Contemplation** People at this stage know they have a problem and intend to take action within six months. They acknowledge the benefits of behavior change but worry about the costs of changing. To be successful, people must believe that the benefits of change outweigh the costs. People in the contemplation stage wonder about possible courses of action but don’t know how to proceed. There may also be specific barriers to change that appear too difficult to overcome.

**Preparation** People at this stage plan to take action within a month or may already have begun to make small changes in their behavior. They may be engaging in their new, healthier

![Figure 1.6 The stages of change: A spiral model.](image)

**Source:** Adapted from Centers for Disease Control and Prevention. (n.d.) PEPE guide: Personal empowerment plan for improving eating and increasing physical activity. Dallas, TX: The Cooper Institute.
TIPS FOR MOVING FORWARD IN THE CYCLE OF BEHAVIOR CHANGE

**Precontemplation**
- **Raise your awareness.** Research your target behavior and its effects.
- **Be self-aware.** Look at the mechanisms you use to resist change, such as denial or rationalization. Find ways to counteract these mechanisms.
- **Seek social support.** Friends and family members can help you identify target behaviors and understand their impact on the people around you.
- **Identify helpful resources.** These might include exercise classes or stress-management workshops offered by your school.

**Contemplation**
- **Keep a journal.** A record of your target behavior and the circumstances that elicit the behavior can help you plan a change program.
- **Do a cost-benefit analysis.** Identify the costs and benefits (both current and future) of maintaining your behavior and of changing it. Costs can be monetary, social, emotional, and so on.
- **Identify barriers to change.** Knowing these obstacles can help you overcome them.
- **Engage your emotions.** Watch movies or read books about people with your target behavior. Imagine what your life will be like if you don’t change.
- **Create a new self-image.** Imagine what you’ll be like after changing your target behavior. Try to think of yourself in new terms right now.
- **Think before you act.** Learn why you engage in the target behavior. Determine what “sets you off” and train yourself not to act reflexively.

**Preparation**
- **Create a plan.** Include a start date, goals, rewards, and specific steps you will take to change your behavior.

**Action**
- **Make change a priority.** Create and sign a contract with yourself.
- **Practice visualization and self-talk.** These techniques can help prepare you mentally for challenging situations.
- **Take short steps.** Successfully practicing your new behavior for a short time—even a single day—can boost your confidence and motivation.
- **Monitor your progress.** Keep up with your journal entries.
- **Change your environment.** Make changes that will discourage the target behavior—for example, getting rid of snack foods or not stocking the refrigerator with beer.
- **Find alternatives to your target behavior.** Make a list of things you can do to replace the behavior.
- **Reward yourself.** Rewards should be identified in your change plan. Give yourself lots of praise, and focus on your success.
- **Don’t get discouraged.** Real change is difficult.

**Maintenance**
- **Keep going.** Continue using the positive strategies that worked in earlier stages.
- **Be prepared for lapses.** Don’t let slip-ups set you back.
- **Be a role model.** After you have successfully changed your behavior, you may be able to help someone else do the same thing.

If relapses keep occurring or if you can’t seem to control them, you may need to return to a previous stage of the behavior change process. If this is necessary, reevaluate your goals and your strategy. A different or less stressful approach may help you avoid setbacks when you try again.

**Termination**
People at the termination stage have exited the cycle of change and are no longer tempted to lapse back into their old behavior. They have a new self-image and total self-efficacy with regard to their target behavior. For ideas on changing stages, see the box “Tips for Moving Forward in the Cycle of Behavior Change.”

**Dealing with Relapse**
People seldom progress through the stages of change in a straightforward, linear way. Rather, they tend to move to a new stage and then slip back to a previous stage before resuming their forward progress. Research suggests that most people
make several attempts before they successfully change a behavior; four out of five people experience some degree of backsliding. For this reason, the stages of change are best conceptualized as a spiral in which people cycle back through previous stages but are further along in the process each time they renew their commitment.

If you experience a lapse—a single slip—or a relapse—a return to old habits—don’t give up. Relapse can be demoralizing, but it is not the same as failure. Failure means stopping before you reach your goal and never changing your target behavior. During the early stages of the change process, it’s a good idea to plan for relapse so you can avoid guilt and self-blame and get back on track quickly. Follow these steps:

1. **Forgive yourself.** A single setback isn’t the end of the world, but abandoning your efforts to change could have negative effects on your life.
2. **Give yourself credit for the progress you have already made.** You can use that success as motivation to continue.
3. **Move on.** You can learn from a relapse and use that knowledge to deal with potential setbacks in the future.

### Developing Skills for Change: Creating a Personalized Plan

Once you are committed to making a change, it’s time to put together a plan of action. Your key to success is a well-thought-out plan that sets goals, anticipates problems, and includes rewards. This plan includes the following steps:

1. **Monitor your behavior and gather data.** Keep a record of your target behavior and the circumstances surrounding it. Record this information for at least a week or two. Keep your notes in a health journal or notebook or on your computer (see the sample journal entries in Figure 1.7). Record each occurrence of your behavior, noting the following:
   - What the activity was
   - When and where it happened
   - What you were doing
   - How you felt at that time

2. **Analyze the data and identify patterns.** After you have collected data on the behavior, analyze the data to identify patterns. When are you most likely to overeat? To skip a meal? What events trigger your appetite? Perhaps you are especially hungry at midmorning or when you put off eating dinner until 9:00 p.m. Perhaps you overindulge in food and drink when you go to a particular restaurant or when you’re with certain friends. Note the connections between your feelings and such external cues as time of day, location, situation, and the actions of others around you.

3. **Be “SMART” about setting goals.** If your goals are too challenging, you will have trouble making steady progress and will be more likely to give up altogether. If, for example, you are in poor physical condition, it will not make sense to set a goal of being ready to run a marathon within two months. If you set goals you can live with, it will be easier to stick with your behavior change plan and be successful.

### Sample Health Journal Entries

<table>
<thead>
<tr>
<th>Date</th>
<th>November 5</th>
<th>Day M</th>
<th>H Food eaten</th>
<th>Cals.</th>
<th>Where did you eat?</th>
<th>What else were you doing?</th>
<th>How did someone else influence you?</th>
<th>What made you want to eat?</th>
<th>Emotions and feelings?</th>
<th>Thoughts and concerns?</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:30 AM</td>
<td>M</td>
<td>1/2 C Crispix cereal</td>
<td>110</td>
<td>home</td>
<td>looking at headlines on my phone</td>
<td>I always eat cereal in the morning</td>
<td>a little keyed up &amp; worried</td>
<td>thinking about quiz in class today</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10:30 AM</td>
<td>S</td>
<td>1 apple</td>
<td>90</td>
<td>hall outside classroom</td>
<td>studying</td>
<td>alone</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12:30 PM</td>
<td>M</td>
<td>1 C chili 1 roll 1 pat butter 1 orange 2 oatmeal cookies 1 soda</td>
<td>290</td>
<td>campus food court</td>
<td>talking</td>
<td>eating w/ friends; we decided to eat at the food court</td>
<td>wanted to be part of group</td>
<td>interested in hearing everyone’s plans for the weekend</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Figure 1.7** Sample health journal entries.
Experts suggest that your goals meet the “SMART” criteria. That is, your behavior change goals should be

- **Specific.** Avoid vague goals like “eat more fruits and vegetables.” Instead, state your objectives in specific terms, such as “eat two cups of fruit and three cups of vegetables every day.”

- **Measurable.** Recognize that your progress will be easier to track if your goals are quantifiable, so give your goal a number. You might measure your goal in terms of time (such as “walk briskly for 20 minutes a day”), distance (“run two miles, three days per week”), or some other amount (“drink eight glasses of water every day”).

- **Attainable.** Set goals that are within your physical limits. For example, if you are a poor swimmer, it might not be possible for you to meet a short-term fitness goal by swimming laps. Walking or biking might be better options.

- **Realistic.** Manage your expectations when you set goals. For example, it may not be possible for a long-time smoker to quit cold turkey. A more realistic approach might be to use nicotine replacement patches or gum for several weeks while getting help from a support group.

- **Time frame-specific.** Give yourself a reasonable amount of time to reach your goal, state the time frame in your behavior change plan, and set your agenda to meet the goal within the given time frame.

Using these criteria, a sedentary person who wants to improve his health and build fitness might set a goal of being able to run three miles in 30 minutes, to be achieved within a time frame of six months. To work toward that goal, he might set a number of smaller, intermediate goals that are easier to achieve. For example, his list of goals might look like this:

<table>
<thead>
<tr>
<th>WEEK</th>
<th>FREQUENCY</th>
<th>ACTIVITY</th>
<th>DURATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>Walk &lt; 1 mile</td>
<td>10–15</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>Walk 1 mile</td>
<td>15–20</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>Walk 1–2 miles</td>
<td>20–25</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>Walk 2–3 miles</td>
<td>25–30</td>
</tr>
<tr>
<td>5–7</td>
<td>3–4</td>
<td>Walk/run 1 mile</td>
<td>15–20</td>
</tr>
<tr>
<td>21–24</td>
<td>4–5</td>
<td>Run 2–3 miles</td>
<td>25–30</td>
</tr>
</tbody>
</table>

It may not be possible to meet these goals, but you never know until you try. As you work toward meeting your long-term goal, you may find it necessary to adjust your short-term goals. For example, you may find that you can start running sooner than you thought, or you may be able to run farther than you originally estimated. In such cases, it may be reasonable to make your goals more challenging. Otherwise, you may want to make them easier in order to stay motivated.

For some goals and situations, it may make more sense to focus on something other than your outcome goal. If your goal involves a long-term lifestyle change, such as reaching a healthy weight, it is better to focus on developing healthy habits than to target a specific weight loss. Your goal in this case might be exercising 30 minutes every day, reducing portion sizes, or eliminating late-night snacks.

4. **Devising a plan of action.** Develop a strategy that will support your efforts to change. Your plan of action should include the following steps:

- **Get what you need.** Identify resources that can help you. For example, you can join a community walking club or sign up for a smoking cessation program. You may also need to buy some new running shoes or nicotine replacement patches. Get the items you need right away; waiting can delay your progress.

- **Modify your environment.** If there are cues in your environment that trigger your target behavior, try to control them. For example, if you normally have alcohol at home, getting rid of it can help prevent you from indulging. If you usually study with a group of friends in an environment that allows smoking, try moving to a nonsmoking area. If you always buy a snack at a certain vending machine, change your route to avoid it.

- **Control related habits.** You may have habits that contribute to your target behavior; modifying these habits can help change the behavior. For example, if you usually plop down on the sofa while watching TV, try putting an exercise bike in front of the set so you can burn calories while watching your favorite programs.

- **Reward yourself.** Giving yourself instant, real rewards for good behavior will reinforce your efforts. Plan your rewards; decide in advance what each one will be and how you will earn it. Tie rewards to achieving specific goals or subgoals. For example, you might treat yourself to a movie after a week of avoiding snacks. Make a list of some other ways you might reward yourself for progress toward your goals.
of items or events to use as rewards. They should be special-
to you and preferably unrelated to food or alcohol.

• **Involvetheproplearoundyou.** Ask family and friends
to help you with your plan. To help them respond appro-
 priately to your needs, create a specific list of dos and
don’ts. For example, ask them to support you when you
set aside time to exercise or when you avoid second
helpings at dinner.

• **Plan for challenges.** Think about situations and people
that might derail your program and develop ways to
cope with them. For example, if you think it will be hard
to stick to your usual exercise program during exams,
schedule short bouts of physical activity (such as a brisk
walk) as stress-reducing study breaks.

5. **Makeapersonalcontract.** A serious personal contract—
one that commits you to your word—can result in a higher
chance of follow-through than a casual, offhand promise.
Your contract can help prevent procrastination by specifying
important dates and can also serve as a reminder of
your personal commitment to change.

Your contract should include a statement of your goal
and your commitment to reaching it. The contract should
also include details, such as the following:

• The date you will start
• The steps you will take to measure your progress
• The strategies you plan to use to promote change
• The date you expect to reach your final goal

Have someone—preferably someone who will be
actively helping you with your program—sign your con-
tract as a witness.

Figure 1.8 shows a sample behavior change contract for
someone committing to eating more fruit every day. A blank
contract is included as Activity 8 in the Behavior Change
Workbook at the end of this text.

**Putting Your Plan into Action**

The starting date has arrived, and you are ready to put your
plan into action. This stage requires commitment, the resolve
to stick with the plan no matter what temptations you encoun-
ter. Remember all the reasons you have to make the change—
and remember that you are the boss. Use all your strategies to
make your plan work. Make sure your environment is change
friendly, and get as much support and encouragement from
others as possible. Keep track of your progress in your health
journal, and give yourself regular rewards. And don’t forget to
give yourself a pat on the back—congratulate yourself, notice
how much better you look or feel, and feel good about how far
you’ve come and how you’ve gained control of your behavior.

**Staying with It**

As you continue with your program, don’t be surprised when
you run up against obstacles; they’re inevitable. In fact, it’s a
good idea to expect problems and give yourself time to step
back, see how you’re doing, and make some changes before
going on. If your program is grinding to a halt, identify what
is blocking your progress. It may come from one of the sources
described in the following sections.

**Social Influences** Take a hard look at the reactions of the
people you’re counting on, and see if they’re really supporting
you. If they come up short, connect with others who will be more
supportive. A related trap is trying to get your friends or family
members to change their behaviors. The decision to make a major
behavior change is something people come to only after intensive
self-examination. You may be able to influence someone by tact-
fully providing facts or support, but that’s all. Focus on yourself.
When you succeed, you may become a role model for others.

**Levels of Motivation and Commitment** You won’t
make real progress until an inner drive leads you to the stage of
change at which you are ready to make a personal commitment
to the goal. If commitment is your problem, you may need to
wait until the behavior you’re dealing with makes you unhap-
pier or unhealthier; then your desire to change it will be stron-
ger. Or you may find that changing your goal will inspire you to
keep going. For more ideas, refer to Activity 9 in the Behavior
Change Workbook.

**Choice of Techniques and Level of Effort** If your
plan is not working as well as you thought it would, make
changes where you’re having the most trouble. If you’ve lagged
on your running schedule, for example, maybe it’s because you

---

**Behavior Change Contract**

1. I, ______________, agree to increase my consumption of fruit from
   1 cup per week to 2 cups per day.

2. I will begin on ___10/5___ and plan to reach my goal of __2 cups of
   fruit per day___ by ___12/7__

3. To reach my final goal, I have devised the following schedule of mini-goals.
   For each step in my program, I will give myself the reward listed.
   
   - I will begin to have ½ cup ___10/5___ see movie
   - I will begin to have ½ cup ___10/26___ new cd
   - I will begin to substitute fruit ___11/16___ concert
   - juice for soda 1 time per day
   
   My overall reward for reaching my goal will be ___trip to beach__

4. I have gathered and analyzed data on my target behavior and have
   identified the following strategies for changing my behavior: Keep the
   fridge stocked with easy-to-carry fruit. Pack fruit in my backpack
   every day. Buy lunch at place that serves fruit.

5. I will use the following tools to monitor my progress toward my final goal:
   Chart on fridge door
   Health journal
   I sign this contract as an indication of my personal commitment to reach
   my goal: ________________

   I have recruited a helper who will witness my contract and also increase
   his consumption of fruit; eat lunch with me twice a week.

   Eric March, 9/28

---

**FIGURE 1.8 A sample behavior change contract.**
don’t like running. An aerobics class might suit you better. There are many ways to move toward your goal. Or you may not be trying hard enough. You do have to push toward your goal. If it were easy, you wouldn’t need a plan.

**Stress Barrier** If you hit a wall in your program, look at the sources of stress in your life. If the stress is temporary, such as catching a cold or having a term paper due, you may want to wait until it passes before strengthening your efforts. If the stress is ongoing, find healthy ways to manage it (see Chapter 10). You may even want to make stress management your highest priority for behavior change.

**Procrastinating, Rationalizing, and Blaming** Be alert to games you might be playing with yourself, so you can stop them. Such games include the following:

- **Procrastinating.** If you tell yourself, “It’s Friday already; I might as well wait until Monday to start,” you’re procrastinating. Break your plan into smaller steps that you can accomplish one day at a time.
- **Rationalizing.** If you tell yourself, “I wanted to go swimming today but wouldn’t have had time to wash my hair afterward,” you’re making excuses.
- **Blaming.** If you tell yourself, “I couldn’t exercise because Dave was hogging the elliptical trainer,” you’re blaming others for your own failure to follow through. Blaming is a way of taking your focus off the real problem and denying responsibility for your own actions.

**Being Fit and Well for Life**

Your first attempts at making behavior changes may never go beyond the contemplation or preparation stage. Those that do may not all succeed. But as you experience some success, you’ll start to have more positive feelings about yourself. You may discover new physical activities and sports you enjoy, and you may encounter new situations and meet new people. Perhaps you’ll surprise yourself by accomplishing things you didn’t think were possible—breaking a long-standing nicotine habit, competing in a race, climbing a mountain, or developing a leaner body. Most of all, you’ll discover the feeling of empowerment that comes from taking charge of your health. Being healthy takes effort, but the paybacks in energy and vitality are priceless.

**TIPS FOR TODAY AND THE FUTURE**

You are in charge of your health. Many of the decisions you make every day have an impact on the quality of your life, both now and in the future.

**RIGHT NOW YOU CAN**

- Go for a 15-minute walk.
- Have a piece of fruit for a snack.
- Call a friend and arrange for a time to catch up with each other.
- Start thinking about whether you have a health behavior you’d like to change. If you do, consider the elements of a behavior change strategy. For example, begin a mental list of the pros and cons of the behavior, or talk to someone who can support you in your attempts to change.

**IN THE FUTURE YOU CAN**

- Stay current on health and wellness news and issues.
- Participate in health awareness and promotion campaigns in your community—for example, support smoking restrictions in local venues.
- Be a role model for someone else who is working on a health behavior you have successfully changed.

Once you’ve started, don’t stop. Assume that health improvement is forever. Take on the easier problems first, and then use what you learn to tackle more difficult problems later. When you feel challenged, remind yourself that you are creating a lifestyle that minimizes your health risks and maximizes your enjoyment of life. You can take charge of your health in a dramatic and meaningful way. *Fit and Well* will show you how.

**SUMMARY**

- Wellness is the ability to live life fully, with vitality and meaning. Wellness is dynamic and multidimensional; it incorporates physical, emotional, intellectual, interpersonal, cultural, spiritual, environmental, financial, and occupational dimensions.
- People today have greater control over and greater responsibility for their health than ever before.
- Behaviors that promote wellness include being physically active, choosing a healthy diet, maintaining a healthy body weight, managing stress effectively, avoiding tobacco and limiting alcohol use, and protecting yourself from disease and injury.
- Although heredity, environment, and health care all play roles in wellness and disease, behavior can mitigate their effects.
- To make lifestyle changes, you need information about yourself, your health habits, and resources available to help you change.
• You can increase your motivation for behavior change by examining the benefits and costs of change, boosting self-efficacy, and identifying and overcoming key barriers to change.

• The stages-of-change model describes six stages that people may move through as they try to change their behavior: precontemplation, contemplation, preparation, action, maintenance, and termination.

• A specific plan for change can be developed by (1) collecting data on your behavior and recording it in a journal; (2) analyzing the recorded data; (3) setting specific goals; (4) devising strategies for modifying the environment, rewarding yourself, and involving others; and (5) making a personal contract.

• To start and maintain a behavior change program, you need commitment, a well-developed and manageable plan, social support, and strong stress-management techniques. It is also important to monitor the progress of your program, revising it as necessary.

FOR FURTHER EXPLORATION

The Internet addresses listed here were accurate at the time of publication.

Centers for Disease Control and Prevention. Through phone, fax, and the Internet, the CDC provides a wide variety of health information.
http://www.cdc.gov

Federal Deposit Insurance Corporation: Money Smart. A free source of information, unaffiliated with commercial interests, that includes eight modules on topics such as “borrowing basics” and “paying for college and cars.”
https://www.fdic.gov/consumers/consumer/monesmart/msc1/msc1.html

Federal Trade Commission: Consumer Protection—Health. Includes online brochures about a variety of consumer health topics, including fitness equipment, generic drugs, and fraudulent health claims.
http://www.ftc.gov/bcp/consumer/health.shtm

Healthfinder. A gateway to online publications, websites, support and self-help groups, and agencies and organizations that produce reliable health information.
http://www.healthfinder.gov

Health.gov. A portal for online information from a wide variety of federal agencies.
http://health.gov/

Healthy Campus. The American College Health Association’s introduction to the Healthy Campus program.
http://www.achanca.org/

Healthy People. Provides information on Healthy People objectives and priority areas.
http://www.healthypeople.gov

MedlinePlus. Provides links to news and reliable information about health from government agencies and professional associations; also includes a health encyclopedia and information on prescription and over-the-counter drugs.
http://www.nlm.nih.gov/medlineplus/

National Health Information Center (NHIC). Puts consumers in touch with the organizations that are best able to provide answers to health-related questions.
http://www.health.gov/nhic/

National Institutes of Health. Provides information about all NIH activities as well as consumer publications, hotline information, and an A-to-Z listing of health issues with links to the appropriate NIH institute.
http://www.nih.gov

National Wellness Institute. Serves professionals and organizations that promote optimal health and wellness.
http://www.nationalwellness.org

National Women’s Health Information Center. Provides information and answers to frequently asked questions.
http://www.womenshealth.gov

Office of Minority Health. Promotes improved health among racial and ethnic minority populations.
http://minorityhealth.hhs.gov

Surgeon General. Includes information on activities of the Surgeon General and the text of many key reports on such topics as tobacco use, physical activity, and mental health.
http://www.surgeongeneral.gov

World Health Organization (WHO). Provides information about health topics and issues affecting people around the world.
http://www.who.int/en

SELECTED BIBLIOGRAPHY


LAB 1.1  Your Wellness Profile

Consider how your lifestyle, attitudes, and characteristics relate to each of the dimensions of wellness. Fill in at least three strengths for each dimension (examples of strengths are listed with each dimension). Once you’ve completed your lists, choose what you believe are your five most important strengths and circle them.

**Physical wellness:** To maintain overall physical health and engage in appropriate physical activity (e.g., stamina, strength, flexibility, healthy body composition).

**Emotional wellness:** To have a positive self-concept, deal constructively with your feelings, and develop positive qualities (e.g., optimism, trust, self-confidence, determination).

**Intellectual wellness:** To pursue and retain knowledge, think critically about issues, make sound decisions, identify problems, and find solutions (e.g., common sense, creativity, curiosity).

**Interpersonal/social wellness:** To develop and maintain meaningful relationships with a network of friends and family members, and to contribute to your community (e.g., friendly, good-natured, compassionate, supportive, good listener).

**Cultural Wellness:** To accept, value, and even celebrate personal and cultural differences (e.g., refuse to stereotype based on ethnicity, gender, religion, or sexual orientation; create relationships with those who are different from you; maintain and value your own cultural identity).

**Spiritual wellness:** To develop a set of beliefs, principles, or values that gives meaning or purpose to your life; to develop faith in something beyond yourself (e.g., religious faith, service to others).

**Environmental wellness:** To protect yourself from environmental hazards and to minimize the negative impact of your behavior on the environment (e.g., carpooling, recycling).

**Financial wellness:** Your ability to live within your means and manage your money in a way that gives you peace of mind.

**Occupational Wellness:** To gain a measure of happiness and fulfillment through your work (e.g., enjoy what you do, feel valued by your manager, build positive relationships with co-workers, take advantage of opportunities to learn and be challenged).
LABORATORY ACTIVITIES

Next, think about where you fall on the wellness continuum for each of the dimensions of wellness. Indicate your placement for each—physical, emotional, intellectual, interpersonal/social, cultural/spiritual, environmental, financial, and occupational—by placing Xs on the continuum below.

Based on both your current lifestyle and your goals for the future, what do you think your placement on the wellness continuum will be in 10 years? What new health behaviors will you have to adopt to achieve your goals? Which of your current behaviors will you need to change to maintain or improve your level of wellness in the future?

Does the description of wellness given in this chapter encompass everything you believe is part of wellness for you? Write your own definition of wellness, including any additional dimensions that are important to you. Then rate your level of wellness based on your own definition.

Using Your Results

How did you score? Are you satisfied with your current level of wellness—overall and in each dimension? In which dimension(s) would you most like to increase your level of wellness?

What should you do next? As you consider possible target behaviors for a behavior change program, choose things that will maintain or increase your level of wellness in one of the dimensions you listed as an area of concern. Remember to consider health behaviors such as smoking or eating a high-fat diet that may threaten your level of wellness in the future. Below, list several possible target behaviors and the wellness dimensions that they influence.

For additional guidance in choosing a target behavior, complete the lifestyle self-assessment in Lab 1.2.
LAB 1.2  Lifestyle Evaluation

How does your current lifestyle compare with the lifestyle recommended for wellness? For each question, choose the answer that best describes your behavior. Then add up your score for each section.

**Exercise/Fitness**

1. I engage in moderate exercise, such as brisk walking or swimming, for the equivalent of at least 150 minutes per week.
   - Almost Always: 4
   - Sometimes: 1
   - Never: 0

2. I do exercises to develop muscular strength and endurance at least twice a week.
   - Almost Always: 4
   - Sometimes: 1
   - Never: 0

3. I spend some of my leisure time participating in individual, family, or team activities, such as gardening, bowling, or softball.
   - Almost Always: 4
   - Sometimes: 1
   - Never: 0

4. I maintain a healthy body weight, avoiding overweight and underweight.
   - Almost Always: 4
   - Sometimes: 1
   - Never: 0

**Nutrition**

1. I eat a variety of foods each day, including seven or more servings of fruits and/or vegetables.
   - Almost Always: 4
   - Sometimes: 1
   - Never: 0

2. I limit the amount of saturated and trans fat in my diet.
   - Almost Always: 4
   - Sometimes: 1
   - Never: 0

3. I avoid skipping meals.
   - Almost Always: 4
   - Sometimes: 1
   - Never: 0

4. I limit the amount of salt and added sugars I eat.
   - Almost Always: 4
   - Sometimes: 1
   - Never: 0

**Tobacco Use**

1. I avoid smoking cigarettes.
   - Almost Always: 4
   - Sometimes: 1
   - Never: 0

2. I avoid using a pipe or cigars.
   - Almost Always: 4
   - Sometimes: 1
   - Never: 0

3. I avoid spit tobacco.
   - Almost Always: 4
   - Sometimes: 1
   - Never: 0

4. I limit my exposure to environmental tobacco smoke.
   - Almost Always: 4
   - Sometimes: 1
   - Never: 0

**Alcohol and Drugs**

1. I avoid alcohol, or I drink no more than one (women) or two (men) drinks a day.
   - Almost Always: 4
   - Sometimes: 1
   - Never: 0

2. I avoid using alcohol or other drugs as a way of handling stressful situations or the problems in my life.
   - Almost Always: 4
   - Sometimes: 1
   - Never: 0

3. I am careful not to drink alcohol when taking medications (such as cold or allergy medications) or when pregnant.
   - Almost Always: 4
   - Sometimes: 1
   - Never: 0

4. I read and follow the label directions when using prescribed and over-the-counter drugs.
   - Almost Always: 4
   - Sometimes: 1
   - Never: 0

**Emotional Health**

1. I enjoy being a student, and I have a job or do other work that I enjoy.
   - Almost Always: 4
   - Sometimes: 1
   - Never: 0

2. I find it easy to relax and express my feelings freely.
   - Almost Always: 4
   - Sometimes: 1
   - Never: 0

3. I manage stress well.
   - Almost Always: 4
   - Sometimes: 1
   - Never: 0

4. I have close friends, relatives, or others whom I can talk to about personal matters and call on for help when needed.
   - Almost Always: 4
   - Sometimes: 1
   - Never: 0

5. I participate in group activities (such as community or church organizations) or hobbies that I enjoy.
   - Almost Always: 4
   - Sometimes: 1
   - Never: 0

**Scores**

- **Exercise/Fitness Score:**
- **Nutrition Score:**
- **Tobacco Use Score:**
- **Alcohol and Drugs Score:**
- **Emotional Health Score:**
### Laboratory Activities

#### Safety

1. I wear a safety belt while riding in a car.  
   - Almost Always: 
   - Sometimes: 2
   - Never: 0
2. I avoid driving while under the influence of alcohol or other drugs.  
   - Almost Always: 
   - Sometimes: 2
   - Never: 0
3. I obey traffic rules and the speed limit when driving.  
   - Almost Always: 
   - Sometimes: 2
   - Never: 0
4. I read and follow instructions on the labels of potentially harmful products or substances, such as household cleaners, poisons, and electrical appliances.  
   - Almost Always: 
   - Sometimes: 2
   - Never: 0
5. I avoid using a cell phone while driving.  
   - Almost Always: 
   - Sometimes: 2
   - Never: 0

Safety Score: __________

#### Disease Prevention

1. I know the warning signs of cancer, heart attack, and stroke.  
   - Almost Always: 
   - Sometimes: 2
   - Never: 0
2. I avoid overexposure to the sun and use sunscreen.  
   - Almost Always: 
   - Sometimes: 2
   - Never: 0
3. I get recommended medical screening tests (such as blood pressure and cholesterol checks and Pap tests), immunizations, and booster shots.  
   - Almost Always: 
   - Sometimes: 2
   - Never: 0
   - Almost Always: 
   - Sometimes: 2
   - Never: 0
5. I am not sexually active, or I have sex with only one mutually faithful, uninfected partner, or I always engage in safer sex (using condoms), and I do not share needles to inject drugs.  
   - Almost Always: 
   - Sometimes: 2
   - Never: 0

Disease Prevention Score: __________

**Scores of 9 and 10** Excellent! Your answers show that you are aware of the importance of this area to your health. More important, you are putting your knowledge to work for you by practicing good health habits. As long as you continue to do so, this area should not pose a serious health risk.

**Scores of 6 to 8** Your health practices in this area are good, but there is room for improvement.

**Scores of 3 to 5** Your health risks are showing.

**Scores of 0 to 2** You may be taking serious and unnecessary risks with your health.

### Using Your Results

**How did you score?** In which areas did you score the lowest? Are you satisfied with your scores in each area? In which areas would you most like to improve your scores?

**What should you do next?** To improve your scores, look closely at any item to which you answered “sometimes” or “never.” Identify and list at least three possible targets for a health behavior change program. (If you are aware of other risky health behaviors you currently engage in, but that were not covered by this assessment, you may include those in your list.) For each item on your list, identify your current “stage of change” and one strategy you could adopt to move forward (see pp. 15–20). Possible strategies might be obtaining information about the behavior, completing an analysis of the pros and cons of change, or beginning a written record of your target behavior.

<table>
<thead>
<tr>
<th>Behavior</th>
<th>Stage</th>
<th>Strategy</th>
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<td>1.</td>
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</table>

**Source:** Adapted from *Healthstyle: A Self-Test*, developed by the U.S. Public Health Service. The behaviors covered in this test are recommended for most Americans, but some may not apply to people with certain chronic diseases or disabilities or to pregnant women, who may require special advice from their physician.
LOOKING AHEAD...

After reading this chapter, you should be able to

■ Describe how much physical activity is recommended for developing health and fitness.
■ Identify the components of physical fitness and the way each component affects wellness.
■ Explain the goal of physical training and the basic principles of training.
■ Describe the principles involved in designing a well-rounded exercise program.
■ List the steps that can be taken to make an exercise program safe, effective, and successful.

TEST YOUR KNOWLEDGE

1. To improve your health, you must exercise vigorously for at least 30 minutes straight, 5 or more days per week. True or false?

2. Which of the following activities uses about 150 calories?
   a. washing a car for 45–60 minutes
   b. shooting a basketball for 30 minutes
   c. jumping rope for 15 minutes

3. Regular exercise can make a person smarter. True or false?

   See answers on the next page.
Any list of the benefits of physical activity is impressive. Although people vary greatly in physical fitness and performance ability, the benefits of regular physical activity are available to everyone. Much of the increased health benefits from exercise occur when going from no activity (sedentary) to some moderate-intensity activity (Figure 2.1). Further health benefits occur when exercising harder or longer. The relative risk of death from all causes and the risk of heart disease decrease by as much as 65% when comparing the least and most active men and women. In Figure 2.1, relative risk of death refers to the risk of death per year of sedentary people compared to people in various activity levels.

This chapter provides an overview of physical fitness. It explains how both lifestyle physical activity and more formal exercise programs contribute to wellness. It also describes the components of fitness, the basic principles of physical training, and the essential elements of a well-rounded exercise program. Chapters 3–6 provide an in-depth look at each of the elements of a fitness program; Chapter 7 puts these elements together in a complete, personalized program.

**PHYSICAL ACTIVITY AND EXERCISE FOR HEALTH AND FITNESS**

Almost any kind of physical activity promotes health. Try to be more active during the day, regardless of whether you can fit in a formal workout. Short periods of intense exercise do not compensate for hours of inactivity. So try to get up and move around each hour when you are studying, working on the computer, or watching TV (see the box “Move More, Sit Less”). Physical activity and exercise are points along a continuum.

**Physical Activity on a Continuum**

Physical activity is movement that is carried out by the skeletal muscles and requires energy. Different types of physical activity can vary by ease or intensity. Standing up or walking down a hallway requires little energy or effort, but each is a higher level of activity than sitting or lying down. More intense sustained activities, such as cycling five miles or running in a race, require considerably more effort.

**Exercise** refers to planned, structured, repetitive movement intended specifically to improve or maintain physical fitness. As discussed in Chapter 1, physical fitness is a set of physical attributes that allows the body to respond or adapt to the demands and stress of physical effort—to perform moderate to vigorous levels of physical activity without becoming overly tired. Levels of fitness depend on such physiological factors as the heart’s ability to pump blood and the energy-generating capacity of the cells. These factors in turn depend both on genetics—a person’s inborn potential for physical fitness—and behavior—getting enough physical activity to stress the body and cause long-term physiological changes.

Physical activity is essential to health and confers wide-ranging health benefits, but exercise is necessary to significantly improve physical fitness. This important distinction between physical activity, which improves health and wellness, and exercise, which improves fitness, is a key concept in understanding the guidelines discussed in this section.

**Increasing Physical Activity to Improve Health and Wellness** According to the U.S. Surgeon General’s Office (USSGO), “Engaging in regular physical activity is one of the most important things that people of all ages can do to improve their health.” Physical activity is central to the national prevention strategy to improve health by promoting community design to support active lifestyles, encouraging exercise in young people, providing safe and accessible places for sports and exercise, and supporting physical activity in the workplace. The U.S. Department of Health and Human Services, American College of Sports Medicine, the American Heart Association,
A regular exercise program provides huge wellness benefits, but it does not cancel out all the negative effects of too much sitting during the day. Advances in technology promote sedentary behavior—we can now work or study at a desk, watch TV or play video games in our leisure time, order take-out and delivery for meals, and shop and bank online. To avoid the negative health effects of too little daily activity, you may need a plan to reduce your sitting time. Try some of the following strategies:

- Stand up and/or walk when you are on work or personal phone calls.
- Take the stairs whenever and wherever you can; walk up and down escalators instead of just riding them.
- At work, walk to a co-worker’s desk rather than emailing or calling; take the long route to the restroom; and take a walk break whenever you take a coffee or snack break. Drink plenty of water so you’ll have to take frequent restroom breaks.
- Set reminders to get up and move: Use commercial breaks while watching TV; at work or while using a digital device, use the clock function on your computer or phone to make sure you don’t sit for longer than an hour at a time.
- Engage in active chores and leisure activities.
- Track your sedentary time to get a baseline, and then continue monitoring to note any improvements. You can also use a step counter to track your general activity level.

And USSGO have made specific exercise recommendations for promoting health. Their reports stress the importance of regular physical activity and emphasize that some physical activity is better than none. They also present evidence that regular activity promotes health and prevents premature death and a variety of diseases (Figure 2.1). The reports include the following key guidelines for adults:

- For substantial health benefits, adults should do at least 150 minutes (2 hours and 30 minutes) a week of moderate-intensity aerobic physical activity, or 75 minutes (1 hour and 15 minutes) a week of vigorous-intensity aerobic physical activity, or an equivalent combination of moderate- and vigorous-intensity aerobic activity. Activity should preferably be spread throughout the week.
- For additional and more extensive health benefits, adults should increase their aerobic physical activity to 300 minutes (5 hours) a week of moderate-intensity activity, or 150 minutes a week of vigorous-intensity activity, or an equivalent combination of moderate- and vigorous-intensity activity. Adults can enjoy additional health benefits by engaging in physical activity beyond this amount. The Health and Retirement Study—a long-term study of older adults sponsored by the National Institute on Aging—found that people who exercised vigorously had a lower death rate than those who exercised at moderate intensities or did no physical activity. After 16 years, the survival rate was 84% in those doing vigorous exercise, 78% in those doing moderate-intensity physical activity, and only 65% in those doing no physical activity.
- Adults should also do muscle-strengthening activities, such as weight training or calisthenics, that are moderate or high intensity and involve all major muscle groups on two or more days a week, because these activities provide additional health benefits.
- Everyone should avoid inactivity. Adults, teenagers, and children should spend less time in front of a television or computer screen because such inactivity decreases metabolic health and contributes to a sedentary lifestyle and increases the risk of obesity.

The reports state that physical activity benefits people of all ages and of all racial and ethnic groups, including people with disabilities. The reports emphasize that the benefits of activity outweigh the dangers.

These levels of physical activity promote health and wellness by lowering the risk of high blood pressure, stroke, heart disease, type 2 diabetes, colon cancer, and osteoporosis and by reducing feelings of mild to moderate depression and anxiety.

What exactly is moderate physical activity? Activities such as brisk walking, dancing, swimming, cycling, and yard work can all count toward the daily total. A moderate amount of activity uses about 150 calories of energy and causes a noticeable increase in heart rate, such as would occur with a brisk walk. Examples of activities that use about 150 calories in 15 to 60 minutes are shown in Figure 2.2. You can burn the same number of calories by doing a lower-intensity activity for a longer time or a higher-intensity activity for a shorter time. People are more likely to participate in physical activities they enjoy, such as dancing.

In contrast to moderate-intensity activity, vigorous physical activity—such as jogging—causes rapid breathing and a substantial increase in heart rate (Table 2.1). Physical activity and exercise recommendations for promoting general health, fitness, and weight management are shown in Table 2.2.

The daily total of physical activity can be accumulated in multiple bouts of 10 or more minutes per day—for example, two
Common Activities | Duration (min.)
---|---
Washing and waxing a car | 45–60
Washing windows or floors | 45–60
Gardening | 30–45
Wheeling self in wheelchair | 30–40
Pushing a stroller 1/2 miles | 30
Raking leaves | 30
Walking 2 miles | 30 (15 min/mile)
Shoveling snow | 15
Stairwalking | 15

Sporting Activities
Playing volleyball | 45–60
Playing touch football | 45
Walking 1 1/4 miles | 35 (20 min/mile)
Basketball (shooting baskets) | 30
Bicycling 5 miles | 30
Dancing fast (social) | 30
Water aerobics | 30
Swimming laps | 20
Basketball (playing game) | 15–20
Bicycling 4 miles | 15
Jumping rope | 15
Running 1 1/2 miles | 15 (10 min/mile)

**FIGURE 2.2 Examples of moderate-intensity physical activity.** Each example uses about 150 calories.

**TABLE 2.1 Examples of Moderate- and Vigorous-Intensity Exercise**

**MODERATE-INTENSITY ACTIVITY**
Uses 3.5 to 7 calories per minute and causes your breathing and heart rate to increase but still allows for comfortable conversation.
- Actively playing with children or pets
- Archery
- Ballroom dancing
- Bicycling or stationary bike, moderate pace
- Downhill skiing, moderate intensity
- Figure skating, recreational
- Fly fishing or walking along stream
- Gardening or yard work, moderate pace
- Golf
- Hiking, leisurely pace
- Horseback riding, recreational
- Housework, moderate intensity
- Skateboarding
- Softball
- Using stair-climber, elliptical trainer, or rowing machine, moderate pace
- Table tennis
- Tennis, doubles
- Walking at a moderate pace: walking to school or work; walking for pleasure
- Water aerobics
- Waxing the car
- Weight training and bodybuilding
- Yoga

**VIGOROUS-INTENSITY ACTIVITY**
Uses more than 7 calories per minute and increases your heart and breathing rates considerably. These exercises cause larger increases in physical fitness.
- Aerobic dancing: high-impact step aerobics
- Backpacking
- Basketball, recreational
- Bicycling, high intensity
- Calisthenics, vigorous: jumping jacks, burpees, air squats
- Circuit weight training
- Cross-country skiing or snowshoeing
- Cross-training, such as CrossFit
- Downhill skiing, vigorous intensity
- Football, recreational
- Gardening or yard work, shoveling heavy snow, digging ditches
- Hand cycling
- Horseback riding, galloping or jumping
- In-line skating
- Interval training: running, elliptical trainer, swimming, cycling
- Jogging
- Kayaking, whitewater
- Pushing a car
- Running up stairs
- Soccer, recreational
- Tennis, singles
- Wheelchair wheeling

**SOURCE:** Adapted from the Centers for Disease Control and Prevention, 2015, http://www.cdc.gov/nccdphp/dnpa/physical/pdf/PA_Intensity_table_2_1.pdf

10-minute bike rides to and from class and a brisk 10-minute walk to the store. In this lifestyle approach to physical activity, people can choose activities that they find enjoyable and that fit into their daily routine; everyday tasks at school, work, and home can be structured to contribute to the daily activity total. If Americans who are currently sedentary were to increase their lifestyle physical activity to 30 minutes per day, both public health and their individual well-being would benefit enormously (see the box “Exercise Is Good for Your Brain”).

**Increasing Physical Activity to Manage Weight**
Because two-thirds of Americans are overweight, the U.S. Department of Health and Human Services has also published physical activity guidelines focusing on weight management. These guidelines recognize that for people who need to prevent weight gain, lose weight, or maintain weight loss, 150 minutes per week of physical activity may not be enough. Instead, they recommend up to 90 minutes of physical activity per day. Unfortunately, exercise alone will seldom promote long-term weight loss; but exercise has many health benefits, even in the absence of substantial weight loss.

**Exercising to Improve Physical Fitness**
As mentioned earlier, moderate physical activity confers significant health and wellness benefits, especially for those who are currently sedentary and become moderately active. However, people can obtain even greater health and wellness benefits by increasing the duration and intensity of physical activity. With
Perform range-of-motion (stretching) exercises at least two days per week. Hold each stretch for 10–30 seconds.

Older adults should do balance training two–three days per week. Examples include yoga, tai chi, and balance exercises. Although you get many of the health benefits of exercise by being more active over the course of the day; the amount of activity needed depends on an individual’s health status and goals. Other experts believe that leisure-time physical activity is not enough; they argue that people should exercise long enough and intensely enough to improve the body’s capacity for exercise—that is, to improve physical fitness. There is probably some truth in both of these positions.

Regular physical activity, regardless of the intensity, makes you healthier and can help protect you from many chronic diseases. Although you get many of the health benefits of exercise by being more active, you obtain even more benefits when you are physically fit. In addition to long-term health benefits, fitness also contributes significantly to quality of life. Fitness can give you freedom to move your body the way you want. Fit people have more energy and better body control. They can enjoy a more active lifestyle than their more sedentary counterparts. Even if you don’t like sports, you need physical energy and stamina in your daily life and for many non-sport leisure activities, such as visiting museums, playing with children, and gardening.

Where does this leave you? Most experts agree that some physical activity is better than none, but that more—as long as it does not result in injury—is better than some. To set a personal goal for physical activity and exercise, consider your current activity level, your health status, and your overall goals. At the very least, strive to become more active and do 30 minutes of moderate-intensity activity at least five days per week. Choose to be active whenever you can. If weight management is a concern for you, begin by achieving the goal of 30 minutes of moderate-intensity activity per day and then try to raise your activity level further, to 60–90 minutes per day or more. For even better health and well-being, participate in a structured exercise program that develops physical fitness. Any increase in physical activity will contribute to your health and well-being, now and in the future.

### Components of Physical Fitness

Some components of fitness relate to specific skill activities, such as tennis and skiing, and others to general health. **Health-related fitness** includes the following components:

- Cardiorespiratory endurance
- Muscular strength

### Table 2.2 Physical Activity and Exercise Recommendations for Promoting General Health, Fitness, and Weight Management

<table>
<thead>
<tr>
<th>GOAL</th>
<th>RECOMMENDATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>General health</td>
<td>Perform moderate-intensity aerobic physical activity for at least 150 minutes per week or 75 minutes of vigorous-intensity physical activity per week. Also, be more active in your daily life: Walk instead of driving, take the stairs instead of the elevator, and watch less television.</td>
</tr>
<tr>
<td>Increased health benefits</td>
<td>Exercise at moderate intensity for 300 minutes per week or at vigorous intensity for 150 minutes per week.</td>
</tr>
<tr>
<td>Achieve or maintain weight loss</td>
<td>Exercise moderately for 60–90 minutes per day on most days of the week.</td>
</tr>
<tr>
<td>Muscle strength and endurance</td>
<td>Perform 1 or more sets of resistance exercises that work the major muscle groups for 8–12 repetitions (10–15 reps for older adults) on at least two nonconsecutive days per week. Examples include weight training and exercises that use body weight as resistance (such as core stabilizing exercises, pull-ups, push-ups, lunges, and squats).</td>
</tr>
<tr>
<td>Flexibility</td>
<td>Perform range-of-motion (stretching) exercises at least two days per week. Hold each stretch for 10–30 seconds.</td>
</tr>
<tr>
<td>Neuromuscular training</td>
<td>Older adults should do balance training two–three days per week. Examples include yoga, tai chi, and balance exercises (standing on one foot, step-ups, and walking lunges). These exercises are probably beneficial for young and middle-aged adults, as well.</td>
</tr>
</tbody>
</table>

The Evidence for Exercise

Exercise Is Good for Your Brain

Some scientists call exercise the new “brain food.” Studies show that even moderate physical activity can improve brain health and function and may delay the decline in cognitive function that occurs for many people as they age. Regular physical activity has the following positive effects on the brain:

- Exercise improves cognitive function—the brain’s ability to learn, remember, think, and reason.
- Exercise can help overcome the negative effects of a poor diet on brain health.
- Exercise promotes the creation of new nerve cells (neurons) throughout the nervous system. By promoting this process (called neurogenesis), exercise provides protection against injury and degenerative conditions that destroy neurons. Physical activity is less effective for promoting brain health when exercising in polluted air.
- Exercise enhances the nervous system’s plasticity—it’s ability to change and adapt. In the brain, spinal cord, and nerves, this can mean developing new pathways for transmitting sensory information or motor commands.
- Exercise appears to have a protective effect on the brain as people age, helping to delay or even prevent the onset of neurodegenerative disorders such as Alzheimer’s disease.

Although most people consider brain health to be a concern for the elderly, it is vital to wellness throughout life. For this reason, many studies on exercise and brain health include children as well as older adults. Targeted research has also focused on the impact of exercise on people with disorders such as cerebral palsy, multiple sclerosis, and developmental disabilities. Generally speaking, these studies all reach a similar conclusion: Exercise enhances brain health, at least to some degree, in people of all ages and a wide range of health statuses.

Along with the brain’s physical health, mental health is enhanced by exercise. Even modest activity, such as taking a daily walk, can help combat a variety of mental health disorders and improve mood.

It’s hard to underestimate the impact of physical and mental disorders related to brain health. According to the Alzheimer’s Association, 5.3 million Americans currently suffer from Alzheimer’s disease, and the number is increasing at a rate of 70 people per second. People with depression, anxiety, or other mental disorders are more likely to suffer from chronic physical conditions. Taken together, these and other brain-related disorders cost untold millions of dollars in health care costs and lost productivity, as well as thousands of years of productive lifetime lost.

So, for the sake of your brain—as well as your muscles, bones, and heart—start creating your exercise program soon. You’ll be healthier, and you may even feel a little smarter.


Health-related fitness helps you withstand physical challenges and protects you from diseases.

Cardiorespiratory Endurance

Cardiorespiratory endurance is the ability to perform prolonged, large-muscle, dynamic exercise at moderate to high levels of intensity. It depends on such factors as the ability of the lungs to deliver oxygen from the environment to the bloodstream, the capacity of the heart to pump blood, the ability of the nervous system and blood vessels to regulate blood flow, and the capability of the cells’ chemical systems to use oxygen and process fuels for exercise and rest.
A healthy heart can better withstand the strains of everyday life, the stress of occasional emergencies, and the wear and tear of time.

Cardiovascular endurance training also improves the functioning of the body’s chemical systems, particularly in the muscles and liver. These changes enhance the body’s ability to derive energy from food, allow the body to perform more exercise with less effort, increase sensitivity to insulin, and prevent type 2 diabetes. Exercise reduces blood vessel inflammation, which is linked to coronary artery disease, heart attack, and stroke.

Physically fit people also have healthier, more resilient genes. Exercise preserves gene structures called telomeres, which form the ends of the DNA strands and hold them together. Over time the telomeres shorten, reducing their effectiveness, which triggers illness and death. Exercise helps to keep them from getting too short.

Cardiorespiratory endurance is a central component of health-related fitness because heart and lung function is so essential to overall good health. A person can’t live very long or very well without a healthy heart or healthy lungs. Poor cardiorespiratory fitness is linked with heart disease, type 2 diabetes, colon cancer, stroke, depression, and anxiety. A moderate level of cardiorespiratory fitness can help compensate for certain health risks, including excess body fat: People with higher levels of body fat but who are otherwise fit have been found to have lower death rates than those who are lean but have low cardiorespiratory fitness.

You can develop cardiorespiratory endurance through activities that involve continuous, rhythmic movements of large-muscle groups, such as the legs. Such activities include walking, jogging, cycling, and group aerobics.

Muscular Strength

Muscular strength is the amount of force a muscle can produce with a single maximum effort. It depends on such factors as the size of muscle cells and the ability of nerves to activate muscle cells. Strong muscles are important for everyday activities, such as climbing stairs, as well as for emergency situations. They help keep the skeleton in proper alignment, preventing back and leg pain and providing the support necessary for good posture. Muscular strength has obvious importance in recreational activities. Strong people can hit a tennis ball harder, kick a soccer ball farther, and ride a bicycle uphill more easily.

Muscle tissue is an important element of overall body composition. Greater muscle mass means faster energy use and a higher rate of metabolism, and the sum of all the vital processes by which food energy and nutrients are made available to and used by the body. Greater muscle mass reduces markers of oxidative stress and maintains mitochondria (the “powerhouses”...

Ask Yourself

Questions for Critical Thinking and Reflection

Does your current lifestyle include enough physical activity—30 minutes of moderate-intensity activity five or more days a week—to support health and wellness? Does your lifestyle go beyond this level to include enough vigorous physical activity and exercise to build physical fitness? What changes could you make in your lifestyle to develop physical fitness?
of the cell); both of these benefits are important for metabolic health and long life. Training to build muscular strength can also help people manage stress and boost their self-confidence.

Maintaining strength and muscle mass is vital for healthy aging. Stronger people live longer. Older people tend to experience a decrease in both number and size of muscle cells, a condition called sarcopenia. Many of the remaining muscle cells become slower, and some become nonfunctional because they lose their attachment to the nervous system. Strength training (also known as resistance training or weight training) increases antioxidant enzymes and lowers oxidative stress. It also helps maintain muscle mass and function and possibly helps decrease the risk of osteoporosis (bone loss) in older people, greatly enhancing their quality of life and preventing life-threatening injuries.

Muscular Endurance

Muscular endurance is the ability to resist fatigue and sustain a given level of muscle tension—that is, to hold a muscle contraction for a long time or to contract a muscle over and over again. It depends on such factors as the size of muscle cells, the ability of muscles to store fuel, blood supply, and the metabolic capacity of muscles.

Muscular endurance is important for good posture and for injury prevention. For example, if abdominal and back muscles cannot support and stabilize the spine correctly when you sit or stand for long periods, the chances of low back pain and back injury are increased. Good muscular endurance in the trunk muscles is more important than muscular strength for preventing back pain. Muscular endurance helps people cope with daily physical demands and enhances performance in sports and work.

Flexibility

Flexibility is the ability to move the joints through their full ranges of motion. It depends on joint structure, the length and elasticity of connective tissue, and nervous system activity. Flexible, pain-free joints are important for good health and well-being. Inactivity causes the joints to become stiffer with age. Stiffness, in turn, often causes people to assume unnatural body postures that can stress joints and muscles. Stretching exercises can help ensure a healthy range of motion for all major joints.

Body Composition

Body composition refers to the proportion of fat and fat-free mass (muscle, bone, and water) in the body. Healthy body composition involves a high proportion of fat-free mass and an acceptably low level of body fat, adjusted for age and gender. A person with excessive body fat—especially excess fat in the abdomen—is more likely to experience health problems, including heart disease, insulin resistance, high blood pressure, stroke, joint problems, type 2 diabetes, gallbladder disease, blood vessel inflammation, some types of cancer, back pain, and premature death.

The best way to lose fat is through a lifestyle that includes a sensible diet and exercise. The best way to add muscle mass is through strength training. Large changes in body composition are not necessary to improve health; even a small increase in physical activity and a small decrease in body fat can lead to substantial health improvements.

Somatotype, or body build, affects a person’s choice of exercise. Endomorphs are round and pear-shaped. They often excel at weight lifting and weight-supported aerobic exercises such as swimming or cycling. Conversely, they might find distance running difficult and painful. Mesomorphs are lean and muscular and usually excel at almost any kind of physical activity or sport. Ectomorphs are thin and linear. Their light frame helps them succeed in activities such as distance running and gymnastics. No matter what body type you have, you can benefit from some form of physical activity.

Skill (Neuromuscular)-Related Components of Fitness

In addition to the five health-related components of physical fitness, the ability to perform a particular sport or activity may depend on skill (neuromuscular)-related fitness. Neuromuscular refers to the complex control of muscles and movement by the brain and spinal column. The components of skill-related fitness include the following:

- **Speed**—the ability to perform a movement in a short period of time
- **Power**—the ability to exert force rapidly, based on a combination of strength and speed
- **Agility**—the ability to change the position of the body quickly and accurately
- **Balance**—the ability to maintain equilibrium while moving or while stationary
- **Coordination**—the ability to perform motor tasks accurately and smoothly using body movements and the senses
- **Reaction and movement time**—the ability to respond and react quickly to a stimulus
and heart rate increase during exercise, for example, the heart gradually develops the ability to pump more blood with each beat. Then, during exercise, it doesn’t have to beat as fast to meet the cells’ demands for oxygen. The goal of physical training is to produce these long-term changes and improvements in the body’s functioning and fitness. Although people differ in the maximum levels of physical fitness and performance they can achieve through training, the wellness benefits of exercise are available to everyone (see the box “Fitness and Disability”).

Particular types and amounts of exercise are most effective in developing the various components of fitness. To put together an effective exercise program, you should first understand the basic principles of physical training, including the following:

- Specificity
- Progressive overload
- Reversibility
- Individual differences

All of these rest on the larger principle of adaptation.

Specificity—Adapting to Type of Training

To develop a particular fitness component, you must perform exercises designed specifically for that component. This is the principle of specificity. Weight training, for example, develops muscular strength but is less effective for developing cardiorespiratory endurance or flexibility. Specificity also applies to the skill-related fitness components (to improve at tennis, you must practice tennis) and to the different parts of the body (to develop stronger arms, you must exercise your arms). A well-rounded exercise program includes exercises geared to each component of fitness, to different parts of the body, and to specific activities or sports.

Sports science pioneer Franklin Henry from the University of California, Berkeley, developed the principle of specificity of training. His studies showed that a specific movement performed at a specific speed develops a unique skill. Motor control studies have shown that practice reinforces motor patterns in the brain that are specific to a given movement. In other words, there is no general coordination, agility, balance, and accuracy. The balance required in skiing is different from the balance required to stand on one foot or do tricks on a skateboard. Each requires its own specific training.

**Fitness Tip** You don’t need to develop the skills of a professional athlete to participate in sports, but boosting sport-specific skills such as speed, power, coordination, and reaction time can make participating in sports more fun. And if you enjoy yourself, you are more likely to stick with the activity!

Skill-related fitness tends to be sport-specific and is best developed through practice. For example, playing basketball can develop the speed, coordination, and agility needed to engage in the sport. Participating in sports is fun, can help build fitness, and contributes to other areas of wellness. Young adults often find it easier to exercise regularly when they participate in sports and activities they enjoy, such as dancing, tennis, snowboarding, or basketball. Older adults can develop balance by practicing exercises such as yoga and tai chi. Skill-related activities are particularly important for older adults to help prevent life-threatening falls.

PRINCIPLES OF PHYSICAL TRAINING: ADAPTATION TO STRESS

The human body is very adaptable. The greater the demands made on it, the more it adjusts to meet those demands. Over time, immediate, short-term adjustments (adaptations) translate into long-term changes and improvements. When breathing and heart rate increase during exercise, for example, the heart gradually develops the ability to pump more blood with each beat. Then, during exercise, it doesn’t have to beat as fast to meet the cells’ demands for oxygen. The goal of physical training is to produce these long-term changes and improvements in the body’s functioning and fitness. Although people differ in the maximum levels of physical fitness and performance they can achieve through training, the wellness benefits of exercise are available to everyone (see the box “Fitness and Disability”).

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Physical fitness and athletic achievement are not limited to the able-bodied. People with disabilities can also attain high levels of fitness and performance. Elite athletes compete in the Paralympics, the premier event for athletes with disabilities that is held in the same year and city as the Olympics. The performance of these skilled athletes makes it clear that people with disabilities can be active, healthy, and extraordinarily fit. Just like able-bodied athletes, athletes with disabilities strive for excellence and can serve as role models.

According to the U.S. Census Bureau, about 54 million Americans have some type of chronic disability. Some disabilities are the result of injury, such as spinal cord injuries sustained in car crashes or war. Other disabilities result from illness, such as the blindness that sometimes occurs as a complication of diabetes or the joint stiffness that accompanies arthritis. And some disabilities are present at birth, as in the case of congenital limb deformities or cerebral palsy.

Exercise and physical activity are as important for people with disabilities as for able-bodied individuals—if not more important. Being active helps prevent secondary conditions that may result from prolonged inactivity, such as circulatory or muscular problems. Currently, about 19% of people with disabilities engage in regular moderate-intensity activity.

People with disabilities don’t have to be elite athletes to participate in sports and lead an active life. Some health clubs, fitness centers, city recreation centers, and universities offer activities and events geared for people of all ages and types of disabilities. They may have modified aerobics classes, special weight training machines, classes for mild exercise in warm water, and other activities adapted for people with disabilities. Popular sports and recreational activities include adapted horseback riding, golf, swimming, and skiing. Competitive sports are also available—for example, there are wheelchair versions of billiards, tennis, weight lifting, hockey, and basketball, as well as sports for people with hearing, visual, or mental impairments. For those who prefer to get their exercise at home, special videos are geared to individuals who use wheelchairs or who have arthritis, hearing impairments, metabolic diseases, or many other disabilities.

The Department of Education’s Office for Civil Rights has issued guidelines for providing equal opportunities for sports and exercise to students with disabilities. Schools and universities must make reasonable modifications to insure that students with disabilities have equal access to sports and physical education.

If you have a disability and want to be more active, check with your physician about what’s appropriate for you. Call your local community center, university, YMCA/YWCA, hospital, independent living center, or fitness center to locate facilities. Look for a facility with experienced personnel and appropriate adaptive equipment. For specialized videos, check with hospitals and health associations that address specific disabilities, such as the Arthritis Foundation.

**Progressive Overload—Adapting to the Amount of Training and the FITT Principle**

The body adapts to the demands of exercise by improving its functioning. When the amount of exercise (also called overload or stress) is increased progressively, fitness continues to improve. This is the principle of **progressive overload**.

The amount of overload is important. Too little exercise will have no effect on fitness (although it may improve health); too much may cause injury and problems with the body’s immune or endocrine (hormone) systems. The point at which exercise becomes excessive is highly individual; it occurs at a much higher level in an Olympic athlete than in a sedentary person. For every type of exercise, there is a training threshold at which fitness benefits begin to occur, a zone within which maximum fitness benefits occur, and an upper limit of safe training.

The amount of exercise needed depends on the individual’s current level of fitness, the person’s genetically determined capacity to adapt to training, his or her fitness goals, and the component being developed. A novice, for example, might experience fitness benefits from jogging a mile in 10 minutes, but this level of exercise would not benefit a trained distance runner. Beginners should start at the lower end of the fitness benefit zone; fitter individuals will make more rapid gains by exercising at the higher end of the fitness benefit zone. Progressive overload is critical. Exercising...
Fitness Tip Progressive overload is important because the body adapts to overload (increased volume and intensity of exercise) by becoming more fit. This is true even if your starting level of fitness is low. At the gym, don’t be intimidated by people who seem to be in better shape than you are. Remember: they got in shape by focusing on themselves, not by worrying about what other people thought about them.

at the same intensity every training session will maintain fitness but will not increase it because the training stress is below the threshold required to produce adaptation. Fitness increases only if the volume and intensity of workouts increase.

The amount of overload needed to maintain or improve a particular level of fitness for a particular fitness component is determined through four dimensions, represented by the acronym FITT:

- **Frequency**—how often
- **Intensity**—how hard
- **Time**—how long (duration)
- **Type**—mode of activity

Chapters 3, 4, and 5 show you how to apply the FITT principle to exercise programs for cardiorespiratory endurance, muscular strength and endurance, and flexibility, respectively.

**Frequency** Developing fitness requires regular exercise. Optimum exercise frequency, expressed in number of days per week, varies with the component being developed and the individual’s fitness goals. For most people, a frequency of three to five days per week for cardiorespiratory endurance exercise and two or more days per week for resistance and flexibility training are appropriate for a general fitness program.

An important consideration in determining appropriate exercise frequency is recovery time. The amount of time required to recover from exercise is highly individual and depends on factors such as training experience, age, and intensity of training. For example, 24 hours of rest between highly intense workouts involving heavy weights or track sprints is not enough recovery time for safe and effective training in most cases. Intense workouts need to be spaced out during the week to allow for sufficient recovery time. On the other hand, you can exercise every day if your program consists of moderate-intensity walking or cycling. Learn to “listen to your body” to get enough rest between workouts. Chapters 3–5 provide more detailed information about training techniques and recovery periods for workouts focused on different fitness components.

**Intensity** Fitness benefits occur when a person exercises harder than his or her normal level of activity. The appropriate exercise intensity varies with each fitness component. To develop cardiorespiratory endurance, for example, you must raise your heart rate above normal. To develop muscular strength, you must lift a heavier weight than normal. To develop flexibility, you must stretch muscles beyond their normal length.

**Time (Duration)** Fitness benefits occur when you exercise for an extended period of time. For cardiorespiratory endurance exercise, 20–60 minutes per exercise session is recommended. Exercise can take place in a single session or in several sessions of 10 or more minutes. The greater the intensity of exercise, the less time needed to obtain fitness benefits. For high-intensity exercise, such as running, 20–30 minutes is appropriate. For moderate-intensity exercise, such as walking, 45–60 minutes may be needed. High-intensity exercise poses a greater risk of injury than low-intensity exercise, so if you are a nonathletic adult, it’s best to first emphasize low- to moderate-intensity activity of longer duration.

To build muscular strength, muscular endurance, and flexibility, similar amounts of time are advisable, but training for these health components is more commonly organized in terms of a specific number of repetitions of a particular exercise. For resistance training, for example, a recommended program includes one or more sets of 8–12 repetitions of 8–10 different exercises that work the major muscle groups. Older adults should do 10–15 repetitions per set with lighter weights.

**Type (Mode of Activity)** The type of exercise in which you should engage varies with each fitness component and with your personal fitness goals. To develop cardiorespiratory endurance, you need to engage in continuous activities involving large-muscle groups—walking, jogging, cycling, or swimming, for example. Resistance exercises develop muscular strength and endurance, and stretching exercises build flexibility. The frequency, intensity, and time of the exercise will be different for each type of activity. (See pp. 38–41 for more on choosing appropriate activities for your fitness program.)

**Reversibility—Adapting to a Reduction in Training**

Fitness is a reversible adaptation. The body adjusts to lower levels of physical activity the same way it adjusts to higher levels. This is the principle of **reversibility**. When a person stops exercising, up to 50% of fitness improvements are lost within two months. However, not all fitness levels reverse at the same rate. Strength fitness is very resilient, so a person can maintain strength fitness
by doing resistance exercise as infrequently as once a week. On the other hand, cardiovascular and cellular fitness reverse themselves more quickly—sometimes within just a few days or weeks. If you must temporarily reduce the frequency or duration of your training, you can maintain much of your fitness improvement by keeping the intensity of your workouts constant.

**Individual Differences—Limits on Adaptability**

Anyone watching the Olympics can see that, from a physical standpoint, we are not all created equal. There are large individual differences in our ability to improve fitness, achieve a desirable body composition, and learn and perform sports skills. Some people are able to run longer distances, lift more weight, or kick a soccer ball more skillfully than others will ever be able to, no matter how much they train. People respond to training at different rates, so a program that works for one person may not be right for another person.

There are limits on the adaptability—the potential for improvement—of any human body. The body’s ability to transport and use oxygen, for example, can be improved by only about 5–30% through training. An endurance athlete must therefore inherit a large metabolic capacity to reach competitive performance levels. In the past few years, scientists have identified specific genes that influence body fat, strength, and endurance. For example, more than 800 genes are associated with endurance performance, and 100 of those determine individual differences in exercise capacity. However, physical training improves fitness regardless of heredity. The average person’s body can improve enough to achieve reasonable fitness goals.

**DESIGNING YOUR OWN EXERCISE PROGRAM**

Physical training works best when you have a plan. A plan helps you make gradual but steady progress toward your goals. First, determine that exercise is safe for you; then assess how fit you are, decide what your goals are, and choose the right activities to help you get there.

**Getting Medical Clearance**

Participating in exercise and sports is usually a wonderful experience that improves wellness in both the short and the long term. In rare instances, however, vigorous exertion is associated with sudden death. It may seem difficult to understand that although regular exercise protects people from heart disease, exercise also increases the risk of sudden death for some.

**Exercise and Cardiac Risk** Overall, the risk of death from exercise is small—and people are much safer exercising than engaging in many other common activities, including driving a car. One study of joggers found one death for every 396,000 hours of jogging; another study of men involved in a variety of physical activities found one death per 1.5 million hours of exercise.

In people under 35, congenital heart defects (heart abnormalities present at birth) are the most common cause of exercise-related sudden death. In nearly all other cases, coronary artery disease is responsible. In this condition, fat and other substances build up in the arteries that supply blood to the heart. Death can result if an artery becomes blocked or if the heart’s rhythm and pumping action are disrupted. Exercise, particularly intense exercise, may trigger a heart attack in someone with underlying heart disease. The riskiest scenario may involve the middle-aged or older individual who suddenly begins participating in a vigorous sport or activity after being sedentary for a long time. Engaging in very vigorous exercise over the long term can also be risky for some individuals, due to the stress on the cardiovascular system. For example, study of joggers in Denmark found the lowest mortality rate among those who jogged a moderate amount (2–3 workouts for a total of 60 to 150 minutes per week); higher rates of death were found among non-joggers and those who jogged at a very intense level and/or for long distances (even moderate jogging is high-intensity exercise).

Where does this leave you? Overall, exercise causes many positive changes in the body—in healthy people as well as those with heart disease—that more than make up for the slightly increased short-term risk of sudden death. People who exercise regularly have an overall risk of sudden death only about two-thirds that of non-exercisers. Active people who stop exercising can expect their heart attack risk to increase by 300%. The risk of heart-related sudden death in middle-aged and older adults is least in people who exercise approximately 150 minutes per week—the activity level recommended by the U.S. Department of Health and Human Services.

**Medical Clearance Recommendations** People of any age who are not at high risk for serious health problems can safely exercise at a moderate intensity (60% or less of maximum heart rate) without a prior medical evaluation (see Chapter 3 for a discussion of maximum heart rate). Likewise, if you are male and under 40 or female and under 50 and in good health, exercise is probably safe for you. If you do not fit into these age groups, or if you have health problems—especially high blood pressure, heart disease, muscle or joint problems, or obesity—see your physician before starting a vigorous exercise program. The Canadian Society for Exercise Physiology has developed the Physical Activity Readiness Questionnaire (PAR-Q) to help evaluate exercise safety; it is included in Lab 2.1. Completing it should alert you to any potential problems you may have. If a physician isn’t sure whether exercise is safe for you, she or he may recommend an exercise stress test or a graded exercise test (GXT) to see whether you
Choosing Activities for a Balanced Program

An ideal fitness program combines a physically active lifestyle with systematic exercise to develop and maintain physical fitness. This overall program is shown in the physical activity pyramid in Figure 2.3. If you are currently sedentary, your goal should be to focus on activities at the bottom of the pyramid and gradually increase the amount of moderate-intensity physical activity in your daily life. Appropriate activities include walking briskly, climbing stairs, doing yard work, and washing your car. You don't have to exercise vigorously, but you should experience a moderate increase in your heart and breathing rates. As described earlier, your activity time can be broken up into small blocks over the course of a day.

The next two levels of the pyramid illustrate parts of a formal exercise program. The principles of this program are consistent with those of the American College of Sports Medicine (ACSM), the professional organization for people involved in sports medicine and exercise science. The ACSM has established guidelines for creating an exercise program that will develop physical fitness (Table 2.3). A balanced program includes activities to develop all the health-related components of fitness:

- **Cardiorespiratory endurance** is developed by continuous rhythmic movements of large-muscle groups in activities such as walking, jogging, cycling, swimming, aerobic dance, and other forms of group exercise. High intensity interval training (HIIT)—short bouts of high-intensity exercise...
followed by rest—also builds endurance quickly. The advantage of HIIT is that it does not take as much time as traditional endurance training. The disadvantage is that it can be painful and uncomfortable. The safety of HIIT has not been determined.

Choose activities that you enjoy and are convenient. Popular choices are in-line skating, skiing, dancing, cycling, and backpacking. Start-and-stop activities such as tennis, racquetball, and soccer can also develop cardiorespiratory endurance if your skill level is sufficient to enable periods of continuous play. Training for cardiorespiratory endurance is discussed in Chapter 3.

- **Muscular strength and endurance** can be developed through resistance training—training with weights or performing calisthenics such as push-ups, planks, and curl-ups. Training for muscular strength and endurance is discussed in Chapter 4.
  - **Flexibility** is developed by stretching the major muscle groups regularly and with proper technique. Flexibility is discussed in Chapter 5.
  - **Healthy body composition** can be developed through a sensible diet and a program of regular exercise. Cardiorespiratory endurance exercise is best for reducing body fat; resistance training builds muscle mass, which, to a small extent, helps increase metabolism. Body composition is discussed in Chapter 6.

Chapter 7 contains guidelines to help you choose activities and put together a complete exercise program that will suit your goals and preferences. (Refer to Figure 2.4 for a summary of the health and fitness benefits of different levels of physical activity and exercise programs.)

What about the tip of the activity pyramid? Although sedentary activities are often unavoidable—attending class, studying, working in an office, and so on—many people choose inactivity over activity during their leisure time. Change sedentary patterns by becoming more active whenever you can.

### Guidelines for Training

The following guidelines will make your exercise program more effective and successful.

**Train the Way You Want Your Body to Change**

Stress your body so it adapts in the desired manner. To have a more muscular build, lift weights. To be more flexible, do stretching exercises. To improve performance in a particular sport, practice that sport or its movements.

**Train Regularly** Consistency is the key to improving fitness. Fitness improvements are lost if too much time passes between exercise sessions.

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**Table 2.3 ACSM Exercise Recommendations for Fitness Development in Healthy Adults**

<table>
<thead>
<tr>
<th>Exercise to Develop and Maintain</th>
<th>Frequency of training</th>
<th>Intensity of training</th>
<th>Time (duration) of training</th>
<th>Type (mode) of activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiorespiratory Endurance and Body Composition</td>
<td>3–5 days per week</td>
<td>55/65–90% of maximum heart rate or 40/50–85% of heart rate reserve or oxygen uptake reserve. The lower-intensity values (55–64% of maximum heart rate and 40–49% of heart rate reserve plus rest) are most applicable to unfit individuals. For average individuals, intensities of 70–85% of maximum heart rate or 60–80% of heart rate reserve plus rest are appropriate. These methods increase exercise intensity within the limits of each person’s reserve capacity.</td>
<td>20–60 total minutes per day of continuous or intermittent (in sessions lasting 10 or more minutes) aerobic activity. Duration depends on the intensity of activity; thus, low-intensity activity should be conducted over a longer period of time (30 minutes or more). Low- to moderate-intensity activity of longer duration is recommended for nonathletic adults.</td>
<td>Any activity that uses large-muscle groups, can be maintained continuously and is rhythmic and aerobic in nature—for example, walking-hiking, running-jogging, bicycling, cross-country skiing, aerobic dancing and other forms of group exercise, rope-skipping, rowing, stair-climbing, swimming, skating, and endurance game activities.</td>
</tr>
<tr>
<td>Muscular Strength and Endurance, Flexibility, and Body Composition</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resistance Training</td>
<td></td>
<td></td>
<td></td>
<td>One set of 8–10 exercises that condition the major muscle groups, performed at least two days per week. Most people should complete 8–12 repetitions of each exercise to the point of fatigue; practicing other repetition ranges (for example, 3–5 or 12–15) also builds strength and endurance; for older and frailer people (approximately 50–60 and older), 10–15 repetitions with a lighter weight may be more appropriate. Multiple-set regimens will provide greater benefits if time allows.</td>
</tr>
<tr>
<td>Flexibility Training</td>
<td></td>
<td></td>
<td></td>
<td>Static stretches, performed for the major muscle groups at least 2–3 days per week, ideally 5–7 days per week. Stretch to the point of tightness, holding each stretch for 10–30 seconds; perform 2–4 repetitions of each stretch.</td>
</tr>
</tbody>
</table>

*Chapter 3 provides instructions for calculating target heart rate intensity for cardiorespiratory endurance exercise.

Start Slowly, and Get in Shape Gradually

As Figure 2.5 shows, an exercise program can be divided into three phases:

- **Beginning phase.** The body adjusts to the new type and level of activity.
- **Progress phase.** Fitness increases.
- **Maintenance phase.** The targeted level of fitness is sustained over the long term.

When beginning a program, start slowly to give your body time to adapt to the stress of exercise. Choose activities carefully according to your fitness status. If you have been sedentary or are overweight, try an activity such as walking or swimming that won’t jar the body or strain the joints.

As you progress, increase duration and frequency before increasing intensity. If you train too much or too intensely, you are more likely to suffer injuries or become overtrained, a condition characterized by lack of energy, aching muscles and joints, and decreased physical performance. Injuries and overtraining slow down an exercise program and impede motivation. The goal is not to get in shape as quickly as possible but to gradually become and then remain physically fit.

**Wellness Tip**

Moderation is important, especially if you’re just starting to get physically active. Work at a pace that’s comfortable and enjoyable, with a goal of making gradual improvements. This will help you get into the habit of being active and will help you avoid burnout.

**overtraining**

A condition caused by training too much or too intensely, characterized by lack of energy, decreased physical performance, and aching muscles and joints.

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**FIGURE 2.4** Health and fitness benefits of different amounts of physical activity and exercise.
**FIGURE 2.5 Progression of an exercise program.** This figure shows how the amount of overload is increased gradually over time in a walking and running program. Regardless of the activity chosen, it is important that an exercise program begin slowly and progress gradually. After you achieve the desired level of fitness, you can maintain it by exercising 3–5 days a week.


**Warm Up before Exercise** Warming up can decrease your chances of injury by helping your body gradually progress from rest to activity. A good warm-up can increase muscle temperature, reduce joint stiffness, bathe the joint surfaces in lubricating fluid, and increase blood flow to the muscles, including the heart. Some studies suggest that warming up may also enhance muscle metabolism and mentally prepare you for a workout.

A warm-up should include low-intensity, whole-body movements similar to those used in the activity. For example, runners may walk and jog slowly prior to running at full speed. A tennis player might hit forehands and backhands at a low intensity before playing a vigorous set of tennis. A warm-up is not the same as a stretching workout. For safety and effectiveness, it is best to stretch after an endurance or strength training workout, when muscles are warm—and not as part of a warm-up. (Appropriate and effective warm-ups are discussed in greater detail in Chapters 3–5.)

**Cool Down after Exercise** During exercise, as much as 90% of circulating blood is directed to the muscles and skin, up from as little as 20% during rest. If you suddenly stop moving after exercise, the amount of blood returning to your heart and brain may be insufficient, and you may experience dizziness, a drop in blood pressure, or other problems. Cooling down at the end of a workout helps safely restore circulation to its normal resting condition. So, after you exercise, cool down before you sit or lie down or jump into the shower. Cool down by continuing to move at a slow pace—walking for 5–10 minutes, for example, as your heart and breathing rate and blood pressure slowly return to normal. At the end of the cool-down period, do stretching exercises while your muscles are still warm. Cool down longer after intense exercise sessions.

**Exercise Safely** Physical activity can cause injury or even death if you don’t consider safety. For example, you should always:

- Wear a helmet when biking, skiing, or rock climbing.
- Wear eye protection when playing racquetball or squash.
- Wear bright clothing when exercising on a public street.
- Walk or run with a partner on a deserted track or in a park.
- Give vehicles plenty of leeway, even when you have the right of way.
- In the weight room, be aware of people exercising near you, and use spotters and collars when appropriate.

Overloading your muscles and joints can lead to serious injury, so train within your capacity. Use high-quality equipment and keep it in good repair. Report broken gym equipment to the health club manager or physical education instructor. (See Appendix A for more information on personal safety.)

**Listen to Your Body and Get Adequate Rest** Rest can be as important as exercise for improving fitness. Fitness reflects an adaptation to the stress of exercise. Building fitness involves a series of exercise stresses, recuperation, and adaptation leading to improved fitness, followed by further stresses. Build rest into your training program, and don’t exercise if it doesn’t feel right. Sometimes you need a few days of rest to recover enough to train with the intensity required for improving fitness. Getting enough sleep is an important part of the recovery process. On the other hand, don’t train sporadically, either. If you listen to your body and it always tells you to rest, you won’t make any progress.

**Cycle the Volume and Intensity of Your Workouts** To add enjoyment and variety to your program and to further improve fitness, don’t train at the same intensity during every workout. Train intensely on some days and train lightly on others. Proper management of workout intensity is a key to improving physical fitness. Use cycle training, also known as periodization, to provide enough recovery for intense training: By training lightly one workout, you can train harder the next. However, take care to increase the volume and intensity of your program gradually—never more than 10% per week.

**Vary Your Activities** Change your exercise program from time to time to keep things fresh and help develop a higher degree of fitness. The body adapts quickly to an exercise stress, such as walking, cycling, or swimming. Gains in fitness in a particular activity become more difficult with time. Varying the exercises in your program allows you to adapt to many types of exercise and develops fitness in a variety of activities (see the box “Vary Your Activities”). Changing activities may also help reduce your risk of injury. This is a central principle in
Do you have a hard time thinking of new activities to try? Check the boxes next to the activities listed here that interest you. Then look for resources and facilities on your campus or in your community.

**OUTDOOR EXERCISES**
- Walking
- Running
- Cycling
- Swimming
- Basketball
- Tennis
- Volleyball
- Golf
- Soccer
- Water skiing
- Windsurfing
- Badminton
- Ultimate Frisbee
- In-line skating
- Skateboarding
- Rowing
- Horseback riding
- Softball
- Water polo
- Badminton
- Ultimate Frisbee

**EXERCISES YOU CAN DO AT HOME AND WORK**
- Desk exercises
- Calisthenics
- Hiking
- Backpacking
- Ice skating
- Rowing
- Ice fishing
- Pelting
- Yoga
- Cable machine
- Elliptical trainer
- Treadmill
- Recumbent bike
- Stationary bike
- Weight training
- Circuit training
- Group exercise
- Strand machine
- Plyometrics
- Skier machine
- Supine bike
- Rowing machine
- Pulling a rope
- Punching bag

**SPORTS AND GAMES**
- Soccer
- Golf
- Tennis
- Volleyball
- Basketball
- Swimming
- Cycling
- Running
- Non-competitive soccer
- Non-competitive tennis
- Non-competitive volleyball
- Non-competitive basketball
- Non-competitive swimming
- Non-competitive cycling
- Non-competitive running

**HEALTH CLUB EXERCISES**
- Hiking
- Ice skating
- Rowing
- Ice fishing
- Pelting
- Yoga
- Cable machine
- Elliptical trainer
- Treadmill
- Recumbent bike
- Stationary bike
- Weight training
- Circuit training
- Group exercise
- Strand machine
- Plyometrics
- Skier machine
- Supine bike
- Rowing machine
- Pulling a rope
- Punching bag

**DESIGNING YOUR OWN EXERCISE PROGRAM**

**cross-training exercise techniques such as CrossFit. CrossFit is a commercial exercise program that uses a variety of training methods to improve fitness, including running, swimming, climbing, gymnastics, functional training, Olympic weight lifting, kettlebells, rope climbing, and calisthenics.**

**Train with a Partner**  People who train together can motivate and encourage each other through rough spots and help each other develop proper exercise techniques. Training with a partner can make exercising seem easier and more fun. It can also help you keep motivated and on track. A commitment to a friend is a powerful motivator. If you can afford it, you may benefit from a certified personal trainer who can give you instruction in exercise techniques and help provide motivation.

**Train Your Mind**  Becoming fit requires commitment, discipline, and patience. These qualities come from understanding the importance of exercise and setting clear and reachable goals. Use the lifestyle management techniques discussed in Chapter 1 to keep your program on track.

**Fuel Your Activity Appropriately**  Good nutrition, including rehydration and resynthesis of liver and muscle carbohydrate stores, is part of optimal recuperation from exercise. Consume enough calories to support your exercise program without gaining body fat. Many studies show that consuming carbohydrates and protein before or after exercise promotes restoration of stored fuels and helps heal injured tissues so that you can exercise intensely again shortly. Nutrition for exercise is discussed in greater detail in Chapters 3 and 8.

**Have Fun**  You are more likely to stick with an exercise program if it’s fun. Choose a variety of activities that you enjoy. Some people like to play competitive sports, such as tennis, golf, or volleyball. Competition can boost motivation, but remember: Sports are competitive, whereas training for fitness is not. Other people like more solitary activities, such as jogging, walking, or swimming. Still others like high-skill individual sports, such as snowboarding, surfing, or skateboarding. Many activities can help you get fit, so choose the ones you enjoy. You can also boost your enjoyment and build your social support network by exercising with friends and family.

**Track Your Progress**  Monitoring the progress of your program can help you stay motivated and on track. Depending on the activities you’ve included in your program, you may track different measures of your program—minutes of jogging, miles of cycling, laps of swimming, number of push-ups, amount of weight lifted, and so on. If your program focuses on increasing daily physical activity, consider using an inexpensive pedometer or exercise GPS app to monitor the number of steps you take each day. (See Lab 2.3 for more information on setting goals and monitoring activity with a pedometer; see the box “Digital Workout Aids” for an introduction to products and apps that can help you track your progress.) Specific examples of program monitoring can be found in the labs for Chapters 3–5.

**Get Help and Advice If You Need It**  One of the best places to get help starting an exercise program is an exercise class. If you join a health club or fitness center, follow the guidelines in the box “Choosing a Fitness Center.” There, expert instructors can help you learn the basics of training and answer your questions. Make sure the instructor is certified by a recognized professional organization and/or has formal training in exercise physiology. Read articles by credible experts in fitness magazines (such as *Fitness Rx for Women* and *Fitness Rx for Men*). Many of these magazines include articles by leading experts in exercise science written at a layperson’s level.
When you’re just starting to get physically active, you can wind up with a lot of questions. How many miles did I walk? How many sit-ups did I do? How many minutes did I run? When your mind is completely focused on just doing an activity, it’s easy to lose count of time, distance, and reps. But it’s important to keep track of these things: Move too little and you won’t see any progress; move too much and you run the risk of injury or burnout. Either outcome is bad news for your exercise program.

Luckily, we live in a digital age, and the fitness industry is providing an ever-growing array of high-tech tools and apps that can track your progress for you. If you like to walk or run, cell phone apps can track your distance, number of steps you take, and give you a detailed map of where you ran, biked, or skied. Advanced trackers can even record any hills you encounter during your workout. Heart rate monitors can help you reach and maintain the right exercise intensity. If calisthenics are your choice, there are gaming systems and smartphone apps that work for specific exercises to count reps, assess your form, and challenge you to push yourself harder.

Smart phone programs, such as Coach’s Eye, Hudl Technique and Dartfish, can help you analyze your golf swing or tennis forehand in slow motion. The programs even make it possible to compare your progress by showing several performances side-by-side.

You can track more than just your exercise habits with digital assistance. Electronic devices and smart programs are available to help with many aspects of wellness, including the following:

- Dietary habits
- Calories consumed and burned
- Stress management
- Meditation and spirituality
- Heart rate and respiration
- Menstrual cycles
- Family medical history
- Journaling

And that’s just to name a few. We’ll introduce a variety of these digital devices and apps in later chapters, in the “Wellness in the Digital Age” feature box like this one. You may find one or more digital apps (many of which are free) that appeal to you and can help you make progress toward your own fitness and wellness goals.

A qualified personal trainer can also help you get started in an exercise program or a new form of training. Make sure this person has proper qualifications, such as certification by the ACSM, National Strength and Conditioning Association (NSCA), or International Sports Sciences Association (ISSA). Don’t seek out a person for advice simply because he or she looks fit. UCLA researchers found that 60% of the personal trainers in their study couldn’t pass a basic exam on training methods, exercise physiology, or biomechanics. Trainers who performed best had college degrees in exercise physiology, physical education, or physical therapy. So choose your trainer carefully and don’t get caught up with fads or appearances.

Keep Your Exercise Program in Perspective As important as physical fitness is, it is only part of a well-rounded life. You need time for work and school, family and friends, relaxation and hobbies. Some people become over-involved in exercise and neglect other parts of their lives. They think of themselves as runners, dancers, swimmers, or triathletes rather than as people who happen to participate in those activities. Balance and moderation are key ingredients of a fit and well life.

**Ask Yourself**

**QUESTIONS FOR CRITICAL THINKING AND REFLECTION**

If you were to start planning a fitness program, what would be your three most important long-term goals? What would you set as short-term goals? What rewards would be meaningful to you?
I have asthma. Is it OK for me to start an exercise program?

Probably, but you should see your doctor before you start exercising, especially if you have been sedentary up to this point. Your personal physician can advise you on the type of exercise program that is best for you, given the severity of your condition, and how to avoid suffering exercise-related asthma attacks.

What should my fitness goals be?

Begin by thinking about your general overall goals—the benefits you want to obtain by increasing your activity level and/or beginning a formal exercise program. Examples of long-term goals include reducing your risk of chronic diseases, increasing your energy level, and maintaining a healthy body weight.

To help shape your fitness program, you need to set specific, short-term goals based on measurable factors. These specific goals should be an extension of your overall goals—the specific changes to your current activity and exercise habits needed to achieve your general goals. In setting short-term goals, be sure to use the SMART criteria described in Chapter 1. As noted there, your goals should be Specific, Measurable, Attainable, Realistic, and Time frame–specific (SMART).

You need information about your current levels of physical activity and physical fitness in order to set appropriate goals. The labs in this chapter will help you determine your physical activity level—for example, how many minutes per day you engage in moderate or vigorous activity or how many daily steps you take. Using this information, you can set goals for lifestyle physical activity to help you meet your overall goals. For example, if your general long-term goals are to reduce the risk of chronic disease and prevent weight gain, the Dietary Guidelines recommend 60 minutes of moderate physical activity daily. If you currently engage in 30 minutes of moderate activity daily, then your behavior change goal would be to add 30 minutes of daily physical activity (or an equivalent number of additional daily steps—about 3,500–4,000); your time frame for the change might be 8–12 weeks.

Labs in Chapters 3–6 provide opportunities to assess your fitness status for all the health-related components of fitness. The results of these assessments can guide you in setting specific fitness goals. For instance, if the labs in Chapter 4 indicate that you have good muscular strength and endurance in your lower body but poor strength and endurance in your upper body, then setting a specific goal for improving upper-body muscle fitness would be an appropriate goal—increasing the number of push-ups you can do from 22 to 30, for example. Chapters 3–6 include additional advice for setting appropriate goals.

After you start your behavior change program, you may discover that your goals aren’t quite appropriate; perhaps you were overly optimistic, or maybe you set the bar too low. There are limits to the amount of fitness you can achieve, but within the limits of your genes, health status, and motivation, you can make significant improvements in fitness. Adjust your goals as needed.

Should I follow my exercise program if I’m sick?

If you have a mild cold or feel one coming on, it is probably okay to exercise moderately. Just begin slowly and see how you feel. However, if you have symptoms of a more serious illness—fever, swollen glands, nausea, extreme tiredness, muscle aches—wait until you have recovered fully before resuming your exercise program. Continuing to exercise while suffering from an illness more serious than a cold can compromise your recovery and may even be dangerous.
Choosing a Fitness Center

Fitness centers can provide you with many benefits—motivation and companionship are among the most important. A fitness center may also offer expert instruction and supervision as well as access to better equipment than you could afford on your own. All fitness centers, however, are not of the same overall quality, and every fitness center is not for every person. If you’re thinking of joining a fitness center, here are some guidelines to help you choose a club that’s right for you.

**Convenience**
- Look for an established facility that’s within 10–15 minutes of your home or work. If it’s farther away, your chances of sticking to an exercise regimen start to diminish.
- Visit the facility at the time you would normally exercise. Is there adequate parking? Will you have easy access to equipment and classes at that time?
- What child care services are available, and how are they supervised?

**Atmosphere**
- Look around to see if there are other members who are your age and at about your fitness level. Some clubs cater to a certain age group or lifestyle, such as hard-core bodybuilders.
- Observe how the members dress. Will you fit in, or will you be uncomfortable?
- Observe the staff. Are they easy to identify? Are they friendly, professional, and helpful?
- Check to see that the facility is clean, including showers and lockers. Make sure the facility is climate controlled, well ventilated, and well lit.

**Safety**
- Find out if the facility offers some type of preactivity screening as well as basic fitness testing that includes cardiovascular screening.
- Determine if personnel are trained in CPR and if there is emergency equipment such as automated external defibrillators (AEDs) on the premises. An AED can help someone who has a cardiac arrest.
- Ask if at least one staff member on each shift is trained in first aid.

**Trained Personnel**
- Determine if the personal trainers and fitness instructors are certified by a recognized professional association such as the ACSM, Aerobics and Fitness Association of America (AFAA), NSCA, or ISSA. All personal trainers are not equal; more than 100 organizations certify trainers, and few of these require much formal training.
- Find out if the club has a trained exercise physiologist on staff, such as someone with a degree in exercise physiology, kinesiology, or exercise science. If the facility offers nutritional counseling, it should employ someone who is a registered dietitian (RD) or has similar formal training.
- Ask how much experience the instructors have. Ideally, trainers should have both academic preparation and practical experience.

**Cost**
- Buy only what you need and can afford. If you want to use only workout equipment, you may not need a club that has racquetball courts and saunas.
- Check the contract. Choose the one that covers the shortest period of time possible, especially if it’s your first fitness club experience. Don’t feel pressured to sign a long-term contract.
- Make sure the contract permits you to extend your membership if you have a prolonged illness or go on vacation. Some clubs have exchange agreements that allow you to train in other cities while on vacation or business.
- Try out the club. Ask for a free trial workout, or a one-day pass, or an inexpensive one- or two-week trial membership.
- Find out whether there is an extra charge for the particular services you want. Get any special offers in writing.

**Effectiveness**
- Tour the facility. Does it offer what the brochure says it does? Does it offer the activities and equipment you want?
- Check the equipment. A good club will have treadmills, bikes, stair-climbers, resistance machines, and weights. Make sure these machines are up to date and well maintained.
- Find out if new members get a formal orientation and instruction on how to safely use the equipment. Will a staff member help you develop a program that is appropriate for your current fitness level and goals?
- Make sure the facility is certified. Look for the displayed names ACSM, American Council on Exercise (ACE), AFAA, or International Health, Racquet, and Sportsclub Association (IHRSA).
TIPS FOR TODAY AND THE FUTURE

Physical activity and exercise offer benefits in nearly every area of wellness. Even a low to moderate level of activity provides valuable health benefits. The important thing is to get moving!

RIGHT NOW YOU CAN

- Look at your calendar for the rest of the week and write in some physical activity—such as walking, running, biking, skating, swimming, hiking, or playing Frisbee—on as many days as you can. Schedule the activity for a specific time and stick to it.
- Call a friend and invite her or him to start planning a regular exercise program with you.
- Download a pedometer app on your phone and keep track of your daily activity.

IN THE FUTURE YOU CAN

- Schedule a session with a qualified personal trainer who can evaluate your current fitness level and help you set personalized fitness goals.
- Create seasonal workout programs for the spring, summer, fall, and winter. Develop programs that are varied but consistent with your overall fitness goals.

SUMMARY

- Moderate daily physical activity contributes substantially to good health. Even without a formal, vigorous exercise program, you can get many of the same health benefits just by becoming more physically active.
- If you are already active, you benefit even more by increasing the intensity or duration of your activities.
- The five components of physical fitness most important for health are cardiorespiratory endurance, muscular strength, muscular endurance, flexibility, and body composition.
- Physical training is the process of producing long-term improvements in the body’s functioning through exercise. All training is based on the fact that the body adapts to physical stress.
- According to the principle of specificity, bodies change specifically in response to the type of training received.
- Bodies also adapt to progressive overload. When you progressively increase the frequency, intensity, and time (duration) of the right type of exercise, you become increasingly fit.
- Bodies adjust to lower levels of activity by losing fitness, a principle known as reversibility. To counter the effects of reversibility, it’s important to keep training at the same intensity, even if you have to reduce the number or length of sessions.
- According to the principle of individual differences, people vary in the maximum level of fitness they can achieve and in the rate of change they can expect from an exercise program.
- When designing an exercise program, determine if medical clearance is needed, assess your current level of fitness, set realistic goals, and choose activities that develop all the components of fitness.
- Train regularly, get in shape gradually, warm up and cool down, maintain a structured but flexible program, get enough rest, exercise safely, vary activities, consider training with a partner or personal trainer, train your mind, eat sensibly, have fun, monitor your progress, and keep exercise in perspective.

FOR FURTHER EXPLORATION

American Alliance for Health, Physical Education, Recreation, and Dance (AAHPERD). A professional organization dedicated to promoting quality health and physical education programs.
http://www.aaahperd.org

American College of Sports Medicine (ACSM). The principal professional organization for sports medicine and exercise science. Provides brochures, publications, and videos.
http://www.acsm.org

American Council on Exercise (ACE). Promotes exercise and fitness; the website features fact sheets on many consumer topics, including choosing shoes, cross-training, and steroids.
http://www.acefitness.org

American Heart Association: Start! Walking for a Healthier Lifestyle. Provides practical advice for people of all fitness levels plus an online fitness diary.
http://startwalkingnow.org

CDC Physical Activity Information. Provides information on the benefits of physical activity and suggestions for incorporating moderate physical activity into daily life.
http://www.cdc.gov/physicalactivity

CrossFit. A cross-training method involving a variety of exercises and unaccustomed physical challenges. The program includes franchised health clubs and training facilities. The website provides extensive information on cross training, nutrition, exercise techniques, and sports psychology.
http://www.crossfit.com

Disabled Sports USA. Provides sports and recreation services to people with physical or mobility disorders.
http://www.dsusa.org

Health and Retirement Study. A website describing a study of 20,000 people begun in 1992 at the University of Michigan and updated every two years. Included is an extensive reference list of published studies.
hrsonline.isr.umich.edu

International Health, Racquet, and Sportsclub Association (IHRSA): Health Clubs. Provides guidelines for choosing a health or fitness facility and links to clubs that belong to IHRSA.
http://www.healthclubs.com

http://www.issaonline.com


John, D. 2013. Intervention: Course Correction for the Athlete and Trainer. Santa Cruz, Ca: On Target.


LAB 2.1 Safety of Exercise Participation

Physical Activity Readiness Questionnaire - PAR-Q
(revised 2002)

Regular physical activity is fun and healthy, and increasingly more people are starting to become more active every day. Being more active is very safe for most people. However, some people should check with their doctor before they start becoming much more physically active.

If you are planning to become much more physically active than you are now, start by answering the seven questions in the box below. If you are between the ages of 15 and 69, the PAR-Q will tell you if you should check with your doctor before you start. If you are over 69 years of age, and you are not used to being very active, check with your doctor.

Common sense is your best guide when you answer these questions. Please read the questions carefully and answer each one honestly: check YES or NO.

1. Has your doctor ever said that you have a heart condition and that you should only do physical activity recommended by a doctor?
   □ YES □ NO

2. Do you feel pain in your chest when you do physical activity?
   □ YES □ NO

3. In the past month, have you had chest pain when you were not doing physical activity?
   □ YES □ NO

4. Do you lose your balance because of dizziness or do you ever lose consciousness?
   □ YES □ NO

5. Do you have a bone or joint problem (for example, back, knee or hip) that could be made worse by a change in your physical activity?
   □ YES □ NO

6. Is your doctor currently prescribing drugs (for example, water pills) for your blood pressure or heart condition?
   □ YES □ NO

7. Do you know of any other reason why you should not do physical activity?
   □ YES □ NO

**YES to one or more questions**

Talk with your doctor by phone or in person BEFORE you start becoming much more physically active or BEFORE you have a fitness appraisal.

Tell your doctor about the PAR-Q and which questions you answered YES.

- You may be able to do any activity you want — as long as you start slowly and build up gradually. Or, you may need to restrict your activities to those which are safe for you. Talk with your doctor about the kinds of activities you wish to participate in and follow his/her advice.
- Find out which community programs are safe and helpful for you.

**NO to all questions**

If you answered NO honestly to all PAR-Q questions, you can be reasonably sure that you can:
- Start becoming much more physically active — begin slowly and build up gradually. This is the safest and easiest way to go.
- Take part in a fitness appraisal — this is an excellent way to determine your basic fitness so that you can plan the best way for you to live actively. It is also highly recommended that you have your blood pressure evaluated. If your reading is over 144/94, talk with your doctor before you start becoming much more physically active.

**DELAY BECOMING MORE ACTIVE:**

- If you are not feeling well because of a temporary illness such as a cold or a fever — wait until you feel better; or
- If you are or may be pregnant — talk to your doctor before you start becoming more active.

**PLEASE NOTE:** If your health changes so that you then answer YES to any of the above questions, tell your fitness or health professional. Ask whether you should change your physical activity plan.

Informed Use of the PAR-Q: The Canadian Society for Exercise Physiology, Health Canada, and their agents assume no liability for persons who undertake physical activity, and if in doubt after completing this questionnaire, consult your doctor prior to physical activity.

**No changes permitted. You are encouraged to photocopy the PAR-Q but only if you use the entire form.**

**I have read, understood and completed this questionnaire. Any questions I had were answered to my full satisfaction.**

Name ________________________________
Signature of Parent or Guardian (for participants under the age of majority) ________________________________
Date ________________________________
Witness ________________________________

**Note:** This physical activity clearance is valid for a maximum of 12 months from the date it is completed and becomes invalid if your condition changes so that you would answer YES to any of the seven questions.

LABORATORY ACTIVITIES

General Health Profile
To help further assess the safety of exercise for you, complete as much of this health profile as possible.

General Information
Age: __________ Total cholesterol: __________ Blood pressure: ________ / ________
Height: __________ HDL: __________ Triglycerides: __________
Weight: __________ LDL: __________
Are you currently trying to ________ gain or ________ lose weight? (check one if appropriate)

Medical Conditions/Treatments
Check any of the following that apply to you, and add any other conditions that might affect your ability to exercise safely.
________ heart disease __________ depression, anxiety, or other disease
________ lung disease __________ psychological disorder
________ diabetes __________ eating disorder
________ allergies __________ back pain
________ asthma __________ arthritis
________ other: __________ other: __________
________ Do you have a family history of cardiovascular disease (CVD) (a parent, sibling, or child who had a heart attack or stroke before age 55 for men or 65 for women)?

List any medications or supplements you are taking or any medical treatments you are undergoing. Include the name of the substance or treatment and its purpose. Include both prescription and over-the-counter drugs and supplements.

________________________________________________________
________________________________________________________

Lifestyle Information
Check any of the following that is true for you, and fill in the requested information.
________ I usually eat high-fat foods (fatty meats, cheese, fried foods, butter, full-fat dairy products) every day.
________ I consume fewer than 5 servings of fruits and vegetables on most days.
________ I smoke cigarettes or use other tobacco products. If true, describe your use of tobacco (type and frequency):
________________________________________________________
________ I regularly drink alcohol. If true, describe your typical weekly consumption pattern:
________________________________________________________
________ I often feel as if I need more sleep. (I need about ________ hours per day; I get about ________ hours per day.)
________ I feel as though stress has adversely affected my level of wellness during the past year.

Describe your current activity pattern. What types of moderate physical activity do you engage in on a daily basis? Are you involved in a formal exercise program, or do you regularly participate in sports or recreational activities?

________________________________________________________
________________________________________________________

Using Your Results
Are you ready to exercise? Did the PAR-Q indicate that exercise is likely to be safe for you? Is there anything in your health profile that you think may affect your ability to exercise safely? Have you had any problems with exercise in the past?

What should you do next? If the assessments in this lab indicate that you should see your physician before beginning an exercise program, or if you have any questions about the safety of exercise for you, make an appointment to talk with your health care provider to address your concerns.
LAB 2.2 Overcoming Barriers to Being Active

Barriers to Being Active Quiz

Directions: Listed below are reasons that people give to describe why they do not get as much physical activity as they think they should. Please read each statement and circle the number that describes how likely you are to say each of the following statements.

<table>
<thead>
<tr>
<th>How likely are you to say this?</th>
<th>Very likely</th>
<th>Somewhat likely</th>
<th>Somewhat unlikely</th>
<th>Very unlikely</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. My day is so busy now, I just don’t think I can make the time to include physical activity in my regular schedule.</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2. None of my family members or friends like to do anything active, so I don’t have a chance to exercise.</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>3. I’m just too tired after work to get any exercise.</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>4. I’ve been thinking about getting more exercise, but I just can’t seem to get started.</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>5. I’m getting older so exercise can be risky.</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>6. I don’t get enough exercise because I have never learned the skills for any sport.</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>7. I don’t have access to jogging trails, swimming pools, bike paths, etc.</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>8. Physical activity takes too much time away from other commitments—like work, family, etc.</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>9. I’m embarrassed about how I will look when I exercise with others.</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>10. I don’t get enough sleep as it is. I just couldn’t get up early or stay up late to get some exercise.</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>11. It’s easier for me to find excuses not to exercise than to go out and do something.</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>12. I know of too many people who have hurt themselves by overdoing it with exercise.</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>13. I really can’t see learning a new sport at my age.</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>14. It’s just too expensive. You have to take a class or join a club or buy the right equipment.</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>15. My free times during the day are too short to include exercise.</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>16. My usual social activities with family or friends do not include physical activity.</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>17. I’m too tired during the week, and I need the weekend to catch up on my rest.</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>18. I want to get more exercise, but I just can’t seem to make myself stick to anything.</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>19. I’m afraid I might injure myself or have a heart attack.</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>20. I’m not good enough at any physical activity to make it fun.</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>21. If we had exercise facilities and showers at work, then I would be more likely to exercise.</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>
LABORATORY ACTIVITIES

Scoring

- Enter the circled numbers in the spaces provided below, putting the number for statement 1 on line 1, statement 2 on line 2, and so on.
- Add the three scores on each line. Your barriers to physical activity fall into one or more of seven categories: lack of time, social influences, lack of energy, lack of willpower, fear of injury, lack of skill, and lack of resources. A score of 5 or above in any category shows that this is an important barrier for you to overcome.

<table>
<thead>
<tr>
<th>1</th>
<th>+</th>
<th>8</th>
<th>+</th>
<th>15</th>
<th>=</th>
<th>Lack of time</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>+</td>
<td>9</td>
<td>+</td>
<td>16</td>
<td>=</td>
<td>Social influences</td>
</tr>
<tr>
<td>3</td>
<td>+</td>
<td>10</td>
<td>+</td>
<td>17</td>
<td>=</td>
<td>Lack of energy</td>
</tr>
<tr>
<td>4</td>
<td>+</td>
<td>11</td>
<td>+</td>
<td>18</td>
<td>=</td>
<td>Lack of willpower</td>
</tr>
<tr>
<td>5</td>
<td>+</td>
<td>12</td>
<td>+</td>
<td>19</td>
<td>=</td>
<td>Fear of injury</td>
</tr>
<tr>
<td>6</td>
<td>+</td>
<td>13</td>
<td>+</td>
<td>20</td>
<td>=</td>
<td>Lack of skill</td>
</tr>
<tr>
<td>7</td>
<td>+</td>
<td>14</td>
<td>+</td>
<td>21</td>
<td>=</td>
<td>Lack of resources</td>
</tr>
</tbody>
</table>

Using Your Results

How did you score? How many key barriers did you identify? Are they what you expected?

What should you do next? For your key barriers, try the strategies listed on the following pages and/or develop additional strategies that work for you. Check off any strategy that you try.
Suggestions for Overcoming Physical Activity Barriers

**Lack of Time**

- Identify available time slots. Monitor your daily activities for one week. Identify at least three 30-minute time slots you could use for physical activity.
- Add physical activity to your daily routine. For example, walk or ride your bike to work or shopping, organize social activities around physical activity, walk the dog, exercise while you watch TV, park farther from your destination, etc.
- Make time for physical activity. For example, walk, jog, or swim during your lunch hour, or take fitness breaks instead of coffee breaks.
- Select activities requiring minimal time, such as walking, jogging, or stair climbing.
- Other:

**Social Influences**

- Explain your interest in physical activity to friends and family. Ask them to support your efforts.
- Invite friends and family members to exercise with you. Plan social activities involving exercise.
- Develop new friendships with physically active people. Join a group, such as the YMCA or a hiking club.
- Other:

**Lack of Energy**

- Schedule physical activity for times in the day or week when you feel energetic.
- Convince yourself that if you give it a chance, exercise will increase your energy level. Then try it.
- Other:

**Lack of Willpower**

- Plan ahead. Make physical activity a regular part of your daily or weekly schedule and write it on your calendar.
- Invite a friend to exercise with you on a regular basis and write it on both your calendars.
- Join an exercise group or class.
- Other:

**Fear of Injury**

- Learn how to warm up and cool down to prevent injury.
- Learn how to exercise appropriately considering your age, fitness level, skill level, and health status.
- Choose activities involving minimal risk.
- Other:

**Lack of Skill**

- Select activities requiring no new skills, such as walking, jogging, or stair climbing.
- Exercise with friends who are at the same skill level as you are.
- Find a friend who is willing to teach you some new skills.
- Take a class to develop new skills.
- Other:

**Lack of Resources**

- Select activities that require minimal facilities or equipment, such as walking, jogging, jumping rope, or calisthenics.
- Identify inexpensive, convenient resources available in your community (community education programs, park and recreation programs, worksite programs, etc.).
- Other:
LABORATORY ACTIVITIES

Are any of the following additional barriers important for you? If so, try some of the strategies listed here or invent your own.

**Weather Conditions**

- Develop a set of regular activities that are always available regardless of weather (indoor cycling, aerobic dance, indoor swimming, calisthenics, stair-climbing, rope-skipping, mall-walking, dancing, gymnasium games, etc.).
- Look at outdoor activities that depend on weather conditions (cross-country skiing, outdoor swimming, outdoor tennis, etc.) as “bonuses”—extra activities possible when weather and circumstances permit.
- Other:

**Travel**

- Put a jump rope in your suitcase and jump rope.
- Walk the halls and climb the stairs in hotels.
- Stay in places with swimming pools or exercise facilities.
- Join the YMCA or YWCA (ask about reciprocal membership agreements).
- Visit the local shopping mall and walk for half an hour or more.
- Bring a personal music player loaded with your favorite workout music.
- Other:

**Family Obligations**

- Trade babysitting time with a friend, neighbor, or family member who also has small children.
- Exercise with the kids—go for a walk together, play tag or other running games, or get an aerobic dance or exercise DVD for kids (there are several on the market) and exercise together. You can spend time together and still get your exercise.
- Hire a babysitter and look at the cost as a worthwhile investment in your physical and mental health.
- Jump rope, do calisthenics, ride a stationary bicycle, or use other home gymnasium equipment while the kids watch TV or when they are sleeping.
- Try to exercise when the kids are not around (e.g., during school hours or their nap time).
- Other:

**Retirement Years**

- Look on your retirement as an opportunity to become more active instead of less. Spend more time gardening, walking the dog, and playing with your grandchildren. Children with short legs and grandparents with slower gaits are often great walking partners.
- Learn a new skill you’ve always been interested in, such as ballroom dancing, square dancing, or swimming.
- Now that you have the time, make regular physical activity a part of every day. Go for a walk every morning or every evening before dinner. Treat yourself to an exercycle and ride every day during a favorite TV show.
- Other:

LAB 2.3 Using a Pedometer to Track Physical Activity

How physically active are you? Would you be more motivated to increase daily physical activity if you had an easy way to monitor your level of activity? If so, consider wearing a pedometer to track the number of steps you take each day—a rough but easily obtainable reflection of daily physical activity. Smartphone pedometer apps use sensors that can provide reasonably accurate step measure counts. These apps are either low cost or free.

Determine Your Baseline

Wear the pedometer for a week to obtain a baseline average daily number of steps.

<table>
<thead>
<tr>
<th></th>
<th>M</th>
<th>T</th>
<th>W</th>
<th>Th</th>
<th>F</th>
<th>Sa</th>
<th>Su</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steps</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Set Goals

Set an appropriate goal for increasing steps. The goal of 10,000 steps per day is widely recommended, but your personal goal should reflect your baseline level of steps. For example, if your current daily steps are far below 10,000, a goal of walking 2,000 additional steps each day might be appropriate. If you are already close to 10,000 steps per day, choose a higher goal. Also consider the following guidelines from health experts:

- To reduce the risk of chronic disease, aim to accumulate at least 150 minutes of moderate physical activity per week.
- To help manage body weight and prevent gradual, unhealthy weight gain, engage in 60 minutes of moderate to vigorous-intensity activity on most days of the week.
- To sustain weight loss, engage daily in at least 60–90 minutes of moderate-intensity physical activity.

To help gauge how close you are to meeting these time-based physical activity goals, you might walk for 10–15 minutes while wearing your pedometer to determine how many steps correspond with the time-based goals.

Once you have set your overall goal, break it down into several steps. For example, if your goal is to increase daily steps by 2,000, set mini-goals of increasing daily steps by 500, allowing two weeks to reach each mini-goal. Smaller goals are easier to achieve and can help keep you motivated and on track. Having several interim goals also gives you the opportunity to reward yourself more frequently. Note your goals below:

<table>
<thead>
<tr>
<th>Mini-goal 1:</th>
<th>Target date:</th>
<th>Reward:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mini-goal 2:</td>
<td>Target date:</td>
<td>Reward:</td>
</tr>
<tr>
<td>Mini-goal 3:</td>
<td>Target date:</td>
<td>Reward:</td>
</tr>
<tr>
<td>Overall goal:</td>
<td>Target date:</td>
<td>Reward:</td>
</tr>
</tbody>
</table>

Develop Strategies for Increasing Steps

What can you do to become more active? The possibilities include walking when you do errands, getting off one stop from your destination on public transportation, parking an extra block or two away from your destination, and doing at least one chore every day that requires physical activity. If weather or neighborhood safety is an issue, look for alternative locations to walk. For example, find an indoor gym or shopping mall or even a long hallway. Check out locations that are near or on the way to your campus, workplace, or residence. If you think walking indoors will be dull, walk with friends or family members or wear headphones (if safe) and listen to music or audiobooks.

Are there any days of the week for which your baseline steps are particularly low and/or it will be especially difficult because of your schedule to increase your number of steps? Be sure to develop specific strategies for difficult situations.

Below, list at least five strategies for increasing daily steps:

____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________
L A B O R A T O R Y  A C T I V I T I E S

Track Your Progress

Based on the goals you set, fill in your goal portion of the progress chart with your target average daily steps for each week. Then wear your pedometer every day and note your total daily steps. Track your progress toward each mini-goal and your final goal. Every few weeks, stop and evaluate your progress. If needed, adjust your plan and develop additional strategies for increasing steps. In addition to the chart in this worksheet, you might also want to graph your daily steps to provide a visual reminder of how you are progressing toward your goals. Make as many copies of this chart as you need.

<table>
<thead>
<tr>
<th>Week</th>
<th>Goal</th>
<th>M</th>
<th>Tu</th>
<th>W</th>
<th>Th</th>
<th>F</th>
<th>Sa</th>
<th>Su</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
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Weeks 1–4 Progress Checkup

How close are you to meeting your goal? How do you feel about your program and your progress?

If needed, describe changes to your plan and additional strategies for increasing steps:

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<tr>
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<th>Goal</th>
<th>M</th>
<th>Tu</th>
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<th>Th</th>
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Weeks 5–8 Progress Checkup

How close are you to meeting your goal? How do you feel about your program and your progress?

If needed, describe changes to your plan and additional strategies for increasing steps:

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Weeks 9–12 Progress Checkup

How close are you to meeting your goal? How do you feel about your program and your progress?

If needed, in the space below, describe changes to your plan and additional strategies for increasing steps.
LOOKING AHEAD…

After reading this chapter, you should be able to

■ Describe how the body produces the energy it needs for exercise.

■ List the major effects and benefits of cardiorespiratory endurance exercise.

■ Explain how cardiorespiratory endurance is measured and assessed.

■ Describe how frequency, intensity, time (duration), and type of exercise (FITT) affect the development of cardiorespiratory endurance.

■ Explain the best ways to prevent and treat common exercise injuries.

TEST YOUR KNOWLEDGE

1. Compared to sedentary people, those who engage in regular moderate endurance exercise are likely to:
   a. have fewer colds.
   b. be less anxious and depressed.
   c. fall asleep more quickly and sleep better.
   d. be more alert and creative.
   e. all of the above

2. About how much blood does the heart pump each minute during maximum-intensity aerobic exercise?
   a. 5 quarts
   b. 10 quarts
   c. 20 quarts

3. During an effective 30-minute cardiorespiratory endurance workout, you should lose 1–2 pounds. True or false?

See answers on the next page.
Cardiorespiratory endurance—the ability of the body to perform prolonged, large-muscle, dynamic exercise at moderate to high levels of intensity—is a key health-related component of fitness. As explained in Chapter 2, a healthy cardiorespiratory system is essential to high levels of fitness and wellness.

This chapter reviews the short- and long-term effects and benefits of cardiorespiratory endurance exercise. It then describes several tests commonly used to assess cardiorespiratory fitness. Finally, it provides guidelines for creating your own cardiorespiratory endurance training program—one that is geared to your current level of fitness and built around activities you enjoy.

**BASIC PHYSIOLOGY OF CARDIORESPIRATORY ENDURANCE EXERCISE**

A basic understanding of the body processes involved in cardiorespiratory endurance exercise can help you design a safe and effective fitness program.

**The Cardiorespiratory System**

The cardiorespiratory system consists of the heart, the blood vessels, and the respiratory system (the lungs). (See page T3-2 of the color transparency insert “Touring the Cardiorespiratory System” in this chapter.) The cardiorespiratory system circulates blood through the body, transporting oxygen, nutrients, and other key substances to the organs and tissues that need them. It also carries away waste products so they can be used or expelled.

**The Heart** The heart is a four-chambered, fist-sized muscle located just beneath the sternum (breastbone) (Figure 3.1). It pumps oxygen-poor blood to the lungs and delivers oxygen-rich blood to the rest of the body. Blood travels through two separate circulatory systems: The right side of the heart pumps blood to the lungs through the pulmonary circulation, and the left side pumps blood through the rest of the body in systemic circulation.

The path of blood flow through the heart and cardiorespiratory system is illustrated on page T3-3 of the color transparency insert “Touring the Cardiorespiratory System” in this chapter. Refer to that illustration as you trace these steps:

1. Waste-laden, oxygen-poor blood travels through large vessels, called venae cavae, into the heart’s right upper chamber, or atrium.
2. After the right atrium fills, it contracts and pumps blood into the heart’s right lower chamber, or ventricle.
3. When the right ventricle is full, it contracts and pumps blood through the pulmonary artery into the lungs.
4. In the lungs, blood picks up oxygen and discards carbon dioxide. Oxygen moves from the lungs to the blood and carbon dioxide moves from the blood to the lungs by a process called diffusion. During exercise, you breathe faster to promote diffusion of these gases.
5. The cleaned, oxygenated blood flows from the lungs through the pulmonary veins into the heart’s left atrium.
6. After the left atrium fills, it contracts and pumps blood into the left ventricle.
7. When the left ventricle is full, it pumps blood through the aorta—the body’s largest artery—for distribution to the rest of the body’s blood vessels.

The period of the heart’s contraction is called systole; the period of relaxation is called diastole. During systole, the atria contract first, pumping blood into the ventricles. A fraction of a second later, the ventricles contract, pumping blood to the lungs and the body. During diastole, blood flows into the heart.

**Blood pressure**, the force exerted by blood on the walls of the blood vessels, is created by the pumping action of the heart. Blood pressure is greater during systole than during diastole. A person weighing 150 pounds has about 5 quarts of blood, which are circulated about once every minute at rest.

**Answers (Test Your Knowledge)**

1. **All of the above.** Endurance exercise has many immediate benefits that affect all the dimensions of wellness and improve overall quality of life.
2. **C.** During exercise, cardiac output increases to 20 or more quarts per minute, compared to about 5 quarts per minute at rest.
3. **False.** Any weight loss during an exercise session is due to fluid loss that needs to be replaced to prevent dehydration and enhance performance. It is best to drink enough during exercise to match fluid lost as sweat; weigh yourself before and after a workout to make sure you are drinking enough.
The heartbeat—the split-second sequence of contractions of the heart’s four chambers—is controlled by nerve impulses. These signals originate in a bundle of specialized cells in the right atrium called the pacemaker, or sinoatrial (SA) node. The heart produces nerve impulses at a steady rate—unless it is speeded up or slowed down by the brain in response to stimuli such as exercise.

The Blood Vessels Blood vessels are classified by size and function. Veins carry blood to the heart. Arteries carry it away from the heart. Veins have thin walls, but arteries have thick elastic walls that enable them to expand and relax with the volume of blood being pumped through them. The blood vessels are lined with endothelial cells that secrete nitric oxide—a chemical messenger regulating blood flow. Inflammation, physical inactivity, poor diet, smoking, high blood pressure, or insulin resistance can promote blood vessel disease, which has a wide range of negative effects ranging from erectile dysfunction to heart disease. Regular physical activity helps maintain healthy blood vessels.

After leaving the heart, the aorta branches into smaller and smaller vessels. The smallest arteries branch further still into capillaries, tiny vessels only one cell thick. The capillaries deliver oxygen and nutrient-rich blood to the tissues and pick up oxygen-poor, waste-laden blood. From the capillaries, this blood empties into small veins (venules) and then into larger veins that return it to the heart to repeat the cycle.

Blood pumped through the heart doesn’t reach the heart’s own cells, so the organ has its own network of blood vessels. Two large vessels, the right and left coronary arteries, branch off the aorta and supply the heart muscle with oxygenated blood. (The coronary arteries are shown on page T3-3 of the color transparency insert “Touring the Cardiorespiratory System” in this chapter.) The fit and well lifestyle helps prevent coronary artery disease.

The Respiratory System The respiratory system supplies oxygen to the body, carries off carbon dioxide—a waste product of body processes—and helps regulate acid produced during metabolism. Air passes in and out of the lungs as a result of pressure changes brought about by the contraction and relaxation of the diaphragm and rib muscles. As air is inhaled, it passes through the nasal passages, throat, larynx, trachea (windpipe), and bronchi into the lungs. The lungs consist of many branching tubes that end in tiny, thin-walled air sacs called alveoli.

Carbon dioxide and oxygen are exchanged between alveoli and capillaries in the lungs. Carbon dioxide passes from blood cells into the alveoli, where it is carried up and out of the lungs (exhaled). Oxygen from inhaled air is passed from the alveoli into blood cells; these oxygen-rich blood cells then return to the heart and are pumped throughout the body. Oxygen is an important component of the body’s energy-producing system, so the cardiorespiratory system’s ability to pick up and deliver oxygen is critical for the functioning of the body.

The Cardiorespiratory System at Rest and during Exercise At rest and during light activity, the cardiorespiratory system functions at a fairly steady pace. Your heart beats at a rate of about 50–90 beats per minute, and you take about 12–20 breaths per minute. A typical resting blood pressure in a healthy adult, measured in millimeters of mercury, is 120 systolic and 80 diastolic (120/80).

During exercise, the demands on the cardiorespiratory system increase. Body cells, particularly working muscles, need to obtain more oxygen and fuel and to eliminate more waste.
products. To meet these demands, your body makes the follow-
ing changes:

- Heart rate increases up to 170–210 beats per minute dur-
ing intense exercise.
- The heart’s stroke volume increases, meaning that the
  heart pumps out more blood with each beat.
- The heart pumps and circulates more blood per minute as
  a result of the faster heart rate and greater stroke volume.
  During exercise, this cardiac output increases to 20 or
  more quarts per minute, compared to about 5 quarts per
  minute at rest.
- Blood flow changes, so as much as 85–90% of the blood
  may be delivered to working muscles. At rest, about
  15–20% of blood is distributed to the skeletal muscles.
- Systolic blood pressure increases, while diastolic blood
  pressure holds steady or declines slightly. A typical exer-
  cise blood pressure might be 175/65.
- To oxygenate this increased blood flow, you take deeper
  breaths and breathe faster, up to 40–60 breaths per
  minute.

All of these changes are controlled and coordinated by spe-
cial centers in the brain, which use the nervous system and
chemical messengers to control the process.

Energy Production

Metabolism is the sum of all the chemical processes neces-
sary to maintain the body. Energy is required to fuel vital body
functions—to build and break down tissue, contract muscles,
conduct nerve impulses, regulate body temperature, and so on.

The rate at which your body uses energy—its metabolic rate—depends on your level of activity. At rest, you have a
low metabolic rate; if you begin to walk, your metabolic rate increases. If you jog, your metabolic rate may increase more
than 800% above its resting level. Olympic-caliber distance runners can increase their metabolic rate by 2000% or more.

Energy from Food The body converts chemical energy
from food into substances that cells can use as fuel. These fuels
can be used immediately or stored for later use. The body’s
ability to store fuel is critical, because if all the energy from
food were released immediately, much of it would be wasted.

The three classes of energy-containing nutrients in food are carbohydrates (sugar, wheat flour, honey), fats (meat,
nuts, fried foods), and proteins (seafood, poultry, dairy food). During digestion, most carbohydrates are broken down into
the simple sugar glucose. Some glucose circulates in the blood
(“blood sugar”), where it can be used as a quick source of fuel
to produce energy. Glucose may also be converted to glycogen
and stored mainly in the liver and muscles. If glycogen stores
are full and the body’s immediate need for energy is met, the
remaining glucose is converted to fat and stored in the body’s
fatty tissues. Excess energy from fat in the diet is also stored as
body fat. Protein in the diet is used primarily to build new tis-
sue, but it can be broken down for energy or incorporated into

fat stores. Glucose, glycogen, and fat are important fuels for the
production of energy in the cells; protein is a significant energy
source only when other fuels are lacking. (See Chapter 8 for
more on the roles of carbohydrate, fat, and protein in the body.)

ATP: The Energy “Currency” of Cells The basic form
of energy used by cells is adenosine triphosphate, or ATP.
When a cell needs energy, it breaks down ATP, a process that
releases energy in the only form the cell can use directly. Cells
store a small amount of ATP; when they need more, they cre-
itate through chemical reactions that utilize the body’s stored
fuels—glucose, glycogen, and fat. When you exercise, your
cells need to produce more energy. Consequently, your body
mobilizes its stores of fuel to increase ATP production.

Exercise and the Three Energy Systems

The muscles in your body use three energy systems to create
ATP and fuel cellular activity. These systems use different fuels
and chemical processes and perform different, specific func-
tions during exercise (Table 3.1).

The Immediate Energy System The immediate
(“explosive”) energy system provides energy rapidly but for
only a short period of time. It is used to fuel activities that last
for about 10 or fewer seconds—such as weight lifting and shot-
putting or in daily life just rising from a chair or picking up a
bag of groceries. The components of this energy system include
existing cellular ATP stores and creatine phosphate (CP), a
chemical that cells can use to make ATP. CP levels deplete rap-
idly during exercise, so the maximum capacity of this energy
system is reached within a few seconds. Cells must then switch
to the other energy systems to restore levels of ATP and CP.
(Without adequate ATP, muscles will stiffen and become
unusable.)

The Nonoxidative Energy System The nonoxidative
(anaerobic) energy system is used at the start of an exer-
cise session and for high-intensity activities lasting for about
10 seconds to 2 minutes, such as the 400-meter run. During
daily activities, this system may be called on to help you run to
catch a bus or dash up several flights of stairs. The nonoxidative
energy system creates ATP by breaking down glucose and gly-
cogen. This system doesn’t require oxygen, which is why it is
sometimes referred to as the anaerobic system. This system’s
capacity to produce energy is limited, but it can generate a great
deal of ATP in a short period of time. For this reason, it is the
most important energy system for very intense exercise.

There are two key limitations to the nonoxidative energy
system. First, the body’s supply of glucose and glycogen is lim-
ited. If these are depleted, a person may experience fatigue, diz-
izziness, and impaired judgment. (The brain and nervous system
rely on carbohydrates as fuel.) Second, the rapid metabolism
caused by this energy system increases hydrogen and potassium
ions that interfere with metabolism and muscle contraction and
cause fatigue. During heavy exercise, such as sprinting, large
The anaerobic energy system also creates metabolic acids. Fortunately, exercise training increases the body’s ability to cope with metabolic acid. Improved fitness allows you to exercise at higher intensities before the abrupt buildup of metabolic acids—a point that scientists call the lactate threshold. One metabolic acid, called lactic acid (lactate), is often linked to fatigue during intense exercise. Lactic acid does not last long in blood. It breaks down into lactate and hydrogen ion (acid) as soon as it is produced. Lactate is an important fuel at rest and during exercise.

The Oxidative Energy System  The oxidative (aerobic) energy system operates during any physical activity that lasts longer than about 2 minutes, such as distance running, swimming, hiking, or even just standing in line. The oxidative system requires oxygen to generate ATP, which is why it is considered an aerobic system. The oxidative system cannot produce energy as quickly as the other two systems, but it can supply energy for much longer periods of time. It is the source of our energy during most daily activities.

In the oxidative energy system, ATP production takes place in cellular structures called mitochondria. Because mitochondria can use carbohydrates (glucose and glycogen) or fats to produce ATP, the body’s stores of fuel for this system are much greater than those for the other two energy systems. The actual fuel used depends on the intensity and duration of exercise and on the fitness status of the individual. Carbohydrates are favored during more intense exercise (more than 65% of maximum capacity); fats are used for mild, low-intensity activities. During a prolonged exercise session, carbohydrates are the predominant fuel at the start of the workout, but fat utilization increases over time. Fit individuals use a greater proportion of fat as fuel because increased fitness allows people to do

<table>
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<th>characteristic</th>
<th>oxidative (aerobic) energy system</th>
<th>anaerobic (anaerobic) energy system</th>
<th>nonoxidative (anaerobic) energy system</th>
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<tr>
<td>location</td>
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<td>glucose, glycogen, and lactate</td>
<td>carbohydrates or fats</td>
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<td>ATP</td>
<td>lactic acid, lactate and hydrogen ion</td>
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<td>muscle stores of glucose and glycogen</td>
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<td>oxygen used?</td>
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<td>400-meter run, running up several flights of stairs</td>
<td>Weight lifting, picking up a bag of groceries</td>
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*For most activities, all three systems contribute to energy production; the duration and intensity of the activity determine which system predominates.


**Table 3.1: Characteristics of the Body’s Energy Systems**

<table>
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<th>DURATION OF ACTIVITY FOR WHICH SYSTEM PREDOMINATES</th>
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<td>0–10 seconds</td>
<td>IMMEDIATE</td>
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<td>10 seconds–2 minutes</td>
<td>NONOXIDATIVE</td>
</tr>
<tr>
<td>&gt;2 minutes</td>
<td>OXIDATIVE</td>
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**TERMS**

- **stroke volume**  The amount of blood the heart pumps with each beat.
- **cardiac output**  The volume of blood pumped by the heart per minute via heart rate and stroke volume.
- **metabolic rate**  The rate at which the body uses energy.
- **glucose**  A simple sugar circulating in the blood that can be used by cells to fuel adenosine triphosphate (ATP) production.
- **glycogen**  A complex carbohydrate stored principally in the liver and skeletal muscles; the major fuel source during most forms of intense exercise. Glycogen is the storage form of glucose.
- **adenosine triphosphate (ATP)**  The energy source for cellular processes.
- **immediate ("explosive") energy system**  The system that supplies very short bursts of energy to muscle cells through the breakdown of cellular stores of ATP and creatine phosphate (CP).
- **nonoxidative (anaerobic) energy system**  The system that supplies energy to muscle cells for highly intense exercise of short duration by breaking down muscle stores of glucose and glycogen; called the anaerobic system because chemical reactions take place without oxygen and produce lactic acid.
- **anaerobic**  Occurring in the absence of oxygen.
- **lactic acid**  A metabolic acid resulting from the metabolism of glucose and glycogen. It is broken down in the body into lactate and hydrogen ions as soon as it is produced.
- **oxidative (aerobic) energy system**  The system that supplies energy to cells for long periods of activity through the breakdown of glucose, glycogen, and fats; called the aerobic system because its chemical reactions require oxygen.
- **aerobic**  Dependent on the presence of oxygen.
- **mitochondria**  Cell structures that convert the energy in food to a form the body can use.
activities at lower intensities. This is an important adaptation because glycogen depletion is one of the limiting factors for the oxidative energy system. By being able to use more fat as fuel, a fit individual can exercise for a longer time before glycogen is depleted and muscles become fatigued. Aerobic exercise and high-intensity interval training increase the number and capacity of mitochondria. Increased mitochondrial capacity is the most important benefit of exercise. Mitochondrial health and fitness are linked to a reduced risk of disease and improved longevity.

Oxygen is another factor limiting exercise capacity. The oxygen requirement of this energy system is proportional to the intensity of exercise. As intensity increases, so does oxygen consumption. The body’s ability to increase oxygen use is limited; this limit, known as maximal oxygen consumption, or \( \text{VO}_2\text{max} \), refers to the highest rate of oxygen consumption an individual is capable of during maximum physical effort. It is expressed in milliliters of oxygen per kilogram of body weight per minute. In the symbol, the \( V \) stands for volume, the dot over the \( V \) means per minute, the \( O_2 \) stands for oxygen, and the max means maximum. \( \text{VO}_2\text{max} \) determines how intensely a person can perform endurance exercise and for how long, and it is considered the best overall measure of the capacity of the cardiorespiratory system. (The assessment tests described later in the chapter are designed to help you evaluate your \( \text{VO}_2\text{max} \).

**The Energy Systems in Combination** Your body typically uses all three energy systems when you exercise. The intensity and duration of the activity determine which system predominates. For example, when you play tennis, you use the immediate energy system when hitting the ball, but you replenish cellular energy stores by using the nonoxidative and oxidative systems. When cycling, the oxidative system predominates. However, if you must suddenly exercise intensely—by riding up a steep hill, for example—the other systems become important because the oxidative system is unable to supply ATP fast enough to sustain high-intensity effort.

**Physical Fitness and Energy Production** Physically fit people can increase their metabolic rate substantially, generating the energy needed for powerful or sustained exercise. People who are not fit cannot respond to exercise in the same way. Their bodies are less capable of delivering oxygen and fuel to exercising muscles, they can’t burn as many calories during or after exercise, and they are less able to cope with lactic acid and other substances produced during intense physical activity that contribute to fatigue. Because of this, they become fatigued more rapidly; their legs hurt and they breathe heavily walking up a flight of stairs, for example. Regular physical training can substantially improve the body’s ability to produce energy and meet the challenges of increased physical activity.

In designing an exercise program, focus on the energy system most important to your goals. Because improving the functioning of the cardiorespiratory system is critical to overall wellness, endurance exercise that utilizes the oxidative energy system—activities performed at moderate to high intensities for a prolonged duration—is a key component of any health-related fitness program.

**BENEFITS OF CARDIORESPIRATORY ENDURANCE EXERCISE**

Cardiorespiratory endurance exercise helps the body become more efficient and better able to cope with physical challenges. It also lowers risk for many chronic diseases.

**Improved Cardiorespiratory Functioning**

Earlier, this chapter described some of the major changes that occur in the cardiorespiratory system when you exercise, such as increases in cardiac output and blood pressure, breathing rate, and blood flow to the skeletal muscles. In the short term, all these changes help the body respond to the challenge of exercise. When performed regularly, endurance exercise also leads to permanent adaptation in the cardiorespiratory system (Figure 3.2). This improvement reduces the effort required to perform everyday tasks and enables the body to respond to physical challenges. This, in a nutshell, is what it means to be physically fit.

Endurance exercise enhances the heart’s health by doing the following:

- Maintaining or increasing the heart’s own blood and oxygen supply.
- Improving the heart muscle’s function, so it pumps more blood per beat. This improved function keeps the heart rate lower both at rest and during exercise. The resting heart rate of a fit person is often 10–20 beats per minute lower than that of an unfit person. This translates into as many as 10 million fewer beats in the course of a year.
- Strengthening the heart’s contractions.
- Increasing the heart’s cavity size (in young adults).

---

**Ask Yourself**

**QUESTIONS FOR CRITICAL THINKING AND REFLECTION**

When you think about the types of physical activity you engage in during your typical day or week, which ones use the immediate energy system? The nonoxidative energy system? The oxidative energy system? How can you increase activities that use the oxidative energy system?
**Immediate effects**

Increased levels of neurotransmitters; constant or slightly increased blood flow to the brain.

Increased heart rate and stroke volume (amount of blood pumped per beat).

Increased pulmonary ventilation (amount of air breathed into the body per minute). More air is taken into the lungs with each breath and breathing rate increases.

Reduced blood flow to the stomach, intestines, liver, and kidneys, resulting in less activity in the digestive tract and less urine output.

Increased energy (ATP) production.

Increased blood flow to the skin and increased sweating to help maintain a safe body temperature.

Increased systolic blood pressure; increased blood flow and oxygen transport to working skeletal muscles and the heart; increased oxygen consumption. As exercise intensity increases, blood levels of lactic acid increase.

**Long-term effects**

Improved self-image, cognitive functioning, and ability to manage stress; enhanced learning, memory, energy level, and sleep; decreased depression, anxiety, and risk for stroke.

Increased heart size and resting stroke volume; lower resting heart rate. Risk of heart disease and heart attack reduced significantly.

Improved ability to extract oxygen from air during exercise. Reduced risk of colds and upper respiratory tract infections.

Increased sweat rate and earlier onset of sweating, helping to cool the body.

Decreased body fat.

Reduced risk of colon cancer and certain other forms of cancer.

Increased number and size of mitochondria in muscle cells; increased amount of stored glycogen; improved ability to use lactic acid and fats as fuel. All of these changes allow for greater energy production and power output. Insulin sensitivity remains constant or improves, helping to prevent type 2 diabetes. Fat-free mass may also increase somewhat.

Increased density and breaking strength of bones, ligaments, and tendons; reduced risk for low-back pain, injuries, and osteoporosis.

Increased blood volume and capillary density; higher levels of high-density lipoproteins (HDL) and lower levels of triglycerides; lower resting blood pressure; increased ability of blood vessels to secrete nitric oxide; and reduced platelet stickiness (a factor in coronary artery disease).

**Improved Cellular Metabolism**

Regular endurance exercise improves the body’s metabolism, down to the cellular level, enhancing your ability to produce and use energy efficiently. Cardiorespiratory training improves metabolism by doing the following (see Figure 3.2):

- Increasing the number of capillaries in the muscles. Additional capillaries supply the muscles with more fuel and oxygen and more quickly eliminate waste products. Greater capillary density also helps heal injuries and reduce muscle aches.
- Training muscles to make the most of oxygen and fuel so they work more efficiently.
- Increasing the size and number of mitochondria in muscle and brain cells, thereby increasing the cells’ energy capacity.
- Preventing glycogen depletion and increasing the muscles’ ability to use lactate and fat as fuels.

Regular exercise may also help protect cells from chemical damage caused by agents called free radicals. (See Chapter 8 for details on free radicals and the special enzymes the body uses to fight them.)
Research has shown that most aspects of physiological functioning peak when people are about 30 years old, then decline at a rate of about 0.5–1.0% per year. This decline in physical capacity shows up in decreases in maximal oxygen consumption, cardiac output, muscular strength, fat-free mass, joint mobility, and other factors. However, regular exercise can substantially alter the rate of decline and promote both longevity and improved quality of life.

Regular endurance exercise can improve maximal oxygen consumption in older adults by up to 15–30%—the same degree of improvement seen in younger adults. In fact, studies have shown that Masters athletes in their seventies have VO_{2\text{max}} values equivalent to those of sedentary 20-year-olds.

Fitness programs that best develop metabolic efficiency include both long-duration, moderately intense endurance exercise and brief periods of more intense effort. For example, climbing a small hill while jogging or cycling introduces the kind of intense exercise that leads to more efficient use of lactate and fats.

**Reduced Risk of Chronic Disease**

Regular endurance exercise lowers your risk of many chronic, disabling diseases. It can also help people with those diseases improve their health (see the box “Benefits of Exercise for Older Adults”). The most significant health benefits occur when someone who is sedentary becomes moderately active.

**Cardiovascular Diseases** Sedentary living is a key contributor to cardiovascular disease (CVD). CVD is a general category that encompasses several diseases of the heart and blood vessels, including coronary heart disease (which can cause heart attacks), stroke, and high blood pressure (see the box “Combine Aerobic Exercise with Strength Training”). Sedentary people are significantly more likely to die of CVD than are fit individuals.

Cardiorespiratory endurance exercise lowers your risk of CVD by doing the following:

- Promoting a healthy balance of fats in the blood. High concentrations of blood fats such as cholesterol and triglycerides are linked to CVD. Exercise raises levels of “good cholesterol” (high-density lipoproteins, or HDL) and may lower levels of “bad cholesterol” (low-density lipoproteins, or LDL).
- Reducing high blood pressure, which is a contributing factor to several kinds of CVD.
- Enhancing the capacity of the cells that line the arteries (endothelial cells).
- Reducing chronic inflammation.
- Preventing obesity and type 2 diabetes, both of which contribute to CVD.

Details on various types of CVD, their associated risk factors, and a lifestyle that can reduce your risk for developing CVD are discussed in Chapter 11. To learn more about atherosclerosis, the underlying disease process in CVD, see page T3-4 of the color transparency insert “Touring the Cardiorespiratory System” in this chapter.

**Cancer** Although the findings are not conclusive, some studies have shown a relationship between increased physical activity and a reduction in a person’s risk of cancer. Exercise reduces the risk of colon cancer, and it may reduce the risk of cancers of the breast and reproductive organs. Physical activity during the high school and college years may be particularly important for preventing breast cancer later in life. Exercise may also reduce the risk of lung cancer, endometrial cancer, pancreatic cancer, and prostate cancer. (See Chapter 12 for more information on various types of cancer.)
Emphasizing one aspect of fitness at the expense of others may be a special concern for those exercising with weights who don’t do enough cardiorespiratory conditioning. Although exercise experts universally agree that resistance training is beneficial for a variety of reasons (as detailed in Chapter 4), it also has a downside.

A number of global studies have tracked the impact of weight training exercises on the cardiovascular system to find out if such training helps or harms the heart and blood vessels. These studies have shown that strength training poses short- and long-term risks to cardiovascular health and especially to arterial health. Aside from the risk of injury, lifting weights has been shown to have the following adverse effects on the cardiovascular system:

- Weight training promotes short-term stiffness of the blood vessels, which could promote hypertension (high blood pressure) over time and increase the load on the heart.
- Lifting weights (especially heavy weights) causes extreme short-term boosts in blood pressure; a Canadian study revealed that blood pressure can reach 480/350 millimeters of mercury during heavy lifting. Over the long term, sharp elevations in blood pressure can damage arteries, even if each pressure increase lasts only a few seconds.
- Weight training places stress on the endothelial cells that line blood vessels. Because these cells secrete nitric oxide (a chemical messenger involved in a variety of bodily functions), this stress can contribute to a wide range of negative effects, from erectile dysfunction to heart disease.

A variety of studies have shown that the best way to offset cardiovascular stress caused by strength training is to do cardiorespiratory endurance exercise (such as brisk walking or using an elliptical machine) immediately after a weight training session. Groundbreaking Japanese research showed that following resistance exercise with aerobic exercise prevents the stiffening of blood vessels and its associated damage. In this eight-week study, participants did aerobics before lifting weights, after lifting weights, or not at all. The group that did aerobics after weight training saw the greatest positive impact on arterial health.


**Type 2 Diabetes** Regular exercise helps prevent the development of type 2 diabetes, the most common form of diabetes. Physical activity is also an important part of treating the disease. Obesity is a key risk factor for diabetes, and exercise helps keep body fat at healthy levels. But even without fat loss, exercise improves control of blood sugar levels in many people with diabetes. Exercise metabolizes (burns) excess sugar and makes cells more sensitive to the hormone insulin, which helps regulate blood sugar levels. (See Chapter 6 for more on diabetes and insulin resistance.)

**Osteoporosis** A special benefit of exercise, especially for women, is protection against osteoporosis, a disease that results in loss of bone density and strength. Weight-bearing exercise—particularly weight training—helps build bone during the teens and twenties. People with denser bones can better endure the bone loss that occurs with aging. With stronger bones and muscles and better balance, fit people are less likely to experience debilitating falls and bone fractures. (See Chapter 8 for more on osteoporosis.)

**Inflammation** Inflammation is the body’s response to tissue and cell damage (from injury, high blood pressure, or intense exercise), environmental poisons (e.g., cigarette smoke), or poor metabolic health (high blood fats, poor blood

**Terms**

**Inflammation** The body’s response to tissue and cell damage, environmental poisons, or poor metabolic health.
sugar control). Acute inflammation is a short-term response to exercise and is an important way that the body improves physical fitness. For example, short-term inflammation triggers increased muscle protein synthesis that promotes muscle fitness and recovery from exercise. Chronic inflammation, on the other hand, is a prolonged, abnormal process that causes tissue breakdown and diseases such as atherosclerosis, cancer, and rheumatoid arthritis.

While exercise increases acute inflammation during and shortly after a workout, it reduces chronic levels of inflammation—if the training program is not too severe. For example, practicing endurance training three to five days a week will reduce inflammation. Training excessively, such as running a marathon several times a month or doing severe cross-training workouts five to seven days per week, will cause overtraining and chronic inflammation. We could call this the Goldilocks effect: the training program should not be too much or too little; it should be just right.

Deaths from All Causes Physically active people have a reduced risk of dying prematurely from all causes, with the greatest benefits found for people with the highest levels of physical activity and fitness (Figure 3.3). Physical inactivity is a predictor of premature death and is as important of a risk factor as smoking, high blood pressure, obesity, and diabetes.

Better Control of Body Fat

Too much body fat is linked to a variety of health problems, including cardiovascular disease, cancer, and type 2 diabetes. Healthy body composition can be difficult to achieve and maintain—especially for someone who is sedentary—because a diet that contains all essential nutrients can be relatively high in calories. Excess calories are stored in the body as fat. Regular exercise increases daily calorie expenditure, which means that a healthy diet is less likely to lead to weight gain. Endurance exercise burns calories directly and, if intense enough, continues to do so by raising resting metabolic rate for several hours following an exercise session. A higher metabolic rate makes it easier for a person to maintain a healthy weight or to lose weight. However, exercise alone cannot ensure a healthy body composition. As described in Chapters 6 and 9, you will lose more weight more rapidly and keep it off longer if you decrease your calorie intake and boost your calorie expenditure through exercise.

Improved Immune Function

Exercise can have either positive or negative effects on the immune system, the physiological processes that protect us from diseases such as colds, bacterial infections, and even cancer. Moderate endurance exercise boosts immune function, whereas overtraining (excessive training) depresses it, at least temporarily. Physically fit people get fewer colds and upper respiratory tract infections than people who are not fit.

Exercise affects immune function by influencing levels of specialized cells and chemicals involved in the immune response. As discussed in Chapter 2, physically active people also have healthier, more resilient genes, which promotes immunity. Exercise preserves the telomeres, which form the ends of the DNA strands and holds them together. Without exercise, the telomeres shorten over time, eventually reducing the effectiveness of the immune system. In addition to getting regular moderate exercise, you can further strengthen your immune system by eating a well-balanced diet, managing stress, and getting 7 to 8 hours of sleep every night.

Improved Psychological and Emotional Well-Being

Most people who participate in regular endurance exercise experience social, psychological, and emotional benefits. Skill mastery and self-control enhance one’s self-image. Recreational sports provide an opportunity to socialize, have fun, and strive to excel. Endurance exercise lessens anxiety, depression, stress, anger, and hostility, thereby improving mood while boosting cardiovascular health. Regular exercise also improves sleep.

ASSESSING CARDIORESPIRATORY FITNESS

The body’s ability to maintain a level of exertion (exercise) for an extended time is a direct reflection of cardiorespiratory fitness. One’s level of fitness is determined by the body’s ability to take up, distribute, and use oxygen during physical activity. As explained earlier, the best quantitative measure of

cardiorespiratory endurance is maximal oxygen consumption, expressed as \( \text{VO}_2\text{max} \), the amount of oxygen the body uses when a person reaches his or her maximum ability to supply oxygen during exercise. Maximal oxygen consumption can be measured precisely in an exercise physiology laboratory through analysis of the air a person inhales and exhales when exercising to a level of exhaustion (maximum intensity). This procedure can be expensive and time-consuming, however, making it impractical for the average person.

### Choosing an Assessment Test

Fortunately, several simple assessment tests provide reasonably good estimates of maximal oxygen consumption (within 10–15% of the results of a laboratory test). Four commonly used assessments are the following:

- **The 1-Mile Walk Test.** This test measures the amount of time it takes you to complete 1 mile of brisk walking and your heart rate at the end of your walk. A fast time and a low heart rate indicate a high level of cardiorespiratory endurance.

- **The 3-Minute Step Test.** In the step test, you step continually at a steady rate for 3 minutes and then monitor your heart rate during recovery. The rate at which the pulse returns to normal is a good measure of cardiorespiratory capacity; heart rate remains lower and recovers faster in people who are more physically fit.

- **The 1.5-Mile Run-Walk Test.** Oxygen consumption increases with speed in distance running, so a fast time on this test indicates high maximal oxygen consumption.

- **The Beep Test.** This test predicting maximal oxygen consumption is excellent for people who are physically fit and wish to measure their capacity for high-intensity exercise, such as sprints. A prerecorded series of “beeps” (tones) sound off at faster and faster intervals. Your task is to keep up with the beeps during the exercise.

Lab 3.1 provides detailed instructions for each of these tests. An additional assessment, the 12-Minute Swim Test, is also provided. To assess yourself, choose one of these methods based on your access to equipment, your current physical condition, and your own preference.

Don’t take any of these tests without checking with your physician if you are ill or have any of the risk factors for exercise discussed in Chapter 2 and Lab 2.1.

### Monitoring Your Heart Rate

Each time your heart contracts, it pumps blood into your arteries. You can measure your heart rate—the number of heart contractions per minute—by using a heart rate monitor or counting your pulse beats. Modern heart rate monitors are inexpensive and accurate. Several companies make heart rate monitor apps that are used with smart phones to measure heart rate, distances, route maps, running or cycling speed, and calories burned. Counting your pulse is the traditional method of measuring heart rate. Each contraction of the heart produces a surge of blood that causes a pulse you can feel by holding your fingers against an artery. Heart rate is a good way to monitor exercise intensity during a workout. (Intensity is described in more detail in the next section.)

The two most common sites for monitoring heart rate are the carotid artery in the neck and the radial artery in the wrist (Figure 3.4). To take your pulse, press your index and middle fingers gently on the correct site. You may have to shift position several times to find the best place to feel your pulse. Don’t use your thumb to check your pulse; it has a pulse of its own that can confuse your count. (Use your middle and ring finger if you have a strong pulse in your index finger.) Be careful not to push too hard, particularly when taking your pulse in the carotid artery (strong pressure on this artery may cause a reflex that slows the heart rate).

**Figure 3.4 Checking your pulse.** The pulse can be taken at the carotid artery in the neck (top) or at the radial artery in the wrist (bottom).
WELLNESS IN THE DIGITAL AGE
Fitness Trackers, Heart Rate Monitors, and GPS Devices

Technology has transformed the market for trackers and monitors. It is difficult to keep up with the latest exercise monitors designed as stand-alone units, smart phone apps, and GPS accessories. A heart rate monitor is an electronic device that checks the user’s pulse, either continuously or on demand. These devices make it easy to monitor your heart rate before, during, and after exercise. Some include global positioning system (GPS) receivers that help you track the distance you walk, run, or bike. Wearable fitness trackers, made by Adidas, Nike, Fitbit, Withings, and BodyMedia, among others, measure distance and steps covered, calories burned, and exercise intensity.

Fitness Trackers
High-tech monitors and phone apps such as the Nike Fuelband, Ciclometer, Nike + Sensor, and Adidas miCoach track daily activities including running and walking and sports like basketball. They track steps taken, distance covered, and calories burned. Fitness trackers allow you to keep track of your progress, compete against other people, and meet challenges.

Wearable Heart Rate Monitors
Most consumer-grade heart rate monitors have two pieces—a strap that wraps around the user’s chest and a wrist strap. The chest strap contains one or more small electrodes, which detect changes in the heart’s electrical voltage. A transmitter in the chest strap sends the data to a receiver in the wrist strap. A small computer in the wrist strap calculates the wearer’s heart rate and displays it on a small screen.

In a few low-cost monitors, the chest and wrist straps are connected by a wire, but the most popular monitors use wireless technology to transmit data to the heart rate monitor display. In advanced wireless monitors, data are encoded so they cannot be read by other monitors that may be nearby, as is often the case in a crowded gym. A one-piece (or “strapless”) heart rate monitor does not include a chest strap; the wrist-worn device contains sensors that detect a pulse in the wearer’s hand.

Monitors in Gym Equipment
Many pieces of workout equipment—including newer-model treadmills, stationary bikes, and elliptical trainers—feature built-in heart rate monitors. The monitor is usually mounted into the device’s handles. To check your heart rate at any time while working out, simply grip the handles in the appropriate place; within a few seconds, your current heart rate will appear on the device’s console.

Other Features
Heart rate monitors can do more than just check your pulse. Most can also tell you the following:

- Highest and lowest heart rate during a session
- Average heart rate
- Target heart rate range, based on your age, weight, and other factors
- Time spent within the target range
- Number of calories burned during a session

Some monitors can upload their data to a computer, so information can be stored and analyzed. The analytical software can help you track your progress over a period of time or a number of workouts. AliveECG is a phone app that can send an electrocardiogram instantly to a physician via email. Monitors with GPS provide an accurate estimate of distance traveled during a workout or over an entire day.

Choosing and Using Monitors
Heart rate monitors are useful if very close tracking of heart rate is important in your program. They offer several advantages:

- They are accurate, and they reduce the risk of mistakes when checking your own pulse. (Note: Chest-strap monitors are considered more accurate than strapless models. If you use a monitor built into gym equipment, its accuracy will depend on how well the device is maintained.)
- They are easy to use, although a sophisticated, multifunction monitor may take some time to master.
- They do the monitoring for you, so you don’t have to worry about checking your own pulse.

When shopping for a heart rate, fitness tracker, phone app, or exercise GPS monitor, do your homework. Quality, reliability, and warranties vary. Ask personal trainers in your area for their recommendations, and look for product reviews in consumer magazines or online.

Heart rates are usually assessed in beats per minute (bpm). But counting your pulse for an entire minute isn’t practical when you’re exercising. And because heart rate slows rapidly when you stop exercising, a full minute’s worth of counting can give inaccurate results. It’s best to do a shorter count—15 seconds—and then multiply the result by 4 to get your heart rate in beats per minute. (You can also use a heart rate monitor to check your pulse. See the box “Fitness Trackers, Heart Rate Monitors, and GPS Devices” for more information.)
Interpreting Your Score

After you’ve completed one or more of the assessment tests, use the table under “Rating Your Cardiovascular Fitness” in Lab 3.1 to determine your current level of cardiorespiratory fitness. As you interpret your score, remember that field tests of cardiorespiratory fitness are not precise scientific measurements and have up to a 10–15% margin of error.

You can use the assessment tests to monitor the progress of your fitness program by retesting yourself from time to time. Always compare scores for the same test: Your scores on different tests may vary considerably because of differences in skill and motivation and quirks in the tests themselves.

DEVELOPING A CARDIORESPIRATORY ENDURANCE PROGRAM

Cardiorespiratory endurance exercises are best for developing the type of fitness associated with good health, so they should serve as the focus of your exercise program. To create a successful endurance exercise program, follow these guidelines:

- Set realistic goals.
- Set your starting frequency, intensity, and duration of exercise at appropriate levels.
- Choose suitable activities.
- Warm up and cool down.
- Adjust your program as your fitness improves.

Setting Goals

You can use the results of cardiorespiratory fitness assessment tests to set a specific oxygen consumption goal for your cardiorespiratory endurance program. Your goal should be high enough to ensure a healthy cardiorespiratory system, but not so high that it will be impossible to achieve. Scores in the fair and good ranges for maximal oxygen consumption suggest good fitness; scores in the excellent and superior ranges indicate a high standard of physical performance.

Through endurance training, an individual may be able to improve maximal oxygen consumption \(（\text{VO}_{2\text{max}}）\) by about 10–30%. The amount of improvement possible depends on genetics, age, health status, and initial fitness level. People who start at a very low fitness level can improve by a greater percentage than elite athletes because the latter are already at a much higher fitness level, one that may approach their genetic physical limits. If you are tracking \(\text{VO}_{2\text{max}}\) by using the field tests described in this chapter, you may be able to increase your score by more than 30% due to improvements in other physical factors, such as muscle power, which can affect your performance on the tests.

Another physical factor you can track to monitor progress is resting heart rate—your heart rate at complete rest, measured in the morning before you get out of bed and move around. Resting heart rate may decrease by as much as 10–15 beats per minute in response to endurance training. Changes in resting heart rate may be noticeable after only about four–six weeks of training.

You may want to set other types of goals for your fitness program. For example, if you walk, jog, or cycle as part of your fitness program, you may want to set a time or distance goal—working up to walking 5 miles in one session, completing a 4-mile run in 28 minutes, or cycling a total of 35 miles per week. A more modest goal might be to achieve the recommendation of the U.S. Department of Health and Human Services and American College of Sports Medicine (ACSM) of 150 minutes per week of moderate-intensity physical activity. Although it’s best to base your program on “SMART” goals (those that are specific, measurable, attainable, realistic, and time frame-specific), you may also want to set more qualitative goals, such as becoming more energetic, sleeping better, and improving the fit of your clothes.

Applying the FITT Equation

As described in Chapter 2, you can use the acronym FITT to set key parameters of your fitness program: Frequency, Intensity, Time (duration), and Type of activity.

Frequency of Training Accumulating at least 150 minutes per week of moderate-intensity physical activity (or at least 75 minutes per week of vigorous physical activity) is enough to promote health. Most experts recommend that people exercise three to five days per week to build cardiorespiratory endurance. Training more than five days per week can lead to injury and isn’t necessary for the typical person on an exercise program designed to promote wellness. It is safe to do moderate-intensity activity such as walking and gardening every day. Training fewer than three days per week makes it difficult to improve your fitness (unless exercise intensity is very high) or to lose weight through exercise. Remember, however, that some exercise is better than none.

Intensity of Training Intensity is the most important factor for increasing aerobic fitness. You must exercise intensely

Fitness Tip Listen to fast-paced music for a better workout! In a recent study, students rode a stationary bike while listening to music at different tempos. The subjects rode harder when listening to faster music and performed less exercise in response to slower music. 

DEVELOPING A CARDIORESPIRATORY ENDURANCE PROGRAM 69
enough to stress your body so that fitness improves. Four methods of monitoring exercise intensity are described in the following sections; choose the method that works best for you. Be sure to make adjustments in your intensity levels for environmental or individual factors. For example, on a hot and humid day or on your first day back to your program after an illness, you should decrease your intensity level.

**TARGET HEART RATE ZONE** One of the best ways to monitor the intensity of cardiorespiratory endurance exercise is to measure your heart rate (calculated in beats per minute). It isn’t necessary to exercise at your maximum heart rate to improve maximal oxygen consumption. Fitness adaptations occur at lower heart rates with a much lower risk of injury.

According to the American College of Sports Medicine, your **target heart rate zone**—a range of rates at which you should exercise to experience cardiorespiratory benefits—is between 65% and 90% of your maximum heart rate. To calculate your target heart rate zone, follow these steps:

1. Estimate your maximum heart rate (MHR) by subtracting your age from 220, or have it measured precisely by undergoing an exercise stress test in a doctor’s office, hospital, or sports medicine lab. *(Note: The formula to estimate MHR carries an error of about ±10–15 beats per minute and can be very inaccurate for some people, particularly older adults and young children. If your exercise heart rate seems inaccurate—that is, exercise within your target zone seems either too easy or too difficult—then use the perceived exertion method described in the next section, or have your maximum heart rate measured precisely.) You can get a reasonable estimate of maximal heart rate by exercising at maximal intensities on a stationary bike, treadmill, or elliptical trainer that has a built-in heart rate monitor. This method is not recommended unless you are physically fit and accustomed to intense exercise.

2. Multiply your MHR by 65% and 90% to calculate your target heart rate zone. Very unfit people should use 55% of MHR for their training threshold.

For example, a 19-year-old would calculate her target heart rate zone as follows:

\[
\text{MHR} = 220 - 19 = 201 \text{ bpm} \\
65\% \text{ training intensity} = 0.65 \times 201 = 131 \text{ bpm} \\
90\% \text{ training intensity} = 0.90 \times 201 = 181 \text{ bpm}
\]

**TERMS**

- **target heart rate zone** The range of heart rates that should be reached and maintained during cardiorespiratory endurance exercise to obtain optimal training effects.
- **heart rate reserve** The difference between maximum heart rate and resting heart rate; used in one method for calculating target heart rate zone.
- **MET** A unit of measure that represents the body’s resting metabolic rate—that is, the energy requirement of the body at rest.

To gain fitness benefits, the young woman in our example would have to exercise at an intensity that raises her heart rate to between 131 and 181 bpm.

An alternative method for calculating target heart rate zone uses **heart rate reserve**, the difference between maximum heart rate and resting heart rate. Using this method, target heart rate is equal to resting heart rate plus between 50% (40% for very unfit people) and 85% of heart rate reserve. Although some people (particularly those with very low levels of fitness) will obtain more accurate results using this more complex method, both methods provide reasonable estimates of an appropriate target heart rate zone. Lab 3.2 gives formulas for both methods of calculating target heart rate.

If you have been sedentary, start by exercising at the lower end of your target heart rate zone (65% of maximum heart rate or 50% of heart rate reserve) for at least four–six weeks. Exercising closer to the top of the range can cause fast and significant gains in maximal oxygen consumption, but you may increase your risk of injury and overtraining. You can achieve significant health benefits by exercising at the bottom of your target zone, so don’t feel pressure to exercise at an unnecessarily intense level. If you exercise at a lower intensity, you can increase the duration or frequency of training to obtain as much benefit to your health, as long as you are above the 65% training threshold. For people with a very low initial level of fitness, a lower training intensity of 55–64% of maximum heart rate or 40–49% of heart rate reserve may be sufficient to achieve improvements in maximal oxygen consumption, especially at the start of an exercise program. Intensities of 70–85% of maximum heart rate are appropriate for average individuals.

By monitoring your heart rate, you will always know if you are working hard enough to improve, not hard enough, or too hard. As your program progresses and your fitness improves, you will need to jog, cycle, or walk faster to reach your target heart rate zone. To monitor your heart rate during exercise, count your pulse while you’re still moving or immediately after you stop exercising. Count beats for 15 seconds, then multiply that number by 4 to see if your heart rate is in your target zone. Table 3.2 shows target heart rate ranges and 15-second counts based on the maximum heart rate formula.

**METs** One way scientists describe fitness is in terms of the capacity to increase metabolism (energy usage level) above rest. Scientists use METs to measure the metabolic cost of an exercise. One **MET** represents the body’s resting metabolic rate—that is, the energy or calorie requirement of the body at rest. Exercise intensity is expressed in multiples of resting metabolic rate. For example, an exercise intensity of 2 METs is twice the resting metabolic rate.

METs are used to describe exercise intensities for occupational activities and exercise programs. Exercise intensities of less than 3–4 METs are considered low. Household chores and most industrial jobs fall into this category. Exercise at these intensities does not improve fitness for most people, but it will improve fitness for people with low physical capacities. Activities that increase metabolism by 6–8 METs are classified as moderate-intensity exercises and are suitable for most people beginning an
METs are intended to be only an approximation of exercise intensity. Skill, body weight, body fat, and environment affect the accuracy of METs. As a practical matter, however, we can disregard these limitations. METs are a good way to express exercise intensity because this system is easy for people to remember and apply.

RATINGS OF PERCEIVED EXERTION Another way to monitor intensity is to monitor your perceived level of exertion. Repeated pulse counting during exercise can become a nuisance if it interferes with the activity. As your exercise program progresses, you will probably become familiar with the amount of exertion required to raise your heart rate to target levels. In other words, you will know how you feel when you have exercised intensely enough. If this is the case, you can use the scale of ratings of perceived exertion (RPE) shown in Figure 3.5 to monitor the intensity of your exercise session without checking your pulse.

To use the RPE scale, select a rating that corresponds to your subjective perception of how hard you are exercising when you are training in your target heart rate zone. If your target zone is about 135–155 bpm, exercise intensely enough to raise your heart rate to that level, and then associate a rating—for example, 8–9 (very hard) to your perceived exertion.

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**Table 3.2** Target Heart Rate Zone and 15-Second Counts

<table>
<thead>
<tr>
<th>AGE (years)</th>
<th>TARGET HEART RATE ZONE (bpm)*</th>
<th>15-SECOND COUNT (beats)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20–24</td>
<td>127–180</td>
<td>32–45</td>
</tr>
<tr>
<td>25–29</td>
<td>124–176</td>
<td>31–44</td>
</tr>
<tr>
<td>30–34</td>
<td>121–171</td>
<td>30–43</td>
</tr>
<tr>
<td>35–39</td>
<td>118–167</td>
<td>30–42</td>
</tr>
<tr>
<td>40–44</td>
<td>114–162</td>
<td>29–41</td>
</tr>
<tr>
<td>45–49</td>
<td>111–158</td>
<td>28–40</td>
</tr>
<tr>
<td>50–54</td>
<td>108–153</td>
<td>27–38</td>
</tr>
<tr>
<td>55–59</td>
<td>105–149</td>
<td>26–37</td>
</tr>
<tr>
<td>60–64</td>
<td>101–144</td>
<td>25–36</td>
</tr>
<tr>
<td>65+</td>
<td>97–140</td>
<td>24–35</td>
</tr>
</tbody>
</table>

*Target heart rates lower than those shown here are appropriate for individuals with a very low initial level of fitness. Ranges are based on the following formula: target heart rate = 0.65 to 0.90 of maximum heart rate, assuming maximum heart rate = 220 – age.

**Table 3.3** Approximate MET and Caloric Costs of Selected Activities for a 154-Pound Person

<table>
<thead>
<tr>
<th>ACTIVITY</th>
<th>METs</th>
<th>CALORIC EXPENDITURE PER MINUTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rest</td>
<td>1</td>
<td>1.2</td>
</tr>
<tr>
<td>Light housework</td>
<td>2–4</td>
<td>2.4–4.8</td>
</tr>
<tr>
<td>Bowling</td>
<td>2–4</td>
<td>2.5–5</td>
</tr>
<tr>
<td>Walking</td>
<td>2–7</td>
<td>2.5–8.5</td>
</tr>
<tr>
<td>Archery</td>
<td>3–4</td>
<td>3.7–5</td>
</tr>
<tr>
<td>Dancing</td>
<td>3–7</td>
<td>3.7–8.5</td>
</tr>
<tr>
<td>Hiking</td>
<td>3–7</td>
<td>3.7–8.5</td>
</tr>
<tr>
<td>Horseback riding</td>
<td>3–8</td>
<td>3.7–10</td>
</tr>
<tr>
<td>Cycling</td>
<td>3–8</td>
<td>3.7–10</td>
</tr>
<tr>
<td>Basketball (recreational)</td>
<td>3–9</td>
<td>3.7–11</td>
</tr>
<tr>
<td>Swimming</td>
<td>4–8</td>
<td>5–10</td>
</tr>
<tr>
<td>Tennis</td>
<td>4–9</td>
<td>5–11</td>
</tr>
<tr>
<td>Fishing (fly, stream)</td>
<td>5–6</td>
<td>6–7.5</td>
</tr>
<tr>
<td>In-line skating</td>
<td>5–8</td>
<td>6–10</td>
</tr>
<tr>
<td>Skiing (downhill)</td>
<td>5–8</td>
<td>6–10</td>
</tr>
<tr>
<td>Rock climbing</td>
<td>5–10</td>
<td>6–12</td>
</tr>
<tr>
<td>Scuba diving</td>
<td>5–10</td>
<td>6–12</td>
</tr>
<tr>
<td>Skiing (cross-country)</td>
<td>6–12</td>
<td>7.5–15</td>
</tr>
<tr>
<td>Jogging</td>
<td>8–12</td>
<td>10–15</td>
</tr>
</tbody>
</table>

**Figure 3.5** Ratings of perceived exertion (RPE).

Experienced exercisers may use this subjective scale to estimate how near they are to their target heart rate zone.

“somewhat hard” or “hard” (14 or 15)—with how hard you feel you are working. To reach and maintain a similar intensity in future workouts, exercise hard enough to reach what you feel is the same level of exertion. You should periodically check your RPE against your target heart rate zone to make sure it’s correct. RPE is an accurate means of monitoring exercise intensity, and you may find it easier and more convenient than pulse counting.

**TALK TEST**  Another easy method of monitoring exercise exertion—in particular, to prevent overly intense exercise—is the talk test. Although your breathing rate will increase during moderate-intensity cardiorespiratory endurance exercise, you should not work out so intensely that you cannot communicate. Speech is limited to short phrases during vigorous-intensity exercise. The talk test is an effective gauge of intensity for many types of activities.

Table 3.4 provides a quick reference to each of the four methods of estimating exercise intensity discussed here.

**Time (Duration) of Training**  A total duration of 20–60 minutes per day is recommended; exercise can take place in a single session or in multiple sessions lasting 10 or more minutes. The total duration of exercise depends on its intensity. To improve cardiorespiratory endurance during a low- to moderate-intensity activity such as walking or slow swimming, you should exercise for 30–60 minutes. For high-intensity exercise performed at the top of your target heart rate zone, a duration of 20 minutes is sufficient.

Some studies have shown that 5–10 minutes of extremely intense exercise (greater than 90% of maximal oxygen consumption) improves cardiorespiratory endurance. However, training at high intensity, particularly during high-impact activities, increases the risk of injury. Also, if you experience discomfort in high-intensity exercise, you are more likely to discontinue your exercise program. Longer-duration, low- to moderate-intensity activities generally result in more gradual gains in maximal oxygen consumption. In planning your program, start with less vigorous activities and gradually increase intensity.

**Type of Activity**  Cardiorespiratory endurance exercises include activities that involve the rhythmic use of large-muscle groups for an extended period of time, such as jogging, walking, cycling, aerobic dancing and other forms of group exercise, cross-country skiing, and swimming. Start-and-stop sports, such as tennis and racquetball, also qualify if you have enough skill to play continuously and intensely enough to raise your heart rate to target levels. Other important considerations are access to facilities, expense, equipment, and the time required to achieve an adequate skill level and workout.

### Warming Up and Cooling Down

As we saw in Chapter 2, it’s important to warm up before every session of cardiorespiratory endurance exercise and to cool down afterward. Because the body’s muscles work better when their temperature is slightly above resting level, warming up enhances performance and decreases the chance of injury. It gives the body time to redirect blood to active muscles and the heart time to adapt to increased demands. Warming up also helps spread protective fluid throughout the joints, preventing injury to their surfaces.

A warm-up session should include low-intensity, whole-body movements similar to those in the activity that will follow, such as walking slowly before beginning a brisk walk. An active warm-up of 5–10 minutes is adequate for most types of exercise. However, warm-up time will depend on your level of fitness, experience, and individual preferences.

What about stretching as part of a warm-up? Performing static stretches—those in which you move a joint to the end of the range of motion and hold the position—as part of your pre-exercise warm-up has not been found to prevent injury and has little or no effect on post-exercise muscle soreness. Static stretching before exercise may also adversely affect strength, power, balance, reaction time, and movement time. (Stretching may interfere with muscle and joint receptors that are used in the performance of sport and movement skills.) For these reasons, it is often recommended that static stretches be performed at the end of your workout, after your cool-down but while your muscles are still warm and your joints are lubricated. On the flip side, dynamic stretches—those involving continuous movement of joints through a range of motion—can be an appropriate part of a warm-up. Slow and controlled movements such as walking lunges, heel kicks, and arm circles can raise muscle temperature while moving joints through their range of motion. (See Chapter 5 for a detailed discussion of stretching and flexibility exercises.)

Cooling down after exercise is important for returning the body to a nonexercising state. A cool-down helps maintain blood flow to the heart and brain and redirects blood from working muscles to other areas of the body. This helps prevent a large drop in blood pressure, dizziness, and other potential cardiovascular complications. A cool-down, consisting of 5–10 minutes of reduced activity, should follow every workout to allow heart rate, breathing, and circulation to return to normal. Decrease the intensity of exercise gradually during your cool-down. For example, following a running workout, begin your cool-down by jogging at half speed for 30 seconds to a minute; then do several minutes of walking, reducing your speed slowly. A good rule of thumb is to cool down at least until your heart rate drops below 100 beats per minute.

The general pattern of a safe and successful workout for cardiorespiratory fitness is illustrated in Figure 3.6.

---

**Table 3.4** Estimating Exercise Intensity

<table>
<thead>
<tr>
<th>METHOD</th>
<th>MODERATE INTENSITY</th>
<th>VIGOROUS INTENSITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage of maximum heart rate</td>
<td>55–69%</td>
<td>70–90%</td>
</tr>
<tr>
<td>Heart rate reserve</td>
<td>40–59%</td>
<td>60–85%</td>
</tr>
<tr>
<td>Rating of perceived exertion</td>
<td>12–13 (somewhat hard)</td>
<td>14–16 (hard)</td>
</tr>
<tr>
<td>Talk test</td>
<td>Speech with some difficulty</td>
<td>Speech limited to short phrases</td>
</tr>
</tbody>
</table>
Building Cardiorespiratory Fitness

Building fitness is as much an art as a science. Your fitness improves when you overload your body. However, you must increase the intensity, frequency, and duration of exercise carefully to avoid injury and overtraining.

General Program Progression For the initial stage of your program, which may last anywhere from three to six weeks, exercise at the low end of your target heart rate zone. Begin with a frequency of three–four days per week, and choose a duration appropriate for your fitness level: 12–15 minutes if you are very unfit, 20 minutes if you are sedentary but otherwise healthy, and 30–40 minutes if you are an experienced exerciser. Use this stage of your program to allow both your body and your schedule to adjust to your new exercise routine. When you can exercise at the upper levels of frequency (four–five days per week) and duration (30–40 minutes) without excessive fatigue or muscle soreness, you are ready to progress.

The next phase of your program is the improvement stage, lasting from four to six months. During this phase, slowly and gradually increase the amount of overload until you reach your target level of fitness (see the sample training progression in Table 3.5). Take care not to increase overload too quickly. It is usually best to avoid increasing both intensity and duration during the same session or increasing all three training variables (intensity, duration, and frequency) in one week. Increasing duration in increments of 5–10 minutes every two–three weeks is usually appropriate. Signs that you are increasing overload too quickly include muscle aches and pains, lack of usual interest in exercise, extreme fatigue, and inability to complete a workout. Keep an exercise log or training diary to monitor your workouts and progress.

Interval Training You will not improve your fitness indefinitely. The more fit you become, the harder you must work to improve. Few exercise techniques are more effective at improving fitness rapidly than high-intensity interval training (HIIT)—a series of very brief, high-intensity exercise sessions interspersed with short rest periods. The four components of interval training are distance, repetition, intensity, and rest, defined as follows:

- **Distance** refers to either the distance or the time of the exercise interval.
- **Repetition** is the number of times the exercise is repeated.
endurance capacity by 100%. The subjects made these amazing improvements by exercising only 15 minutes over a period of two weeks. Each workout consisted of 4 to 7 repetitions of high-intensity exercise (each repetition consisted of 30 seconds at near maximum effort) on a stationary bike. Follow-up studies showed that practicing HIIT one to three times per week improved endurance and aerobic capacity just as well as training five times per week for 60 minutes for six weeks. These studies (and more than 50 others) showed the value of high-intensity training for building aerobic capacity and endurance.

**CONS**

High-intensity interval training appears to be safe and effective in the short term, but there are concerns about the long-term safety and effectiveness of this type of training, so consider the following issues:

- **High-intensity training could be dangerous for some people.** A physician might be reluctant to give certain patients the green light for this type of exercise.

- **Always warm up with several minutes of low-intensity exercise before practicing HIIT.** HIIT without a warm-up can cause cardiac arrhythmias (abnormal heart rhythms), even in healthy people.

- **HIIT might trigger overuse injuries in unfit people.** For this reason, it is essential to start gradually, especially for someone at a low level of fitness. Exercise at submaximal intensities for at least four to six weeks before starting high-intensity interval training. Cut back on interval training or rest if you feel overly fatigued or develop overly sore joints or muscles.

Other types of high-intensity training may combine intervals with other types of exercises and training techniques; see the box “High-Intensity Conditioning Programs.”

**Maintaining Cardiorespiratory Fitness**

There are limits to the level of fitness you can achieve, and if you increase intensity and duration indefinitely, you are likely

---

**Table 3.5 Sample Progression for an Endurance Program**

<table>
<thead>
<tr>
<th>STAGE/WEEK</th>
<th>FREQUENCY (days/week)</th>
<th>INTENSITY* (beats/minute)</th>
<th>TIME (duration in minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial stage</td>
<td>1</td>
<td>3</td>
<td>120–130</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>3</td>
<td>120–130</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>4</td>
<td>130–145</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>4</td>
<td>130–145</td>
</tr>
<tr>
<td>Improvement stage</td>
<td>5–7</td>
<td>3–4</td>
<td>145–160</td>
</tr>
<tr>
<td></td>
<td>8–10</td>
<td>3–4</td>
<td>145–160</td>
</tr>
<tr>
<td></td>
<td>11–13</td>
<td>3–4</td>
<td>150–165</td>
</tr>
<tr>
<td></td>
<td>14–16</td>
<td>4–5</td>
<td>150–165</td>
</tr>
<tr>
<td></td>
<td>17–20</td>
<td>4–5</td>
<td>160–180</td>
</tr>
<tr>
<td></td>
<td>21–24</td>
<td>4–5</td>
<td>160–180</td>
</tr>
<tr>
<td>Maintenance stage</td>
<td>25+</td>
<td>3–5</td>
<td>160–180</td>
</tr>
</tbody>
</table>

*The target heart rate shown here are based on calculations for a healthy 20-year-old with a resting heart rate of 60 beats per minute; the program progresses from an initial target heart rate of 50% to a maintenance range of 70–85% of heart rate reserve.


**Fitness Tip**

High-intensity interval training can be an effective technique for boosting fitness. For a runner, HIIT might be half a dozen 200-meter sprints one to three times a week. If you decide to try HIIT, be sure to start slowly, progress gradually, and listen to your body to avoid injury.
In recent years, high-intensity power-based “extreme” conditioning programs, such as CrossFit, Gym Jones, and Insanity, have grown in popularity. The programs typically incorporate a range of activity types and may include high-intensity aerobic exercise, interval training, free-weight exercises, and gymnastics moves. The programs may be geared toward developing whole-body fitness, limiting workout time by utilizing short but high-intensity sessions, and/or adding a competitive aspect to fitness training.

CrossFit is a popular example of a high-intensity program that emphasizes use of broad and constantly changing training stimuli. It includes activities designed to develop not only cardiorespiratory endurance but also strength, power, speed, coordination, ability, balance, and accuracy. Workouts are short and intense but should be tailored to an individual’s current fitness level and age. They may include aerobic activities such as running and rope skipping, plus whole-body strength training activities such as power lifts, plyometrics, sled pulls, and kettlebell exercises.

The sample workouts below provide a flavor of this type of high-intensity training.

**Sample Workouts**

Complete three circuits (series) of the activities, but do not exceed 20–30 minutes for the workout. Break the exercises into sets if you cannot complete all the repetitions (e.g., 20 pull-ups). Record your time. Train as hard and as fast as you can while maintaining good technique. Select a weight that allows you to complete the reps in the sets. (Principles of resistance exercise are described in Chapter 4.) Change the exercises with every workout.

**Workout 1**

- 40 push-ups
- 10 standing long jumps
- 40 squats with hands on your hips
- 20 dumbbell or kettlebell swings
- Skip rope rapidly for three minutes
- Rest three minutes; repeat circuit 2 more times

**Workout 2**

- 20 pull-ups
- 20 dumbbell thrusters (front squat with barbell or dumbbells, then immediately perform an overhead press)
- 20 overhead squats
- 10 kettlebell snatches (10 for each arm)
- 2 minutes spinning on bike while standing, maximum intensity
- Rest 3 minutes; repeat circuit 2 more times

**Cautions and Guidelines**

High-intensity training programs have their critics, who point to the increased risk of severe injury and lack of concern for the principle of specificity (training the way you want your body to adapt) with this type of training. Good technique is essential. The emphasis on speed and intensity can make it difficult to achieve good technique, but performing high-speed free-weight exercises such as cleans and squats improperly can lead to severe injury.

Performing high-speed, high-repetition sit-ups or squats often pushes muscles and joints to failure, causing severe knee or back injury or muscle destruction (rhabdomyolysis or "rhabdo"). Until recently, physicians encountered rhabdo only after extreme trauma from automobile accidents. These days, rhabdo may becoming more common because of the popularity of “feel the burn” high-intensity training programs. Biomechanical studies suggest that high-speed sit-ups and squats can damage the spine. The benefits of high levels of fitness are counterbalanced by the risk of injury.

In spite of the potential risks of high-intensity training, it can be a suitable option for fit individuals who enjoy and are motivated by varied, high-intensity workouts that require little time or equipment. If you are considering this type of training, consider the following:

- Follow general guidelines for medical clearance for exercise (see Chapter 2).
- Use good form and appropriate safety equipment for all exercises and activities; do not sacrifice form for speed, number of repetitions, or any other goal.
- Drink plenty of water and avoid exercise in hot and humid environments.
- Don’t push yourself beyond the limits of your strength or conditioning level.
- Monitor yourself for signs of overtraining (unusual fatigue or muscle soreness), injuries, and rhabdomyolysis (severe muscle pain or weakness; dark, red, or cola-colored urine).
- Get advice from a qualified professional; when choosing a class, fitness facility, or trainer, follow the guidelines presented in Chapter 2.

**Sources**

to become injured or overtrained. After an improvement stage of four–six months, you may reach your goal of an acceptable level of fitness. You can then maintain fitness by continuing to exercise at the same intensity at least three nonconsecutive days every week. If you stop exercising, you lose your gains in fitness fairly rapidly. If you take time off for any reason, start your program again at a lower level and rebuild your fitness in a slow and systematic way.

When you reach the maintenance stage, you may want to set new goals for your program and make some adjustments to maintain your motivation. For example, you might set a new goal of participating in a local 5K race. Or you might add new buddies to your program, or mix up your exercise sessions by working out in a new setting. Adding variety to your program can be a helpful strategy. Engaging in multiple types of endurance activities, an approach known as cross-training, can help boost enjoyment and prevent some types of injuries. For example, someone who has been jogging five days a week may change her program so she jogs three days a week, plays tennis one day a week, and goes for a bike ride one day a week.

While all these activities build endurance, alternating between them reduces the strain on specific joints and muscles. Varying your activities also offers new physical and mental challenges that can keep your fitness program fresh and fun.

**EXERCISE SAFETY AND INJURY PREVENTION**

Exercising safely and preventing injuries are two important challenges for people who engage in cardiorespiratory endurance exercise. This section provides basic safety guidelines that can be applied to a variety of fitness activities. Chapters 4 and 5 include additional advice specific to strength training and flexibility training.

**Hot Weather and Heat Stress**

Human beings require a relatively constant body temperature to survive. A change of just a few degrees in body temperature can quickly lead to distress and even death. If you lose too much water or if your body temperature gets too high, you may suffer from heat stress. Problems associated with heat stress include dehydration, heat cramps, heat exhaustion, and heatstroke.

When it is hot, exercise safety depends on the body’s ability to dissipate heat and maintain blood flow to active muscles. The body releases heat from exercise through the evaporation of sweat. This process cools the skin and the blood circulating near the body’s surface. Sweating is an efficient process as long as the air is relatively dry. As humidity increases, however, the sweating mechanism becomes less efficient because extra moisture in the air inhibits the evaporation of sweat from the skin. This is why it takes longer to cool down in humid weather than in dry weather.

You can avoid significant heat stress by staying fit, avoiding overly intense or prolonged exercise for which you are not prepared, drinking adequate fluids before and during exercise, and wearing clothes that allow heat to dissipate.

**Dehydration** Your body needs water to carry out many chemical reactions and to regulate body temperature. Sweating during exercise depletes your body’s water supply and can lead to dehydration, excessive loss of body fluids, if fluids aren’t replaced. Although dehydration is most common in hot weather, it can occur even in comfortable temperatures if fluid intake is insufficient.

Dehydration increases body temperature and decreases sweat rate, plasma volume, cardiac output, maximal oxygen consumption, exercise capacity, muscular strength, and stores of liver glycogen. You may begin to feel thirsty when you have a fluid deficit greater than about 1% of total body weight.

Drinking fluids before and during exercise is important to prevent dehydration and enhance performance. As a general rule, drink 16–20 ounces (about 2 cups) of fluid four hours before exercise, and 8–12 ounces 15 minutes immediately before exercise. During exercise lasting less than 60 minutes, drink 3–8 ounces of water every 15–20 minutes. Consume a sports drink with electrolytes every 15–20 minutes when exercising longer than 60 minutes.

Don’t drink more than one quart of water per hour. Very rarely, active people consume too much water and develop hyponatremia (water intoxication), a condition that can cause lung congestion, muscle weakness, nervous system problems, and even death. Following the guidelines presented here can help prevent this condition.

To determine if you’re drinking enough fluid, weigh yourself before and after an exercise session; any weight loss is due to fluid loss that needs to be replaced. Urine color is a good marker of hydration (see Figure 3.7). A dark color means that you might be dehydrated. Diet and supplements can affect urine color, which affects the accuracy of the test.

Bring a water bottle when you exercise so you can replace your fluids while they’re being depleted. For exercise sessions lasting less than 60 minutes, cool water is an excellent fluid

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**Figure 3.7 Urine chart to assess hydration.** A large amount of light-colored urine means you are well hydrated. The darker the color, the more dehydrated you are. Vitamins and some foods can make urine darker.

replacement. For longer workouts, choose sports drinks containing water and small amounts of electrolytes (sodium, potassium, and magnesium) and simple carbohydrates (“sugar,” usually in the form of sucrose, glucose, lactate, or glucose polymers). Electrolytes, which are lost from the body in sweat, are important because they help regulate the balance of fluids in body cells and the bloodstream. The carbohydrates in typical sports drinks are rapidly digestible, which enables them to help maintain blood glucose levels. Choose a beverage with no more than eight grams of simple carbohydrate per 100 milliliters of fluid. Nonfat milk and chocolate milk, for those who can tolerate dairy products, are excellent fluid replacement beverages because they promote long-term hydration. See Chapter 8 for more on diet and fluid recommendations for active people.

**Heat Cramps** Involuntary cramping and spasms in the muscle groups used during exercise are sometimes called heat cramps. Although depletion of sodium and potassium from the muscles is involved with the problem, the primary cause of cramps is muscle fatigue. Children are particularly susceptible to heat cramps, but the condition can also occur in adults, even those who are fit. The best treatment for heat cramps is a combination of gentle stretching, replacement of fluid and electrolytes, and rest.

**Heat Exhaustion** Symptoms of heat exhaustion include the following:

- Rapid, weak pulse
- Low blood pressure
- Headache
- Faintness, weakness, dizziness
- Profuse sweating
- Pale face
- Psychological disorientation (in some cases)
- Normal or slightly elevated core body temperature

Heat exhaustion occurs when an insufficient amount of blood returns to the heart because so much of the body’s blood volume is being directed to working muscles (for exercise) and to the skin (for cooling). Treatment for heat exhaustion includes resting in a cool area, removing excess clothing, applying cool or damp towels to the body, and drinking fluids. An affected individual should rest for the remainder of the day and drink plenty of fluids for the next 24 hours.

**Heatstroke** Heatstroke is a major medical emergency resulting from the failure of the brain’s temperature regulatory center. The body does not sweat enough, and body temperature rises dramatically to extremely dangerous levels. In addition to high body temperature, symptoms can include the following:

- Hot, flushed skin (dry or sweaty), red face
- Chills, shivering
- Very high or very low blood pressure
- Confusion, erratic behavior
- Convulsions, loss of consciousness

A heatstroke victim should be cooled as rapidly as possible and immediately transported to a hospital. To lower body temperature, get out of the heat, remove excess clothing, drink cold fluids, and apply cool or damp towels to the body or immerse the body in cold water. People experiencing heatstroke during exercise may still be sweating.

**Cold Weather**

In extremely cold conditions, problems can occur if a person’s body temperature drops or if particular parts of the body are exposed. If the body’s ability to warm itself through shivering or exercise can’t keep pace with heat loss, the core body temperature begins to drop. This condition, known as hypothermia, depresses the central nervous system, resulting in sleepiness and a lower metabolic rate. As metabolic rate drops, body temperature declines even further, and coma and death can result. The risk of hypothermia is particularly severe in cold water.

**Frostbite**—the freezing of body tissues—is another potential danger of exercise in extremely cold conditions. Frostbite most commonly occurs in exposed body parts like earlobes, fingers, and the nose. It can cause permanent circulatory damage; its symptoms are numbness, pale color, and lack of sensation to cold in the affected areas. Hypothermia and frostbite both require immediate medical treatment.

To exercise safely in cold conditions, don’t stay out in very cold temperatures for too long. Take both the temperature and the wind into account when planning your exercise session. Frostbite is possible within 30 minutes in calm conditions when the temperature is colder than –5°F, or in windy conditions (30 mph or more) if the temperature is below 10°F. Wind chill values that reflect a combination of the temperature and the wind speed are available as part of a local weather forecast and from the National Weather Service (http://www.weather.gov).

Appropriate clothing provides insulation and helps trap warm air next to the skin. Dress in layers so you can remove them as you warm up and can put them back on if you get cold. A substantial amount of heat loss comes from the head and

** cross-training** Alternating activities to improve components of fitness.

**dehydration** Excessive loss of body fluids.

**heat cramps** Sudden muscle spasms and pain associated with intense exercise in hot weather.

**heat exhaustion** Heat illness resulting from exertion in hot weather.

**heatstroke** A severe and often fatal heat illness characterized by significantly elevated core body temperature.

**hypothermia** Low body temperature due to exposure to cold conditions.

**frostbite** Freezing of body tissues characterized by pallor, numbness, and a loss of cold sensation.

**wind chill** A measure of how cold it feels based on the rate of heat loss from exposed skin caused by cold and wind.
Do not exercise outdoors during a smog alert or if air quality is very poor. If you have any type of cardiorespiratory difficulty, you should take particular care to avoid exertion outdoors in poor air quality. You can avoid some smog and air pollution by exercising in indoor facilities, in parks, near water (riverbanks, lakeshores, and ocean beaches), or in residential areas with less traffic. Air quality is also usually better in the early morning and late evening, before and after the commute hours.

**Poor Air Quality**

Air pollution can decrease exercise performance and negatively affect health, particularly if you smoke or have respiratory problems such as asthma, bronchitis, or emphysema. The effects of smog are worse during exercise than at rest because air enters the lungs faster. Polluted air may also contain carbon monoxide, which displaces oxygen in the blood and reduces the amount of oxygen available to working muscles. One study found that exercise in polluted air could decrease lung function to the same extent as heavy smoking. Another study found that training in a polluted environment counteracted the normally beneficial effects of exercise on the brain. Symptoms of exercising in poor air quality include eye and throat irritations, difficulty breathing, and possibly headache and malaise.

**Exercise Injuries**

Most injuries are annoying rather than serious or permanent. However, an injury that isn’t cared for properly can escalate into a chronic problem, sometimes serious enough to permanently curtail the activity. It’s important to learn how to deal with injuries so they don’t derail your fitness program. Strategies for the care of common exercise injuries and discomforts appear in Table 3.6; some general guidelines are given in the following sections.

**When to Call a Physician** Some injuries require medical attention. Consult a physician for the following:

- Head and eye injuries
- Possible ligament injuries

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### Table 3.6 Care of Common Exercise Injuries and Discomforts

<table>
<thead>
<tr>
<th>INJURY</th>
<th>SYMPTOMS</th>
<th>TREATMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blister</td>
<td>Accumulation of fluid in one spot under the skin</td>
<td>Don’t pop or drain it unless it interferes too much with your daily activities. If it does pop, clean the area with antiseptic and cover with a bandage. Do not remove the skin covering the blister.</td>
</tr>
<tr>
<td>Bruise (contusion)</td>
<td>Pain, swelling, and discoloration</td>
<td>R-I-C-E: rest, ice, compression, elevation.</td>
</tr>
<tr>
<td>Fracture and/or dislocation</td>
<td>Pain, swelling, tenderness, loss of function, and deformity</td>
<td>Seek medical attention, immobilize the affected area, and apply cold.</td>
</tr>
<tr>
<td>Joint sprain</td>
<td>Pain, tenderness, swelling, discoloration, and loss of function</td>
<td>R-I-C-E: apply heat when swelling has disappeared. Stretch and strengthen affected area.</td>
</tr>
<tr>
<td>Muscle cramp</td>
<td>Painful, spasmodic muscle contractions</td>
<td>Gently stretch for 15–30 seconds at a time and/or massage the cramped area. Drink fluids and increase dietary salt intake if exercising in hot weather.</td>
</tr>
<tr>
<td>Muscle soreness or stiffness</td>
<td>Pain and tenderness in the affected muscle</td>
<td>Stretch the affected muscle gently; exercise at a low intensity; apply heat. Nonsteroidal anti-inflammatory drugs, such as ibuprofen, help some people.</td>
</tr>
<tr>
<td>Muscle strain</td>
<td>Pain, tenderness, swelling, and loss of strength in the affected muscle</td>
<td>R-I-C-E; apply heat when swelling has disappeared. Stretch and strengthen the affected area.</td>
</tr>
<tr>
<td>Plantar fascitis</td>
<td>Pain and tenderness in the connective tissue on the bottom of the foot</td>
<td>Apply ice, take nonsteroidal anti-inflammatory drugs, and stretch. Wear night splints when sleeping.</td>
</tr>
<tr>
<td>Shin splint</td>
<td>Pain and tenderness on the front of the lower leg; sometimes pain in the calf muscle</td>
<td>Rest; apply ice to the affected area several times a day and before exercise; wrap with tape for support. Stretch and strengthen muscles in the lower legs. Purchase good-quality footwear and run on soft surfaces.</td>
</tr>
<tr>
<td>Side stitch</td>
<td>Pain on the side of the abdomen</td>
<td>Stretch the arm on the affected side as high as possible; if that doesn’t help, try bending forward while tightening the abdominal muscles.</td>
</tr>
<tr>
<td>Tendinitis</td>
<td>Pain, swelling, and tenderness of the affected area</td>
<td>R-I-C-E; apply heat when swelling has disappeared. Stretch and strengthen the affected area.</td>
</tr>
</tbody>
</table>
Managed Minor Exercise Injuries

- Reduce the initial inflammation using the R-I-C-E principle (see text).
- After 36–48 hours, apply heat if the swelling has disappeared completely. Immerse the affected area in warm water or apply warm compresses, a hot water bottle, or a heating pad. As soon as you feel comfortable, begin moving the affected joints slowly. If you feel pain, or if the injured area begins to swell again, reduce the amount of movement. Continue gently stretching and moving the affected area until you have regained normal range of motion.
- Gradually begin exercising the injured area to build strength and endurance. Depending on the type of injury, weight training, walking, and resistance training can all be effective.
- Gradually reintroduce the stress of an activity until you can return to full intensity. Don’t progress too rapidly or you’ll re-injure yourself. Before returning to full exercise participation, you should have a full range of motion in your joints, normal strength and balance among your muscles, normal coordinated patterns of movement (with no injury compensation movements, such as limping), and little or no pain.

Managing Minor Exercise Injuries

- Broken bones
- Internal disorders: chest pain, fainting, elevated body temperature, intolerance to hot weather

Also seek medical attention for ostensibly minor injuries that do not get better within a reasonable amount of time. You may need to modify your exercise program for a few weeks to allow an injury to heal.

Managing Minor Exercise Injuries

For minor cuts and scrapes, stop the bleeding and clean the wound. Treat injuries to soft tissue (muscles and joints) with the R-I-C-E principle: rest, ice, compression, and elevation.

- Rest: Stop using the injured area as soon as you experience pain. Avoid any activity that causes pain.
- Ice: Apply ice to the injured area to reduce swelling and alleviate pain. Apply ice immediately for 10–20 minutes, and repeat every few hours as needed for pain. Let the injured part return to normal temperature between icing, and do not apply ice to one area for more than 20 minutes. An easy method for applying ice is to freeze water in a paper cup, peel some of the paper away, and rub the exposed ice on the injured area. If the injured area is large, you can surround it with several bags of crushed ice or ice cubes, or bags of frozen vegetables. Place a thin towel between the bag and your skin. If you use a cold gel pack, limit application time to 10 minutes. Some experts recommend regular icing for up to about 6 hours after an injury, while others suggest continuing as long as swelling persists.
- Compression: Wrap the injured area firmly with an elastic or compression bandage between icings. If the area starts throbbing or begins to change color, the bandage may be wrapped too tightly. Do not sleep with the wrap on.
- Elevation: Raise the injured area above heart level to decrease the blood supply and reduce swelling. When lying down use pillows, books, or a low chair or stool to raise the injured area.

The day after the injury, some experts recommend also taking an over-the-counter medication, such as aspirin, ibuprofen, or naproxen, to decrease inflammation. To rehabilitate your body, follow the steps listed in the box “Rehabilitation Following a Minor Athletic Injury.”

Preventing Injuries

The best method for dealing with exercise injuries is to prevent them. If you choose activities for your program carefully and follow the training guidelines described here and in Chapter 2, you should be able to avoid most types of injuries. Important guidelines for preventing athletic injuries include the following:

- Train regularly and stay in condition.
- Gradually increase the intensity, duration, or frequency of your workouts.
- Avoid or minimize high-impact activities such as running; alternate them with low-impact activities such as swimming or cycling.
- Get proper rest between exercise sessions.
- Drink plenty of fluids.
- Warm up thoroughly before you exercise and cool down afterward.
- Achieve and maintain a normal range of motion in your joints.
- Use proper body mechanics when lifting objects or executing sports skills.
- Don’t exercise when you are ill or overtrained.
- Use proper equipment, particularly shoes, and choose an appropriate exercise surface. If you exercise on a grass field, soft track, or wooden floor, you are less likely to be injured than on concrete or a hard track. (For information on athletic shoes, see the box “Choosing Exercise Footwear.”)
- Don’t return to your normal exercise program until any athletic injuries have healed. Restart your program at a lower intensity and gradually increase the amount of overload.
Choosing Exercise Footwear

Footwear is perhaps the most important item of equipment for almost any activity. Shoes protect and support your feet and improve your traction. When you jump or run, you place as much as six times more force on your feet than when you stand still. Shoes can help cushion against the stress that this additional force places on your lower legs, thereby preventing injuries. Some athletic shoes are also designed to help prevent ankle rollover, another common source of injury.

General Guidelines

When choosing athletic shoes, first consider the activity you’ve chosen for your exercise program. Shoes appropriate for different activities have very different characteristics.

Foot type is another important consideration. If your feet tend to roll inward excessively, you may need shoes with additional stability features on the inner side of the shoe to counteract this movement. If your feet tend to roll outward excessively, you may need highly flexible and cushioned shoes that promote foot motion. Most women will get a better fit if they choose shoes specifically designed for women’s feet rather than downsized versions of men’s shoes.

Successful Shopping

For successful shoe shopping, keep the following strategies in mind:

- Shop late in the day or, ideally, following a workout. Your foot size increases over the course of the day and after exercise.
- Wear socks like those you plan to wear during exercise.
- Try on both shoes and wear them for 10 or more minutes. Try walking on a noncarpeted surface. Approximate the movements of your activity: walk, jog, run, jump, and so on.
- Check the fit and style carefully:
  - Is the toe box roomy enough? Your toes will spread out when your foot hits the ground or when you push off. There should be at least one thumb’s width of space from the longest toe to the end of the toe box.
  - Do the shoes have enough cushioning? Do your feet feel supported when you bounce up and down? Try bouncing on your toes and on your heels.
  - Do your heels fit snugly into the shoe? Do they stay put when you walk, or do they slide up?
  - Are the arches of your feet right on top of the shoes’ arch supports?
  - Do the shoes feel stable when you twist and turn on the balls of your feet? Try twisting from side to side while standing on one foot.
  - Do you feel any pressure points?
- If you exercise at dawn or dusk, choose shoes with reflective sections for added visibility and safety.
- Replace athletic shoes about every three months or 300–500 miles of jogging or walking.

Barefoot Shoes or Minimalist Footwear

Two-thirds of runners experience an injury every year. Humans have evolved to run, so some scientists blame running shoes for the high injury rate. Most runners strike heel first when using heavily padded running shoes. Barefoot runners strike the ground with their forefoot (at least they’re supposed to), which better uses the shock absorbing capacity of the skeleton. Some researchers speculate that using “minimalist” footwear allows people to run more naturally, which should cut down on the injury rate. Other research suggests that traditional running shoes provide a physiological advantage that makes running easier. We need more research to determine whether barefoot running is safe and viable or just the latest running fad.

TIPS FOR TODAY AND THE FUTURE

Regular, moderate exercise, even in short bouts spread through the day, can improve cardiorespiratory fitness.

RIGHT NOW YOU CAN
- Assess your cardiorespiratory fitness by using one of the methods discussed in this chapter and in Lab 3.1.
- Do a short bout of endurance exercise, such as 10–15 minutes of walking, jogging, or cycling.

IN THE FUTURE YOU CAN
- If you have physical activity planned for later in the day, drink some fluids now to make sure you are fully hydrated for your workout.
- Consider the exercise equipment, including shoes, you currently have on hand. If you need new equipment, start researching your options to get the best equipment you can afford.
- Graduate to a different, more challenging fitness assessment as your cardiorespiratory fitness improves.
- Vary the exercises in your cardiorespiratory endurance training to keep yourself challenged and motivated.
**COMMON QUESTIONS ANSWERED**

**Q** Do I need a special diet for my endurance exercise program?

**A** No. For most people, a nutritionally balanced diet contains all the energy and nutrients needed to sustain an exercise program. Don’t waste your money on unnecessary supplements. (Chapter 8 provides detailed information about putting together a healthy diet.)

**Q** How can I measure how far I walk or run?

**A** The simplest way to measure distance is with a GPS-based phone app, which measures your distance, speed, and change in elevation. You can also use a pedometer, which counts your steps. Although stride length varies among individuals, 2000 steps typically equals about one mile, and 10,000 steps equals about five miles. To track your distance and your progress using a pedometer, follow the guidelines in Lab 2.3.

**Q** How can I avoid being so sore when I start an exercise program?

**A** Post-exercise muscle soreness is caused by muscle injury followed by muscle inflammation. Muscles get stronger and larger in response to muscle tension and injury. However, excessive injury can delay progress. The best approach is to begin conservatively with low-volume, low-intensity workouts, and gradually increase the severity of the exercise sessions. If you are currently sedentary, begin with 5 to 10 minutes of exercise and gradually increase the distance and speed you walk, run, cycle, or swim.

**Q** Is it OK to do cardiorespiratory endurance exercise while menstruating?

**A** Yes. There is no evidence that exercise during menstruation is unhealthy or that it has negative effects on performance. If you have headaches, backaches, and abdominal pain during menstruation, you may not feel like exercising. For some women, exercise helps relieve these symptoms. Listen to your body and exercise at whatever intensity is comfortable for you.

**Q** Will high altitude affect my ability to exercise?

**A** At high altitude (above 1500 meters, or about 4900 feet), there is less oxygen available in the air than at lower altitude. High altitude doesn’t affect anaerobic exercise, such as stretching and weight lifting, but it does affect aerobic activities—that is, any type of cardiorespiratory endurance exercise—because the heart and lungs have to work harder, even when the body is at rest, to deliver enough oxygen to body cells. The increased cardiovascular strain of exercise at high altitude reduces endurance. To play it safe when at high altitude, avoid heavy exercise—at least for the first few days—and drink plenty of water. And don’t expect to reach your normal lower-altitude exercise capacity.

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**SUMMARY**

- The cardiorespiratory system consists of the heart, blood vessels, and respiratory system; it picks up and transports oxygen, nutrients, and waste products.
- The body takes chemical energy from food and uses it to produce ATP and fuel cellular activities. ATP is stored in the body’s cells as the basic form of energy.
- During exercise, the body supplies ATP and fuels cellular activities by combining three energy systems: immediate, for short periods of activity; nonoxidative (anaerobic), for intense activity; and oxidative (aerobic), for prolonged activity. Which energy system predominates depends on the duration and intensity of the activity.
- Cardiorespiratory endurance exercise improves cardiorespiratory functioning and cellular metabolism; it reduces the risk of chronic diseases such as heart disease, cancer, type 2 diabetes, obesity, and osteoporosis; and it improves immune function and psychological and emotional well-being.
- Cardiorespiratory fitness is measured by determining how well the cardiorespiratory system transports and uses oxygen. The upper limit of this measure, called maximal oxygen consumption, or \( \dot{V}O_{2\text{max}} \) can be measured precisely in a laboratory, or it can be estimated reasonably well through self-assessment tests.
- To create a successful exercise program, set realistic goals, choose suitable activities, begin slowly, and always warm up and cool down. As fitness improves, exercise more often, longer, and/or harder.
- Intensity of training can be measured through target heart rate zone, METs, ratings of perceived exertion, or the talk test.
- With careful attention to fluid intake, clothing, duration of exercise, and exercise intensity, endurance training can be safe in hot and cold weather conditions.
- Serious injuries require medical attention. Application of the R-I-C-E principle (rest, ice, compression, elevation) is appropriate for treating many types of muscle or joint injuries.
American Academy of Orthopaedic Surgeons: Sports and Exercise. Provides fact sheets on many fitness and sports topics, including how to begin a program, how to choose equipment, and how to prevent and treat many types of injuries. http://orthoinfo.aaos.org/menu/sports.cfm

American Cancer Society: Eat Healthy and Get Active. Provides tools for managing an exercise program and discusses the links between cancer and lifestyle, including the importance of physical activity in preventing some cancers. http://www.cancer.org/healthy/eathealthygetactive/

American Heart Association: Exercise and Fitness. Provides information on cardiovascular health and disease, including the role of exercise in maintaining heart health and exercise tips for people of all ages. http://www.heart.org/HEARTORG/GettingHealthy/PhysicalActivity/Physical-Activity_UCM_001080_SubHomePage.jsp

Centers for Disease Control and Prevention: Physical Activity for Everyone. Explains the latest government recommendations on exercise and physical activity and provides strategies for getting the appropriate type and amount of exercise. http://www.cdc.gov/physicalactivity/

CrossFit Journal. A fitness, health, and lifestyle publication dedicated to the improvement of athletic performance, with new articles published daily and an archive of articles, videos, and audio files covering exercise technique, nutrition, injuries and rehab, equipment, coaching, and more. http://journal.crossfit.com/


Runner’s World Online. Contains a wide variety of information about running, including tips for beginning runners, advice about training, and a shoe buyer’s guide. http://www.runnersworld.com

Weight-control Information Network: Walking. An online fact sheet that explains the benefits of walking for exercise, tips for starting a walking program, and techniques for getting the most from walking workouts. http://win.niddk.nih.gov

Women’s Sports Foundation. Provides information and links about training and about many specific sports activities. http://www.womenssportsfoundation.org

FOR FURTHER EXPLORATION

SELECTED BIBLIOGRAPHY


SELECTED BIBLIOGRAPHY


LAB 3.1 Assessing Your Current Level of Cardiorespiratory Endurance

The conditions for exercise safety given in Chapter 2 apply to all fitness assessment tests. Talk to a physician if needed, and if you experience any unusual symptoms while taking a test, stop exercising and discuss your condition with your instructor. Additional cautions and prerequisites for the five test options presented in this lab are described below.

1-Mile Walk Test
Recommended for anyone who meets the criteria for safe exercise. This test can be used by people who cannot perform other tests because of low fitness level or injury.

3-Minute Step Test
If you suffer from joint problems in your ankles, knees, or hips or are significantly overweight, check with your physician before taking this test. People with balance problems or for whom a fall would be particularly dangerous, including older adults and pregnant women, should use special caution or avoid this test.

1.5-Mile Run-Walk Test
Recommended for people who are healthy and at least moderately active. If you have been sedentary, you should participate in a 4- to 8-week walk-run program before taking the test. Don’t take this test in extremely hot or cold weather or if you aren’t used to exercising under those conditions.

Beep Test
Recommended for fit individuals; the test is highly strenuous and requires the ability to jog, run, and sprint. Don’t take this test unless you can complete at least 10 sets of 50-meter sprints.

12-Minute Swim Test
Recommended for relatively strong swimmers who are confident in the water; if needed, ask a qualified swimming instructor to evaluate your swimming ability before attempting this test.

Choose one of the tests based on your fitness level and available facilities. For best results, don’t exercise strenuously or consume caffeine the day of the test, and don’t smoke or eat a heavy meal within about three hours of the test.

The 1-Mile Walk Test

Equipment
1. A track or course that provides a measurement of 1 mile
2. A stopwatch, clock, or watch with a second hand
3. A weight scale

Preparation
Measure your body weight (in pounds) before taking the test.

Body weight: ____________________ lbs

Instructions
1. Warm up before taking the test. Do some walking, easy jogging, or calisthenics.
2. Cover the 1-mile course as quickly as possible. Walk at a pace that is brisk but comfortable. You must raise your heart rate above 120 beats per minute (bpm).
3. As soon as you complete the distance, note your time and take your pulse for 15 seconds.
   Walking time: ____________________ min ____________________ sec
   15-second pulse count: ____________________ beats
4. Cool down after the test by walking slowly for several minutes.

Determining Maximal Oxygen Consumption
1. Convert your 15-second pulse count into a value for exercise heart rate by multiplying it by 4.
   Exercise heart rate: ____________________ × 4 = ____________________ bpm
2. Convert your walking time from minutes and seconds to a decimal figure. For example, a time of 14 minutes and 45 seconds would be 14 + (45/60), or 14.75 minutes.
   Walking time: ____________________ min + (____________________ sec ÷ 60 sec/min) = ____________________ min
3. Insert values for your age, gender, weight, walking time, and exercise heart rate in the following equation, where
   \[ W = \text{your weight (in pounds)} \]
   \[ A = \text{your age (in years)} \]
LABORATORY ACTIVITIES

G = your gender (male = 1; female = 0)
T = your time to complete the 1-mile course (in minutes)
H = your exercise heart rate (in beats per minute)

\[
VO_{2\max} = 132.853 - (0.0769 \times W) - (0.3877 \times A) + (6.315 \times G) - (3.2649 \times T) - (0.1565 \times H) = \text{________________________ ml/kg/min (maximum oxygen consumption measured in milliliters of oxygen used per minute per kilogram of body weight)}
\]

For example, a 20-year-old, 190-pound male with a time of 14.75 minutes and an exercise heart rate of 152 bpm would calculate maximal oxygen consumption as follows:

\[
VO_{2\max} = 132.853 - (0.0769 \times 190) - (0.3877 \times 20) + (6.315 \times 1) - (3.2649 \times 14.75) - (0.1565 \times 152) = 45 \text{ ml/kg/min}
\]

4. Copy this value for \( VO_{2\max} \) into the appropriate place in the chart on page 90.

The 3-Minute Step Test

Equipment
1. A step, bench, or bleacher step that is 16.25 inches from ground level
2. A stopwatch, clock, or watch with a second hand
3. A metronome

Preparation
Practice stepping up onto and down from the step before you begin the test. Each step has four beats: up-up-down-down. Males should perform the test with the metronome set for a rate of 96 beats per minute, or 24 steps per minute. Females should set the metronome at 88 beats per minute, or 22 steps per minute.

Instructions
1. Warm up before taking the test. Do some walking or easy jogging.
2. Set the metronome at the proper rate. Your instructor or a partner can call out starting and stopping times; otherwise, have a clock or watch within easy viewing during the test.
3. Begin the test and continue to step at the correct pace for three minutes.
4. Stop after three minutes. Remain standing and count your pulse for the 15-second period from 5 to 20 seconds into recovery.
5. Cool down after the test by walking slowly for several minutes.

Determining Maximal Oxygen Consumption

1. Convert your 15-second pulse count to a value for recovery heart rate by multiplying by 4.
   Recovery heart rate: \( \frac{\text{15-sec pulse count}}{4} = \text{_______ bpm} \)

2. Insert your recovery heart rate in the equation below, where
   \[ H = \text{recovery heart rate (in beats per minute)} \]
   Males: \( VO_{2\max} = 111.33 - (0.42 \times H) \)
   Females: \( VO_{2\max} = 65.81 - (0.18470 \times H) \)
   For example, a man with a recovery heart rate of 162 bpm would calculate maximal oxygen consumption as follows:
   \( VO_{2\max} = 111.33 - (0.42 \times 162) = 43 \text{ ml/kg/min} \)
   Males: \( VO_{2\max} = 111.33 - (0.42 \times \text{_______}) = \text{___________ ml/kg/min} \)
   Females: \( VO_{2\max} = 65.81 - (0.1847 \times \text{_______}) = \text{___________ ml/kg/min} \)

3. Copy this value for \( VO_{2\max} \) into the appropriate place in the chart on page 90.

The 1.5-Mile Run-Walk Test

Equipment
1. A running track or course that is flat and provides exact measurements of up to 1.5 miles
2. A stopwatch, clock, or watch with a second hand
**Preparation**

You may want to practice pacing yourself prior to taking the test to avoid going too fast at the start and becoming prematurely fatigued. Allow yourself a day or two to recover from your practice run before taking the test.

**Instructions**

1. Warm up before taking the test. Do some walking or easy jogging.
2. Try to cover the distance as fast as possible without overexerting yourself. If possible, monitor your own time, or have someone call out your time at various intervals of the test to determine whether your pace is correct.
3. Record the amount of time, in minutes and seconds, it takes you to complete the 1.5-mile distance.
   
   Running-walking time: ____________________ min ____________________ sec
4. Cool down after the test by walking or jogging slowly for about five minutes.

**Determining Maximal Oxygen Consumption**

1. Convert your running time from minutes and seconds to a decimal figure. For example, a time of 14 minutes and 25 seconds would be 14 + (25/60), or 14.4 minutes.

   Running-walking time: ____________________ min + (____________________ sec ÷ 60 sec/min) = ____________________ min

2. Insert your running time into the equation below, where

   
   \[ T = \text{running time (in minutes)} \]

   \[ \text{VO}_{2\text{max}} = \left( \frac{483}{T} \right) + 3.5 \]

   For example, a person who completes 1.5 miles in 14.4 minutes would calculate maximal oxygen consumption as follows:

   \[ \text{VO}_{2\text{max}} = \left( \frac{483}{14.4} \right) + 3.5 = 37 \text{ ml/kg/min} \]

   \[ \text{VO}_{2\text{max}} = \left( \frac{483}{\left( \frac{\text{run-walk time (min)}}{} \right)} \right) + 3.5 = \text{ ml/kg/min} \]

3. Copy this value for \( \text{VO}_{2\text{max}} \) into the appropriate place in the chart on page 90.

**The Beep Test**

This is also called the Multi-Stage Fitness Test, Pacer Test, Yo Yo test, or 20-Meter Shuttle Run Test.

**Description**

The Beep Test involves running a series of 20-meter shuttles at a specified pace. The pace gets faster each minute as you go to another level. For example, the series begins at a speed of 8.5 kilometers per hour and then increases by 0.5 kilometers per hour with each advancing level. The MP3 audio recording or phone app signals the end of a shuttle with a single beep and the start of the next level with three beeps. The object of the test is to keep up with the beeps as long as possible.

**Facilities and Equipment**

1. Running track, open field, or gymnasium
2. Two cones or field markers set 20 meters (21 yards, 32 inches) apart (use four cones if testing a large group)
3. Beep Test app or MP3 recording of beeps (widely available free on the Internet—e.g., http://www.beeptestacademy.com; free Beep Test apps are also available for the iPhone and Android smart phones)
4. Method of playing Beep Test: MP3 player with speaker, smart phone with speaker, iPad with speaker. You could run this test by yourself if you have an MP3 player with earphones.

**Preparation**

Don’t take this test until you are prepared. A good technique is to run intervals on a track or playing field. For example, run 50 meters, rest 30 seconds, repeat. Gradually, increase the speed and number of repetitions until you can complete at least 10 sets of 50-meter sprints.

**Instructions**

The Beep Test is a popular assessment of cardiovascular endurance levels and maximal oxygen consumption.

1. Set up the audio alert system for the test (MP3 player with speaker, or personal MP3 player, or smart phone with headphones).
2. Run back and forth between two cones or field markers placed 20 meters apart, keeping pace with an audio beep that plays during the test. The test is arranged in levels. The beeps get faster with each increasing stage. A single beep will sound at the end of the time for each shuttle. A triple beep sounds at the end of each level. The triple beep is a signal that the pace will get faster. Do not stop when you hear the triple beat; continue running toward the other field marker or cone.
3. The test ends when you can’t keep pace with the beeps for two consecutive shuttles.

4. Note your level and the total number of shuttles you completed. Record your maximal oxygen consumption and enter it on the chart labeled “Rating Your Cardiovascular Fitness.”

Videos of the test are widely available on the Internet.

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## Laboratory Activities

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<th>Minutes per mile</th>
<th>Total Shuttles</th>
<th>Predicted VO$_{2\text{max}}$ (milliliters oxygen per kilogram body weight)</th>
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Record your score. Copy this value for VO$_{2\text{max}}$ into the appropriate place in the chart below:

Highest level: __________

Total shuttles run: __________

Predicted VO$_{2\text{max}}$: __________


## Rating Your Cardiovascular Fitness

Record your VO$_{2\text{max}}$ score(s) and the corresponding fitness rating from the table below.

### Women

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<tr>
<th>Age</th>
<th>Very Poor</th>
<th>Poor</th>
<th>Fair</th>
<th>Good</th>
<th>Excellent</th>
<th>Superior</th>
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<td>35.5–39.4</td>
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<td>44.0–50.1</td>
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<td>Below 29.9</td>
<td>29.9–33.7</td>
<td>33.8–36.7</td>
<td>36.8–40.9</td>
<td>41.0–46.8</td>
<td>Above 46.8</td>
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<td>31.6–35.0</td>
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<td>38.9–45.1</td>
<td>Above 45.1</td>
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<td>50–59</td>
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<td>31.4–35.1</td>
<td>35.2–39.8</td>
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<td>60–69</td>
<td>Below 23.7</td>
<td>23.7–26.5</td>
<td>26.6–29.0</td>
<td>29.1–32.2</td>
<td>32.3–36.8</td>
<td>Above 36.8</td>
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### Men

<table>
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<tr>
<th>Age</th>
<th>Very Poor</th>
<th>Poor</th>
<th>Fair</th>
<th>Good</th>
<th>Excellent</th>
<th>Superior</th>
</tr>
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<td>48.9–54.2</td>
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<tr>
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<td>Below 34.6</td>
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<td>35.0–39.4</td>
<td>39.5–46.0</td>
<td>Above 46.0</td>
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**SOURCE:** Ratings based on norms from The Cooper Institute of Aerobic Research, Dallas, Tex.; from *The Physical Fitness Specialist Manual*, Revised 2002. Used with permission.
The 12-Minute Swim Test

If you enjoy swimming and prefer to build a cardiorespiratory training program around this type of exercise, you can assess your cardiorespiratory endurance by taking the 12-Minute Swim Test. You will receive a rating based on the distance you can swim in 12 minutes. A complete fitness program based on swimming is presented in Chapter 7.

Note, however, that this test is appropriate only for relatively strong swimmers who are confident in the water. If you are unsure about your swimming ability, this test may not be appropriate for you. If necessary, ask your school’s swim coach or a qualified swimming instructor to evaluate your ability in the water before attempting this test.

Equipment

1. A swimming pool that provides measurements in yards
2. A wall clock that is clearly visible from the pool, or someone with a watch who can time you

Preparation

You may want to practice pacing yourself before taking the test to avoid going too fast at the start and becoming prematurely fatigued. Allow yourself a day or two to recover from your practice swim before taking the test.

Instructions

1. Warm up before taking the test. Do some walking or light jogging before getting in the pool. Once in the water, swim a lap or two at an easy pace to make sure your muscles are warm and you are comfortable.
2. Try to cover the distance as fast as possible without overexerting yourself. If possible, monitor your own time, or have someone call out your time at various intervals of the test to determine whether your pace is correct.
3. Record the distance, in yards, that you were able to cover during the 12-minute period.
4. Cool down after the test by swimming a lap or two at an easy pace.
5. Use the following chart to gauge your level of cardiorespiratory fitness.

<table>
<thead>
<tr>
<th>DISTANCE IN YARDS</th>
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<tr>
<td>Age: 13–19</td>
</tr>
<tr>
<td>Below 500</td>
</tr>
<tr>
<td>Below 400</td>
</tr>
<tr>
<td>Below 300</td>
</tr>
<tr>
<td>Below 250</td>
</tr>
<tr>
<td>60 and over</td>
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</table>

| **Men**           |
| Age: 13–19        |
| Below 400         | 400–499 | 500–599 | 600–699 | Above 700 |
| Below 300         | 300–399 | 400–499 | 500–599 | Above 600 |
| Below 250         | 250–349 | 350–449 | 450–549 | Above 550 |
| Below 200         | 200–299 | 300–399 | 400–499 | Above 500 |
| Below 150         | 150–249 | 250–349 | 350–449 | Above 450 |
| 60 and over       | Below 150 | 150–199 | 200–299 | 300–399 | Above 400 |

100 yards = 91 meters


Record your fitness rating:

<table>
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<tr>
<th>Cardiovascular Fitness Rating</th>
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<tbody>
<tr>
<td>12-Minute Swim Test</td>
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</table>
Using Your Results

*How did you score? Does your rating for cardiovascular fitness surprise you? Are you satisfied with your current rating?*

If you’re not satisfied, set a realistic goal for improvement: __________________________________________________________

Are you satisfied with your current level of cardiovascular fitness as evidenced in your daily life—your ability to walk, run, bicycle, climb stairs, do yard work, or engage in recreational activities?

If you’re not satisfied, set some realistic goals for improvement, such as completing a 5K run or 25-mile bike ride: __________________________________________________________

What should you do next? Enter the results of this lab in the Preprogram Assessment column in Appendix C. If you’ve set goals for improvement, begin planning your cardiorespiratory endurance exercise program by completing the plan in Lab 3.2. After several weeks of your program, complete this lab again, and enter the results in the Postprogram Assessment column of Appendix C. How do the results compare? (Remember, it’s best to compare VO₂max scores for the same test.)

LAB 3.2 Developing an Exercise Program for Cardiorespiratory Endurance

1. **Goals.** List goals for your cardiorespiratory endurance exercise program. Your goals can be specific or general, short or long term. In the first section, include specific, measurable goals that you can use to track the progress of your fitness program. These goals might be things like raising your cardiorespiratory fitness rating from fair to good or swimming laps for 30 minutes without resting. In the second section, include long-term and more qualitative goals, such as improving self-confidence and reducing your risk for chronic disease.

   **Specific Goals:**
   
<table>
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<th>Current Status</th>
<th>Final Goals</th>
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</table>

   **Other goals:** _____________________________________________________________________________________
   ______________________________________________________________________________________

2. **Type of Activities.** Choose one or more endurance activities for your program. These can include any activity that uses large-muscle groups, can be maintained continuously, and is rhythmic and aerobic in nature. Examples include walking, jogging, cycling, e-bike cycling, group exercise such as aerobic dance, rowing, rope skipping, stair-climbing, cross-country skiing, swimming, skating, and endurance game activities such as soccer and tennis. Choose activities that are both convenient and enjoyable. Fill in the activity names on the program plan.

3. **Frequency.** On the program plan, fill in how often you plan to participate in each activity; the ACSM recommends participating in cardiorespiratory endurance exercise three–five days per week.

**Program Plan**

<table>
<thead>
<tr>
<th>Type of Activity</th>
<th>Frequency (check ✓)</th>
<th>Intensity (bpm or RPE)</th>
<th>Time (min)</th>
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4. **Intensity.** Determine your exercise intensity using one of the following methods, and enter it on the program plan. Begin your program at a lower intensity and slowly increase intensity as your fitness improves. Select a range of intensities for your program.

   a. **Target heart rate zone:** Calculate target heart rate zone in beats per minute and then calculate the corresponding 15-second exercise count by dividing the total count by 4. For example, the 15-second exercise counts corresponding to a target heart rate zone of 122–180 bpm would be 31–45 beats.

      Maximum heart rate: 220 – age (years) = ________________________ bpm

      **Maximum Heart Rate Method**

      65% training intensity = ________________________ bpm × 0.65 = ________________________ bpm

      90% training intensity = ________________________ bpm × 0.90 = ________________________ bpm

      Target heart rate zone = ___________ to ___________ bpm

      15-second count = ___________ to ___________
**LABORATORY ACTIVITIES**

**Heart Rate Reserve Method**

Resting heart rate: _______________ bpm (taken after 10 minutes of complete rest)

Heart rate reserve = _______________ bpm − _______________ bpm = _______________ bpm

50% training intensity = (_____________ bpm × 0.50) + _______________ bpm = _______________ bpm

85% training intensity = (_____________ bpm × 0.85) + _______________ bpm = _______________ bpm

Target heart rate zone = _________ to ___________ bpm

15-second count = _________ to _________

b. Ratings of perceived exertion (RPE): If you prefer, determine an RPE value that corresponds to your target heart rate range (see p. 71–72 and Figure 3.5).

5. Time (Duration). A total time of 20–60 minutes per exercise session is recommended; your duration of exercise will vary with intensity. For developing cardiorespiratory endurance, higher-intensity activities can be performed for a shorter duration; lower intensities require a longer duration. Enter a duration (or a range of duration) on the program plan.

6. Monitoring Your Program. Complete a log like the one below to monitor your program and track your progress. Note the date on top, and fill in the intensity and time (duration) for each workout. If you prefer, you can also track other variables such as distance. For example, if your cardiorespiratory endurance program includes walking and swimming, you may want to track miles walked and yards swum in addition to the duration of each exercise session.

<table>
<thead>
<tr>
<th>Activity/Date</th>
<th>Intensity</th>
<th>Time</th>
<th>Distance</th>
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7. Making Progress. Follow the guidelines in the chapter and in Table 3.5 and Figure 3.6 to slowly increase the amount of overload in your program. Continue keeping a log, and periodically evaluate your progress.

Progress Checkup: Week _____ of program

<table>
<thead>
<tr>
<th>Goals: Original Status</th>
<th>Current Status</th>
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List each activity in your program and describe how satisfied you are with the activity and with your overall progress. List any problems you’ve encountered or any unexpected costs or benefits of your fitness program so far.
Looking Ahead...
After reading this chapter, you should be able to:
- Describe the basic physiology of muscles and explain how strength training affects muscles.
- Define muscular strength and endurance, and describe how they relate to wellness.
- Assess muscular strength and endurance.
- Apply the FITT principle to create a safe and successful strength training program.
- Describe the effects of supplements and drugs that are marketed to active people and athletes.
- Explain how to safely perform common strength training exercises using body weight, free weights, and weight machines.

Test Your Knowledge
1. For women, weight training typically results in which of the following?
   a. bulky muscles
   b. significant increases in body weight
   c. improved body image

2. To maximize strength gains, it is a good idea to hold your breath as you lift a weight. True or false?

3. Regular strength training is associated with which of the following benefits?
   a. denser bones
   b. reduced risk of heart disease
   c. improved body composition
   d. fewer injuries
   e. improved metabolic health
   f. Increased longevity

See answers on the next page.
Muscles make up more than 40% of your body mass. You depend on them for movement, and, because of their mass, they are the sites of a large portion of the energy reactions (metabolism) that take place in your body. Strong, well-developed muscles help you perform daily activities with greater ease, protect you from injury, and enhance your well-being in other ways.

As described in Chapter 2, muscular strength is the amount of force a muscle can produce with a single maximum effort; muscular endurance is the ability to hold or repeat a muscular contraction for a long time. This chapter explains the benefits of strength training (also called resistance training or weight training) and describes methods of assessing muscular strength and endurance. It then explains the basics of strength training and provides guidelines for setting up your own training program. The musculoskeletal system is depicted on pages T4-2 and T4-3 of the color transparency insert “Touring the Musculoskeletal System” in this chapter. You can refer to this illustration as you set up your program.

**Answers (Test Your Knowledge)**

1. c. Because the vast majority of women have low levels of testosterone, they do not develop large muscles or gain significant amounts of weight in response to a moderate-intensity weight training program. Men have higher levels of testosterone, so they can build large muscles more easily.

2. False. Holding one’s breath while lifting weights can significantly elevate blood pressure; it also reduces blood flow to the heart and may cause faintness. You should breathe smoothly and normally while weight training. Some experts recommend that you exhale during the most difficult part of each exercise.

3. All six. Regular strength training has many benefits for both men and women.

**BASIC MUSCLE PHYSIOLOGY AND THE EFFECTS OF STRENGTH TRAINING**

Muscles move the body and enable it to exert force. When a muscle contracts (shortens), it moves a bone by pulling on the tendon that attaches the muscle to the bone.

**Muscle Fibers**

Muscles consist of individual muscle cells, or muscle fibers, connected in bundles called fascicles (Figure 4.1). A single muscle is made up of many bundles of muscle fibers and is covered by layers of connective tissue that hold the fibers together. Muscle fibers, in turn, are made up of smaller protein structures called myofibrils. Myofibrils consist of a series of contractile units called sarcomeres, which are composed largely of actin and myosin molecules. Muscle cells contract when the myosin molecules glide across the actin molecules in a ratchet-like movement. Each muscle cell has many nuclei containing genes that direct the production of enzymes and structural proteins required for muscle contraction.

Strength training increases the size and number of myofibrils, resulting in larger individual muscle fibers. Larger muscle fibers mean a larger and stronger muscle. The development of large muscle fibers is called hypertrophy; inactivity causes atrophy, the reversal of this process. For a depiction of the process of hypertrophy, see page T4-4 of the color transparency insert “Touring the Musculoskeletal System” in this chapter. In some species, muscles can increase in size through a separate process called hyperplasia, which involves an increase in the number of muscle fibers rather than the size of muscle fibers. In humans, hyperplasia is not thought to play a significant role in determining muscle size.

**FIGURE 4.1** Components of skeletal muscle tissue.
Muscle fibers are classified as slow-twitch or fast-twitch fibers according to their strength, speed of contraction, and energy source. (See Chapter 3 for more on energy systems.)

- **Slow-twitch muscle fibers** are relatively fatigue resistant, but they don’t contract as rapidly or strongly as fast-twitch fibers. The principal energy system that fuels slow-twitch fibers is aerobic (oxidative). Slow-twitch muscle fibers are typically reddish in color.

- **Fast-twitch muscle fibers** contract more rapidly and forcefully than slow-twitch fibers but fatigue more quickly. Although oxygen is important in the energy system that fuels fast-twitch fibers, they rely more on anaerobic (nonoxidative) metabolism than do slow-twitch fibers. Fast-twitch muscle fibers are typically whitish in color (e.g., white meat versus dark meat in a turkey).

Most muscles contain both slow-twitch and fast-twitch fibers. The proportion of the types of fibers varies significantly among different muscles and different individuals, and that proportion is largely fixed at birth, although fibers can contract faster or slower following a period of training or a period of inactivity. The type of fiber that acts during a particular activity depends on the type of work required. Endurance activities like jogging tend to use slow-twitch fibers, whereas strength and power activities like sprinting, use fast-twitch fibers. Strength training can increase the size and strength of both fast-twitch and slow-twitch fibers, although fast-twitch fibers are preferentially increased.

**Motor Units**

To exert force, a muscle recruits one or more motor units to contract. A **motor unit** is made up of a nerve connected to a number of muscle fibers. The number of muscle fibers in a motor unit varies from two to hundreds. Small motor units contain slow-twitch fibers, whereas large motor units contain fast-twitch fibers. When a motor unit calls on its fibers to contract, all fibers contract to their full capacity. The number of motor units recruited depends on the amount of strength required: When you pick up a small weight, you use fewer and smaller motor units than when picking up a large weight.

Strength training improves the body’s ability to recruit motor units—a phenomenon called **muscle learning**—which increases strength even before muscle size increases. The physiological changes and benefits that result from strength training are summarized in Table 4.1; see the box “Gender Differences in Muscular Strength” for additional information on hormonal and nervous system influences on muscle tissue.

As a person ages, motor nerves can become disconnected from the portion of muscle they control. By age 70, 15% of the motor nerves in most people are no longer connected to muscle tissue. Aging and inactivity also cause muscles to become slower and therefore less able to perform quick, powerful movements. Strength training helps maintain motor nerve connections and the quickness of muscles.

Osteoporosis (bone loss) is common in people over age 55, particularly postmenopausal women. Osteoporosis leads to fractures that can be life-threatening. Hormonal changes from aging account for much of the bone loss that occurs, but lack of bone mass due to inactivity and a poor diet are contributing factors. Strength training can lessen bone loss even if it is taken up later in life; if practiced regularly, strength training may even build bone mass in postmenopausal women and older men. Increased muscle strength can also help prevent falls, which are a major cause of injury in people with osteoporosis (see the box “Benefits of Muscular Strength and Endurance”).

**Metabolic and Heart Health**

Strength training helps prevent and manage both cardiovascular disease (CVD) and diabetes by doing the following:

- Improving glucose metabolism
- Increasing maximal oxygen consumption
- Reducing blood pressure
- Increasing HDL cholesterol and reducing LDL cholesterol (in some people)
- Improving blood vessel health

Stronger muscles reduce the demand on the heart during ordinary daily activities such as lifting and carrying objects. The benefits of resistance exercise to the heart are so great that the American Heart Association recommends strength training two to three days per week for healthy adults and many low-risk cardiac patients. Resistance training may not be appropriate for people with some types of heart disease.
with a submaximal (lighter) weight. It is best to train for several weeks before attempting a direct 1 RM test; after you have a baseline value, you can retest after 6–12 weeks to check your progress. See Lab 4.1 for guidelines on taking these tests.

For more accurate results, avoid strenuous weight training for 48 hours beforehand.

Muscular endurance is usually assessed by counting the maximum number of repetitions of an exercise a person can do (such as in push-ups or kettlebell snatches) or the maximum amount of time a person can hold a muscular contraction (such as in the flexed-arm hang). You can test the muscular endurance of major muscle groups in your body by taking the curl-up test, the push-up test, the core muscle plank test (Chapter 5), and the squat endurance test. See Lab 4.2 for complete instructions on taking these assessment tests.

CREATING A SUCCESSFUL STRENGTH TRAINING PROGRAM

When the muscles are stressed by a greater load than they are used to, they adapt and improve their function. The type of adaptation that occurs depends on the type of stress applied.

Static versus Dynamic Strength Training Exercises

Strength training exercises are generally classified as static or dynamic. Each involves a different way of using and strengthening muscles.
Enhanced muscular strength and endurance can lead to improvements in the areas of performance, injury prevention, body composition, self-image, lifetime muscle and bone health, and metabolic health. Most important, greater muscular strength and endurance reduce the risk of premature death. Stronger people—particularly men—have a lower death rate due to all causes, including cardiovascular disease and cancer. The link between strength and death rate is independent of age, physical activity, smoking, alcohol intake, body composition, and family history of cardiovascular disease.

**Improved Performance of Physical Activities**

A person with a moderate to high level of muscular strength and endurance can perform everyday tasks—such as climbing stairs and carrying groceries—with ease. Increased strength can enhance enjoyment of recreational sports by making it possible to achieve high levels of performance and to handle advanced techniques. Strength training also results in modest improvements in maximal oxygen consumption. People with poor muscle strength tire more easily and are less effective in both everyday and recreational activities.

**Injury Prevention**

Increased muscular strength and endurance help protect you from injury in two key ways:

- By enabling you to maintain good posture. Good muscle strength and endurance help stabilize the spine, which protects against back and neck injuries.
- By encouraging proper body mechanics during everyday activities such as walking and lifting.

Good muscle strength and, particularly, endurance in the abdomen, hips, lower back, and legs maintain the spine in proper alignment and help prevent low-back pain, which afflicts more than 85% of Americans at some time in their lives. (Prevention of low-back pain is discussed in Chapter 5.)

Training for muscular strength and endurance also makes the tendons, ligaments, and cartilage cells stronger and less susceptible to injury. Resistance exercise prevents injuries best when the training program is gradual and progressive and builds all the major muscle groups.

**Improved Body Composition**

Healthy body composition means that the body has a high proportion of fat-free mass and a relatively small proportion of fat. Strength training improves body composition by increasing muscle mass, thereby tipping the body composition ratio toward fat-free mass and away from fat.

Building muscle mass through strength training also helps with losing fat because metabolic rate is related to muscle mass: The greater your muscle mass, the higher your metabolic rate. A high metabolic rate means that a nutritionally sound diet coupled with regular exercise will not lead to an increase in body fat. Strength training can boost resting metabolic rate by up to 15%, depending on how hard you train.

Resistance exercise also increases muscle temperature, which in turn slightly increases the rate at which you burn calories over the hours following a weight training session.

**Enhanced Self-Image and Quality of Life**

Strength training leads to an enhanced self-image in both men and women by providing stronger, firmer muscles and a toned, healthy-looking body. Women tend to lose inches, increase strength, and develop greater muscle definition. Men tend to build larger, stronger muscles. The larger muscles in men combine with high levels of the hormone testosterone for a strong tissue-building effect; see the box “Gender Differences in Muscular Strength.”

Because strength training involves measurable objectives (pounds lifted, repetitions accomplished), a person can easily recognize improved performance, leading to greater self-confidence and self-esteem. Strength training also improves quality of life by increasing energy, preventing injuries, and making daily activities easier and more enjoyable.

**Improved Muscle and Bone Health with Aging**

Research has shown that good muscular strength helps people live healthier lives. A lifelong program of regular strength training prevents muscle and nerve degeneration that can compromise the quality of life and increase the risk of hip fractures and other potentially life-threatening injuries.

In the general population, people begin to lose muscle mass after age 30, a condition called sarcopenia. At first they may notice that they cannot play sports as well as they could in high school. After more years of inactivity and strength loss, people may have trouble performing even the simple movements of daily life, such as walking up a flight of stairs or doing yard work. By age 75, about 25% of men and 75% of women cannot lift more than 10 pounds overhead. Although aging contributes to decreased strength, inactivity causes most of the loss. Poor strength makes it much more likely that a person will be injured during everyday activities.

**Increased Longevity**

Strength training helps you live longer. A number of studies have associated greater muscular strength with lower rates of death from all causes, including cancer and cardiovascular disease. A study of more than 9,000 men showed that compared to men with the lowest levels of muscular strength, stronger men were 1.5 times less likely to die from all causes; 1.6 times less likely to die from cardiovascular disease; and 1.25 times less likely to die from cancer. The results were particularly striking in men age 60 and older with low levels of muscular strength, who were more than four times more likely to die from cancer than similar-age men with greater muscular strength.
DIVERSITY MATTERS
Gender Differences in Muscular Strength

Men are generally stronger than women because they typically have larger bodies and a larger proportion of their total body mass is made up of muscle. But when strength is expressed per unit of cross-sectional area of muscle tissue, men are only 1–2% stronger than women in the upper body and about equal to women in the lower body. Because of the larger proportion of muscle tissue in the upper male body, men can more easily build upper-body strength than women can. Individual muscle fibers are larger in men, but the metabolism of cells within those fibers is the same in both sexes.

Two factors that help explain these disparities are testosterone levels and the speed of nervous control of muscle. Testosterone promotes the growth of muscle tissue in both males and females, but testosterone levels are 5–10 times higher in men than in women, allowing men to have larger muscles. Also, because the male nervous system can activate muscles faster, men tend to have more power.

Women are often concerned that they will develop large muscles from strength training. Because of hormonal differences, however, most women do not develop big muscles unless they train intensely over many years or take anabolic steroids. Women do gain muscle and improve body composition through strength training, but they don’t develop bulky muscles or gain significant amounts of weight. A study of average women who weight trained two–three days per week for eight weeks found that they gained about 1.75 pounds of muscle and lost about 3.5 pounds of fat. Losing muscle over time is a much greater health concern for women than small gains in muscle weight, especially because any gains in muscle weight are typically more than offset by loss of fat weight. Both men and women lose muscle mass and power as they age, but because men start out with more muscle and don’t lose power as quickly, older women tend to have greater impairment of muscle function than older men. This may partially account for the higher incidence of life-threatening falls in older women.

The bottom line is that both men and women can increase strength through strength training. Women may not be able to lift as much weight as men, but pound for pound of muscle, they have nearly the same capacity to gain strength as men.

**Static Exercise** Also called isometric exercise, static exercise causes a muscle contraction without changing the length of the muscle or the angle in the joint on which the muscle acts (Figure 4.2A). In isometrics, the muscle contracts, but there is no movement. To perform an isometric exercise, a person can use an immovable object like a wall to provide resistance, or simply tighten a muscle while remaining still (for example, tightening the abdominal muscles while sitting at a desk). The spine extension and the side bridge, shown on page 112, are both isometric exercises.

Static exercises are particularly important for developing stiff core or torso muscles that support the spine and provide a firm foundation for whole body motions. During almost all movements some muscles contract statically to support the skeleton so other muscles can contract dynamically. For example, when you throw something, hit a ball, or ski, the core muscles in the abdomen and back stabilize the spine. This stability allows more powerful contractions in the lower- and upper-body muscles. The core muscles also contract statically during dynamic exercises, such as squats, lunges, and overhead presses.

Static exercises are useful in strengthening muscles after an injury or surgery, when movement of the affected joint could delay healing. Isometrics are also used to overcome weak points in an individual’s range of motion. Statically strengthening a muscle at its weakest point will allow more weight to be lifted with that muscle during dynamic exercise. Certain types of calisthenics and Pilates exercises (described in more detail later in the chapter) also involve static contractions. For maximum strength gains, hold the isometric contraction maximally for six seconds; do 2–10 repetitions.

**Dynamic Exercise** Also called isotonic exercise, dynamic exercise causes a muscle contraction and a change in the length of the muscle and the angle of the joint (Figure 4.2 B,C). Dynamic exercises are the most popular type of exercises for increasing muscle strength and seem to be most valuable for developing strength that can be transferred to other forms of physical activity. They can be performed with weight machines, free weights, or a person’s own body weight (as in curl-ups or push-ups).
exercise and variable resistance exercise. Both exercises are extremely effective for building muscular strength and endurance.

- **Constant resistance exercise** uses a constant load (weight) throughout a joint’s full range of motion. Training with free weights is a form of constant resistance exercise. A problem with this technique is that, because of differences in leverage, there are points in a joint’s range of motion where the muscle controlling the movement is stronger and points where it is weaker. The weakest point in the range limits the amount of weight a person can lift.

- **Variable resistance exercise**, the load is changed to provide maximum load throughout the entire range of motion. This form of exercise uses machines that place more stress on muscles at the end of the range of motion, where a person has better leverage and can exert more force. Use elastic bands and chains with free weights to add variable resistance to the exercises.

**OTHER DYNAMIC EXERCISE TECHNIQUES** Athletes use four other kinds of isotonic techniques, primarily for training and rehabilitation.

- **Eccentric (pliometric) loading** places a load on a muscle as it lengthens. The muscle contracts eccentrically to control the weight. Eccentric loading is practiced during most types of resistance training. For example, you are performing an eccentric movement as you lower the weight to your chest during a bench press in preparation for the active movement. You can also perform exercises designed specifically to overload muscle eccentrically, a technique called negatives.

- **Plyometrics** is the sudden eccentric loading and stretching of muscles followed by a forceful concentric

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**FIGURE 4.2** A static (isometric) exercise such as a plank (A) involves muscle contraction without movement; the position is held. A dynamic exercise such as a biceps curl involves muscle contraction with a change in the length of the muscle and angle of the joint. Dynamic muscle contractions can be concentric (B), in which the muscle shortens as it contracts, or eccentric (C), in which the muscle lengthens as it contracts.

There are two kinds of dynamic muscle contractions:

- **A concentric muscle contraction** (also called a miometric contraction) occurs when the muscle applies enough force to overcome resistance and shortens as it contracts.

- **An eccentric muscle contraction** (also called a pliometric contraction) occurs when the resistance is greater than the force applied by the muscle and the muscle lengthens as it contracts.

For example, in an arm curl, the biceps muscle works concentrically as the weight is raised toward the shoulder and eccentrically as the weight is lowered.

**CONSTANT AND VARIABLE RESISTANCE** Two of the most common dynamic exercise techniques are constant resistance

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**TERMS**

- **Static (isometric) exercise** Exercise causing a muscle contraction without a change in the muscle’s length or a joint’s angle.

- **Dynamic (isotonic) exercise** Exercise causing a muscle contraction and a change in the muscle’s length.

- **Concentric muscle contraction** A dynamic contraction in which the muscle gets shorter as it contracts; also called a miometric contraction.

- **Eccentric muscle contraction** A dynamic contraction in which the muscle lengthens as it contracts; also called a pliometric contraction.

- **Constant resistance exercise** A type of dynamic exercise that uses a constant load throughout a joint’s full range of motion.

- **Variable resistance exercise** A type of dynamic exercise that uses a changing load, providing a maximum load at the strongest point in the affected joint’s range of motion.

- **Eccentric (pliometric) loading** Loading the muscle while it is lengthening; sometimes called negatives.

- **Plyometrics** Rapid stretching of a muscle group that is undergoing eccentric stress (that is, the muscle is exerting force while it lengthens), followed by a rapid concentric contraction.
contraction—a movement that scientists call the stretch-shortening cycle. An example would be the action of the lower-body muscles when jumping from a bench to the ground and then jumping back onto the bench. This type of exercise helps develop explosive strength; it also helps build and maintain bone density.

- In **speed loading** you move a weight as rapidly as possible in an attempt to approach the speeds used in movements like throwing a softball or sprinting. In the bench press, for example, speed loading might involve doing 5 repetitions as fast as possible using a weight that is half the maximum load you can lift. You can gauge your progress by timing how fast you can perform the repetitions.

Training with a **kettlebell**—an iron ball with a handle—is a type of speed loading. Kettlebell training is highly ballistic, meaning that many exercises involve fast, pendulum-type motions, extreme decelerations, and high-speed eccentric muscle contractions. Kettlebell swings require dynamic concentric muscle contractions during the upward phase of the exercise followed by high-speed eccentric contractions to control the movement when returning to the starting position.

- **Isokinetic exercise** involves exerting force at a constant speed against an equal force exerted by a special strength training machine. The isokinetic machine provides variable resistance at different points in the joint’s range of motion, matching the effort applied by the individual while keeping the speed of the movement constant. Isokinetic exercises are excellent for building strength and endurance.

**Comparing Static and Dynamic Exercise** Static exercises require no equipment, so they can be done virtually anywhere. They build strength rapidly and are useful for rehabilitating injured joints and stabilizing joints in the shoulder and spine. On the other hand, they have to be performed at several different angles for each joint to improve strength throughout its entire range of motion. Dynamic exercises can be performed without equipment (calisthenics) or with equipment (weight training). Not only are they excellent for building muscular strength and endurance, but they also tend to build strength through a joint’s full range of motion. Most people develop muscular strength and endurance using dynamic exercises. Ultimately, however, the type of exercise a person chooses depends on individual goals, preferences, and access to equipment.

**Weight Machines, Free Weights, and Body Weight Exercises**

Muscles get stronger when made to work against resistance. Resistance can be provided by free weights, body weight, or exercise machines. Many people prefer machines because they are safe, convenient, and easy to use. You just set the resistance, sit down at the machine, and start working. Machines make it easy to isolate and work specific muscles. You don’t need a **spotter**—someone who stands by to assist when free weights are used—and you don’t have to worry about dropping a weight on yourself. Many machines provide support for the back.

Free weights, such as barbells and kettlebells, require more care, balance, and coordination to use than machines, but they strengthen your body in ways that are more adaptable to real life. They are also more popular with athletes for developing functional strength for sports, especially sports that require a great deal of strength. Free weights are widely available, inexpensive, and convenient for home use.

Exercises that use body weight, elastic bands, rocks, or soup cans as resistance enable you to do workouts at home. You can purchase elastic bands at sporting good stores or any home improvement or hardware store. A basic principle of resistant exercise is to “train movements and not muscles.” This means that you can overload the body in everyday movements like sitting and standing from a chair, climbing a fence, getting out of a swimming pool without a ladder, and standing after lying on the ground.

**Other Training Methods and Types of Equipment**

You don’t need a fitness center or expensive equipment to strength train. If you prefer to train at home or like low-cost alternatives, consider the following options.

**Resistance Bands** Resistance or exercise bands are elastic strips or tubes of rubber material that are inexpensive, lightweight, and portable. They are available in a variety of styles and levels of resistance. Some are sold with instructional guides or DVDs, and classes may be offered at fitness centers. Many free-weight exercises can be adapted for resistance bands. For example, you can do biceps curls by standing on the center of the band and holding one end of the band in each hand; the band provides resistance when you stretch it to perform the curl.

**Exercise (Stability) Balls** The exercise or stability ball is an extra-large inflatable ball. It was originally developed for use in physical therapy but has become a popular piece of exercise equipment for use in the home or gym. It can be used to work the entire body, but it is particularly effective for working the core stabilizing muscles in the abdomen, chest, and

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**TERMS**

- **speed loading** Moving a load as rapidly as possible.
- **kettlebell** A large iron weight with a connected handle; used for ballistic weight training exercises such as swings and one-arm snatches.
- **isokinetic exercise** A type of dynamic exercise that provides variable resistance to a movement, so the movement occurs at a constant speed no matter how much effort is exerted.
- **spotter** A person who assists with a weight training exercise done with free weights.
Vibration Training  Vibration training consists of doing basic exercises, such as squats, push-ups, lunges, and modified pull-ups, on a vibrating platform. Vibration is transferred to whichever part of the body is in contact with the vibrating plate or handlebars. Vibration activates stretch receptors in the muscles, which triggers thousands of small reflex muscle contractions. Most studies have found that vibration training caused little or no additional effects above weight training alone.

Pilates  Pilates (pil LAH teez) was developed by German gymnast and boxer Joseph Pilates early in the 20th century. Pilates focuses on strengthening and stretching the core muscles in the back, abdomen, and buttocks to create a solid base of support for whole-body movement; the emphasis is on concentration, control, movement flow, and breathing. Pilates often makes use of specially designed resistance training devices, although some classes feature just mat or floor work. Mat exercises can be done at home, but because there are hundreds of Pilates exercises, some of them strenuous, it is best to begin with some qualified instruction.

Medicine Balls, Suspension Training, Stones, and Carrying Exercises  Almost anything that provides resistance to movement will develop strength. Rubber medicine balls weighing up to 50 pounds can be used for a variety of functional movements, such as squats and overhead throws. Suspension training (e.g., TRX system) uses body weight as the resistance in exercises using ropes or cords attached to a hook, bar, door jam, or sturdy tree branch. You can train with a stone found in your backyard or local riverbank in performing exercises such as squats, presses, and carries. Walking while carrying dumbbells, farmer’s bars, or heavy stones is an easy and effective way to develop whole-body strength. Carrying exercises are particularly useful for building the core muscles.

Power-Based Conditioning Programs  This type of training combines aerobics, weight training, gymnastics, and high-intensity interval training. Programs such as CrossFit and GymJones employ different exercises every day. More traditional circuit training methods often use the same exercises set up in series. (See the box “High-Intensity Conditioning Programs” in Chapter 3.)

Applying the FITT Principle: Selecting Exercises and Putting Together a Program  A complete weight training program works all the major muscle groups. It usually takes about 8–10 different exercises to

<table>
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<th>Table 4.2: The Pros and Cons of Stability Balls</th>
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<td><strong>PROS</strong></td>
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<tr>
<td>Stability balls activate muscle and nerve groups that might not otherwise get involved in a particular exercise.</td>
</tr>
<tr>
<td>Some exercises, such as the stir the pot exercise, can enhance the stability of supporting joints throughout the body.</td>
</tr>
<tr>
<td>Stability balls can be useful for some older adults because they require balance and can enhance overall stability.</td>
</tr>
<tr>
<td>Stability balls add variety and challenge to a workout</td>
</tr>
</tbody>
</table>
Want to get stronger? Then you need to focus on developing your skills at least as much as you focus on lifting more weight. Improving skill is the best way to increase strength during movements such as hitting a tennis ball or baseball, performing a bench press, driving a golf ball, skiing down a slope, or carrying a bag of groceries up a flight of stairs. In the world of weight training, skill means lifting weights with proper form; the better your form, the better your results.

The brain develops precise neural pathways as you learn a skill. As you improve, the pathways conduct nervous impulses faster and more precisely until the movement almost becomes reflexive. The best way to learn a skill is through focused practice that involves identifying mistakes, correcting them, and practicing the refined movement many times. However, simply practicing the skill is not enough if you want to improve and perform more powerful movements. You must perform the movements correctly instead of practicing mistakes or poor form over and over again.

Here’s where technology can help. Watch videos of people performing weight training movements correctly. You may be able to borrow videos from your instructor, purchase low-cost training videos through magazines and sporting goods stores, or find them on the Internet. If you watch training videos online, however, make sure they were produced by an authoritative source on weight training. Otherwise, you may be learning someone else’s mistakes.

Film your movements using a phone camera or inexpensive video camera. Compare your movements with those of a more skilled person performing them correctly. Make a note of movement patterns that need work and try to change your technique to make it more mechanically correct. Share your videos with your instructor or a certified personal trainer, who can help you identify poor form and teach you ways to correct your form. Smart phone apps such as Coaches’ Eye, Hudl Technique and Dartfish allow you to analyze movements in slow motion, compare movements side by side, and share your videos with others.

For example, if your maximum capacity for the leg press is 160 pounds, you might lift 130 pounds to build strength and 80 pounds in more repetitions to build endurance. For a general fitness program to develop both muscular strength and endurance, choose a weight in the middle of this range, perhaps 70% of 1 RM. Or you can create a program that includes both higher-intensity exercise (80% of 1 RM for 8–10 repetitions) and lower-intensity exercise (60% of 1 RM for 15–20 repetitions); this routine will develop both fast-twitch and slow-twitch muscle fibers.

Because it can be tedious and time-consuming to continually reassess your maximum capacity for each exercise, you might find it easier to choose a weight based on the number of repetitions of an exercise you can perform with a given resistance.

Frequency of Exercise For general fitness, the American College of Sports Medicine (ACSM) recommends a frequency of at least two nonconsecutive days per week for weight training. Allow your muscles at least one day of rest between workouts; if you train too often, your muscles won’t be able to work with enough intensity to improve their fitness, and soreness and injury are more likely to result. If you enjoy weight training and want to train more often, try working different muscle groups on alternate days—a training plan called a split routine. For example, work your arms and upper body one day, work your lower body the next day, and then return to upper-body exercises on the third day.

Intensity of Exercise: Amount of Resistance The amount of weight (resistance) you lift in weight training exercises is equivalent to intensity in cardiopulmonary endurance training. It determines how your body will adapt to weight training and how quickly these adaptations will occur.

Choose weights based on your current level of muscular fitness and your fitness goals. Choose a weight heavy enough to fatigue your muscles but light enough for you to complete the repetitions with good form. (For tips on perfecting your form, see the box “Improving Your Technique with Video.”) To build strength rapidly, you should lift weights as heavy as 80% of your maximum capacity (1 RM). If you’re more interested in building endurance, choose a lighter weight (perhaps 40–60% of 1 RM), and do more repetitions. New research has found that you can stimulate muscle hypertrophy using only 30–50% of maximum capacity if you stress the muscles adequately.

For example, if your maximum capacity for the leg press is 160 pounds, you might lift 130 pounds to build strength and 80 pounds in more repetitions to build endurance. For a general fitness program to develop both muscular strength and endurance, choose a weight in the middle of this range, perhaps 70% of 1 RM. Or you can create a program that includes both higher-intensity exercise (80% of 1 RM for 8–10 repetitions) and lower-intensity exercise (60% of 1 RM for 15–20 repetitions); this routine will develop both fast-twitch and slow-twitch muscle fibers.

Because it can be tedious and time-consuming to continually reassess your maximum capacity for each exercise, you might find it easier to choose a weight based on the number of repetitions of an exercise you can perform with a given resistance.

Time of Exercise: Repetitions and Sets To improve fitness, you must do enough repetitions of each exercise to fatigue your muscles. The number of repetitions needed to cause fatigue depends on the amount of resistance: The heavier the weight, the fewer repetitions to reach fatigue. In general, a heavy weight and a low number of repetitions (1–5) build strength and overload primarily fast-twitch fibers, whereas a light weight and a high number of repetitions (15–20) build endurance and overload primarily slow-twitch fibers.

For a general fitness program to build both strength and endurance, try to do about 8–12 repetitions of each exercise; a few exercises, such as abdominal crunches and calf raises, may require more. To avoid injury, older (approximately age 50–60 and above) and frailer people should perform more repetitions (10–15) using a lighter weight.

In weight training, a set refers to a group of repetitions of an exercise followed by a rest period. To develop strength and endurance for general fitness, you can make gains doing a single set of each exercise, provided you use enough resistance to
fatigue your muscles. (You should just barely be able to complete the 8–12 repetitions—using good form—for each exercise.) Doing more than one set of each exercise will increase strength development; most serious weight trainers do at least three sets of each exercise (see the section “More Advanced Strength Training Programs” for guidelines on more advanced programs).

If you perform more than one set of an exercise, you need to rest long enough between sets to allow your muscles to work with enough intensity to increase fitness. The length of the rest interval depends on the amount of resistance. In a program to develop a combination of strength and endurance for wellness, a rest period of one–three minutes between sets is appropriate. If you are lifting heavier loads to build strength, rest three–five minutes between sets. You can save time in your workouts by alternating sets of different exercises. One muscle group can rest between sets while you work on another group.

Overtraining—doing more exercise than your body can recover from—can occur in response to heavy resistance training. Possible signs of overtraining include lack of progress or decreased performance, chronic fatigue, decreased coordination, and chronic muscle soreness. The best remedy for overtraining is rest; add more days of recovery between workouts. With extra rest, chances are you’ll be refreshed and ready to train again.

Adding variety to your program, as discussed later in the chapter, can also help you avoid overtraining with resistance exercise.

**Type or Mode of Exercise** For overall fitness, you need to include exercises for your neck, upper back, shoulders, arms, chest, abdomen, lower back, thighs, buttocks, and calves—about 8–10 exercises in all. If you are also training for a particular sport, include exercises to strengthen the muscles important for optimal performance and the muscles most likely to be injured. Weight training exercises for general fitness are presented later in this chapter.

**BALANCE EXERCISES FOR OPPOSING MUSCLE GROUPS** It is important to balance exercises between antagonistic muscle groups. When a muscle contracts, the opposing muscle must relax. Whenever you do an exercise that moves a joint in one direction, also select an exercise that works the joint in the opposite direction. For example, if you do knee extensions to develop the muscles on the front of your thighs, also do leg curls to develop the antagonistic muscles on the back of your thighs.

**SETTING ORDER OF EXERCISES** The order of exercises can also be important. Do exercises for large-muscle groups or for more than one joint before you do exercises that use small-muscle groups or single joints. This allows for more effective overload of the larger, more powerful muscle groups. Small-muscle groups fatigue more easily than larger ones, and small-muscle fatigue limits your capacity to overload large-muscle groups. For example, lateral raises, which work the shoulder muscles, should be performed after bench presses, which work the chest and arms in addition to the shoulders. If you fatigue your shoulder muscles by doing lateral raises first, you won’t be able to lift as much weight and effectively fatigue all the key muscle groups used during the bench press.

<table>
<thead>
<tr>
<th>Warm-up 5–10 minutes</th>
<th>Strength training exercises for major muscle groups (8–10 exercises)</th>
<th>Cool-down 5–10 minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Exercise</strong></td>
<td><strong>Muscle group(s) developed</strong></td>
<td><strong>Exercise</strong></td>
</tr>
<tr>
<td>Bench press</td>
<td>Chest, shoulders, triceps</td>
<td>Biceps curls</td>
</tr>
<tr>
<td>Pull-ups</td>
<td>Lats, biceps</td>
<td>Lateral raises</td>
</tr>
<tr>
<td>Shoulder press</td>
<td>Shoulders, trapezius, triceps</td>
<td>Squats</td>
</tr>
<tr>
<td>Upright rowing</td>
<td>Deltoids, trapezius</td>
<td>Heel raises</td>
</tr>
<tr>
<td>Biceps curls</td>
<td>Biceps</td>
<td>Abdominal curls</td>
</tr>
<tr>
<td>Lateral raises</td>
<td>Shoulders</td>
<td>Spine extensions</td>
</tr>
<tr>
<td>Squats</td>
<td>Gluteals, quadriceps</td>
<td>Side bridges</td>
</tr>
<tr>
<td>Heel raises</td>
<td>Calves</td>
<td></td>
</tr>
<tr>
<td>Abdominal curls</td>
<td>Abdominals</td>
<td></td>
</tr>
<tr>
<td>Spine extensions</td>
<td>Low- and mid-back spine extensors</td>
<td></td>
</tr>
<tr>
<td>Side bridges</td>
<td>Obliques, quadratus lumborum</td>
<td></td>
</tr>
</tbody>
</table>

**Frequency:** 2–3 nonconsecutive days per week
**Intensity/Resistance:** Weights heavy enough to cause muscle fatigue when exercises are performed with good form for the selected number of repetitions
**Time:** Repetitions: 8–12 of each exercise (10–15 with a lower weight for people over age 50–60); Sets: 1 (doing more than 1 set per exercise may result in faster and greater strength gains); rest 1–2 minutes between exercises

**Type of activity:** 8–10 strength training exercises that focus on major muscle groups

**FIGURE 4.3** The FITT principle for a strength training workout.

Also, order exercises so you work opposing muscle groups in sequence, one after the other. For example, follow biceps curls, which work the biceps, with triceps extensions, which exercise the triceps—the antagonistic muscle to the biceps.

**The Warm-Up and Cool-Down**

As with cardiorespiratory endurance exercise, you should warm up before every weight training session and cool down afterward (Figure 4.3). You should do both a general warm-up—several minutes of walking or easy jogging and a warm-up for the weight training exercises you plan to perform. For example, if you plan to do one or more sets of 10 repetitions of bench presses with 125 pounds, you might do one set of 10 repetitions with 50 pounds as a warm-up. Do similar warm-up exercises for each exercise in your program.
To cool down after weight training, relax for 5–10 minutes after your workout. Although this is controversial, a few studies have suggested that including a period of post-exercise stretching may help prevent muscle soreness; warmed-up muscles and joints make the cool-down period a particularly good time to work on flexibility.

**Getting Started and Making Progress**

The first few sessions of weight training should be devoted to learning the movements and allowing your nervous system to practice communicating with your muscles so you can develop strength effectively. To start, choose a weight that you can move easily through 8–12 repetitions, do only one set of each exercise, and rest one–two minutes between exercises. Gradually add weight and (if you want) sets to your program over the first few weeks until you are doing one to three sets of 8–12 repetitions of each exercise.

As you progress, add weight according to the “two-for-two” rule: When you can perform two additional repetitions with a given weight on two consecutive training sessions, increase the load. For example, if your target is to perform 8–10 repetitions per exercise, and you performed 12 repetitions in your previous two workouts, it would be appropriate to increase your load. If adding weight means you can do only 7 or 8 repetitions, stay with that weight until you can again complete 12 repetitions per set. If you can do only 4–6 repetitions after adding weight, or if you can’t maintain good form, you’ve added too much and should take some off.

You can add more resistance in large-muscle exercises, such as squats and bench presses, than you can in small-muscle exercises, such as curls. For example, when you can complete 12 repetitions of squats with good form, you may be able to add 10–20 pounds of additional resistance; for curls, on the other hand, you might add only 3–5 pounds. As a general guideline, try increases of approximately 5%, which is half a pound of additional weight for each 10 pounds you are currently lifting.

You can expect to improve rapidly during the first 6–10 weeks of training—a 10–30% increase in the amount of weight lifted. Gains will then come more slowly. Your rate of improvement will depend on how hard you work and how your body responds to resistance training. Factors such as age, gender, motivation, and heredity also will affect your progress.

After you achieve the level of strength and muscularity you want, you can maintain your gains by training two–three days per week. You can monitor the progress of your program by recording the amount of resistance and the number of repetitions and sets you perform on a workout card like the one shown in Figure 4.4.

**More Advanced Strength Training Programs**

The program just described is sufficient to develop and maintain muscular strength and endurance for general fitness. Performing more sets and fewer repetitions with a heavier load will cause greater increases in strength. Such a program might include three to five sets of 4–6 repetitions each; the load should be heavy enough to cause fatigue with the smaller number of repetitions. Rest long enough after a set (three–five minutes) to allow your muscles to recover and work intensely during the next set.

Experienced weight trainers often practice some form of cycle training, also called periodization, in which the exercises, number of sets and repetitions, and intensity vary within a workout and/or between workouts. For example, you might do a particular exercise more intensely during some sets or on some days than others. You might also vary the exercises you perform for particular muscle groups. For more detailed information on these more advanced training techniques, consult a certified strength coach. If you decide to adopt a more advanced training regimen, start off slowly to give your body a chance to adjust and to minimize the risk of injury.

**Weight Training Safety**

Injuries happen in weight training. Maximum physical effort, elaborate machinery, rapid movements, and heavy weights can...
General Guidelines

- When beginning a program or trying new exercises or equipment, ask a qualified trainer or instructor to show you how to do exercises safely and correctly.
- Lift weights from a stabilized body position; keep weights as close to your body as possible.
- Protect your back by maintaining control of your spine and avoiding dangerous positions. Don’t twist your body while lifting.
- Observe proper lifting techniques and good form at all times. Don’t lift beyond the limits of your strength.
- Don’t hold your breath while doing weight training exercises. Doing so causes a decrease in blood returning to the heart and can make you dizzy and faint. It can also increase blood pressure to dangerous levels. Exhale when exerting the greatest force, and inhale when moving the weight into position for the active phase of the lift. Breathe smoothly and steadily.
- Don’t use defective equipment. Be aware of broken collars or bolts, frayed cables, broken chains, or loose cushions.
- Don’t exercise if you’re ill, injured, or overtrained. Do not try to work through the pain.

Free Weights

- Make sure the bar is loaded evenly on both sides and weights are secured with collars or spring clips.
- When you pick a weight up from the ground, keep your back straight and your head level. Don’t bend at the waist with straight legs.
- Lift weights smoothly; don’t jerk them. Control the weight through the entire range of motion.
- Do most of your lifting with your legs. Keep your hips and buttocks back. When doing standing lifts, maintain a good posture so that you protect your back. Bend at the hips, not with the spine. Feet should be shoulder-width apart, heels and balls of the feet in contact with the floor, and knees slightly bent.

Use Proper Lifting Technique Every exercise has a proper technique that is important for obtaining maximum benefits and preventing injury. Your instructor or weight room attendant can help explain the specific techniques for different exercises and weight machines.

Spotting

- Use spotters for free-weight exercises in which the bar crosses the face or head (e.g., the bench press), is placed on the back (e.g., squats), or is racked in front of the chest (e.g., overhead press from the rack holding the weight).
- If one spotter is used, the spotter should stand behind the lifter; if two spotters are used, one spotter should stand at each end of the barbell.
- For squats with heavy resistance, use at least three spotters—one behind the lifter (hands near lifter’s hips, waist, or torso) and one at each end of the bar. Squatting in a power rack will increase safety during this exercise. A power rack consists of four vertical posts with two movable horizontal bar catchers on each side.
- Spot dumbbell exercises at the forearms, as close to the weights as possible.
- For over-the-face and over-the-head lifts, the spotter should hold the bar with an alternate grip (one palm up and one palm down) inside the lifter’s grip.
- Spotter and lifter should ensure good communication by agreeing on verbal signals before the exercise.

Perform exercises smoothly and with good form. Lift or push the weight forcefully during the active phase of the lift and then lower it with control. Perform all lifts through the full range of motion and strive to maintain a neutral spine position during each exercise.

Use Spotters and Collars with Free Weights Spotters are necessary when an exercise has potential for danger; a weight that is out of control or falls can cause a serious injury. A spotter can assist you if you cannot complete a lift or if the
Be Alert for Injuries Report any obvious muscle or joint injuries to your instructor or physician, and stop exercising the affected area. Training with an injured joint or muscle can lead to a more serious injury. Make sure you get the necessary first aid. Even minor injuries heal faster if you use the R-I-C-E principle of treating injuries described in Chapter 3.

Consult a physician if you have any unusual symptoms during exercise or if you’re uncertain whether weight training is a proper activity for you. Weight training can aggravate conditions such as heart disease and high blood pressure. Immediately report symptoms such as headaches; dizziness; labored breathing; numbness; vision disturbances; and chest, neck, or arm pain. As discussed in Chapter 3, pushing muscles to failure can sometimes result in rhabdomyolysis (destruction of muscle cells), which can cause serious illness or even death.

### A Caution about Supplements and Drugs

Many active people use nutritional supplements and drugs in the quest for improved performance and appearance. Table 4.3 lists a selective summary of “performance aids” along with their potential side effects. While some of these substances improve performance, most are ineffective and expensive, and some are dangerous. A balanced diet should be your primary nutritional strategy.

## WEIGHT TRAINING EXERCISES

A general book on fitness and wellness cannot include a detailed description of all weight training exercises. The following pages present a basic program for developing muscular strength and endurance for general fitness using body weight (no equipment), free weights, and weight machines. Photographs and

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### Table 4.3 Performance Aids Marketed to Weight Trainers

<table>
<thead>
<tr>
<th>SUBSTANCE</th>
<th>SUPPOSED EFFECTS</th>
<th>ACTUAL EFFECTS</th>
<th>SELECTED POTENTIAL SIDE EFFECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adrenal androgens, such as dehydroepiandrosterone (DHEA), androstenedione</td>
<td>Increased testosterone, muscle mass, and strength; decreased body fat</td>
<td>Increased testosterone, strength, and fat-free mass; decreased fat in older subjects (more studies needed in younger people)</td>
<td>Gonadal suppression, prostate hypertrophy, breast development in males, masculinization in women and children; long-term effects unknown</td>
</tr>
<tr>
<td>Amino acids</td>
<td>Increased muscle mass</td>
<td>No effects if dietary protein intake is adequate; consuming before or after training may promote muscle protein synthesis (particularly leucine)</td>
<td>Minimal side effects; unbalanced amino acid intake can cause problems with protein metabolism</td>
</tr>
<tr>
<td>Amphetamines</td>
<td>Prevention of fatigue; increased confidence and training intensity</td>
<td>Increased arousal, wakefulness, and confidence; feeling of enhanced decision-making ability</td>
<td>Depression and fatigue, extreme confusion; aggressiveness, paranoia, hallucinations, restlessness, irritability, heart arrhythmia, high blood pressure, and chest pain</td>
</tr>
<tr>
<td>Anabolic steroids (steroids are controlled substances*)</td>
<td>Increased muscle mass, strength, power, psychological aggressiveness, and endurance</td>
<td>Increased strength, power, fat-free mass, and aggression; no effects on endurance</td>
<td>Liver damage and tumors, abnormal blood lipids, impaired reproductive health, hypertension, depressed immunity, insulin resistance, psychological disturbances, acne, breast development in males, masculinization in women and children, heart disease, thicker blood, and increased risk of cancer</td>
</tr>
<tr>
<td>Caffeine</td>
<td>Weight loss; improved endurance, strength, and power output; stimulant effect</td>
<td>Improves sports performance in low to moderate doses (three-six mg/kg body weight); improves endurance and high-intensity exercise capacity</td>
<td>Abnormal heart rhythm and insomnia; caffeine is addictive</td>
</tr>
<tr>
<td>Creatine monohydrate</td>
<td>Increased creatine phosphate levels in muscles, muscle mass, and capacity for high-intensity exercise</td>
<td>Increased muscle mass and performance in some types of high-intensity exercise</td>
<td>Minimal side effects; long-term effects unknown</td>
</tr>
</tbody>
</table>
### SUBSTANCE | SUPPOSED EFFECTS | ACTUAL EFFECTS | SELECTED POTENTIAL SIDE EFFECTS
--- | --- | --- | ---
Diuretics | Promote loss of body fluid | Promote loss of body fluid to accentuate muscle definition; often taken with potassium supplements and very low-calorie diets | Muscle cell destruction, low blood pressure, blood chemistry abnormalities, and heart problems
Energy drinks | Increased energy, strength, power | Increased training volume; caffeine and carbohydrates are main ingredients; products are overpriced | Insomnia, increased blood pressure, heart palpitations
Erythropoietin | Enhanced performance during endurance events | Stimulated growth of red blood cells; enhanced oxygen uptake and endurance | Increased blood viscosity (thickness), can cause potentially fatal blood clots
Ginseng | Decreased effects of physical and emotional stress; increased oxygen consumption | Most well-controlled studies show no effect on performance | No serious side effects; high doses can cause high blood pressure, nervousness, and insomnia
Growth hormone (extremely expensive controlled substance*) | Increased muscle mass, strength, and power; decreased body fat | Increased muscle mass and strength; decreased fat mass; little effect on exercise performance | Elevated blood sugar, high insulin levels, and carpal tunnel syndrome; enlargement of the heart and other organs
Beta-hydroxy beta-methylbutyrate (HMB) | Increased strength and muscle mass; decreased body fat | Some studies show increased fat-free mass and decreased fat; more research needed | No reported side effects; long-term effects unknown
Insulin | Increased muscle mass | Effectiveness in stimulating muscle growth unknown | Insulin shock (characterized by extremely low blood sugar), which can lead to unconsciousness and death
“Metabolic-optimizing” meals for athletes | Increased muscle mass and energy supply; decreased body fat | No proven effects beyond those of balanced meals | No reported side effects, extremely expensive
Nitric oxide boosters (arginine, beet root) | Increased blood flow by stimulating nitric oxide production in blood vessels | Might increase endurance (beet root); little evidence that they promote muscle hypertrophy | Generally safe; could lower blood pressure in some people and make herpes infections worse
Protein, amino acids, polypeptide supplements | Increased muscle mass and growth hormone release; accelerated muscle development; decreased body fat | No effects if dietary protein intake is adequate; may promote protein synthesis if taken immediately before or after weight training | Can be dangerous for people with liver or kidney disease; substituting amino acid or polypeptide supplements for protein-rich food can cause nutrient deficiencies

*Possession of a controlled substance is illegal without a prescription, and physicians are not allowed to prescribe controlled substances for the improvement of athletic performance. In addition, the use of anabolic steroids, growth hormone, or any of several other substances listed in this table is banned for athletic competition. Some apparently safe supplements may contain substances banned for use in sport.


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A list of the muscles being trained accompany instructions for each exercise. See pages T4-2 and T4-3 of the color transparency insert “Touring the Musculoskeletal System” in this chapter for a clear illustration of the deep and superficial muscles referenced in the exercises.

Labs 4.2 and 4.3 will help you assess your current level of muscular endurance and design your own weight training program. If you want to develop strength for a particular activity, your program should contain exercises for general fitness, exercises for the muscle groups most important for the activity, and exercises for muscle groups most often injured. Regardless of the goals of your program or the type of equipment you use, your program should be structured so that you obtain maximum results without risking injury.
EXERCISE 1  

Air Squats

Instructions: (a) Keep your back straight and head level; stand with feet slightly more than shoulder-width apart and toes pointed slightly outward. Hold your hands out in front of you. (b) Squat down until your thighs are below parallel with the floor. Let your thighs move laterally (outward) so that you “squat between your legs.” Hinge at your hips and don’t let your back sag. This will help keep your back straight and your heels on the floor. Drive upward toward the starting position, hinging at the hips and keeping your back in a fixed position throughout the exercise.

Muscles developed:
Quadriceps, gluteus maximus, hamstrings, gastrocnemius

EXERCISE 2  

Lunges

Instructions: (a) Stand with one foot about two feet in front of the other. (b) Lunge forward with the front leg, bending it until the thigh is parallel to the floor. The heel of the lead leg should stay on the ground. Do not shift your weight so far forward that the knee moves out past the toes. Repeat the exercise using the other leg. Keep your back and head as straight as possible and maintain control while performing the exercise.

Muscles developed:
Quadriceps, gluteus maximus, hamstrings, gastrocnemius
EXERCISE 3
Burpees with a Push-up

Instructions: (a) From a standing position, squat down and place your hands on the floor; and then kick your legs behind you and land in the “up” push-up position. Do a push-up. (b) Then move your knees forward until you are in a squat position; (c) spring up as high as you can into a full jump. Repeat.

Muscles developed:
Quadiceps, gluteus maximus, hamstrings, gastrocnemius, deltoids, pectoralis major, triceps

EXERCISE 4
Curl-Up or Crunch

Instructions: (a) Lie on your back on the floor with your arms folded across your chest and your feet on the floor or on a bench. (b) Curl your trunk up, minimizing your head and shoulder movement. Lower to the starting position. Focus on using your abdominal muscles rather than the muscles in your shoulders, chest, and neck.

Muscles developed:
Rectus abdominis, obliques
EXERCISE 5  Spine Extension ("Bird Dog") (Isometric Exercise)

Instructions: Begin on all fours with your knees below your hips and your hands below your shoulders.

Unilateral spine extension:
(a) Extend your right leg to the rear and reach forward with your right arm. Keep your spine neutral and your raised arm and leg in line with your torso. Don’t arch your back or let your hip or shoulder sag. Hold this position for 10–30 seconds. Repeat with your left leg and left arm.

Bilateral spine extension:
(b) Extend your left leg to the rear and reach forward with your right arm. Keep your spine neutral and your raised arm and leg in line with your torso. Don’t arch your back or let your hip or shoulder sag. Hold this position for 10–30 seconds. Repeat with your right leg and left arm.

Muscles developed: Erector spinae, gluteus maximus, hamstrings, deltoids

You can make this exercise more difficult by making box patterns with your arms and legs.

EXERCISE 6  Isometric Side Bridge

Instructions: Lie on the floor on your side with your knees bent and your top arm lying alongside your body. Lift and drive your hips forward so your weight is supported by your forearm and knee. Hold this position for 3–10 seconds, breathing normally. Repeat on the other side. Perform 3–10 repetitions on each side.

Variation: You can make the exercise more difficult by keeping your legs straight and supporting yourself with your feet and forearm (see Lab 5.3) or with your feet and hand (with elbow straight). An advanced version of this exercise that builds the core and shoulder muscles is to do a side bridge on the right side, rotate to a front plank, and then rotate to a side bridge on the left side. Hold each position for three seconds.

Muscles developed: Obliques, quadratus lumborum
**EXERCISE 7**

**Thrusters**

**Instructions:** (a) From a standing position, hold stones, soup cans, dumbbells, or barbells (or a single rock with both hands) at chest level with palms facing outward. (b) Squat down until your thighs are parallel with the floor. (c) Immediately stand and press the objects overhead in one continuous motion. Lower the objects to the starting position and immediately repeat the exercise.

**Muscles developed:** Quadriceps, gluteus maximus, hamstrings, gastrocnemius, deltoids, pectoralis major, triceps

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**EXERCISE 8**

**Overhead squats**

**Instructions:** (a) Stand holding a broom handle, stones, barbell, or soup cans overhead with straight arms, feet placed slightly more than shoulder-width apart, toes pointed out slightly, head neutral, and back straight. Center your weight over your arches or slightly behind. (b) Squat down, keeping your weight centered over your arches, and actively flex the hips (hinge at the hips with buttocks back) until your legs break parallel. During the movement, keep your back straight, shoulders back, and chest out, and let your thighs part to the side so that you are “squatting between your legs.” Try to “spread the floor” with your feet. Push up to the starting position, maximizing the use of the posterior hip and thigh muscles, and maintaining a straight back and neutral head position.

**Muscles developed:** Quadriceps, gluteus maximus

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**EXERCISE 9**

**Front Plank**

**Instructions:** Lying on your front with body straight, raise your body upward, supporting your weight on forearms and toes. Hold the position. Begin with 10-second holds and progress until you can hold the plank for at least two minutes. Breathe normally. Tighten your abs, glutes, and quads as you do this exercise.

**Muscles developed:** Rectus abdominis, erector spinae, trapezius, rhomboids, deltoids, pectorals, gluteals
EXERCISE 10

**Push-ups**

**Instructions:** (a) Start in the push-up position with your body weight supported by your hands and feet. Your arms and back should be straight and your fingers pointed forward. Lower your chest to the floor with your back straight, and then return to the starting position.

**Variation:** (b) Do modified push-ups if you can’t do at least 10 regular push-ups. Start with your body weight supported by your hands and knees. Your arms and back should be straight and your fingers pointed forward. Lower your chest to the floor with your back straight, and then return to the starting position.

**Muscles developed:** Pectoralis muscles, triceps, deltoids

---

**EXERCISE 1**

**Bench Press**

**Instructions:** (a) Lying on a bench on your back with your feet on the floor, grasp the bar with palms upward and hands shoulder-width apart. If the weight is on a rack, move the bar carefully from the supports to a point over the middle of your chest or slightly above it (at the lower part of the sternum). (b) Lower the bar to your chest. Then press it in a straight line to the starting position. Don’t arch your back or bounce the bar off your chest. You can also do this exercise with dumbbells or one arm at a time (unilateral training).

**Muscles developed:** Pectoralis major, triceps, deltoids

**Note:** To allow an optimal view of exercise technique, a spotter does not appear in these demonstration photographs; however, spotters should be used for most exercises with free weights.
EXERCISE 2  
**Pull-Up**

**Instructions:** (a) Begin by grasping the pull-up bar with both hands, palms facing forward and elbows extended fully. (b) Pull yourself upward until your chin goes above the bar. Then return to the starting position.

**Muscles developed:** Latissimus dorsi, biceps

**Assisted pull-up:** (c) This is done as described for a pull-up, except that a spotter assists the person by pushing upward at the waist, hips, or legs during the exercise.

---

EXERCISE 3  
**Shoulder Press (Overhead or Military Press)**

**Instructions:** This exercise can be done standing or seated, with dumbbells or a barbell. The shoulder press begins with the weight at your chest, preferably on a rack. (a) Grasp the weight with your palms facing away from you. (b) Push the weight overhead until your arms are extended. Then return to the starting position (weight at chest). Be careful not to arch your back excessively.

If you are a more advanced weight trainer, you can “clean” the weight (lift it from the floor to your chest). The clean should be attempted only after instruction from a knowledgeable coach; otherwise, it can lead to injury.

**Muscles developed:** Deltoids, triceps, trapezius

---

EXERCISE 4  
**Upright Rowing**

**Instructions:** (a) From a standing position with arms extended fully, grasp a barbell with a close grip (hands about 6–12 inches apart) and palms facing the body. (b) Raise the bar to about the level of your collarbone, keeping your elbows above bar level at all times. Return to the starting position.

This exercise can be done using dumbbells, a weighted bar (shown), or a barbell.

**Muscles developed:** Trapezius, deltooids, biceps
**EXERCISE 5**

**Biceps Curl**

*Instructions:* (a) From a standing position, grasp the bar with your palms facing away from you and your hands shoulder-width apart. (b) Keeping your upper body rigid, flex (bend) your elbows until the bar reaches a level slightly below the collarbone. Return the bar to the starting position.

This exercise can be done using dumbbells, a curl bar (shown), or a barbell; some people find that using a curl bar places less stress on the wrists.

**Muscles developed:**
- Biceps, brachialis

---

**EXERCISE 6**

**Lateral Raise**

*Instructions:* (a) Stand with feet shoulder-width apart and a dumbbell in each hand. Hold the dumbbells in front of you and parallel to each other. (b) With elbows slightly bent, slowly lift both weights to the side until they reach shoulder level. Keep your wrists in a neutral position, in line with your forearms. Return to the starting position.

**Muscles developed:**
- Deltoids

---

**EXERCISE 7**

**Squat**

*Instructions:* (a) If the bar is racked, place the bar on the fleshy part of your upper back and grasp the bar at shoulder width. Keeping your back straight and head level, remove the bar from the rack and take a step back. Stand with feet slightly more than shoulder-width apart and toes pointed slightly outward. (b) Rest the bar on the back of your shoulders, holding it there with palms facing forward. (c) Keeping your head level and lower back straight and pelvis back, squat down until your thighs are below parallel with the floor. Let your thighs move laterally (outward) so that you “squat between your legs.” This will help keep your back straight and keep your heels on the floor. Drive upward toward the starting position, hinging at the hips and keeping your back in a fixed position throughout the exercise.

**Muscles developed:**
- Quadriceps, gluteus maximus, hamstrings, gastrocnemius
**EXERCISE 8**

**Heel Raise**

**Instructions:** Stand with feet shoulder-width apart and toes pointed straight ahead. (a) Rest the bar on the back of your shoulders, holding it there with palms facing forward. (b) Press down with your toes while lifting your heels. Return to the starting position.

**Muscles developed:**
- Gastrocnemius
- Soleus

**EXERCISE 9**

**Kettlebell Swing**

**Instructions:** (a) Begin by holding the kettlebell in both hands with palms facing toward you, in a standing position with knees bent, feet placed slightly more than shoulder-width apart, hips flexed, back straight, chest out, and head in a neutral position. (b) Holding the kettlebell at knee level, swing the weight to a horizontal position by initiating the motion with the hips, thighs, and abs (tighten the quads, glutes, and ab muscles as hard as you can), keeping your arm straight and relaxed during the movement. Let the weight swing back between your legs in a “football hiking motion” and then repeat the exercise. During the movement, hinge at the hips and not at the spine.

**Muscles developed:**
- Quadriceps
- Gluteals
- Latissimus dorsi

**EXERCISE 10**

**Kettlebell One-Arm Snatch**

**Instructions:** (a) Begin by holding the kettlebell in one hand with your palm facing toward you, in a standing position with knees bent, feet placed slightly more than shoulder-width apart, hips flexed, back straight, chest out, and head in a neutral position. Hold the kettlebell at knee level. (b) Swing the weight to a horizontal position by initiating the motion with the hips, thighs, and abs (tighten the quads, glutes, and ab muscles as hard as you can), bending your arm as it approaches the chest and continuing the motion until straightening it overhead. The kettlebell should rotate from the front of your hand to the back during the motion. Use an upward punching motion at the top of the movement to prevent injuring your forearm. (c) Let the weight swing back between your legs in a “football hiking motion” and then repeat the exercise. During the movement, hinge at the hips and not at the spine.
EXERCISE 11  
Kettlebell or Dumbbell Carry (Suitcase Carry)

Instructions: This is an excellent exercise for building the core muscles. Pick up a dumbbell or kettlebell in one or both hands. Maintaining good posture, walk 20 to 100 yards carrying the weight. Carry 10 to several hundred pounds, depending on your fitness.

Muscles developed: 
Core muscles, trapezius, leg and hip muscles

WEIGHT TRAINING EXERCISES  
Weight Machines

EXERCISE 1  
Bench Press (Chest or Vertical Press) Weight Machines

Instructions: Sit or lie on the seat or bench, depending on the type of machine and the manufacturer’s instructions. Your back, hips, and buttocks should be pressed against the machine pads. Place your feet on the floor or the foot supports.

Muscles developed: 
Pectoralis major, anterior deltoids, triceps

(a) Grasp the handles with your palms facing away from you; the handles should be aligned with your armpits.

(b) Push the bars until your arms are fully extended, but don’t lock your elbows. Return to the starting position.

EXERCISE 2  
Lat Pull

Instructions: Begin in a seated or kneeling position, depending on the type of lat machine and the manufacturer’s instructions.

Note: This exercise focuses on the same major muscles as the assisted pull-up (Exercise 3); choose an appropriate exercise for your program based on your preferences and equipment availability.

Muscles developed: 
Latissimus dorsi, biceps

(a) Grasp the bar of the machine with arms fully extended.

(b) Slowly pull the weight down until it reaches the top of your chest. Slowly return to the starting position.
**EXERCISE 3**  
**Assisted Pull-Up**

**Instructions:** Set the weight according to the amount of assistance you need to complete a set of pull-ups—the heavier the weight, the more assistance provided.

(a) Stand or kneel on the assist platform, and grasp the pull-up bar with your elbows fully extended and your palms facing away.

(b) Pull up until your chin goes above the bar, and then return to the starting position.

**Muscles developed:**  
Latissimus dorsi, biceps

---

**EXERCISE 4**  
**Overhead Press (Shoulder Press)**

**Instructions:** Adjust the seat so your feet are flat on the ground and the hand grips are slightly above your shoulders. (a) Sit down, facing away from the machine, and grasp the hand grips with your palms facing forward. (b) Press the weight upward until your arms are extended. Return to the starting position.

**Muscles developed:**  
Deltoids, trapezius, triceps

---

**EXERCISE 5**  
**Biceps Curl**

**Instructions:** (a) Adjust the seat so that your back is straight and your arms rest comfortably against the top and side pads. Place your arms on the support cushions and grasp the hand grips with your palms facing up. (b) Keeping your upper body still, flex (bend) your elbows until the hand grips almost reach your collarbone. Return to the starting position.

**Muscles developed:**  
Biceps, brachialis
EXERCISE 6  Pullover

**Instructions:** Adjust the seat so your shoulders are aligned with the cams. Push down on the foot pads with your feet to bring the bar forward until you can place your elbows on the pads. Rest your hands lightly on the bar. If possible, place your feet flat on the floor. (a) To get into the starting position, let your arms go backward as far as possible. (b) Pull your elbows forward until the bar almost touches your abdomen. Return to the starting position.

**Muscles developed:**
Latissimus dorsi, pectoralis major and minor, triceps, rectus abdominis

---

EXERCISE 7  Lateral Raise

**Instructions:** (a) Adjust the seat so the pads rest just above your elbows when your upper arms are at your sides, your elbows are bent, and your forearms are parallel to the floor. Lightly grasp the handles. (b) Push outward and up with your arms until the pads are at shoulder height. Lead with your elbows rather than trying to lift the bars with your hands. Return to the starting position.

**Muscles developed:**
Deltoids, trapezius

---

EXERCISE 8  Triceps Extension

**Instructions:** (a) Adjust the seat so your back is straight and your arms rest comfortably against the top and side pads. Place your arms on the support cushions and grasp the hand grips with palms facing inward. (b) Keeping your upper body still, extend your elbows as much as possible. Return to the starting position.

**Note:** This exercise focuses on some of the same muscles as the Assisted Dip (Exercise 9); choose an appropriate exercise for your program based on your preferences and equipment availability.

**Muscles developed:**
Triceps
**EXERCISE 9**  
**Assisted Dip**

**Instructions:** Set the weight according to the amount of assistance you need to complete a set of dips—the heavier the weight, the more assistance provided.  
(a) Stand or kneel on the assist platform with your body between the dip bars. With your elbows fully extended and palms facing your body, support your weight on your hands.  
(b) Lower your body until your upper arms are almost parallel with the bars. Then push up until you reach the starting position.

**Muscles developed:**  
Triceps, deltoids, pectoralis major

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**EXERCISE 10**  
**Leg Press**

**Instructions:** Sit or lie on the seat or bench, depending on the type of machine and the manufacturer’s instructions. Your head, back, hips, and buttocks should be pressed against the machine pads. Loosely grasp the handles at the side of the machine.  
(a) Begin with your feet flat on the foot platform about shoulder-width apart. Extend your legs, but do not forcefully lock your knees.  
(b) Slowly lower the weight by bending your knees and flexing your hips until your knees are bent at about a 90-degree angle or your heels start to lift off the foot platform. Keep your lower back flat against the support pad. Then extend your knees and return to the starting position.

**Muscles developed:**  
Gluteus maximus, quadriceps, hamstrings

---

**EXERCISE 11**  
**Leg Extension (Knee Extension)**

**Instructions:**  
(a) Adjust the seat so the pads rest comfortably on top of your lower shins. Loosely grasp the handles.  
(b) Extend your knees until they are almost straight. Return to the starting position.

Knee extensions cause kneecap pain in some people. If you have kneecap pain during this exercise, check with an orthopedic specialist before repeating it.

**Muscles developed:**  
Quadriceps
EXERCISE 12  
Seated Leg Curl

Instructions: (a) Sit on the seat with your back against the back pad and the leg pad below your calf muscles. (b) Flex your knees until your lower and upper legs form a 90-degree angle. Return to the starting position.

Muscles developed: Hamstrings, gastrocnemius

EXERCISE 13  
Heel Raise

Instructions: (a) Stand with your head between the pads and one pad on each shoulder. The balls of your feet should be on the platform. Lightly grasp the handles. (b) Press down with your toes while lifting your heels. Return to the starting position. Changing the direction your feet are pointing (straight ahead, inward, and outward) will work different portions of your calf muscles.

Muscles developed: Gastrocnemius, soleus

Note: Abdominal machines, low-back machines, and trunk rotation machines are not recommended because of injury risk. Refer to the “Body Weight” and “Free Weights” exercise sections for appropriate exercises to strengthen the abdominal and low-back muscles. For the rectus abdominis, obliques, and transverse abdominis, perform curl-ups (Exercise 4 in the “Body Weight” section), and for the erector spinae and quadratus lumborum, perform the spine extension and the isometric side bridge (Exercises 5 and 6 in the “Body Weight” section).
**Will I gain weight if I do resistance exercises?**

*Q* Your weight probably will not change significantly as a result of a general fitness program: one set of 8–12 repetitions of 8–10 exercises, performed on at least two nonconsecutive days per week. You will lose body fat but also increase muscle mass, so your weight will stay about the same. You may notice a change in how your clothes fit, however, because muscle is denser than fat. Increased muscle mass will help you control body fat. Muscle increases your metabolism, which means you burn more calories every day. If you combine resistance exercises with endurance exercises, you will be on your way to developing a healthier body composition. Concentrate on fat loss rather than weight loss.

**Do I need more protein in my diet when I train with weights?**

*Q* No. Although there is some evidence that power athletes involved in heavy training have a higher-than-normal protein requirement, there is no reason for most people to consume extra protein. Most Americans take in more protein than they need, so even if there is an increased protein need during heavy training, it is probably supplied by the average diet. Consuming a protein-rich snack before or after training may promote muscle hypertrophy.

**What causes muscle soreness the day or two following a weight training workout?**

*Q* The muscle pain you feel a day or two after a heavy weight training workout is caused by injury to the muscle fibers and surrounding connective tissue. Contrary to popular belief, delayed-onset muscle soreness is not caused by lactic acid buildup. Scientists believe that injury to muscle fibers causes inflammation, which in turn causes the release of chemicals that break down part of the muscle tissue and cause pain. After a bout of intense exercise that causes muscle injury and delayed-onset muscle soreness, the muscles produce protective proteins that prevent soreness during future workouts. If you don’t work out regularly, you lose these protective proteins and become susceptible to soreness again.

**Will strength training improve my sports performance?**

*Q* Strength developed in the weight room does not automatically increase your power in sports such as skiing, tennis, or cycling. Hitting a forehand in tennis and making a turn on skis are precise skills that require coordination between your nervous system and muscles. For skilled people, movements become reflex; you don’t think about them when you do them. Increasing strength can disturb this coordination. Only by simultaneously practicing a sport and improving fitness can you expect to become more powerful in the skill. Practice helps you integrate your new strength with your skills, which makes you more powerful. Consequently, you can hit the ball harder in tennis or make more forceful turns on the ski slopes. (Refer to Chapter 2 for more on the concept of specificity in physical training.)

**Will I improve faster if I train every day?**

*Q* No. Your muscles need time to recover between training sessions. Doing resistance exercises every day will cause you to become overtrained, which will increase your chance of injury and impede your progress. If your strength training program reaches a plateau, try one of these strategies:

- Vary the number of sets. If you have been performing one set of each exercise, add sets.

- Train less frequently. If you are currently training the same muscle groups three or more times per week, you may not be allowing your muscles to fully recover from intense workouts.

- Change exercises. Using different exercises for the same muscle group may stimulate further strength development.

- Vary the load and number of repetitions. Try increasing or decreasing the loads you are using and changing the number of repetitions accordingly.

- If you are training alone, find a motivated training partner. A partner can encourage you and assist you with difficult lifts, forcing you to work harder.

**If I stop training, will my muscles turn to fat?**

*Q* No. Fat and muscle are two different kinds of tissue, and one cannot turn into the other. Muscles that aren’t used become smaller (atrophy), and body fat may increase if caloric intake exceeds calories burned. Although the result of inactivity may be smaller muscles and more fat, the change is caused by two separate processes.

**Should I wear a weight belt when I lift?**

*Q* Until recently, most experts advised people to wear weight belts. However, several studies have shown that weight belts do not prevent back injuries and may, in fact, increase the risk of injury by encouraging people to lift more weight than they are capable of lifting with good form. Although wearing a belt may allow you to lift more weight in some lifts, you may not get the full benefit of your program because use of a weight belt reduces the effectiveness of the workout on the muscles that help support your spine.
SUMMARY

- Hypertrophy (increased muscle fiber size) occurs when weight training causes the size and number of myofibrils to increase, thereby increasing total muscle size. Strength also increases through muscle learning. Most women do not develop large muscles from weight training.
- Improvements in muscular strength and endurance lead to enhanced physical performance, protection against injury, improved body composition, better self-image, improved muscle and bone health with aging, reduced risk of chronic disease, and decreased risk of premature death.
- Muscular strength can be assessed by determining the amount of weight that can be lifted in one repetition of an exercise. Muscular endurance can be assessed by determining the number of repetitions of a particular exercise that can be performed.
- Static (isometric) exercises involve contraction without movement. They are most useful when a person is recovering from an injury or surgery or needs to overcome weak points in a range of motion.
- Dynamic (isotonic) exercises involve contraction that results in movement. The two most common types are constant resistance (free weights and body weight) and variable resistance (many weight machines).
- Free weights and weight machines have pluses and minuses for developing fitness, although machines tend to be safer.
- Lifting heavy weights for only a few repetitions helps develop strength. Lifting lighter weights for more repetitions helps develop muscular endurance.
- A strength training program for general fitness includes at least one set of 8–12 repetitions (enough to cause fatigue) of 8–10 exercises, carried out at least two nonconsecutive days per week.
- Safety guidelines for strength training include using proper technique, using spotters and collars when necessary, and taking care of injuries.
- Supplements or drugs that are promoted as instant or quick “cures” usually don’t work and are either dangerous, expensive, or both.

FOR FURTHER EXPLORATION

American College of Sports Medicine Position Stand: Progression Models in Resistance Training for Healthy Adults. Provides an in-depth look at strategies for setting up a strength training program and making progress based on individual program goals.

Centers for Disease Control and Prevention. Podcast on problems associated with over-consumption of energy drinks.
http://www2c.cdc.gov/podcasts/player.asp?f=8626332

Dan John. An excellent website for people serious about improving strength and fitness, written by a world-class athlete and coach in track and field and Highland games.
http://danjohn.net

Human Anatomy On-line. Provides text, illustrations, and animation about the muscular system, nerve-muscle connections, muscular contraction, and other topics.
http://www.innerbody.com/htm/body.html

Mayo Clinic: Weight Training: Improve Your Muscular Fitness. Provides a basic overview of weight training essentials along with links to many other articles on specific weight training-related topics.
http://www.mayoclinic.com/health/weight-training/HQ01627

National Strength and Conditioning Association. A professional organization that focuses on strength development for fitness and athletic performance.
http://www.nsca-lift.org

Pilates Method Alliance. Provides information about Pilates and about instructor certification; includes a directory of instructors.
http://www.pilatesmethodalliance.org

University of California, San Diego: Muscle Physiology Home Page. Provides an introduction to muscle physiology, including information about types of muscle fibers and energy cycles.
http://muscle.ucsd.edu/index.shtml

University of Michigan: Muscles in Action. Interactive descriptions of muscle movements.
http://www.med.umich.edu/lrc/Hypermuscle/Hyper.html

Yoga Alliance A resource site for yoga instructors and people interested in yoga.
http://www.yogaalliance.org

See also the listings in Chapter 2.

SELECTED BIBLIOGRAPHY


LAB 4.1 Assessing Your Current Level of Muscular Strength

For best results, don’t do any strenuous weight training within 48 hours of any test. Use great caution when completing 1-RM tests; do not take the maximum bench press test if you have any injuries to your shoulders, elbows, back, hips, or knees. In addition, do not take these tests until you have had at least one month of weight training experience.

The Maximum Bench Press Test

Equipment
The free weights bench press test uses the following equipment
1. Flat bench (with or without racks)
2. Barbell
3. Assorted weight plates with collars to hold them in place
4. One or two spotters
5. Weight scale
If a weight machine is preferred, use the following equipment:
1. Bench press machine
2. Weight scale

Preparation
Try a few bench presses with a small amount of weight so you can practice your technique, warm up your muscles, and, if you use free weights, coordinate your movements with those of your spotters. Weigh yourself and record the results.

Body weight: _________ lb.

Instructions
1. Use a weight that is lower than the amount you believe you can lift. For free weights, men should begin with a weight about two-thirds of their body weight; women should begin with the weight of just the bar (45 lb).
2. Lie on the bench with your feet firmly on the floor. If you are using a weight machine, grasp the handles with palms away from you; the tops of the handles should be aligned with the tops of your armpits.
   If you are using free weights, grasp the bar slightly wider than shoulder width with your palms away from you. If you have one spotter, she or he should stand directly behind the bench; if you have two spotters, they should stand to the side, one at each end of the barbell. Signal to the spotter when you are ready to begin the test by saying, “1, 2, 3.” On “3,” the spotter should help you lift the weight to a point over your midchest (nipple line).
3. Push the handles or barbell until your arms are fully extended. Exhale as you lift. If you are using free weights, the weight moves from a low point at the chest straight up. Keep your feet firmly on the floor, don’t arch your back, and push the weight evenly with your right and left arms. Don’t bounce the weight on your chest.
4. Rest for several minutes, then repeat the lift with a heavier weight. It will probably take several attempts to determine the maximum amount of weight you can lift (1 RM).
   1 RM: _________ lb
   Check one: _________ Free weights _________ Universal _________ Other
5. If you used free weights, convert your free weights bench press score to an estimated value for 1 RM on the Universal bench press or other bench press machine using the appropriate formula:
   Males: Estimated Universal 1 RM = (1.016 × free weights 1 RM _________ lb) + 18.41 = _________ lb
   Females: Estimated Universal 1 RM = (0.848 × free weights 1 RM _________ lb) + 21.37 = _________ lb
   (Note: this formula might not be accurate on other bench press machines.)
LABORATORY ACTIVITIES

Rating Your Bench Press Result

1. Divide your 1-RM value by your body weight.
   \[ \text{1 RM} \quad \text{lb} \div \text{body weight} \quad \text{lb} = \quad \text{____________} \]

2. Find this ratio in the table to determine your bench press strength rating. Record the rating here and in the chart at the end of this lab. Bench press strength rating: ____________

Strength Ratings for the Maximum Bench Press Test

<table>
<thead>
<tr>
<th>Pounds Lifted/Body Weight (lb)</th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Very Poor</td>
<td>Poor</td>
</tr>
<tr>
<td>Age: Under 20</td>
<td>Below 0.89</td>
<td>0.89–1.05</td>
</tr>
<tr>
<td>20–29</td>
<td>Below 0.88</td>
<td>0.88–0.98</td>
</tr>
<tr>
<td>30–39</td>
<td>Below 0.78</td>
<td>0.78–0.87</td>
</tr>
<tr>
<td>40–49</td>
<td>Below 0.72</td>
<td>0.72–0.79</td>
</tr>
<tr>
<td>50–59</td>
<td>Below 0.63</td>
<td>0.63–0.70</td>
</tr>
<tr>
<td>60 and over</td>
<td>Below 0.57</td>
<td>0.57–0.65</td>
</tr>
</tbody>
</table>

|                              | Poor         | Fair        | Good        | Excellent    | Superior    |
| Age: Above 20                 | Below 0.89   | 0.89–1.05   | 1.06–1.18   | 1.19–1.33    | 1.34–1.75    | Above 1.75  |
| 20–29                         | Below 0.88   | 0.88–0.98   | 0.99–1.13   | 1.14–1.31    | 1.32–1.62    | Above 1.62  |
| 30–39                         | Below 0.78   | 0.78–0.87   | 0.88–0.97   | 0.98–1.11    | 1.12–1.34    | Above 1.34  |
| 40–49                         | Below 0.72   | 0.72–0.79   | 0.80–0.87   | 0.88–0.99    | 1.00–1.19    | Above 1.19  |
| 50–59                         | Below 0.63   | 0.63–0.70   | 0.71–0.78   | 0.79–0.89    | 0.90–1.04    | Above 1.04  |
| 60 and over                   | Below 0.57   | 0.57–0.65   | 0.66–0.71   | 0.72–0.81    | 0.82–0.93    | Above 0.93  |

**SOURCE:** Based on norms from The Cooper Institute of Aerobic Research, Dallas, Tex; from The Physical Fitness Specialist Manual, revised 2005. Used with permission.

Predicting 1 RM from Multiple-Repetition Lifts Using Free Weights

Instead of doing the 1-RM maximum strength bench press test, you can predict your 1 RM from multiple-repetition lifts.

**Instructions**

1. Choose a weight you think you can bench press five times.
2. Follow the instructions for lifting the weight given in the maximum bench press test.
3. Do as many repetitions of the bench press as you can. A repetition counts only if done correctly.
4. Refer to the chart on p. 131, or calculate predicted 1 RM using the Brzycki equation:
   \[ 1 \text{ RM} = \text{weight} \div (1.0278 - [0.0278 \times \text{number of repetitions}]) \]
   \[ 1 \text{ RM} = \quad \text{weight} \quad \text{lb} \div (1.0278 - [0.0278 \times \quad \text{number of repetitions}]) = \quad \text{____________} \]
5. Divide your predicted 1-RM value by your body weight.
   \[ 1 \text{ RM} \quad \text{lb} \div \text{body weight} \quad \text{lb} = \quad \text{____________} \]
6. Find this ratio in the table above to determine your bench press strength rating. Record the rating here and in the chart at the end of the lab.
   Bench press strength rating: ____________
### Functional Lower Body Movement Tests

The following tests assess functional leg movement skills using squats. Most people do squats improperly, increasing their risk of knee and back pain. Before you add weight-bearing squats to your weight training program, you should determine your functional leg movement skills, check your ability to squat properly, and give yourself a chance to master squatting movements. The following leg strength tests will help you in each of these areas.

These tests are progressively more difficult, so do not move to the next test until you have scored at least a 3 on the current test. On each test, give yourself a rating of 0, 1, 3, or 5, as described in the instructions that follow the last test.

#### 1. Chair Squat

**Instructions**

1. Sit up straight in a chair with your back resting against the backrest and your arms at your sides. Your feet should be placed more than shoulder-width apart so that you can get them under the body.

2. Begin the motion of rising out of the chair by flexing (bending) at the hips—not the back. Then squat up using a hip hinge movement (no spine movement). Stand without rocking forward, bending your back, or using external support, and keep your head in a neutral position.
LABORATORY ACTIVITIES

3. Return to the sitting position while maintaining a straight back and keeping your weight centered over your feet. Your thighs should abduct (spread) as you sit back in the chair. Use your rear hip and thigh muscles as much as possible as you sit.

Do five repetitions.
Your rating: ________
(See rating instructions that follow.)

2. Single-Leg Step-Up
Instructions

1. Stand facing a bench, with your right foot placed on the middle of the bench, right knee bent at 90 degrees, and arms at your sides.
2. Step up on the bench until your right leg is straight, maximizing the use of the hip muscles.
3. Return to the starting position. Keep your hips stable, back straight, chest up, shoulders back, and head neutral during the entire movement.

Do five repetitions for each leg.
Your rating: ________
(See rating instructions that follow.)

3. Unweighted Squat
Instructions

1. Stand with your feet placed slightly more than shoulder-width apart, toes pointed out slightly, hands on hips or across your chest, head neutral, and back straight. Center your weight over your arches or slightly behind.
2. Squat down, keeping your weight centered over your arches and actively flexing (bending) your hips until your legs break parallel. During the movement, keep your back straight, shoulders back, and chest out, and let your thighs part to the side so that you are “squatting between your legs.”
3. Push back up to the starting position, hinging at the hips and not with the spine, maximizing the use of the rear hip and thigh muscles, and maintaining a straight back and neutral head position.

Do five repetitions.
Your rating: ________
(See rating instructions that follow.)
4. Single-Leg Lunge-Squat with Rear-Foot Support

Instructions

1. Stand about three feet in front of a bench (with your back to the bench).
2. Place the top of your left foot on the bench, and put most of your weight on your right leg (your left leg should be bent), with your hands at your sides.
3. Squat on your right leg until your thigh is parallel with the floor. Keep your back straight, chest up, shoulders back, and head neutral.
4. Return to the starting position.

Do three repetitions for each leg.
Your rating: __________
(See rating instructions that follow.)

Rating Your Functional Leg Strength Test Results

5 points: Performed the exercise properly with good back and thigh position, weight centered over the middle or rear of the foot, chest out, and shoulders back; good use of hip muscles on the way down and on the way up, with head in a neutral position throughout the movement; maintained good form during all repetitions; abducted (spread) the thighs on the way down during chair squats and double-leg squats; for single-leg exercises, showed good strength on both sides; for single-leg lunge-squat with rear-foot support, maintained straight back, and knees stayed behind toes.

3 points: Weight was forward on the toes, with some rounding of the back; used thigh muscles excessively, with little use of hip muscles; head and chest were too far forward; showed little abduction of the thighs during double-leg squats; when going down for single-leg exercises, one side was stronger than the other; form deteriorated with repetitions; for single-leg lunge-squat with rear-foot support, could not reach parallel (thigh parallel with floor).

1 point: Had difficulty performing the movement, rocking forward and rounding back badly; used thigh muscles excessively, with little use of hip muscles on the way up or on the way down; chest and head were forward; on unweighted squats, had difficulty reaching parallel and showed little abduction of the thighs; on single-leg exercises, one leg was markedly stronger than the other; could not perform multiple repetitions.

0 points: Could not perform the exercise.

Summary of Results

Maximum bench press test from either the 1-RM test or the multiple-repetition test: Weight pressed: ________ lb Rating: ________
Functional leg strength tests (0–5): Chair squat: ________ Single-leg step-up: ________ Unweighted squat: ________
Single-leg lunge-squat with rear-foot support: ________
Remember that muscular strength is specific: Your ratings may vary considerably for different parts of your body.
LABORATORY ACTIVITIES

Using Your Results

How did you score? Are you surprised by your ratings for muscular strength? Are you satisfied with your current ratings?

If you’re not satisfied, set realistic goals for improvement:

Are you satisfied with your current level of muscular strength as evidenced in your daily life—for example, your ability to lift objects, climb stairs, and engage in sports and recreational activities?

If you’re not satisfied, set realistic goals for improvement:

What should you do next? Enter the results of this lab in the Preprogram Assessment column in Appendix C. If you’ve set goals for improvement, begin planning your strength training program by completing the plan in Lab 4.3. After several weeks of your program, complete this lab again and enter the results in the Post-program Assessment column of Appendix C. How do the results compare?
LAB 4.2 Assessing Your Current Level of Muscular Endurance

For best results, don’t do any strenuous weight training within 48 hours of any test. To assess endurance of the abdominal muscles, perform the curl-up test. To assess endurance of muscles in the upper body, perform the push-up test. To assess endurance of the muscles in the lower body, perform the squat endurance test.

The Curl-Up Test

**Equipment**

1. Two six-inch strips of self-stick Velcro or heavy tape
2. Ruler
3. Partner
4. Mat (optional)

**Preparation**

Affix the strips of Velcro or long strips of tape on the mat or testing surface. Place the strips three inches apart.

**Instructions**

1. Start by lying on your back on the floor or mat, arms straight and by your sides, shoulders relaxed, palms down and on the floor, and fingers straight. Adjust your position so that the longest fingertip of each hand touches the end of the near strip of Velcro or tape. Your knees should be bent about 90 degrees, with your feet about 12–18 inches from your buttocks.
2. To perform a curl-up, flex your spine while sliding your fingers across the floor until the fingertips of each hand reach the second strip of Velcro or tape. Then return to the starting position; the shoulders must be returned to touch the mat between curl-ups, but the head need not touch. Shoulders must remain relaxed throughout the curl-up, and feet and buttocks must stay on the floor. Breathe easily, exhaling during the lift phase of the curl-up; do not hold your breath.
3. Once your partner says “go,” perform as many curl-ups as you can at a steady pace with correct form. Your partner counts the curl-ups you perform and calls a stop to the test if she or he notices any incorrect form or drop in your pace.

   Number of curl-ups: __________

**Rating Your Curl-Up Test Result**

Your score is the number of completed curl-ups. Refer to the appropriate portion of the table for a rating of your abdominal muscular endurance. Record your rating below and in the summary at the end of this lab.

Rating: __________
LABORATORY ACTIVITIES

Ratings for the Curl-Up Test

<table>
<thead>
<tr>
<th>Number of Curl-Ups</th>
<th>Very Poor</th>
<th>Poor</th>
<th>Average</th>
<th>Good</th>
<th>Excellent</th>
<th>Superior</th>
</tr>
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<tbody>
<tr>
<td>Men</td>
<td>Below 48</td>
<td>48–57</td>
<td>58–64</td>
<td>65–74</td>
<td>75–93</td>
<td>Above 93</td>
</tr>
<tr>
<td>Age: 16–19</td>
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<tr>
<td>20–29</td>
<td>Below 46</td>
<td>46–54</td>
<td>55–63</td>
<td>64–74</td>
<td>75–93</td>
<td>Above 93</td>
</tr>
<tr>
<td>40–49</td>
<td>Below 38</td>
<td>38–45</td>
<td>46–53</td>
<td>54–62</td>
<td>63–79</td>
<td>Above 79</td>
</tr>
<tr>
<td>50–59</td>
<td>Below 36</td>
<td>36–43</td>
<td>44–51</td>
<td>52–60</td>
<td>61–77</td>
<td>Above 77</td>
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<td>60–69</td>
<td>Below 33</td>
<td>33–40</td>
<td>41–48</td>
<td>49–57</td>
<td>58–74</td>
<td>Above 74</td>
</tr>
<tr>
<td>Women</td>
<td>Below 42</td>
<td>42–50</td>
<td>51–58</td>
<td>59–67</td>
<td>68–84</td>
<td>Above 84</td>
</tr>
<tr>
<td>Age: 16–19</td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<td>Below 41</td>
<td>41–51</td>
<td>52–57</td>
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<td>40–49</td>
<td>Below 36</td>
<td>36–45</td>
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<td>55–64</td>
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<td>53–62</td>
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<td>60–69</td>
<td>Below 31</td>
<td>31–40</td>
<td>41–49</td>
<td>50–59</td>
<td>60–78</td>
<td>Above 78</td>
</tr>
</tbody>
</table>

SOURCE: Ratings based on norms calculated from data collected by Robert Lualhati on 4545 college students, 16–80 years of age, at Skyline College, San Bruno, Calif. Used with permission.

The Push-Up Test

Equipment: Mat or towel (optional)

Preparation

In this test, you will perform either standard push-ups or modified push-ups, in which you support yourself with your knees. The Cooper Institute developed the ratings for this test with men performing push-ups and women performing modified push-ups. Biologically, males tend to be stronger than females; the modified technique reduces the need for upper-body strength in a test of muscular endurance. Therefore, for an accurate assessment of upper-body endurance, men should perform standard push-ups and women should perform modified push-ups. However, in using push-ups as part of a strength training program, individuals should choose the technique most appropriate for increasing their level of strength and endurance—regardless of gender.

Instructions

1. For push-ups: Start in the push-up position with your body supported by your hands and feet. For-modified push-ups: Start in the modified push-up position with your body supported by your hands and knees. For both positions, keep your arms and your back straight and your fingers pointed forward.

2. Lower your chest to the floor with your back straight, and then return to the starting position.

3. Perform as many push-ups or modified push-ups as you can without stopping.

   Number of push-ups: ________ number of modified push-ups: ________

Rating Your Push-Up Test Result

Your score is the number of completed push-ups or modified push-ups. Refer to the appropriate portion of the table for a rating of your upper-body endurance. Record your rating below and in the summary at the end of this lab.

Rating: ________
Ratings for the Push-Up and Modified Push-Up Tests

<table>
<thead>
<tr>
<th>Men</th>
<th>Age</th>
<th>Number of Push-Ups</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Very Poor</td>
</tr>
<tr>
<td></td>
<td>50–59</td>
<td>Below 9</td>
</tr>
<tr>
<td>60 and over</td>
<td>Below 6</td>
<td>6–9</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Number of Modified Push-Ups</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
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<tr>
<td>-----</td>
</tr>
<tr>
<td>18–29</td>
</tr>
<tr>
<td>40–49</td>
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<tr>
<td>60 and over</td>
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</tbody>
</table>

Source: Based on norms from The Cooper Institute of Aerobic Research, Dallas, Tex.; from The Physical Fitness Specialist Manual, revised 2002. Used with permission.

The Squat Endurance Test

Instructions

1. Stand with your feet placed slightly more than shoulder width apart, toes pointed out slightly and hands on hips or across your chest, head neutral, and back straight. Center your weight over your arches or slightly behind.

2. Squat down, keeping your weight centered over your arches, until your thighs are parallel with the floor. Push back up to the starting position, maintaining a straight back and neutral head position.

3. Perform as many squats as you can without stopping.

Number of squats: _____________

Rating Your Squat Endurance Test Result

Your score is the number of completed squats. Refer to the appropriate portion of the table for a rating of your leg muscular endurance. Record your rating below and in the summary at the end of this lab.

Rating: _____________

Ratings for the Squat Endurance Test

<table>
<thead>
<tr>
<th>Number of Squats Performed</th>
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<tbody>
<tr>
<td>Age</td>
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<tr>
<td>-----</td>
</tr>
<tr>
<td>18–25</td>
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<tr>
<td>65+</td>
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</tbody>
</table>

Source: www.topendsports.com/testing/tests/home-squat.htm
LABORATORY ACTIVITIES

Summary of Results

Curl-up test: Number of curl-ups: _________ Rating: _________
Push-up test: Number of push-ups: _________ Rating: _________
Squat endurance test: Number of squats: _________ Rating: _________

Remember that muscular endurance is specific: Your ratings may vary considerably for different parts of your body.

Using Your Results

How did you score? Are you surprised by your ratings for muscular endurance? Are you satisfied with your current ratings?

If you’re not satisfied, set realistic goals for improvement:

Are you satisfied with your current level of muscular endurance as evidenced in your daily life—for example, your ability to carry groceries or your books, hike, and do yard work?

If you’re not satisfied, set realistic goals for improvement:

What should you do next? Enter the results of this lab in the Preprogram Assessment column in Appendix C. If you’ve set goals for improvement, begin planning your strength training program by completing the plan in Lab 4.3. After several weeks of your program, complete this lab again and enter the results in the Post-program Assessment column of Appendix C. How do the results compare?
LAB 4.3  Designing and Monitoring a Strength Training Program

1. **Set goals.** List goals for your strength training program. Your goals can be specific or general, short or long term. In the first section, include specific, measurable goals that you can use to track the progress of your fitness program—for example, raising your upper-body muscular strength rating from fair to good or being able to complete 10 repetitions of a lat pull with 125 pounds of resistance. In the second section, include long-term and more qualitative goals, such as improving self-confidence and reducing your risk for back pain.

   Specific Goals: Current Status
   ______________________________________________________
   ______________________________________________________
   ______________________________________________________

   Final Goals
   ______________________________________________________
   ______________________________________________________
   ______________________________________________________

   Other goals: _________________________________________________________________________________________________
   __________________________________________________________________________________________

2. **Choose exercises.** Based on your goals, choose 8–10 exercises to perform during each weight training session. If your goal is general training for wellness, use the sample program in Figure 4.3 on p. 105. List your exercises and the muscles they develop in your program plan.

3. **Frequency:** Choose the number of training sessions per week. Work out at least two nonconsecutive days per week. Indicate the days you will train in your program plan; be sure to include days of rest to allow your body to recover.

4. **Intensity:** Choose starting weights. Experiment with different amounts of weight until you settle on a good starting weight, one that you can lift easily for 10–12 repetitions. As you progress in your program, add more weight. Fill in the starting weight for each exercise in your program plan.

5. **Time:** Choose a starting number of sets and repetitions. Include at least one set of 8–12 repetitions of each exercise. (When you add weight, you may have to decrease the number of repetitions slightly until your muscles adapt to the heavier load.) If your program is focusing on strength alone, your sets can contain fewer repetitions using a heavier load. If you are over approximately age 50–60, your sets should contain more repetitions (10–15) using a lighter load. Fill in the starting number of sets and repetitions of each exercise in your program plan.

6. **Monitor your progress.** Use the workout card on the next page to monitor your progress and keep track of exercises, weights, sets, and repetitions.

**Program Plan for Weight Training**

<table>
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<th>Exercise</th>
<th>Muscle(s) Developed</th>
<th>Frequency (✓)</th>
<th>Intensity: Weight (lb.)</th>
<th>Time</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>M T W Th F Sa Su</td>
<td>Repetitions Sets</td>
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### WORKOUT CARD FOR

<table>
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<tr>
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<th>Wt</th>
<th>Sets</th>
<th>Reps</th>
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Flexibility and Low-Back Health

LOOKING AHEAD...

After reading this chapter, you should be able to
- Identify the potential benefits of flexibility and stretching exercises.
- List the factors that affect a joint’s flexibility.
- Describe the different types of stretching exercises and how they affect muscles.
- Describe the intensity, duration, and frequency of stretching exercises that will develop the most flexibility with the lowest risk of injury.
- List safe stretching exercises for major joints.
- Explain how low-back pain can be prevented and managed.

TEST YOUR KNOWLEDGE

1. Static stretching exercises should be performed
   a. at the start of a warm-up.
   b. first thing in the morning.
   c. after endurance exercise or strength training.

2. If you injure your back, it’s usually best to rest in bed until the pain is completely gone. True or false?

3. It is better to hold a stretch for a short time than to “bounce” while stretching. True or false?

See answers on the next page.
Flexibility—the ability of a joint to move through its normal, full range of motion—is important for general fitness and wellness. Flexibility is a highly adaptable physical fitness component: It increases in response to a regular program of stretching exercises and decreases with inactivity. Flexibility is also specific: Good flexibility in one joint doesn’t necessarily mean good flexibility in another. You can increase your overall flexibility by doing regular stretching exercises for all your major joints.

This chapter describes the factors that affect flexibility and the benefits of maintaining good flexibility. It provides guidelines for assessing your current level of flexibility and putting together a successful stretching program. It also examines the common problem of low-back pain.

TYPES OF FLEXIBILITY

There are two types of flexibility:

- **Static flexibility** is the ability to hold an extended position at one end or point in a joint’s range of motion. For example, static flexibility determines how far you can extend your arm across the front of your body or out to the side. Static flexibility depends on your ability to tolerate stretched muscles, the structure of your joints, and the elasticity of muscles.

- **Dynamic flexibility** is the ability to move a joint through its range of motion with little resistance. It would affect your ability to pitch a ball or swing a golf club. Dynamic flexibility depends on static flexibility, but it also involves strength, coordination, and resistance to movement.

Dynamic flexibility is important for daily activities and sports. But because static flexibility is easier to measure and better researched, most assessment tests and stretching programs target that type of flexibility.

WHAT DETERMINES FLEXIBILITY?

The flexibility of a joint is affected by its structure, by muscle elasticity and length, and by nervous system regulation. Joint structure can’t be changed, but other factors, such as the length of resting muscle fibers, can be changed through exercise; these factors should be the focus of a program to develop flexibility.

**Joint Structure**

How flexible a joint is depends partly on the nature and structure of the joint (Figure 5.1). Hinge joints such as those in your fingers and knees allow only limited forward and backward movement; they lock when fully extended. Ball-and-socket joints like the hip enable movement in many directions and provide for a greater range of motion. Joint capsules, semi-elastic structures that give joints strength and stability but limit movement, surround the major joints. The bone surfaces within the joint are lined with cartilage and separated by a joint cavity containing synovial fluid, which cushions the bones and reduces friction as the joint moves. Ligaments, both inside and outside the joint capsule, strengthen and reinforce the joint. For an illustration of the knee joint and more about its function, see page T4-5 of the color transparency insert “Touring the Musculoskeletal System,” in Chapter 4.

Heredity plays a part in joint structure and flexibility. For example, although everyone has a broad range of motion in the...
hip joint, not everyone can do a split. Gender may also play a role. Some studies have found that women have greater flexibility in certain joints.

**Muscle Elasticity and Length**

Soft tissues—including skin, muscles, tendons, and ligaments—also affect the flexibility of a joint. Muscle tissue is the key to developing flexibility because regular stretching can lengthen it. The most important component of muscle tissue related to flexibility is the connective tissue that envelops every part of muscle tissue, from individual muscle fibers to entire muscles. Connective tissue provides structure, elasticity, and bulk and makes up about 30% of muscle mass. Two principal types of connective tissue are collagen—white fibers that provide structure and support—and elastin—yellow fibers that are elastic and flexible. The collagen and elastin are closely intertwined, so muscle tissue exhibits the properties of both types of fibers. A structural protein in muscles called titin also has elastic properties and contributes to flexibility.

When a muscle is stretched, the wavelike elastin fibers straighten; when the stretch is relieved, they rapidly snap back to their resting position. This temporary lengthening is called elastic elongation. If stretched gently and regularly, connective tissues may lengthen and flexibility may improve. This long-term lengthening is called plastic elongation. Without regular stretching, the process reverses: These tissues shorten, resulting in decreased flexibility. Regular stretching may contribute to flexibility by lengthening muscle fibers through the addition of contractile units called sarcomeres.

A muscle can tolerate a limited amount of stretch. As the limits of its flexibility are reached, connective tissue becomes more brittle and may rupture if overstretched. A safe and effective program stretches muscles enough to slightly elongate the tissues but not so much that they are damaged. Research has shown that flexibility is improved best by stretching when muscles are warm (following exercise or the application of heat) and the stretch is applied gradually and conservatively. Sudden, high-stress stretching is less effective and can lead to muscle damage.

**Nervous System Regulation**

Proprioceptors are nerves that send information about changes in the muscular and skeletal systems to the nervous system, which responds with signals to help control the speed, strength, and coordination of muscle contractions. When a muscle is stretched (lengthened), proprioceptors detect the amount and rate of the change in muscle length. The nerves send a signal to the spinal cord, which then sends a signal back to the muscle, triggering a muscle contraction that resists the change in muscle length. Another signal is sent to the antagonistic, or opposing, muscle, causing it to relax and facilitate contraction of the stretched muscle. These reflexes occur frequently in active muscles and allow for fine control of muscle length and movement. Muscle flexibility is linked to strength. Practicing lower-body eccentric exercise (lengthening contractions) increases strength and flexibility and might decrease the risk of lower body muscle injury.

Small movements that only slightly stimulate the nerves cause small reflex actions. Rapid, powerful, and sudden changes in muscle length strongly stimulate the nerve receptors and can cause large and powerful reflex muscle contractions. Thus, stretches that involve rapid, bouncy movements can be dangerous and cause injury. Each bounce causes a reflex contraction, which means a muscle might be stretching at the same time it is contracting. Performing a gradual stretch and then holding it allows the proprioceptors to adjust to the new muscle length and to reduce the signals sent to the spine, thereby allowing muscles to lengthen and, over time, improving flexibility.

The stretching technique called proprioceptive neuromuscular facilitation (PNF), described later, takes advantage of nerve activity to improve flexibility. For example, contracting a muscle prior to stretching it can help allow the muscle to stretch farther. The advanced strength training technique called plyometrics (Chapter 4) also takes advantage of the nervous system action in stretching and contracting muscles.

Modifying nervous control through movement and specific exercises is the best way to improve the functional range of motion. Regular stretching trains the proprioceptors to allow the muscles to lengthen. Proprioceptors adapt quickly to stretching (or lack of stretching), so frequent stretching helps develop flexibility. Stretching before exercising, however, can disturb proprioceptors and interfere with motor control during exercise. This is another good reason to stretch after exercising.

**BENEFITS OF FLEXIBILITY**

Good flexibility provides benefits for the entire musculoskeletal system. Flexibility training increases range of motion, and it may prevent muscle strains. As long as you don’t overstretch, flexibility training will increase strength and the quality of movement, which might decrease the risk of some sports injuries. Most studies, however, show that stretching does not prevent overuse injuries.

**Joint Health**

Good flexibility is essential to good joint health. When the muscles and other tissues that support a joint are tight, the joint is subject to abnormal stresses that can cause joint deterioration. For example, tight thigh muscles cause excessive pressure on the kneecap, leading to pain in the knee joint. Poor joint flexibility can also cause abnormalities in joint lubrication, leading to deterioration of the sensitive cartilage cells lining the joint; pain and further joint injury can result.

Improved flexibility can greatly improve your quality of life, particularly as you get older. People tend to exercise less as they age, leading to loss of joint mobility and increased incidence of joint pain. Aging also decreases the natural elasticity of
THE EVIDENCE FOR EXERCISE

Does Physical Activity Increase or Decrease the Risk of Bone and Joint Disease?

Most college students don’t worry much about fall-related fractures or chronic bone-related illnesses, such as osteoporosis (loss of bone mass) or osteoarthritis—(degeneration of the cartilage inside joints). Even so, bone health should be a concern throughout life. This is because girls amass 85% of their adult bone mass by age 18, and boys build the same amount by age 20, but most people begin losing bone mass around age 30. For many, poor diet and lack of exercise accelerate bone loss. According to the National Osteoporosis Foundation, 10 million Americans have osteoporosis. Meantime, 34 million Americans are at risk of the disease because of low bone mass. Overall, osteoporosis is a health threat for about 55% of Americans age 50 and older.

Getting enough nutrients is important for bone health (see Chapter 8), but there is mounting evidence that exercise can also help preserve or improve bone health. For example, several studies have shown an inverse relationship between physical activity and the risk for bone fractures. That is, the more you exercise, the less likely you are to suffer fractures, especially of the upper leg and hip. Research has not determined conclusively how much exercise is required to reduce fracture risk; but people who walk at least four hours per week and devote at least one hour per week to other forms of physical activity appear to reduce that risk. These findings seem to be consistent for women and men, but because some studies disagree on this point, further research is needed.

One way that exercise helps both men and women is by increasing the mineral density of bones, or at least by decreasing the loss of mineral density over time. Several one-year-long studies found that exercise can increase bone mineral density by 1–2% per year, which is significant—especially considering that the same amount of bone mineral density can be lost every one–four years in older persons. Currently, the American College of Sports Medicine recommends that adults perform weight-bearing physical activities (such as walking) three–five days per week and strength training exercises two–three days per week to increase bone mass or avoid loss of mineral density. They also recommend that adults practice neuromotor exercise training exercises, such as yoga or tai chi, to prevent falls and bone fractures. Exercise is particularly important in lactating (breastfeeding) women for preventing bone loss.

The evidence is less conclusive for the effect of exercise on osteoarthritis but still fairly positive. All experts agree that regular, moderate-intensity exercise is necessary for joint health. However, they also warn that vigorous or too-frequent exercise may contribute to joint damage and encourage the onset of osteoarthritis. For this reason, experts try to strike a balance in their exercise recommendations, especially for those with a family history of osteoarthritis. Research seems to support this cautious approach. Some studies have found that regular physical activity (as recommended for general health) at least does not increase osteoarthritis risk. Other studies show that moderate activity may provide some protection against the disease, but this evidence is limited.

A few studies also reveal that the type of exercise you do may increase your risk. For example, competitive or strenuous sports such as ballet, orienteering, football, basketball, soccer, and tennis have been associated with the disease, whereas sports such as cross-country skiing, running, swimming, biking, and walking have not.

The bottom line is that the earlier in life you become physically active, the greater your protection against bone loss and bone-related diseases. However, if you have a family history of osteoporosis or osteoarthritis, or if you have already developed symptoms of one of these ailments, be sure to talk to your physician before beginning an exercise program.


Prevention of Low-Back Pain and Injuries

Poor spinal stability puts pressure on the nerves leading out from the spinal column and can lead to low-back pain. Strength and flexibility in the back, pelvis, and thighs may help prevent this type of back pain but may or may not improve back

muscles, tendons, and joints, resulting in stiffness. The problem is often compounded by arthritis (see the box “Does Physical Activity Increase or Decrease the Risk of Bone and Joint Disease?”). Good joint flexibility may help prevent arthritis, and stretching may lessen pain in people who have the condition. Another benefit of good joint flexibility for older adults is that it increases balance and stability.
health or reduce the risk of injury. Good hip and knee flexibility protects the spine from excessive motion during the tasks of daily living.

Although scientific evidence is limited, people with either high or low flexibility seem to have an increased risk of injury. Extreme flexibility reduces joint stability, and poor flexibility limits a joint’s range of motion. Persons of average fitness should try to attain normal flexibility in joints throughout the body, meaning each joint can move through its normal range of motion with no difficulty. Stretching programs are particularly important for older adults, people engaged in high-power sports that require rapid changes in direction (such as football and tennis), workers involved in brief bouts of intense exertion (such as police officers and firefighters), and people who sit for prolonged periods (such as office workers and students).

However, as we have seen, static stretching before a high-intensity activity (such as sprinting or basketball) may increase the risk of injury by interfering with neuromuscular control and reducing muscles’ natural ability to stretch and contract. When injuries occur, flexibility exercises can reduce symptoms and help restore normal range of motion in affected joints.

Additional Potential Benefits of Flexibility

- **Relief of aches and pains.** Studying or working in one place for a long time can make your muscles tense. Stretching helps relieve tension and joint stiffness, so you can go back to work refreshed and effective. Stretching reduces the symptoms of exercise-induced muscle damage, and flexible muscles are less susceptible to the damage.
- **Relief of muscle cramps.** Recent research suggests that exercise-related muscle cramps are caused by increased electrical activity within the affected muscle. The best treatment for muscle cramps is gentle stretching, which reduces the electrical activity and allows the muscle to relax.
- **Improved body position and strength for sports (and life).** Good flexibility lets you assume more efficient body positions and exert force through a greater range of motion. For example, swimmers with more flexible shoulders have stronger strokes because they can pull their arms through the water in the optimal position. Some studies also suggest that flexibility training enhances strength development.
- **Maintenance of good posture and balance.** Good flexibility also contributes to body symmetry and good posture. Bad posture can gradually change your body structures. Sitting in a slumped position, for example, can lead to tightness in the muscles in the front of your chest and overstretching and looseness in the upper spine, causing a rounding of the upper back. This condition, called **kyphosis**, is common in older people. Stretching regularly may prevent it.
- **Relaxation.** Flexibility exercises, particularly when practiced in combination with yoga or tai chi, reduce mental tension, slow your breathing rate, and reduce blood pressure.

**Wellness Tip** Flexibility training helps maintain pain-free joints as you age. You don’t have to be at the gym to stretch. There are lots of simple, small-movement stretches you can do anywhere—whether at your desk or on the go. For some examples, visit a good health website such as http://www.MayoClinic.com and search for “stretching exercises.”

- **Improving impaired mobility.** Stretching often decreases pain and improves functional capacity in people with arthritis, stroke, or muscle and nerve diseases and in people who are recovering from surgery or injury.

**ASSESSING FLEXIBILITY**

Because flexibility is specific to each joint, there are no tests of general flexibility. The most commonly used flexibility test is the sit-and-reach test, which rates the flexibility of the muscles in the lower back and hamstrings. To assess your flexibility and identify inflexible joints, complete Lab 5.1.

**CREATING A SUCCESSFUL PROGRAM TO DEVELOP FLEXIBILITY**

A successful program for developing flexibility includes safe exercises executed with the most effective techniques. Your goal should be to attain normal flexibility in the major joints. Balanced flexibility (not too much or too little) provides joint stability and facilitates smooth, economical movement patterns. You can achieve balanced flexibility by performing stretching exercises regularly and by using a variety of stretches and stretching techniques.

**Applying the FITT Principle**

As with other programs, the acronym FITT can be used to remember key components of a stretching program: Frequency, Intensity, Time, and Type of exercise.
**Frequency** The American College of Sports Medicine (ACSM) recommends that stretching exercises be performed at least two–three days per week, but more often is even better. To prevent injury and improve flexibility, it’s best to stretch when your muscles are warm, either after a warm-up or after cardiorespiratory endurance exercise or weight training.

As described earlier, static stretching can adversely affect muscle performance in the short term. So, if you are planning a workout for which high-performance is important, it is best to perform static stretches after your workout but while your muscles are still warm and your joints are lubricated. Stretching isn’t the same thing as a cool-down, so be sure to do the cardiorespiratory cool-down first, so you can transition to a lower level of intensity before stretching. If the plan for your workout includes a moderate activity like walking, then static stretching prior to your workout isn’t likely to impact performance in a significant way.

Dynamic stretching, described in the next section, may have less of an impact on muscle performance and so is sometimes included as part of an active warm-up. However, dynamic stretching is more challenging to learn and perform.

**Intensity and Time (Duration)** For each exercise, slowly stretch your muscles to the point of slight tension or mild discomfort—but not to the point of pain. Hold the stretch for 10–30 seconds. As you hold the stretch, the feeling of slight tension should slowly subside; at that point, try to stretch a bit farther. Throughout the stretch, try to relax and breathe easily. Rest for about 30–60 seconds between each stretch, and do 2–4 repetitions of each stretch for a total of 60 seconds per exercise. A complete flexibility workout usually takes about 10–30 minutes (Figure 5.2).

**Types of Stretching Techniques** Stretching techniques vary from simply stretching the muscles during the course of normal activities to sophisticated methods based on patterns of muscle reflexes. Improper stretching can do more harm than good, so it’s important to understand the different types of stretching exercises and how they affect the muscles. Four common techniques are static stretches, ballistic stretches, dynamic stretches, and PNF.

### Static Stretching
A technique in which a muscle is slowly and gently stretched and then held in the stretched position.

### Ballistic Stretching
A technique in which muscles are stretched by the force generated as a body part is repeatedly bounced, swung, or jerked.

### Dynamic Stretching
A technique in which muscles are stretched by moving joints slowly and fluidly through their range of motion in a controlled manner; also called functional stretching.

### Passive Stretching
A technique in which muscles are stretched by force applied by an outside source.

### Active Stretching
A technique in which muscles are stretched by the contraction of the opposing muscles.

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**FIGURE 5.2** The FITT principle for a flexibility program.

**Static Stretching** In static stretching, each muscle is gradually stretched, and the stretch is held for 10–30 seconds. A slow stretch prompts less reaction from proprioceptors, and the muscles can safely stretch farther than usual. Static stretching is the type most often recommended by fitness experts because it is safe and effective.

The key to this technique is to stretch the muscles and joints to the point where a pull is felt, but not to the point of pain. (One note of caution: Excess static stretching can decrease joint stability and increase the risk of injury. This may be a particular concern for women, whose joints are less stable and more flexible than men. ) The sample stretching program presented later in this chapter features static stretching exercises.

**Ballistic Stretching** In ballistic stretching, the muscles are stretched suddenly in a forceful bouncing movement. For example, touching the toes repeatedly in rapid succession is a ballistic stretch for the hamstrings. A problem with this technique is that the heightened activity of proprioceptors caused by the rapid stretches can continue for some time, possibly causing injuries during any physical activities that follow. Another concern is that triggering strong responses from the nerves can cause a reflex muscle contraction that makes it harder to stretch. For these reasons, ballistic stretching is usually not recommended, especially for people of average fitness.

Ballistic stretching trains the muscle dynamically, so it can be an appropriate stretching technique for some well-trained athletes. For example, tennis players stretch their hamstrings and quadriceps ballistically when they lunge for a ball during a...
DYNAMIC (FUNCTIONAL) STRETCHING The emphasis in dynamic stretching is on functional movements. Dynamic stretching is similar to ballistic stretching in that it includes movement, but it differs in that it does not involve rapid bouncing. Instead, dynamic stretching moves the joints in an exaggerated but controlled manner through the range of motion used in a specific exercise or sport; movements are fluid rather than jerky. An example of a dynamic stretch is the lunge walk, in which a person takes slow steps with an exaggerated stride length and reaches a lunge stretch position with each step.

Slow dynamic stretches can lengthen the muscles in many directions without developing high tension in the tissues. These stretches elongate the tissues and train the neuromuscular system. Because dynamic stretches are based on sports movements or movements used in daily life, they develop functional flexibility that translates well into activities.

Dynamic stretches are more challenging than static stretches because they require balance and coordination and may carry a greater risk of muscle soreness and injury. People just beginning a flexibility program might want to start off with static stretches and try dynamic stretches only after they are comfortable with static stretching and have improved their flexibility. It is also a good idea to seek expert advice on dynamic stretching technique and program development.

Functional flexibility training can be combined with functional strength training. For example, lunge curls, which combine dynamic lunges with free weights biceps curls, stretch the hip, thigh, and calf muscles; stabilize the core muscles in the trunk; and build strength in the arm muscles. Many activities build functional flexibility and strength at the same time, including yoga, Pilates, tai chi, Olympic weight lifting, plyometrics, stability training (including Swiss and Bosu ball exercises), medicine ball exercises, and functional training machines (for example, Life Fitness and Cybex).

PROPRIOCEPTIVE NEUROMUSCULAR FACILITATION (PNF) PNF techniques use reflexes initiated by both muscle and joint nerves to cause greater training effects. The most popular PNF stretching technique is the contract-relax stretching method, in which a muscle is contracted before it is stretched. The contraction activates proprioceptors, causing relaxation in the muscle about to be stretched. For example, in a seated stretch of calf muscles, the first step in PNF is to contract the calf muscles. The individual or a partner can provide resistance for an isometric contraction. Following a brief period of relaxation, the next step is to stretch the calf muscles by pulling the tops of the feet toward the body. A duration of three to six seconds for the contraction at 20 to 75% of maximum effort and 10–30 seconds for the stretch is recommended. PNF appears to be most effective if the individual pushes hard during the isometric contraction.

Another example of a PNF stretch is the contract-relax-contract pattern. In this technique, begin by contracting the muscle to be stretched and then relaxing it. Next, contract the opposing muscle (the antagonist). Finally, stretch the first muscle. For example, using this technique to stretch the hamstrings (the muscles in the back of the thigh) would require the following steps: Contract the hamstrings, relax the hamstrings, contract the quadriceps (the muscles in the front of the thigh), and then stretch the hamstrings.

PNF appears to allow more effective stretching and greater increases in flexibility than static stretching, but it tends to cause more muscle stiffness and soreness. It also usually requires a partner and takes more time.

PASSIVE VERSUS ACTIVE STRETCHING Stretches can be done either passively or actively. In passive stretching, an outside force or resistance provided by yourself, a partner, gravity, or a weight helps your joints move through their range of motion. For example, a seated stretch of the hamstring and back muscles can be done by reaching the hands toward the feet until a pull is felt in those muscles. You can achieve a greater range of motion (a more intense stretch) using passive stretching. However, because the stretch is not controlled by the muscles themselves, there is a greater risk of injury. Communication between partners in passive stretching is important to ensure that joints aren’t forced outside their normal functional range of motion.

In active stretching, a muscle is stretched by a contraction of the opposing muscle (the muscle on the opposite side of the limb). For example, an active seated stretch of the calf muscles occurs when a person actively contracts the muscles on the top of the shin. The contraction of this opposing muscle produces a reflex that relaxes the muscles to be stretched. The muscle can be stretched farther with a low risk of injury. The only disadvantage of active stretching is that a person may not be able to produce enough stress (enough stretch) to increase flexibility using only the contraction of opposing muscle groups.

In passive stretching (top), an outside force—such as pressure exerted by another person—helps move the joint and stretch the muscles. In active stretching (bottom), the force to move the joint and stretch the muscles is provided by a contraction of the opposing muscles.
The safest and most convenient technique is active static stretching, with an occasional passive assist. For example, you might stretch your calves both by contracting the muscles on the top of your shin and by pulling your feet toward you. This way you combine the advantages of active stretching—safety and the relaxation reflex—with those of passive stretching—greater range of motion. People who are just beginning flexibility training may be better off doing active rather than passive stretches. For PNF techniques, it is particularly important to have a knowledgeable partner.

Making Progress

As with any type of training, you will make progress and improve your flexibility if you stick with your program. Judge your progress by noting your body position while stretching. For example, note how far you can lean forward during a modified hurdler stretch. Repeat the assessment tests that appear in Lab 5.1 periodically and be sure to take the test at the same time of day each time. You will likely notice some improvement after only two to three weeks of stretching, but you may need at least two months to attain significant improvements. By then, you can expect flexibility increases of about 10–20% in many joints.

Exercises to Improve Flexibility: A Sample Program

There are hundreds of exercises that can improve flexibility. Your program should include exercises that work all the major joints of the body by stretching their associated muscle groups (refer back to Figure 5.2). The exercises on the following pages are simple to do and pose a minimum risk of injury. Use these exercises to create a well-rounded program for developing flexibility. Be sure to perform each stretch using the proper technique. Hold each position for 10–30 seconds and perform 2–4 repetitions of each exercise. Complete Lab 5.2 when you’re ready to start your program.

PREVENTING AND MANAGING LOW-BACK PAIN

More than 85% of Americans experience back pain by age 50. Low-back pain is the second most common ailment in the United States—headache tops the list—and the second most common reason for absences from work and visits to a physician. Low-back pain is estimated to cost as much as $50 billion a year in lost productivity, medical and legal fees, and disability insurance and compensation.

Back pain can result from sudden traumatic injuries, but it is more often the long-term result of weak and inflexible muscles, poor posture, or poor body mechanics during activities like lifting and carrying. Any abnormal strain on the back can result in pain. Most cases of low-back pain clear up within a few weeks or months, but some people have recurrences or suffer from chronic pain.

Function and Structure of the Spine

The spinal column performs many important functions in the body.

- It provides structural support for the body, especially the thorax (upper-body cavity).
- It surrounds and protects the spinal cord.
- It supports much of the body’s weight.
- It serves as an attachment site for a large number of muscles, tendons, and ligaments.
- It allows movement of the neck and back in all directions.

The spinal column is made up of bones called vertebrae that provide structural support to the body and protect the spinal cord (Figure 5.3). The spine consists of 7 cervical vertebrae in the neck, 12 thoracic vertebrae in the upper back, and 5 lumbar vertebrae in the lower back. The 9 vertebrae at the base of the spine are fused into two sections and form the sacrum.
FLEXIBILITY EXERCISES

EXERCISE 1  Head Turns and Tilts

Instructions:
- **Head turns**: Turn your head to the right and hold the stretch. Repeat to the left.
- **Head tilts**: Tilt your head to the right and hold the stretch. Repeat to the left.

Areas stretched: Neck

Variation: Place your right palm on your right cheek; try to turn your head to the right as you resist with your hand. Repeat on the left side.

EXERCISE 2  Towel Stretch

Instructions: Roll up a towel and grasp it with both hands, palms down. With your arms straight, slowly lift the towel back over your head as far as possible. The closer together your hands are, the greater the stretch.

Areas stretched: Triceps, shoulders, chest

Variation: Repeat the stretch with your arms down and the towel behind your back. Grasp the towel with your palms forward and thumbs pointing out. Gently raise your arms behind your back. This exercise can also be done without a towel.

EXERCISE 3  Across-the-Body and Overhead Stretches

Instructions: (a) Keeping your back straight, cross your right arm in front of your body and grasp it with your left hand. Stretch your arm, shoulders, and back by gently pulling your arm as close to your body as possible. Hold. (b) Bend your right arm over your head, placing your right elbow as close to your right ear as possible. Grasp your right elbow with your left hand over your head. Stretch the back of your arm by gently pulling your right elbow back and toward your head. Hold. Repeat both stretches on your left side.

Areas stretched: Shoulders, upper back, back of the arm (triceps)
## EXERCISE 4

### Upper-Back Stretch

**Instructions:** Stand with your feet shoulder-width apart, knees slightly bent, and pelvis tucked under. Lace your fingers in front of your body and press your palms forward.

**Areas stretched:** Upper back

**Variation:** In the same position, wrap your arms around your body as if you were giving yourself a hug.

## EXERCISE 5

### Lateral Stretch

**Instructions:** Stand with your feet shoulder-width apart, knees slightly bent, and pelvis tucked under. Raise one arm over your head and bend sideways from the waist. Support your trunk by placing the hand or forearm of your other arm on your thigh or hip for support. Be sure you bend directly sideways and don’t move your body below the waist. Repeat on the other side.

**Areas stretched:** Trunk muscles

**Variation:** Perform the same exercise in a seated position.

## EXERCISE 6

### Step Stretch

**Instructions:** Step forward and bend your forward knee, keeping it directly above your ankle. Stretch your other leg back so your shin is parallel to the floor. Press your hips forward and down to stretch. Your arms can be at your sides, on top of your knee, or on the ground for balance. Repeat on the other side.

**Areas stretched:** Hip, front of thigh (quadriceps)
**EXERCISE 7**

**Side Lunge**

**Instructions:** Stand in a wide straddle with your legs turned out from your hip joints and your hands on your thighs. Lunge to one side by bending one knee and keeping the other leg straight. Keep your bent knee directly over your ankle; do not bend it more than 90 degrees. Repeat on the other side.

**Areas stretched:** Inner thigh, hip, calf

**Variation:** In the same position, lift the heel of the bent knee to provide additional stretch. The exercise may also be performed with your hands on the floor for balance.

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**EXERCISE 8**

**Inner-Thigh Stretch**

**Instructions:** Sit on the floor with the soles of your feet together. Push your knees toward the floor using your hands or forearms.

**Areas stretched:** Inner thigh, hip

**Variation:** When you first begin to push your knees toward the floor, use your legs to resist the movement. Then relax and press your knees down as far as they will go.

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**EXERCISE 9**

**Hip and Trunk Stretch**

**Instructions:** Sit on the floor with your left leg straight, right leg bent and crossed over the left knee, and right hand on the floor next to your right hip. Turn your trunk as far as possible to the right by pushing against your right leg with your left forearm or elbow. Keep your right foot on the floor. Repeat on the other side.

**Areas stretched:** Trunk, outer thigh and hip, buttocks, lower back

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**EXERCISE 10**

**Modified Hurdler Stretch (Seated Single-Leg Hamstring)**

**Instructions:** Sit on the floor with your left leg straight and your right leg tucked close to your body. Reach toward your left ankle as far as possible. Repeat for the other leg.

**Areas stretched:** Back of the thigh (hamstring), lower back

**Variation:** As you stretch forward, alternately flex and point the foot of your extended leg.
EXERCISE 11  
**Leg Stretcher**

**Instructions:** Lie flat on your back with both legs straight. (a) Grasp your left leg behind the thigh, and pull it in to your chest. (b) Hold this position, and then bring your left knee back to your chest and pull your toes toward your shin with your left hand. Stretch the back of the leg by attempting to straighten your knee. Repeat for the other leg.

**Areas stretched:** Back of the thigh (hamstring), hip, knee, ankle, and buttocks

**Variation:** Perform the stretch on both legs at the same time.

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EXERCISE 12  
**Lower-Leg Stretch**

**Instructions:** Stand with one foot about one–two feet in front of the other, with both feet pointing forward. (a) Keeping your back leg straight, lunge forward by bending your front knee and pushing your rear heel backward. Hold. (b) Then pull your back foot in slightly and bend your back knee. Shift your weight to your back leg. Hold. Repeat on the other side.

**Areas stretched:** Back of the lower leg (calf, soleus, Achilles tendon)

**Variation:** Place your hands on a wall and extend one foot back, pressing your heel down to stretch, or stand with the balls of your feet on a step or bench and allow your heels to drop below the level of your toes.

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EXERCISE 13  
**Single-Leg Deadlift**

**Instructions:** Start with a dumbbell or kettlebell placed slightly outside the foot of one leg. Bend down to the weight by hinging at the hips and bending at the knee. Your other leg should be bent and relaxed. Pick up the weight and tighten your body and extend the hip and knee as you stand straight, locking out your hip and contracting your glute. Repeat with the other leg.

**Areas stretched:** This exercise stretches and loads the hamstrings and glute muscles both eccentrically and concentrically (lengthening and shortening contractions). 

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and the coccyx (tailbone). The spine has four curves: the cervical, thoracic, lumbar, and sacral curves (see Figure 5.3). These curves help bring the body weight supported by the spine in line with the axis of the body.

Although the structure of vertebrae depends on their location on the spine, the different types of vertebrae share common characteristics. Each consists of a body, an arch, and several bony processes (Figure 5.4). The vertebral body is cylindrical, with flattened surfaces where intervertebral disks are attached. The vertebral body is designed to carry the stress of body weight and physical activity. The vertebral arch surrounds and protects the spinal cord. Irregularly shaped bony outgrowths serve as joints for adjacent vertebrae and attachment sites for muscles and ligaments. Nerve roots from the spinal cord pass through notches in the vertebral arch.

Intervertebral disks, which absorb and disperse the stresses placed on the spine, separate vertebrae from one another. Disks are made up of a gel- and water-filled nucleus surrounded by a series of fibrous rings. The liquid nucleus can change shape when it is compressed, allowing the disk to absorb shock. The intervertebral disks also help maintain the spaces between vertebrae where the spinal nerve roots are located.

**Core Muscle Fitness**

The core muscles are the trunk muscles extending from the hips to the upper back, including those in the abdomen, pelvic floor, sides of the trunk, back, buttocks, hip, and pelvis (Figure 5.5). These muscles are attached to the ribs, hips, spinal column, and other bones in the trunk of the body. The core muscles stabilize the spine and help transfer force between the upper body and lower body. They stabilize the midsection when you sit, stand, reach, walk, jump, twist, squat, throw, or bend. The muscles on the front, back, and sides of your trunk support your spine when you sit in a chair and fix your midsection as you use your legs to stand up. When hitting a forehand in tennis or batting a softball, most of the force is transferred from the legs and hips, across the core muscles, to the arms. Strong core muscles make movements more forceful and help prevent back pain.

**FIGURE 5.4** Vertebrae and an intervertebral disk.

**FIGURE 5.5** Major core muscles.
During any dynamic movement, the core muscles work together. Some shorten to cause movement, while others contract and hold to provide stability, lengthen to brake the movement, or send signals to the brain about the movements and positions of the muscles and bones (proprioception). When specific core muscles are weak or tired, the nervous system steps in and uses other muscles. This substitution causes abnormal stresses on the joints, decreases power, and increases the risk of injury.

The best exercises for low-back health are whole-body exercises that force the core muscles to stabilize the spine in many directions. The low-back exercises presented later in this chapter include several exercises that focus on the core muscles, including the step stretch (lunge), side bridges, and spine extensions. These exercises are generally safe for beginning exercisers and, with physician approval, people who have some back pain. More challenging core exercises utilize stability balls or free weights. Stability ball exercises require the core muscles to stabilize the ball (and the body) while performing nearly any type of exercise. Many traditional exercises with free weights can strengthen the core muscles if you do them in a standing position. Weight machines train muscles in isolation, while exercises with free weights done while standing help train the body for real-world movements—an essential principle of core training.

**Causes of Back Pain**

Back pain can occur at any point along your spine. The lumbar area, because it bears the majority of your weight, is the most common site. Any movement that puts excessive stress on the spinal column can cause injury and pain. The spine is well equipped to bear body weight and the force or stress of body movements along its long axis. However, it is less capable of bearing loads at an angle to its long axis or when the trunk is flexed (bent). You do not have to carry a heavy load or participate in a vigorous contact sport to injure your back. Picking a pencil up from the floor while using poor body mechanics—reaching too far out in front of you or bending over with your knees straight, for example—can also result in back pain.

Risk factors associated with low-back pain include age greater than 34 years, degenerative diseases such as arthritis or osteoporosis, a family or personal history of back pain or trauma, a sedentary lifestyle, low job satisfaction, low socioeconomic status, excess body weight, smoking (which appears to hasten degenerative changes in the spine), and psychological stress or depression (which can cause muscle tension and back pain). Occupations and activities associated with low-back pain are those requiring physically hard work, such as frequent lifting, twisting, bending, standing up, or straining in forced positions; those requiring high concentration demands while seated (such as computer programming); and those involving vibrations affecting the entire body (such as truck driving).

Underlying causes of back pain include poor muscle endurance and strength in the core muscles; excess body weight; poor posture or body position when standing, sitting, or sleeping; and poor body mechanics when performing actions like lifting and carrying or sports movements. Strained muscles, tendons, or ligaments can cause pain and, over time, lead to injuries to vertebrae, intervertebral disks, and surrounding muscles and ligaments.

Physical stress can cause disks to break down and lose some of their ability to absorb shock. A damaged disk may bulge out between vertebrae and put pressure on a nerve root, a condition commonly referred to as a slipped disk. Painful pressure on nerves can also occur if damage to a disk narrows the space between two vertebrae. With age, you lose fluid from the disks, making them more likely to bulge and put pressure on nerve roots. Depending on the amount of pressure on a nerve, symptoms may include numbness in the back, hip, leg, or foot; radiating pain; loss of muscle function; depressed reflexes; and muscle spasm. If the pressure is severe enough, loss of function can be permanent.

**Preventing Low-Back Pain**

Incorrect posture is responsible for many back injuries. Strategies for maintaining good posture are presented in the box “Good Posture and Low-Back Health.” Follow the same guidelines when you engage in sports or recreational activities. Control your movements, and warm up thoroughly before you exercise. Take special care when lifting weights.

The role of exercise in preventing and treating back pain is still being investigated. However, many experts recommend exercise, especially for people who have already experienced an episode of low-back pain. The exercise can take the form of a workout aimed at increasing muscle endurance and strength in the back and abdomen or just regular lifestyle physical activity such as walking. Movement helps lubricate your spinal joints and increases muscle fitness in your trunk and legs. Other lifestyle recommendations for preventing back pain include the following:

- Maintain a healthy weight. Excess fat contributes to poor posture, which can place harmful stresses on the spine.
- Stop smoking, and reduce stress.
- Avoid sitting, standing, or working in the same position for too long. Stand up every hour or half-hour and move around.
- Use a supportive seat and a medium-firm mattress.
- Use lumbar support when driving, particularly for long distances, to prevent muscle fatigue and pain.
- Warm up thoroughly before exercising.
- Progress gradually when attempting to improve strength or fitness.

**Managing Acute Back Pain**

Sudden (acute) back pain usually involves tissue injury. Symptoms may include pain, muscle spasms, stiffness, and inflammation. Many cases of acute back pain go away by themselves within a few days or weeks. You may be able to reduce pain and inflammation by applying cold and then heat (see Chapter 3). Apply ice several times a day; once inflammation and spasms subside, you can apply heat using a heating pad or a warm bath. If the pain is bothersome, an over-the-counter
Changes in everyday posture and behavior can help prevent and alleviate low-back pain.

- **Lying down.** When resting or sleeping, lie on your side with your knees and hips bent. If you lie on your back, place a pillow under your knees. However, do not elevate your knees so much that the curve in your lower spine is flattened. Don’t lie on your stomach. Use a medium-firm mattress.

- **Sitting at a computer.** Sit in a slightly reclined position of 100–110 degrees, not an upright 90-degree position. Adjust your chair so your knees are slightly lower than your hips. If your back flattens as you sit, try using a lumbar roll to maintain your back’s natural curvature. Place your feet flat on the floor or on a footrest. Place the monitor directly in front of you and adjust it so your eyes are level with the top of the screen; you should be looking slightly downward at the middle of the screen. Adjust the keyboard and mouse so your forearms and wrists are in a neutral position, parallel with the floor.

- **Standing.** When you are standing, a straight line should run from the top of your ear through the center of your shoulder, the center of your hip, the back of your kneecap, and the front of your ankle bone. Support your weight mainly on your heels, with one or both knees slightly bent. Don’t let your pelvis tip forward or your back arch. Shift your weight back and forth from foot to foot. Avoid prolonged standing.

  To check your posture, stand normally with your back to a wall. Your upper back and buttocks should touch the wall; your heels may be a few inches away. Slide one hand into the space between your lower back and the wall. It should slide in easily but should almost touch both your back and the wall. Adjust your posture as needed, and try to hold this position as you walk away from the wall.

- **Lifting.** If you need to lower yourself to grasp an object, bend at the knees and hips rather than at the waist. Your feet should be about shoulder-width apart. Lift gradually, keeping your arms straight, by standing up or by pushing with your hip muscles. Keep the object close to your body. Don’t twist; if you have to turn with the object, change the position of your feet so that you pivot your body as a whole rather than twisting at your waist or shoulders.

- **Walking.** Walk with your toes pointed straight ahead. Keep your back flat, head up and centered over your body, and chin in. Swing your arms freely. Don’t wear tight or high-heeled shoes. Walking briskly is better for back health than walking slowly.
nonsteroidal anti-inflammatory medication such as ibuprofen or naproxen may be helpful. Stronger pain medications and muscle relaxants are available by prescription.

Bed rest immediately following the onset of back pain may make you feel better, but it should be of very short duration. Prolonged bed rest—five days or more—was once thought to be an effective treatment for back pain, but most physicians now advise against it because it may weaken muscles and actually worsen pain. Limit bed rest to one day and begin moderate physical activity as soon as possible. Exercise can increase muscular endurance and flexibility and protect disks from loss of fluid. Three of the back exercises discussed later in the chapter may be particularly helpful following an episode of acute back pain: curl-ups, side bridges, and spine extensions (“bird dogs”).

See your physician if acute back pain doesn’t resolve within a short time. Other warning signals of a more severe problem that requires a professional evaluation include severe pain, numbness, pain that radiates down one or both legs, problems with bladder or bowel control, fever, and rapid weight loss.

Managing Chronic Back Pain

Low-back pain is considered chronic if it persists for more than three months. Symptoms vary—some people experience stabbing or shooting pain, and others a steady ache accompanied by stiffness. Sometimes pain is localized; in other cases, it radiates to another part of the body. Underlying causes of chronic back pain include injuries, infection, muscle or ligament strains, and disk herniations.

Because symptoms and causes are so varied, different people benefit from different treatment strategies, and researchers have found that many treatments have only limited benefits. Potential treatments include over-the-counter or prescription medications; exercise; physical therapy, massage, yoga, or chiropractic care; acupuncture; percutaneous electrical nerve stimulation (PENS), in which acupuncture-like needles deliver an electrical current; education and advice about posture, exercise, and body mechanics; and surgery (see the box “Yoga for Relaxation and Pain Relief”).

Psychological therapy may also be beneficial in some cases. Reducing emotional stress that causes muscle tension can provide direct benefits, and other therapies can help people deal better with chronic pain and its effects on their daily lives. Support groups and expressive writing are beneficial for people with chronic pain and other conditions.

Exercises for the Prevention and Management of Low-Back Pain

The tests in Lab 5.3 can help you assess low-back muscular endurance. The exercises that follow are designed to help you maintain a healthy back by stretching and strengthening the major muscle groups that affect the back—the abdominal muscles, the muscles along your spine and sides, and the muscles of your hips and thighs. If you have back problems, check with your physician before beginning any exercise program. Perform the exercises slowly and progress very gradually. Stop and consult your physician if any exercise causes back pain. General guidelines for back exercise programs include the following:

- Do low-back exercises at least three days per week. Most experts recommend daily back exercises.
- Emphasize muscular endurance rather than muscular strength—endurance is more protective.
- Don’t do spine exercises involving a full range of motion early in the morning. Because your disks have a high fluid content early in the day, injuries may result.
- Engage in regular endurance exercise such as cycling or walking in addition to performing exercises that specifically build muscular endurance and flexibility. Brisk walking with a natural arm swing may help relieve back pain. Start with fast walking if your core muscles are weak or you have back pain.
- Be patient and stick with your program. Increased back fitness and pain relief may require as long as three months of regular exercise.
- The adage “no pain, no gain” does not apply to back exercises. Always use good form and stop if you feel pain.
- Build core stiffness through stabilization exercises because they strengthen muscles, improve muscular endurance, reduce low back pain, and boost sports performance. Greater core stiffness transfers strength and speed to the limbs, increases the load bearing capacity of the spine, and protects the internal organs during sports movements. When working on abdominal muscles, emphasize stabilization exercises, such as side-bridges, carry exercises, planks, bird-dogs, and the “stir-the-pot” exercise rather than spinal flexion exercises such as sit-ups. Poor performance on the spinal endurance labs (see pages 171–174) means that you are not training your abdominal muscles correctly.

TIPS FOR TODAY AND THE FUTURE

To improve and maintain your flexibility, perform stretches that work the major joints at least twice a week.

RIGHT NOW YOU CAN

- Stand up and stretch—do either the upper-back stretch or the across-the-body stretch shown in the chapter.
- Practice the recommended sitting and standing postures described in the chapter. If needed, adjust your chair or find something to use as a footrest.

IN THE FUTURE YOU CAN

- Build up your flexibility by incorporating more sophisticated stretching exercises into your routine.
- Increase the frequency of your flexibility workouts to five or more days per week.
- Increase the efficiency of your workouts by adding stretching exercises to the cool-down period of your endurance or strength workouts.
Exercise, such as yoga and tai chi, can provide relief from back pain, depending on the pain’s underlying cause. Effective exercises stretch the muscles and connective tissue in the hips, stabilize the spine, and strengthen and build endurance in the core muscles of the back and abdomen.

Yoga may be an option for many back pain sufferers because it offers a variety of exercises that target the spine and the core muscles. Yoga is an ancient practice involving slow, gentle movements performed with controlled breathing and focused attention. Yoga practitioners slowly move into a specific posture (called an asana) and hold the posture for up to 60 seconds. There are hundreds of asanas, many of which are easy to do and provide good stretches.

Yoga also involves simple breathing exercises that gently stretch the muscles of the upper back while helping the practitioner focus. Yoga experts say that breathing exercises not only encourage relaxation but also clear the mind and can help relieve mild to moderate pain. Yoga enthusiasts end their workouts energized and refreshed but calm and relaxed.

Many medical professionals now recommend yoga for patients with back pain, particularly asanas that arch and gently stretch the back, such as the cat pose (similar to the cat stretch shown on p. 156) and the child pose (shown here). These are basic asanas that most people can perform repeatedly and hold for a relatively long time.

Because asanas must be performed correctly to be beneficial, qualified instruction is recommended. For those with back pain, physicians advise choosing an instructor who is not only accomplished in yoga but also knowledgeable about back pain and its causes. Such instructors can steer students away from exercises that do more harm than good. It is especially important to choose postures that will benefit the back without worsening the underlying problem. Some asanas can aggravate an injured or painful back if they are performed incorrectly or too aggressively. In fact, people with back pain should avoid a few yoga postures, such as a standing forward bend.

If you have back pain, see your physician to determine its cause before beginning any type of exercise program. Even gentle exercise or stretching can be bad for an already injured back, especially if the spinal disks or nerves are involved. For some back conditions, rest or therapy may be a better option than exercise, at least in the short term.

**Wellness Tip** When practicing yoga, it is important to choose postures, such as this child pose, that will benefit the back without worsening the underlying problem. Some asanas can aggravate an injured or painful back if they are performed incorrectly or too aggressively. In fact, people with back pain should avoid a few yoga postures, such as a standing forward bend.

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**SUMMARY**

- Flexibility, the ability of a joint to move through its full range of motion, is highly adaptable and specific to each joint.
- Range of motion can be limited by joint structure, muscle inelasticity, and proprioceptor activity.
- Developing flexibility depends on stretching the elastic tissues within muscles regularly and gently until they lengthen. Overstretching can make connective tissue brittle and lead to rupture.
- Signals sent between muscle and tendon nerves and the spinal cord can enhance flexibility.
- The benefits of flexibility include preventing abnormal stresses that lead to joint deterioration and possibly reducing the risk of injuries.
- Stretches should be held for 10–30 seconds and performed with 2–4 repetitions. Flexibility training should be done a minimum of two–three days per week, preferably following activity, when muscles are warm.
- Static stretching is slow and held to the point of mild tension; ballistic stretching, consisting of bouncing stretches, can lead to injury.
- Dynamic stretching moves joints slowly and fluidly through their range of motions. Proprioceptive neuromuscular facilitation uses muscle receptors in contracting and relaxing a muscle.
- Passive stretching, using an outside force to move muscles and joints, achieves a greater range of motion (and has a higher injury risk) than active stretching, which uses opposing muscles to initiate a stretch.
- The spinal column consists of vertebrae separated by intervertebral disks. It provides structure and support for the body and protects the spinal cord. The core muscles stabilize the spine and transfer force between the upper and lower body.
- Acute back pain can be treated as a soft tissue injury, with cold treatment followed by application of heat (once swelling subsides); prolonged bed rest is not recommended. A variety of treatments have been suggested for chronic back pain, including regular exercise, physical therapy, acupuncture, education, and psychological therapy.
- In addition to good posture, proper body mechanics, and regular physical activity, a program for preventing low-back pain includes exercises that develop flexibility, strength, and endurance in the muscle groups that affect the lower back.
EXERCISE 1  
Cat Stretch

**Instructions:** Begin on all fours with your knees below your hips and your hands below your shoulders. Slowly and deliberately move through a cycle of extension and flexion of your spine. (a) Begin by slowly pushing your back up and dropping your head slightly until your spine is extended (rounded). (b) Then slowly lower your back and lift your chin slightly until your spine is flexed (relaxed and slightly arched). *Do not press at the ends of the range of motion.* Stop if you feel pain. Do 10 slow, continuous cycles of the movement.

**Target:** Improved flexibility, relaxation, and reduced stiffness in the spine.

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EXERCISE 2  
Step Stretch (See Exercise 6 in the flexibility program, p. 148)

**Instructions:** Hold each stretch for 10–30 seconds and do 2–4 repetitions on each side.

**Target:** Improved flexibility, strength, and endurance in the muscles of the hip and the front of the thigh.

---

EXERCISE 3  
Leg Stretcher (See Exercise 11 in the flexibility program, p. 150)

**Instructions:** Hold each stretch for 10–30 seconds and do 2–4 repetitions on each side.

**Target:** Improved flexibility in the back of the thigh, hip, knee, and buttocks.

---

EXERCISE 4  
Trunk Twist

**Instructions:** Lie on your side with top knee bent, lower leg straight, lower arm extended in front of you on the floor, and upper arm at your side. Push down with your upper knee while you twist your trunk to the opposite side. Try to get your shoulders and upper body flat on the floor, turning your head as well. Return to the starting position, and then repeat on the other side. Hold the stretch for 10–30 seconds and do 2–4 repetitions on each side.

**Target:** Improved flexibility in the lower back and sides.
## EXERCISE 5
**Curl-Up (See Exercise 4 in the body weight program in Chapter 4, p. 111)**

**Instructions:** Lie on your back with one or both knees bent and arms crossed on your chest or hands under your lower back. Maintain a neutral spine. Tuck your chin in and slowly curl up, one vertebra at a time, as you use your abdominal muscles to lift your head first and then your shoulders. Stop when you can see your knees and hold for 5–10 seconds before returning to the starting position. Do 10 or more repetitions.

**Target:** Improved strength and endurance in the abdomen

**Variation:** Add a twist to develop other abdominal muscles. When you have curled up so that your shoulder blades are off the floor, twist your upper body so that one shoulder is higher than the other; reach past your knee with your upper arm. Hold and then return to the starting position. Repeat on the opposite side. Curl-ups can also be done using an exercise ball.

## EXERCISE 6
**Isometric Side Bridge (See Exercise 6 in the body weight program in Chapter 4, p. 112)**

**Instructions:** Hold the bridge position for 10 seconds, breathing normally. Work up to a 60-second hold. Perform one or more repetitions on each side.

**Target:** Increased strength and endurance in the muscles along the sides of the abdomen

**Variation:** You can make the exercise more difficult by keeping your legs straight and supporting yourself with your feet and forearm (see Lab 5.3) or with your feet and hand (with elbow straight).

## EXERCISE 7
**Spine Extensions (“Bird dogs”; see Exercise 5 in the body weight program in Chapter 4, p. 112)**

**Instructions:** Hold each position for 10–30 seconds. Begin with one repetition on each side, and work up to several repetitions.

**Target:** Increased strength and endurance in the back, buttocks, and back of the thighs

**Variation:** If you have experienced back pain in the past or if this exercise is difficult for you, do the exercise with both hands on the ground rather than with one arm lifted. You can make this exercise more difficult by doing it balancing on an exercise ball. Find a balance point on your chest while lying face down on the ball with one arm and the opposite leg on the ground. Tense your abdominal muscles while reaching and extending with one arm and reaching and extending with the opposite leg. Repeat this exercise using the other arm and leg.

## EXERCISE 8
**Wall Squat (Phantom Chair)**

**Instructions:** Lean against a wall and bend your knees as though you are sitting in a chair. Support your weight with your legs. Begin by holding the position for 5–10 seconds. Squeeze your gluteal muscles together as you do the exercise. Build up to one minute or more. Perform one or more repetitions.

**Target:** Increased strength and endurance in the lower back, thighs, and abdomen
EXERCISE 9  Pelvic Tilt

**Instructions:** Lie on your back with knees bent and arms extended to the side. Tilt your pelvis under and try to flatten your lower back against the floor. Tighten your buttck and abdominal muscles while you hold this position for 5–10 seconds. Don’t hold your breath. Work up to 10 repetitions of the exercise. Pelvic tilts can also be done standing or leaning against a wall. **Note:** Although this is a popular exercise with many therapists, some experts question the safety of pelvic tilts. Stop if you feel pain in your back at any time during the exercise.

**Target:** Increased strength and endurance in the abdomen and buttocks

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EXERCISE 10  Back Bridge

**Instructions:** Lie on your back with knees bent and arms extended to the side. Tuck your pelvis under; contract your gluteal muscles; then lift your tailbone, buttocks, and lower back from the floor. Hold this position for 5–10 seconds with your weight resting on your feet, arms, and shoulders, and then return to the starting position. Work up to 10 repetitions of the exercise.

**Target:** Increased strength and endurance in the hips and buttocks

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EXERCISE 11  Stir the Pot

**Instructions:** Assume a plank position on an exercise ball, with forearms on the ball and legs extended to the rear. Maintaining a stiff torso and neutral spine, rotate on the ball in a clockwise direction for 10 repetitions and then repeat in a counterclockwise direction for 10 repetitions.

**Target:** Increased strength and endurance in the core muscles and shoulders.

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EXERCISE 12  Kettlebell or Dumbbell Carry (Suitcase Carry; see Exercise 11 in the body weight program in Ch. 4, p. 118)

**Instructions:** This is an excellent exercise for building the core muscles. Pick up a dumbbell or kettlebell in one or both hands. Maintaining good posture, walk 20 to 100 yards carrying the weights. Carry 10 to several hundred pounds, depending on your fitness.

**Target:** Core muscles, trapezius, leg and hip muscles

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158  CHAPTER 5  FLEXIBILITY AND LOW-BACK HEALTH
FOR FURTHER EXPLORATION

American Academy of Orthopaedic Surgeons. Provides information about a variety of joint problems.
http://orthoinfo.aaos.org

Back Fit Pro. A website maintained by Dr. Stuart McGill, a professor of spine biomechanics at the University of Waterloo, which provides evidence-based information on preventing and treating back pain.
http://www.backfitpro.com

CUErgo: Cornell University Ergonomics Website. Provides information about how to arrange a computer workstation to prevent back pain and repetitive strain injuries, as well as other topics related to ergonomics.
http://ergo.human.cornell.edu

FIFA 11+. Provides information about a specialized warm-up and conditioning programming that includes dynamic stretches; designed to reduce injuries among soccer players.
http://f-marc.com/11plus/home

Georgia State University: Flexibility. Provides information about the benefits of stretching and ways to develop a safe and effective program; includes illustrations of stretches.
http://www2.gsu.edu/~wwwfit/flexibility.html

International Yoga Federation. A good resource for yoga organizations around the world.
http://www.internationalyogafederation.net

Mayo Clinic: Focus on Flexibility. Presents an easy-to-use program of basic stretching exercises for beginners, with a focus on the benefits of greater flexibility.
http://www.mayoclinic.com/health/stretching/HQ01447

NIH Back Pain Fact Sheet. Provides basic information on the prevention and treatment of back pain.

Southern California Orthopedic Institute. Provides information on a variety of orthopedic problems, including back injuries; also has illustrations of spinal anatomy.
http://www.scoi.com

Stretching and Flexibility. Provides information on the physiology of stretching and different types of stretching exercises.
http://www.ifafitness.com/stretch/stretch5.htm

See also the listings for Chapters 2 and 4.


LAB 5.1 Assessing Your Current Level of Flexibility

Part I Sit-and-Reach Test

Equipment
Use a modified Wells and Dillon flexometer or construct your own measuring device using a firm box or two pieces of wood about 30 centimeters (12 inches) high attached at right angles to each other. Attach a metric ruler to measure the extent of reach. With the low numbers of the ruler toward the person being tested, set the 26-centimeter mark of the ruler at the footline of the box. Individuals who cannot reach as far as the footline will have scores below 26 centimeters; those who can reach past their feet will have scores above 26 centimeters. Most studies show no relationship between performance on the sit-and-reach test and the incidence of back pain.

Preparation
Warm up your muscles with a low-intensity activity such as walking or easy jogging. Then perform slow stretching movements.

Instructions
1. Remove your shoes and sit facing the flexibility measuring device with your knees fully extended and your feet flat against the device about 10 centimeters (4 inches) apart.
2. Reach as far forward as you can, with palms down, arms evenly stretched, and knees fully extended; hold the position of maximum reach for about two seconds.
3. Perform the stretch 2 times, recording the distance of maximum reach to the nearest 0.5 centimeters:

       cm

Rating Your Flexibility
Find the score in the table below to determine your flexibility rating. Record it here and on the final page of this lab.

Rating: ________

Ratings for Sit-and-Reach Test

<table>
<thead>
<tr>
<th>Age</th>
<th>Needs Improvement</th>
<th>Fair</th>
<th>Good</th>
<th>Very Good</th>
<th>Excellent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15–19</td>
<td>Below 24</td>
<td>24–28</td>
<td>29–33</td>
<td>34–38</td>
<td>Above 38</td>
</tr>
<tr>
<td>40–49</td>
<td>Below 18</td>
<td>18–23</td>
<td>24–28</td>
<td>29–34</td>
<td>Above 34</td>
</tr>
<tr>
<td>60–69</td>
<td>Below 15</td>
<td>15–19</td>
<td>20–24</td>
<td>25–32</td>
<td>Above 32</td>
</tr>
<tr>
<td>Women</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15–19</td>
<td>Below 29</td>
<td>29–33</td>
<td>34–37</td>
<td>38–42</td>
<td>Above 42</td>
</tr>
<tr>
<td>20–29</td>
<td>Below 28</td>
<td>28–32</td>
<td>33–36</td>
<td>37–40</td>
<td>Above 40</td>
</tr>
<tr>
<td>40–49</td>
<td>Below 25</td>
<td>25–29</td>
<td>30–33</td>
<td>34–37</td>
<td>Above 37</td>
</tr>
<tr>
<td>60–69</td>
<td>Below 23</td>
<td>23–26</td>
<td>27–30</td>
<td>31–34</td>
<td>Above 34</td>
</tr>
</tbody>
</table>

*Footline is set at 26 cm.

LABORATORY ACTIVITIES

Part II Range-of-Motion Assessment

This portion of the lab can be completed by doing visual comparisons or by measuring joint range of motion with a goniometer or other instrument.

Equipment

1. A partner to do visual comparisons or to measure the range of motion of your joints. (You can also use a mirror to perform your own visual comparisons.)
2. For the measurement method, you need a goniometer, flexometer, or other instrument to measure range of motion.

Preparation

Warm up your muscles with some low-intensity activity such as walking or easy jogging.

Instructions

On the following pages, the average range of motion is illustrated and listed quantitatively for some of the major joints. Visually assess the range of motion in your joints, and compare it to that shown in the illustrations. For each joint, note (with a check mark) whether your range of motion is above average, average, or below average and in need of improvement. Average values for range of motion are given in degrees for each joint in the assessment. You can also complete the assessment by measuring your range of motion with a goniometer, flexometer, or other instrument. If you are using this measurement method, identify your rating (above average, average, or below average) and record your range of motion in degrees next to the appropriate category. Although the measurement method is more time-consuming, it allows you to track the progress of your stretching program more precisely and to note changes within the broader ratings categories (below average, above average).

Record your ratings on the following pages and on the chart on the final page of this lab. (Ratings were derived from several published sources.)

1. Shoulder Abduction and Adduction

For each position and arm, check one of the following; fill in degrees if using the measurement method.

**Shoulder abduction**—raise arm up to the side.  
**Shoulder adduction**—move arm down and in front of body.

<table>
<thead>
<tr>
<th>Right</th>
<th>Left</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Below average/needs improvement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average (92–95°)</td>
<td>Average (124–127°)</td>
<td></td>
</tr>
<tr>
<td>Above average</td>
<td>Above average</td>
<td></td>
</tr>
</tbody>
</table>

Assessment of range of motion using a goniometer
2. Shoulder Flexion and Extension

For each position and arm, check one of the following; fill in degrees if using the measurement method.

**Shoulder flexion**—raise arm up in front of the body.

<table>
<thead>
<tr>
<th>Right</th>
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<tbody>
<tr>
<td></td>
<td>Below average/needs improvement</td>
</tr>
<tr>
<td></td>
<td>Average (92–95°)</td>
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<tr>
<td></td>
<td>Above average</td>
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</table>

**Shoulder extension**—move arm down and behind the body.

<table>
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<th>Right</th>
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<tbody>
<tr>
<td></td>
<td>Below average/needs improvement</td>
</tr>
<tr>
<td></td>
<td>Average (145–150°)</td>
</tr>
<tr>
<td></td>
<td>Above average</td>
</tr>
</tbody>
</table>

3. Trunk/Low-Back Lateral Flexion

Bend directly sideways at your waist. To prevent injury, keep your knees slightly bent, and support your trunk by placing your hand or forearm on your thigh. Check one of the following for each side; fill in degrees if using the measurement method.

<table>
<thead>
<tr>
<th>Right</th>
<th>Left</th>
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<tbody>
<tr>
<td></td>
<td>Below average/needs improvement</td>
</tr>
<tr>
<td></td>
<td>Average (36–40°)</td>
</tr>
<tr>
<td></td>
<td>Above average</td>
</tr>
</tbody>
</table>
4. Hip Abduction

Raise your leg to the side at the hip. Check one of the following for each leg; fill in degrees if using the measurement method.

<table>
<thead>
<tr>
<th>Right</th>
<th>Left</th>
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<tbody>
<tr>
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</tbody>
</table>

5. Hip Flexion (Bent Knee)

With one leg flat on the floor, bend the other knee and lift the leg up at the hip. Check one of the following for each leg; fill in degrees if using the measurement method.

<table>
<thead>
<tr>
<th>Right</th>
<th>Left</th>
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<tbody>
<tr>
<td></td>
<td></td>
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</tbody>
</table>

6. Hip Flexion (Straight Leg)

With one leg flat on the floor, raise the other leg at the hip, keeping both legs straight. Take care not to put excess strain on your back. Check one of the following for each leg; fill in degrees if using the measurement method.

<table>
<thead>
<tr>
<th>Right</th>
<th>Left</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>
7. Ankle Dorsiflexion and Plantar Flexion

For each position and foot, check one of the following; fill in degrees if using the measurement method.

*Ankle dorsiflexion*—pull your toes toward your shin.

<table>
<thead>
<tr>
<th>Joint/Assessment</th>
<th>Right</th>
<th>Left</th>
<th>Below average/needs improvement</th>
<th>Average (9–13)</th>
<th>Above average</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Shoulder abduction and adduction</td>
<td></td>
<td></td>
<td>Abduction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Shoulder flexion and extension</td>
<td></td>
<td></td>
<td>Adduction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Trunk/low-back lateral flexion</td>
<td></td>
<td></td>
<td>Flexion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Hip abduction</td>
<td></td>
<td></td>
<td>Extension</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Hip flexion (bent knee)</td>
<td></td>
<td></td>
<td>Flexion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Hip flexion (straight leg)</td>
<td></td>
<td></td>
<td>Abduction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Ankle dorsiflexion and plantar flexion</td>
<td></td>
<td></td>
<td>Dorsiflexion</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Plantar flexion</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Plantar flexion*—point your toes.

<table>
<thead>
<tr>
<th>Joint/Assessment</th>
<th>Right</th>
<th>Left</th>
<th>Below average/needs improvement</th>
<th>Average (50–55)</th>
<th>Above average</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Shoulder abduction and adduction</td>
<td></td>
<td></td>
<td>Below average/needs improvement</td>
<td>Average (50–55)</td>
<td>Above average</td>
</tr>
<tr>
<td>2. Shoulder flexion and extension</td>
<td></td>
<td></td>
<td>Average (50–55)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Trunk/low-back lateral flexion</td>
<td></td>
<td></td>
<td>Average (50–55)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Hip abduction</td>
<td></td>
<td></td>
<td>Average (50–55)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Hip flexion (bent knee)</td>
<td></td>
<td></td>
<td>Average (50–55)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Hip flexion (straight leg)</td>
<td></td>
<td></td>
<td>Average (50–55)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Ankle dorsiflexion and plantar flexion</td>
<td></td>
<td></td>
<td>Average (50–55)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Rating Your Flexibility**

Sit-and-reach test: Score: __________ cm Rating: __________

**Range-of-Motion Assessment**

Identify your rating for each joint on each side of the body. If you used the comparison method, put check marks in the appropriate categories; if you measured range of motion, enter the degrees for each joint in the appropriate category.
LABORATORY ACTIVITIES

Using Your Results

*How did you score?* Do your scores for the flexibility tests surprise you? Are you satisfied with your current ratings?

If you’re not satisfied, set a realistic goal for improvement:

Are you satisfied with your current level of flexibility as expressed in your daily life—for example, your ability to maintain good posture and move easily and without pain?

If you’re not satisfied, set some realistic goals for improvement:

*What should you do next?* Enter the results of this lab in the Preprogram Assessment column in Appendix C. If you’ve set goals for improvement, begin planning your flexibility program by completing the plan in Lab 5.2. After several weeks of your program, complete this lab again and enter the results in the Post-program Assessment column of Appendix C. How do the results compare?
LAB 5.2  Creating a Personalized Program for Developing Flexibility

1. Goals. List goals for your flexibility program. On the left, include specific, measurable goals that you can use to track the progress of your fitness program. These goals might be things like raising your sit-and-reach score from fair to good or your bent-leg hip flexion rating from below average to average. On the right, include long-term and more qualitative goals, such as reducing your risk for back pain.

<table>
<thead>
<tr>
<th>Specific Goals: Current Status</th>
<th>Final Goals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Other Goals:</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. Exercises. The exercises in the program plan below are from the general stretching program presented in Chapter 5. You can add or delete exercises depending on your needs, goals, and preferences. For any exercises you add, fill in the areas of the body affected.

3. Frequency. A minimum frequency of two–three days per week is recommended; five–seven days per week is ideal. You may want to do your stretching exercises the same days you plan to do cardiorespiratory endurance exercise or weight training because muscles stretch better following exercise, when they are warm.

4. Intensity. All stretches should be done to the point of mild discomfort, not pain.

5. Time/Duration. All stretches should be held for 10–30 seconds. (PNF techniques should include a 6-second contraction followed by a 10–30-second assisted stretch.) All stretches should be performed 2–4 times, for a total of 60 seconds per exercise.

**Program Plan for Flexibility**

<table>
<thead>
<tr>
<th>Exercise</th>
<th>Areas Stretched</th>
<th>Frequency (check ✓)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head turns and tilts</td>
<td>Neck</td>
<td>M ✓ T ✓ W ✓ Th ✓ F ✓ Sa ✓ Su ✓</td>
</tr>
<tr>
<td>Towel stretch</td>
<td>Triceps, shoulders, chest</td>
<td></td>
</tr>
<tr>
<td>Across-the-body and overhead stretches</td>
<td>Shoulders, upper back, back of the arm</td>
<td></td>
</tr>
<tr>
<td>Upper-back stretch</td>
<td>Upper back</td>
<td></td>
</tr>
<tr>
<td>Lateral stretch</td>
<td>Trunk muscles</td>
<td></td>
</tr>
<tr>
<td>Step stretch</td>
<td>Hip, front of thigh</td>
<td></td>
</tr>
<tr>
<td>Side lunge</td>
<td>Inner thigh, hip, calf</td>
<td></td>
</tr>
<tr>
<td>Inner-thigh stretch</td>
<td>Inner thigh, hip</td>
<td></td>
</tr>
<tr>
<td>Hip and trunk stretch</td>
<td>Trunk, outer thigh and hip, lower back</td>
<td></td>
</tr>
<tr>
<td>Modified hurdler stretch</td>
<td>Back of the thigh, lower back</td>
<td></td>
</tr>
<tr>
<td>Leg stretcher</td>
<td>Back of the thigh, hip, knee, ankle, buttocks</td>
<td></td>
</tr>
<tr>
<td>Lower-leg stretch</td>
<td>Back of the lower leg</td>
<td></td>
</tr>
<tr>
<td>Single-leg deadlift</td>
<td>Hamstrings and gluteal muscles</td>
<td></td>
</tr>
</tbody>
</table>

You can monitor your program using a chart like the one on the next page.
**Laboratory Activities**

**Flexibility Program Chart**

Fill in the dates you perform each stretch, the number of seconds you hold each stretch (should be 10–30), and the number of repetitions of each (should be 2–4). For an easy check on the duration of your stretches, count “one thousand one, one thousand two,” and so on. You will probably find that over time you’ll be able to hold each stretch longer (in addition to being able to stretch farther).

<table>
<thead>
<tr>
<th>Exercise/Date</th>
<th>Duration</th>
<th>Reps</th>
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<tbody>
<tr>
<td></td>
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</tbody>
</table>
LAB 5.3  Assessing Muscular Endurance for Low-Back Health

The four tests in this lab evaluate the muscular endurance of major spine-stabilizing muscles. These tests are the trunk flexor endurance test, back extensor endurance test, side bridge endurance test, and the front plank endurance test.

Trunk Flexor Endurance Test (also called the V-sit–Flexor Endurance Test)

Equipment
1. Stopwatch or clock with a second hand
2. Exercise mat or padded exercise table
3. Two helpers
4. A wedge angled at 55 degrees from the floor or padded bench (optional)

Preparation
Warm up with some low-intensity activity such as walking or easy jogging.

Instructions
1. To start, assume a sit-up posture with your back supported at an angle of 55 degrees from the floor; support can be provided by a wedge, a padded bench, or a spotter (see photos). Your knees and hips should both be flexed at 90 degrees, and your arms should be folded across your chest with your hands placed on the opposite shoulders. Your toes should be secured under a toe strap or held by a partner.
2. Your goal is to hold the starting position (isometric contraction) as long as possible after the support is pulled away. To begin the test, a helper should pull the wedge or other support back about 10 centimeters (4 inches). The helper should keep track of the time; if a spotter is acting as your support, she or he should be ready to support your weight as soon as your torso begins to move back. Your final score is the total time you are able to hold the contraction—from the time the support is removed until any part of your back touches the support or you request to discontinue the test. Remember to breathe normally throughout the test.
3. Record your time here and on the chart at the end of the lab. Trunk flexors endurance time: ________________ sec

Back Extensor Endurance Test (also called the Biering-Sorensen extension test)

Equipment
1. Stopwatch or clock with a second hand
2. Extension bench with padded ankle and hip support or any padded bench
3. Partner

Preparation
Warm up with some low-intensity activity such as walking or easy jogging.

Instructions
1. Lie face down on the test bench with your upper body extending out over the end of the bench and your pelvis, hips, and knees flat on the bench. Your arms should be folded across your chest with your hands placed on the opposite shoulders. Your legs and hips should be secured under padded straps or held by a partner.
2. Your goal is to hold your upper body in a straight horizontal line with your lower body as long as possible. Keep your neck straight and neutral; don’t raise your head and don’t arch your back. Breathe normally. Your partner should keep track of the time and watch your form. Your final score is the total time you are able to hold the horizontal position—from the time you assume the position until your upper body drops from the horizontal position.

3. Record your time here and on the chart below. Back extensors endurance time: _________________ sec

**Side Bridge Endurance Test**

**Equipment**

1. Stopwatch or clock with a second hand
2. Exercise mat
3. Partner

**Preparation**

Warm up your muscles with some low-intensity activity such as walking or easy jogging. Practice assuming the side bridge position described below.

**Instructions**

1. Lie on the mat on your side with your legs extended. Place your top foot in front of your lower foot for support. Lift your hips off the mat so you are supporting yourself on one elbow and your feet (see photo). Your body should maintain a straight line. Breathe normally; don’t hold your breath.
2. Hold the position as long as possible. Your partner should keep track of the time and make sure that you maintain the correct position. Your final score is the total time you are able to hold the side bridge with correct form—from the time you lift your hips until your hips return to the mat.
3. Rest for five minutes and then repeat the test on the other side. Record your times here and on the chart at the end of the lab.
   - Right side bridge time: _________________ sec
   - Left side bridge time: _________________ sec

**Front Plank Test**

**Equipment**

1. Stopwatch or clock with a second hand
2. Exercise mat
3. Partner

**Preparation**

Warm up your muscles with some low-intensity activity such as walking or easy jogging. Practice assuming the front plank position described below.

**Instructions**

1. Assume a front plank position by lying on your front and then lifting your hips, supporting your weight on your forearms and toes and keeping the torso rigid (see photo). Your body should maintain a straight line; keep your hands together and elbows directly under your shoulders. Breathe normally and don’t hold your breath.
2. Hold the position as long as possible. Your partner should keep track of the time and make sure that you maintain the correct position. Your final score is the total time you are able to hold the front plank with correct form—from the time you lift your hips until your hips return to the mat.
3. Record your time here and on the chart at the end of the lab. Front plank time: _________________ sec
Rating Your Test Results for Muscular Endurance for Low-Back Health

The table below shows percentiles for torso endurance tests for healthy young college students, ages 17 to 25, based on a study of 181 university students. Compare your scores with the times shown in the table. Your percentile on each test tells you the percent of the students in the study scored at or below your score.

Percentiles Ranks for Torso Muscle Endurance Tests for College-Age Men and Women (age 17–25)

<table>
<thead>
<tr>
<th>Percentiles</th>
<th>Trunk flexor test (sec)</th>
<th>Back extensor test (sec)</th>
<th>Side bridge test, right (sec)</th>
<th>Side bridge test, left (sec)</th>
<th>Front plank test (sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men</td>
<td>Women</td>
<td>Men</td>
<td>Women</td>
<td>Men</td>
<td>Women</td>
</tr>
<tr>
<td>99%</td>
<td>276</td>
<td>246</td>
<td>193</td>
<td>130</td>
<td>400</td>
</tr>
<tr>
<td>95%</td>
<td>234</td>
<td>208</td>
<td>164</td>
<td>112</td>
<td>336</td>
</tr>
<tr>
<td>90%</td>
<td>211</td>
<td>188</td>
<td>149</td>
<td>102</td>
<td>302</td>
</tr>
<tr>
<td>85%</td>
<td>196</td>
<td>174</td>
<td>140</td>
<td>96</td>
<td>280</td>
</tr>
<tr>
<td>80%</td>
<td>184</td>
<td>163</td>
<td>131</td>
<td>91</td>
<td>261</td>
</tr>
<tr>
<td>75%</td>
<td>174</td>
<td>154</td>
<td>124</td>
<td>86</td>
<td>245</td>
</tr>
<tr>
<td>70%</td>
<td>164</td>
<td>145</td>
<td>118</td>
<td>83</td>
<td>231</td>
</tr>
<tr>
<td>65%</td>
<td>156</td>
<td>138</td>
<td>113</td>
<td>79</td>
<td>219</td>
</tr>
<tr>
<td>60%</td>
<td>148</td>
<td>130</td>
<td>107</td>
<td>76</td>
<td>206</td>
</tr>
<tr>
<td>55%</td>
<td>140</td>
<td>123</td>
<td>102</td>
<td>72</td>
<td>195</td>
</tr>
<tr>
<td>50%</td>
<td>132</td>
<td>116</td>
<td>97</td>
<td>69</td>
<td>183</td>
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<tr>
<td>45%</td>
<td>124</td>
<td>109</td>
<td>92</td>
<td>66</td>
<td>171</td>
</tr>
<tr>
<td>40%</td>
<td>117</td>
<td>102</td>
<td>87</td>
<td>63</td>
<td>160</td>
</tr>
<tr>
<td>35%</td>
<td>108</td>
<td>94</td>
<td>81</td>
<td>59</td>
<td>147</td>
</tr>
<tr>
<td>30%</td>
<td>100</td>
<td>87</td>
<td>76</td>
<td>55</td>
<td>135</td>
</tr>
<tr>
<td>25%</td>
<td>90</td>
<td>78</td>
<td>70</td>
<td>52</td>
<td>121</td>
</tr>
<tr>
<td>20%</td>
<td>80</td>
<td>69</td>
<td>63</td>
<td>47</td>
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</tr>
<tr>
<td>15%</td>
<td>68</td>
<td>58</td>
<td>54</td>
<td>42</td>
<td>86</td>
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<tr>
<td>10%</td>
<td>53</td>
<td>44</td>
<td>45</td>
<td>36</td>
<td>64</td>
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<tr>
<td>5%</td>
<td>30</td>
<td>24</td>
<td>30</td>
<td>26</td>
<td>30</td>
</tr>
<tr>
<td>1%</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>8</td>
<td>0</td>
</tr>
</tbody>
</table>

**NOTE:** The percentiles were based on data collected on 181 university kinesiology students ages 17–25. The results might not be representative of other populations.


Record Your Scores

<table>
<thead>
<tr>
<th>Test</th>
<th>Time</th>
<th>Percentile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trunk Flexor Test</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Back Extensor Test</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Side Bridge Test, right side</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Side Bridge Test, left side</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Front Plank Test</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
LABORATORY ACTIVITIES

Using Your Results

How did you score? Are you surprised by your scores for the low-back tests? Are you satisfied with your current ratings?

If you’re not satisfied, set a realistic goal for improvement. The norms in this lab are based on healthy young adults, so a score above the mean may or may not be realistic for you. Instead, you may want to set a specific goal based on time rather than rating; for example, set a goal of improving your time by 10%. Imbalances in muscular endurance have been linked with back problems, so if your rating is significantly lower for one of the four tests, you should focus particular attention on that area of your body.

Goal:

What should you do next? Enter the results of this lab in the Preprogram Assessment column in Appendix C. If you’ve set a goal for improvement, begin a program of low-back exercises such as that suggested in this chapter. After several weeks of your program, complete this lab again and enter the results in the Post-Program Assessment column of Appendix C. How do the results compare?
LOOKING AHEAD...

After reading this chapter, you should be able to
- Define fat-free mass and body fat, and describe their functions in the body.
- Explain how body composition affects overall health and wellness.
- Describe how body mass index, body composition, and body fat distribution are measured and assessed.
- Explain how to determine recommended body weight and body fat distribution.

TEST YOUR KNOWLEDGE

1. Exercise helps reduce the risks associated with overweight and obesity even if it doesn’t result in improvements in body composition. True or false?

2. Which of the following is the most significant risk factor for the most common type of diabetes (type 2 diabetes)?
   a. smoking
   b. low-fiber diet
   c. overweight or obesity
   d. inactivity

3. In women, excessive exercise and low energy (calorie) intake can cause which of the following?
   a. unhealthy reduction in body fat levels
   b. amenorrhea (absent menstruation)
   c. bone density loss and osteoporosis
   d. muscle wasting and fatigue

See answers on the next page.
Body composition, the body’s relative amounts of fat and fat-free mass, is an important component of fitness for health and wellness. People with an optimal body composition tend to be healthier, to move more efficiently, and to feel better about themselves. They also have a lower risk of many chronic diseases.

Many people, however, don’t succeed in their efforts to obtain a fit and healthy body because they set unrealistic goals and emphasize short-term weight loss rather than permanent lifestyle changes that lead to fat loss and a healthy body composition. Successful management of body composition requires the long-term, consistent coordination of many aspects of a wellness program. Even in the absence of changes in body composition, an active lifestyle improves wellness and decreases the risk of disease and premature death (see the box “Why Is Physical Activity Important Even If Body Composition Doesn’t Change?”).

This chapter focuses on defining and measuring body composition. The aspects of lifestyle that affect body composition are discussed in detail in other chapters: physical activity and exercise in Chapters 2–5 and 7, nutrition in Chapter 8, weight management in Chapter 9, and stress management in Chapter 10.

**WHAT IS BODY COMPOSITION, AND WHY IS IT IMPORTANT?**

The human body can be divided into fat-free mass and body fat. As defined in Chapter 2, fat-free mass comprises all the body’s nonfat tissues: bone, water, muscle, connective tissue, organ tissues, and teeth.

Body fat is incorporated into the nerves, brain, heart, lungs, liver, mammary glands, and other body organs and tissues. A certain amount of body fat is necessary for the body to function. It is the main source of stored energy in the body; it also cushions body organs and helps regulate body temperature. This essential fat makes up about 3–5% of total body weight in men and about 8–12% in women (Figure 6.1). The percentage is higher in women due to fat deposits in the breasts, uterus, and other gender-specific sites.

Most of the fat in the body is stored in fat cells, or adipose tissue, located under the skin (subcutaneous fat) and around major organs (visceral fat or intra-abdominal fat). People have a genetically determined number of fat cells, but these cells can become larger or smaller depending on how much fat is being stored. The amount of stored fat depends on several factors, including age, gender, metabolism, diet, and activity level. The primary source of excess body fat is excess calories consumed in the diet—that is, calories consumed beyond what are expended in metabolism, physical activity, and exercise. A pound of body fat is equal to 3500 calories, so an intake of just 100 calories a day in excess of calories expended will result in a 10-pound weight gain over the course of a year. Excess stored body fat is associated with increased risk of chronic diseases like diabetes and cardiovascular disease, as described later in this chapter.

---

**Answers (Test Your Knowledge)**

1. True. Regular physical activity provides protection against the health risks of overweight and obesity. It lowers the risk of death for people who are overweight or obese as well as for those at a normal weight.

2. c. All four are risk factors for diabetes, but overweight/obesity is the most significant. It’s estimated that 90% of cases of type 2 diabetes could be prevented if people adopted healthy lifestyle behaviors.

3. All four. Very low levels of body fat, and the behaviors used to achieve them, have serious health consequences for both men and women.
Physical activity is important for health even if it produces no changes in body composition—that is, even if a person remains overweight or obese. Physical activity confers benefits no matter how much you weigh; conversely, physical inactivity operates as a risk factor for health problems independently of body composition.

Regular physical activity and exercise block many of the destructive effects of obesity. For example, physical activity improves blood pressure, blood glucose levels, cholesterol levels, and body fat distribution. It also lowers the risk of cardiovascular disease, diabetes, and premature death. Although physical activity and exercise produce these improvements quickly in some people and slowly in others, due to genetic differences, the improvements do occur. Physical activity is particularly important for the many people who have metabolic syndrome or prediabetes, both of which are characterized by insulin resistance. Exercise encourages the body’s cells to take up and use insulin efficiently for converting nutrients into usable energy. Being physically inactive for just one day decreases the capacity of the cells to take up and use blood sugar. Exercise makes fat cells fit by improving the function of their mitochondria (powerhouses of the cell) and decreasing inflammation.

Although being physically active and not being sedentary may sound identical, experts describe them as different dimensions of the same health issue. Data suggest that it is important not only to be physically active but also to avoid prolonged sitting. In one study, people who watched TV or used a computer four or more hours a day had twice the risk of having metabolic syndrome as those who spent less than one hour a day in these activities; other studies reported similar results. Thus, in addition to increasing physical activity, avoiding or reducing sedentary behavior is an important—and challenging—health goal.

Physical activity, then, is important even if it doesn’t change body composition. But at a certain level, physical activity and exercise do improve body composition (meaning less fat and more lean muscle mass). Evidence supports a dose-response relation between exercise and fat loss: The more you exercise, the more fat you will lose. This includes both total body fat and abdominal fat. In addition, the more body fat a person has, the greater the loss of abdominal fat with exercise. Studies show that, even without calorie reduction, walking 150 minutes per week at a pace of four miles per hour, or jogging 75 minutes a week at six miles per hour, decreases total fat and abdominal fat and improves metabolic health.

Studies also show, however, that combining exercise with an appropriate reduction in calories is an even better way to reduce levels of body fat and increase lean muscle mass. The results of combining exercise and calorie reduction may not show up as expected on the scale because the weight of body fat lost is partially offset by the weight of muscle mass gained. Still, your body composition, physical fitness, and overall health have improved.

The question is sometimes asked: Which is more important in combating the adverse health effects of obesity—physical activity or physical fitness? Many studies suggest that both are important; the more active and fit you are, the lower your risk of having health problems and dying prematurely. Of the two, however, physical activity appears to be more important for health than physical fitness.

**Overweight and Obesity Defined**

When looking at body composition, the most important consideration is the proportion of the body’s total weight that is fat—the **percent body fat**. For example, two women may both be 5 feet, 5 inches tall and weigh 130 pounds. But one woman may have only 15% of her body weight as fat, whereas the other woman could have 34% body fat. Although neither woman is overweight by most standards, the second woman is considered overfat. Too much body fat (not just total weight) has a negative effect on health and well-being. Just as the amount of body fat is important, so is its location on your body. Visceral fat is more harmful to health than subcutaneous fat.

**Overweight** is usually defined as total body weight above the recommended range for good health as determined by large-scale population surveys. **Obesity** is defined as a more serious degree of overweight that carries multiple major health risks. The cutoff point for obesity may be set in terms of percent body fat or in terms of some measure of total body weight.
Prevalence of Overweight and Obesity among Americans

Americans are getting fatter. Since 1960, the average American man’s weight has increased from 166 to 196 pounds, and the average American woman’s weight has increased from 140 to 166 pounds. The prevalence of obesity has increased from about 13% in 1960 to 27.7–34.9% today—depending on whether measures are self-reported or measured by healthcare professionals. By any measure, 62–69% of Americans are overweight (Figures 6.2 and 6.3). In 2012, according to the National Health and Nutrition Examination Survey (NHANES), about 33.5% of adult men and 36.1% of adult women were obese. The general trend recorded by NHANES since 1960 has been for a significant overall increase in the proportion of Americans who are above the normal weight classification defined by body mass index (see Figure 6.2).

Looking at how self-reported obesity rates have changed in recent years, certain demographic patterns are clear, including higher rates of obesity in certain geographic regions (Midwest) and among people with lower income. Between 2008 and 2014, increases in self-reported obesity rates were lowest among Hispanics, young adults, and blacks (see Figure 6.3). However, the self-reported obesity rate among blacks is higher than in most groups, at 35.5%. Obesity rates increased most among middle-aged and older adults.

Possible explanations for this increase include more time spent in sedentary work and leisure activities, fewer short trips on foot and more by automobile, fewer daily gym classes for students, more meals eaten outside the home, greater consumption of fast food, increased portion sizes, and increased consumption of soft drinks and convenience foods. According to NHANES, energy intake increased from 1955 calories per day in 1971 to 2269 calories per day in 2003 and then declined to 2195 calories per day in 2010. In spite of this decline, overweight and obesity rates have continued to increase. People are not losing weight because they are doing less daily physical activity.

Excess Body Fat and Wellness

As rates of overweight and obesity increase, so do the problems associated with them. Obesity doubles mortality rates and can reduce life expectancy by 10–20 years. In fact, if the current trends in overweight and obesity (and their related health problems) continue, scientists believe the average American’s life expectancy will soon decline by five years.

Metabolic Syndrome and Premature Death

Many overweight and obese people—especially those who are sedentary and eat a poor diet—suffer from a group of symptoms called metabolic syndrome (or insulin resistance syndrome). Metabolic syndrome is diagnosed if a person has at least 3 out of 5 of these key factors: large waistline (fat deposits in the abdominal region), high blood pressure, high fasting blood sugar, high triglycerides, and low HDL (“good” cholesterol). Associated conditions include chronic inflammation, erectile dysfunction, and fatty liver disease. Metabolic syndrome increases the risk of heart disease, more so in men than in women. According to the American Heart Association, about 34% of adult Americans have metabolic syndrome.

Obesity is also associated with increased risk of death from many types of cancer. Other health problems associated with

![Figure 6.2: Trends in overweight and obesity in adults age 20–74, by sex, in the United States, 1960–2012.](image)
Obesity can affect psychological as well as physical wellness. Being perceived as fat can be a source of judgment, ostracism, and sometimes discrimination by others; it can contribute to psychological problems such as depression, anxiety, and low self-esteem.

The popular image of the “ideal” body has changed greatly in the past 50 years, evolving from slightly plump to unhealthily thin. The ideal body—as presented by the media—is an unrealistic goal for most Americans. This is because one’s ability to change body composition depends on heredity as well

### TERMS

**metabolic syndrome** A cluster of symptoms present in many overweight and obese people that greatly increases their risk of heart disease, diabetes, and other chronic illnesses; symptoms include insulin resistance, abnormal blood fats, abdominal fat deposition, type 2 diabetes, high blood pressure, and high blood glucose.

**chronic inflammation** A response of blood vessels to harmful substances, such as germs, damaged cells, or irritants; can lead to heart disease, cancer, allergies, and muscle degeneration.

**fatty liver** Increased fat storage in the liver that can lead to liver inflammation and failure.

### Body Fat Distribution and Health

The distribution of body fat (the locations of fat on the body) is also an important indicator of health. Men and postmenopausal women tend to store fat in the upper regions of their bodies, particularly in the abdominal area (the “apple shape”). Premenopausal women usually store fat in the hips, buttocks, and thighs (the “pear shape”). Excess fat in the abdominal area increases risk of high blood pressure, diabetes, early-onset heart disease, stroke, certain cancers, and mortality. The reason for this increase in risk is not entirely clear, but it appears that abdominal fat is more easily mobilized and sent into the bloodstream, increasing disease-related blood fat levels.

A measure of waist circumference helps assess the risks of unhealthy body fat distribution. A total waist measurement of more than 40 inches (102 cm) for men and more than 35 inches (88 cm) for women is associated with a significantly increased risk of disease. In the United States, waist circumference increased by about 1 inch in men and women between 1999 and 2010.

Waist circumference tends to be higher in taller people, so waist-to-height ratio is a more accurate measure than waist circumference alone. Your waist measurement should be less than half your height. Using this index, a person who is 5 feet 8 inches (68 inches) tall should have a waist circumference of less than 34 inches. A person who is 6 feet 4 inches (76 inches) tall should have a waist circumference of less than 38 inches.

**Performance of Physical Activities** Too much body fat makes physical activity difficult because moving the body through everyday activities entails working harder and using more energy. In general, overfat people are less fit than others and don’t have the muscular strength, endurance, and flexibility that make normal activity easy. Because exercise is more difficult, they do less of it, depriving themselves of an effective way to improve body composition.

**Emotional Wellness and Self-Image** Obesity can affect psychological as well as physical wellness. Being perceived as fat can be a source of judgment, ostracism, and sometimes discrimination by others; it can contribute to psychological problems such as depression, anxiety, and low self-esteem.

### FIGURE 6.3 Percentage of self-reported obesity (BMI ≥ 30) among various demographic groups, adults 18 and older, in the United States, 2008 and 2014. The self-reported values differ from those collected by the CDC, but the trend toward increasing obesity in nearly all groups is clear. The association between obesity and lower income is particularly strong. Since 2008, the largest increases in obesity rates were among older adults, adults aged 45–64, those living in the Midwest, and women. Source: Data from Jenna Levy. January 26, 2015. U.S. obesity rate inches up to 27% in 2014. Gallup-Healthways Well-Being Index. http://www.gallup.com/poll/181271/obesity-rate-inches-2014.aspx.
as diet and exercise. Body image, problems with body image, and unhealthy ways of dealing with a negative body image are all discussed in Chapter 9. We need to change popular perceptions so that active obese people are regarded as more fit, and normal-weight sedentary people as less fit.

### Diabetes and Excess Body Fat

Even mild to moderate overweight is associated with a substantial increase in the risk of type 2 diabetes. Obese people are more than three times as likely as nonobese people to develop type 2 diabetes, and the incidence of this disease among Americans has increased dramatically as the rate of obesity has climbed (see the depiction of diabetes on page T3-5 of the color transparency insert “Touring the Cardiorespiratory System” in Chapter 3).

*Diabetes mellitus* is a disease that disrupts normal metabolism. The pancreas normally secretes the hormone insulin, which stimulates cells to take up glucose (blood sugar) to produce energy. Diabetes interferes with this process, causing a buildup of glucose in the bloodstream. Diabetes is associated with kidney failure; nerve damage; circulation problems; retinal damage and blindness; and increased rates of heart attack, stroke, and hypertension. Diabetes is currently the seventh leading cause of death in the United States.

#### Types of Diabetes

About 29.1 million Americans (9.3% of the population) have one of two major forms of diabetes—more than double the number of people affected in 1995. About 5–10% of people with diabetes have the more serious form, known as *type 1 diabetes*. In this type of diabetes, the pancreas produces little or no insulin, which means a person can lapse into a coma. Daily doses of insulin are required, and other medications to control blood sugar levels and other complications of the disease may also be necessary. Type 1 diabetes usually strikes before age 30.

The remaining 90–95% of Americans with diabetes have *type 2 diabetes*. This condition can develop slowly, and about 25% of affected individuals are unaware of their condition. In type 2 diabetes, the pancreas doesn’t produce enough insulin, cells are resistant to insulin, or both. This condition is usually diagnosed in people over age 40, although there has been a tenfold increase in type 2 diabetes in children in the past two decades. About one-third of people with type 2 diabetes must take insulin; others may take medications that increase insulin production or stimulate cells to take up glucose.

A third type of diabetes occurs in 2–10% of women during pregnancy. *Gestational diabetes* usually disappears after pregnancy, but 5–10% of women with gestational diabetes go on to have type 2 diabetes immediately after pregnancy. Women who had gestational diabetes during pregnancy have up to a 60% chance of developing diabetes within 10–20 years.

The term *prediabetes* describes blood glucose levels that are higher than normal but not high enough for a diagnosis of full-blown diabetes. According to a 2014 estimate from the American Diabetes Association, about 86 million Americans have prediabetes. Experts warn that most people with the condition will develop type 2 diabetes unless they adopt preventive lifestyle measures.

The major factors involved in the development of diabetes are age, obesity, physical inactivity, a family history of diabetes, and lifestyle. Excess body fat reduces cell sensitivity to insulin, and insulin resistance is usually a precursor of type 2 diabetes. Ethnicity also plays a role. According to the Centers for Disease Control and Prevention (CDC), the rate of diagnosed diabetes cases is highest among Native Americans and Alaska Natives, followed by blacks, Hispanics, Asian Americans, and white Americans. Across all races, about 26% of Americans age 65 and older have diabetes, either diagnosed or undiagnosed.

#### Treatment

There is no cure for diabetes, but it can be managed successfully by keeping blood sugar levels within safe limits through diet, exercise, and, if necessary, medication. Blood sugar levels can be monitored with a home test; close control of glucose levels can significantly reduce the rate of serious complications.

Nearly 90% of people with type 2 diabetes are overweight when diagnosed, including 55% who are obese. An important step in treatment is to lose weight. Even a small amount of exercise and weight loss can be beneficial. Regular exercise and a healthy diet are often sufficient to control type 2 diabetes.

#### Prevention

It is estimated that 90% of cases of type 2 diabetes could be prevented if people adopted healthy lifestyle behaviors, including regular physical activity, a moderate diet, and modest weight loss. For people with prediabetes, lifestyle measures are more effective than medication for delaying or preventing the development of diabetes. Studies of people with prediabetes show that a 5–7% weight loss can lower diabetes onset by nearly 60%. Exercise
Even while obesity is at epidemic levels in the United States, many girls and women strive for unrealistic thinness in response to pressure from peers and a society obsessed with appearance. This quest for thinness has led to an increasingly common, under-reported condition called the female athlete triad.

The triad consists of three interrelated disorders: abnormal eating patterns (and excessive exercising), followed by lack of menstrual periods (amenorrhea), followed by decreased bone density (premature osteoporosis). Left untreated, the triad can lead to decreased physical performance, reproductive problems, increased incidence of bone fractures, disturbances of heart rhythm and metabolism, and even death.

Abnormal eating leads to the other two components of the triad. Abnormal eating ranges from moderately restricting food intake, to binge eating and purging (bulimia), to severely restricting food intake (anorexia nervosa). Whether serious or relatively mild, eating disorders prevent women from getting enough calories to meet their bodies’ needs.

Disordered eating, combined with intense exercise and emotional stress, can suppress the hormones that control the menstrual cycle. If the menstrual cycle stops for three consecutive months, the condition is called amenorrhea. Prolonged amenorrhea can lead to osteoporosis. Bone density may erode to the point that a woman in her twenties has the bone density of a woman in her sixties. Women with osteoporosis have fragile, easily fractured bones. Some researchers have found that even a few missed menstrual periods can decrease bone density.

All physically active women and girls have the potential to develop one or more components of the female athlete triad. For example, it is estimated that 5–20% of women who exercise regularly and vigorously may develop amenorrhea. But the triad is most prevalent among athletes who participate in certain sports: those in which appearance is highly important, those that emphasize a prepubertal body shape, those that require contour-revealing clothing for competition, those that require weight categories for participation. Such sports include gymnastics, figure skating, swimming, distance running, cycling, cross-country skiing, track, volleyball, rowing, horse racing, and cheerleading.

The female athlete triad can be life-threatening. Typical signs of the eating disorders that trigger the condition are extreme weight loss, dry skin, loss of hair, brittle fingernails, cold hands and feet, low blood pressure and heart rate, swelling around the ankles and hands, and weakening of the bones. Female athletes who have repeated stress fractures may be suffering from the condition.

Early intervention is the key to stopping this series of interrelated conditions. Unfortunately, once the condition has progressed, long-term consequences, especially bone loss, are unavoidable. Teenagers may need only to learn about good eating habits; college-age women with a long-standing problem may require psychological counseling.


(Endurance and/or strength training) makes cells more sensitive to insulin and helps stabilize blood glucose levels; it also helps keep body fat at healthy levels.

A moderate diet to control body fat is perhaps the most important dietary recommendation for the prevention of diabetes. However, the composition of the diet may also be important. Studies have linked diets low in fiber and high in sugar, refined carbohydrates, saturated fat, red meat, and high-fat dairy products to increased risk of diabetes. Specific foods linked to higher diabetes risk include soft drinks, white bread, white rice, French fries, processed meats, and sugary desserts. Diets rich in whole grains, fruits, vegetables, legumes, fish, and poultry may be protective.

female athlete triad A condition consisting of three interrelated disorders: abnormal eating patterns (and excessive exercising) followed by lack of menstrual periods (amenorrhea) and decreased bone density (premature osteoporosis).
**Warning Signs and Testing** Be alert for the warning signs of diabetes:

- Frequent urination
- Extreme hunger or thirst
- Unexplained weight loss
- Extreme fatigue
- Blurred vision
- Frequent infections
- Cuts and bruises that are slow to heal
- Tingling or numbness in the hands or feet
- Generalized itching with no rash

The best way to avoid complications is to recognize these symptoms and get early diagnosis and treatment. Because type 2 diabetes is often asymptomatic in the early stages, major health organizations now recommend routine screening for people over age 45 and anyone younger who is at high risk, including those who are obese.

Screening involves a blood test to check glucose levels after either a period of fasting or the administration of a set dose of glucose. A fasting glucose level of 126 mg/dl or higher indicates diabetes; a level of 100–125 mg/dl indicates prediabetes. If you are concerned about your risk for diabetes, talk with your physician about being tested.

**Problems Associated with Very Low Levels of Body Fat**

Though not as prevalent a problem as overweight or obesity, having too little body fat is also dangerous. Essential fat is necessary for the functioning of the body, and health experts generally view too little body fat—less than 8–12% for women and 3–5% for men—as a threat to health. Extreme thinness is linked with reproductive, respiratory, circulatory, and immune system disorders and with premature death. Extremely lean people may experience muscle wasting and fatigue. They are also more likely to have eating disorders (described in more detail in Chapter 9). For women, an extremely low percentage of body fat is associated with loss of bone mass and amenorrhea—absent or infrequent menstruation (see the box “The Female Athlete Triad”). In older adults, having a low level of lean body mass is a better predictor of premature death than BMI.

**ASSESSING BODY MASS INDEX, BODY COMPOSITION, AND BODY FAT DISTRIBUTION**

Although a scale can tell your total weight, it can’t reveal whether a fluctuation in weight is due to a change in muscle, body water, or fat. Most important, a scale can’t differentiate between overweight and overfat. Some methods of assessing and classifying body composition are based on body fat and others on total body weight. Methods based on total body weight are less accurate, but they are commonly used because body weight is easier to measure than body fat. (Various methods of assessing body composition are described later in the chapter.)

In the past, many people relied on height/weight tables (which were based on insurance company mortality statistics) to determine whether they were at a healthy weight. Such tables, however, can be highly inaccurate for some people. Because muscle tissue is denser and heavier than fat, a fit person can easily weigh more than the recommended weight on a height/weight table. For the same reason, an unfit person may weigh less than the table’s recommended weight.

There are a number of simple, inexpensive ways to estimate healthy body weight and healthy body composition. These assessments can provide you with information about the health risks associated with your current body weight and body composition. They can also help you establish reasonable goals and set a starting point for current and future decisions about weight loss and weight gain.

**Calculating Body Mass Index**

Body mass index (BMI) is useful for classifying the health risks of body weight if you don’t have access to more sophisticated methods. Though more accurate than height-weight tables, body mass index is also based on the concept that weight should be proportional to height. BMI is easy to calculate and rate. Researchers frequently use BMI in conjunction with waist circumference in studies that examine the health risks associated with body weight.

BMI is calculated by dividing your body weight (expressed in kilograms) by the square of your height (expressed in meters). The following example is for a person who is 5 feet, 3 inches tall (63 inches) and weighs 130 pounds:

1. Divide body weight in pounds by 2.2 to convert weight to kilograms:
   \[ 130 \div 2.2 = 59.1 \]

2. Multiply height in inches by 0.0254 to convert height to meters:
   \[ 63 \times 0.0254 = 1.6 \]

3. Multiply the result of step 2 by itself to get the square of the height measurement:
   \[ 1.6 \times 1.6 = 2.56 \]
4. Divide the result of step 1 by the result of step 3 to determine BMI:
   \[ \frac{59.1}{2.56} = 23 \]

An alternative equation, based on pounds and inches, is

\[ \text{BMI} = \frac{\text{weight} \times \text{height}}{703} \]

Space for your own calculations can be found in Lab 6.1, and a complete BMI chart appears in Lab 6.2.

A BMI between 18.5 and 24.9 is considered normal and desirable under separate standards from the National Institutes of Health (NIH) and the World Health Organization (WHO). A person with a BMI of 25 or above is classified as overweight, and someone with a BMI of 30 or above is classified as obese (Table 6.1). A person with a BMI below 18.5 is classified as underweight, although low BMI values may be healthy in some cases if they are not the result of smoking, an eating disorder, or an underlying disease. A BMI of 17.5 or less is sometimes used as a diagnostic criterion for the eating disorder anorexia nervosa (Chapter 9).

A meta-analysis from the National Center for Health Statistics, pooling data from studies of nearly 3 million people, found that those with severe obesity (BMI greater than 34.9) had a higher death rate from all causes than did people with normal weight (BMI = 18.5–24.9). However, overweight people (BMI = 25–29.9) had a lower all-cause death rate than normal weight people, and moderately obese people (BMI = 30–34.9) had similar death rates to normal weight people. These controversial results showed that there are problems associated with using BMI to predict health and longevity. Other factors, such as amount of physical activity, lean mass, level of stress, dietary composition, and social factors, might account for the results.

Fat percentage varies for people with a given BMI. In the NHANES, for example, people with BMIs less than 25 had fat percentages ranging from 10% to nearly 32%. Factors influencing fat percentage at a given BMI included age, race, gender, and physical activity.

In classifying the health risks associated with overweight and obesity, the NIH and WHO guidelines consider body fat distribution and other disease risk factors in addition to BMI. As described earlier, excess fat in the abdomen is of greater concern than excess fat in other areas. Measurement of waist circumference (see Table 6.1) is one method of assessing body fat distribution. At a given level of overweight, people with a large waist circumference and/or additional disease risk factors are at risk for health problems. For example, a man with a BMI of 27, a waist circumference of more than 40 inches, and high blood pressure is at greater risk for health problems than another man who has a BMI of 27 but a smaller waist circumference and no other risk factors.

Thus, optimal BMI for good health depends on many factors; if your BMI is 25 or above, consult a physician for help in determining a healthy BMI for you. While BMI and waist circumference are important measures of health, they must be considered with other factors such as high blood pressure, diabetes, blood fats, and insulin resistance.

Because BMI doesn’t distinguish between fat weight and fat-free weight, it is inaccurate for some groups. For example, athletes who weight train have more muscle mass—and thus weigh more—than average people and may be classified as overweight by the BMI scale. Because their “excess” weight is in the form of muscle, however, it is healthy. Further, BMI is not particularly useful for tracking changes in body composition—gains in muscle mass and losses of fat. BMI also does not take into account differences in gender; women are likely to have more body fat for a given BMI than men. BMI measurements have also over- and underestimated the prevalence of obesity in several ethnic groups, such as Hispanics and blacks, because of racial and ethnic differences in muscle mass and muscle density. Finally, BMI is a poor predictor of health in people short in stature, whose gene function may have been altered by environmental factors early in life. If you are an athlete, a serious weight trainer, or a person of short stature, do not use BMI as your primary means of assessing whether your current weight is healthy. Instead, try one of the methods described in the next section for estimating percent body fat.

### Estimating Percent Body Fat

Assessing body composition involves estimating percent body fat. Unfortunately, an autopsy—the dissection and chemical analysis of the body—is the only method for directly measuring the percentage of body weight that is fat. However, there

<table>
<thead>
<tr>
<th>Table 6.1</th>
<th>Classifications from the World Health Organization</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Body Mass Index (BMI) Classifications</strong></td>
<td><strong>BODY MASS INDEX</strong></td>
</tr>
<tr>
<td>WEIGHT STATUS CLASSIFICATION</td>
<td>UNDERWEIGHT</td>
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<tr>
<td>&lt;18.5</td>
<td>&lt;16.0</td>
</tr>
</tbody>
</table>

**Waist Circumference Classifications**

<table>
<thead>
<tr>
<th>RISK CLASSIFICATION</th>
<th>WOMEN</th>
<th>MEN</th>
</tr>
</thead>
<tbody>
<tr>
<td>NORMAL</td>
<td>&lt;32 in. (80 cm)</td>
<td>&lt;37 in. (94 cm)</td>
</tr>
<tr>
<td>INCREASED</td>
<td>≥32 in. (80 cm)</td>
<td>≥37 in. (94 cm)</td>
</tr>
<tr>
<td>SUBSTANTIALLY INCREASED</td>
<td>≥35 in. (88 cm)</td>
<td>≥40 in. (102 cm)</td>
</tr>
</tbody>
</table>

are indirect techniques that can provide an estimate of percent body fat. One of the most accurate is underwater weighing. Other techniques include skinfold measurements, the Bod Pod, bioelectrical impedance analysis, and dual-energy X-ray absorptiometry.

All of these methods have a margin of error, so it is important not to focus too much on precise values. For example, underwater weighing has a margin of error of about ±3%, meaning that if a person’s percent body fat is actually 17%, the test result could range from 14–20%. The results of different methods may also vary. If you plan to track changes in body composition over time, be sure to perform the assessment using the same method each time. See Table 6.2 for body composition ratings based on percent body fat as a criterion for obesity. It should be noted, however, that the National Institutes of Health has not developed an official standard linking body fat percentage with obesity.

**Underwater Weighing** In hydrostatic (underwater) weighing, an individual is submerged and weighed under water. The percentages of fat and fat-free weight are calculated from body density. Muscle has a higher density and fat a lower density than water. Therefore, people with more body fat tend to float and weigh less under water, and lean people tend to sink and weigh more under water. Many university exercise physiology departments or sports medicine laboratories have an underwater weighing facility. For an accurate assessment of your body composition, find a place that does underwater weighing or has a BodPod (described in the next section).

**The Bod Pod** The Bod Pod, a small chamber containing computerized sensors, measures body composition by air displacement. The technique’s technical name is plethysmography. It determines the percentage of fat by calculating body density from how much air is displaced by the person sitting inside the chamber. The Bod Pod has an error rate of about ±2–4% in determining percent body fat.

**Skinfold Measurements** Skinfold measurement is a simple, inexpensive, and practical way to assess body composition. Equations can link the thickness of skinfolds at various sites to percent body fat calculations from more precise laboratory techniques.

Skinfold assessment typically involves measuring the thickness of skinfolds at several different places on the body. You can sum the skinfold values as an indirect measure of body fatness. For example, if you plan to create a fitness (and dietary change) program to improve body composition, you can compare the sum of skinfold values over time as an indicator of your program’s progress and of improvements in body composition. You can also plug your skinfold values into equations like those in Lab 6.1 that predict percent body fat. When using these equations, however, remember that they have a fairly substantial margin of error (±4% if performed by a skilled technician), so don’t focus too much on specific values. The sum represents only a relative measure of body fatness.

Skinfolds are measured with a device called a caliper, which is a pair of spring-loaded, calibrated jaws. High-quality calipers are made of metal and have parallel jaw surfaces and constant spring tension. Inexpensive plastic calipers are also available, but you need to make sure they are spring-loaded and have metal jaws to ensure accuracy. Refer to Lab 6.1 for instructions on how to take skinfold measurements.

Taking accurate measurements with calipers requires patience, experience, and considerable practice. It’s best to take several measurements at each site (or have several different people take each measurement). Be sure to take the measurements in the exact location called for in the procedure. Because the

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Table 6.2 Percent Body Fat Classification

<table>
<thead>
<tr>
<th>PERCENT BODY FAT (%)</th>
<th>Women</th>
<th>Men</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>YEARS</td>
<td>YEARS</td>
</tr>
<tr>
<td>Essential*</td>
<td>20–39</td>
<td>20–39</td>
</tr>
<tr>
<td>Low/athletic**</td>
<td>20–39</td>
<td>20–39</td>
</tr>
<tr>
<td>Recommended</td>
<td>20–39</td>
<td>20–39</td>
</tr>
<tr>
<td>Overfat</td>
<td>20–39</td>
<td>20–39</td>
</tr>
<tr>
<td>Obese</td>
<td>20–39</td>
<td>20–39</td>
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<table>
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<th>PERCENT BODY FAT (%)</th>
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<tbody>
<tr>
<td></td>
<td>YEARS</td>
<td>YEARS</td>
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<tr>
<td>Essential*</td>
<td>40–59</td>
<td>40–59</td>
</tr>
<tr>
<td>Low/athletic**</td>
<td>40–59</td>
<td>40–59</td>
</tr>
<tr>
<td>Recommended</td>
<td>40–59</td>
<td>40–59</td>
</tr>
<tr>
<td>Overfat</td>
<td>40–59</td>
<td>40–59</td>
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<tr>
<td>Obese</td>
<td>40–59</td>
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<table>
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<th>PERCENT BODY FAT (%)</th>
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<td>60–79</td>
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<tr>
<td>Essential*</td>
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<tr>
<td>Low/athletic**</td>
<td>60–79</td>
<td>60–79</td>
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<td>Recommended</td>
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</tr>
<tr>
<td>Obese</td>
<td>60–79</td>
<td>60–79</td>
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</table>

**Note:** The cutoffs for recommended, overfat, and obese ranges in this table are based on a study that linked body mass index classifications from the National Institutes of Health with predicted percent body fat (measured using dual-energy X-ray absorptiometry).

*Essential body fat is necessary for the basic functioning of the body.

**Percent body fat in the low/athletic range may be appropriate for some people as long as it is not the result of illness or disordered eating habits.

*Health risks increase as percent body fat exceeds the recommended range.

Bioelectrical Impedance Analysis (BIA)  The BIA technique works by sending a small electrical current through the body and measuring the body’s resistance to it. Fat-free tissues, where most body water is located, are good conductors of electrical current, whereas fat is not (see the box “Using BIA at Home”). Thus, the amount of resistance to electrical current is related to the amount of fat-free tissue in the body (the lower the resistance, the greater the fat-free mass) and can be used to estimate percent body fat.

Bioelectrical impedance analysis has an error rate of about ±4–5%. To reduce error, follow the manufacturer’s instructions carefully and avoid overhydration or underhydration (more or less body water than normal). Because measurement varies with the type of BIA analyzer, use the same instrument to compare measurements over time.

Advanced Techniques: DEXA and TOBEC  Dual-energy X-ray absorptiometry (DEXA) works by measuring the tissue absorption of high- and low-energy X-ray beams. The procedure has an error rate of about ±2%. Total body electrical conductivity (TOBEC) estimates lean body mass by passing a body through a magnetic field. These methods are often used in sophisticated research projects but are seldom available to the average person. We mention them because they are often used for comparison with some of the field tests described in this chapter.

Assessing Body Fat Distribution

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As discussed in Chapter 2, somatotype describes your basic body build. The three somatotypes are endomorph, mesomorph, and ectomorph. Endomorphs are round and pear shaped, with wide hips and shoulders. They gain weight easily and will typically regain weight rapidly if they resume their normal lifestyle.

amount of water in your body changes during the day, skinfold measurements taken in the morning and evening often differ. If you repeat the measurements in the future to track changes in your body composition, measure skinfolds at approximately the same time of day.

**Fitness Tip** If you plan to track body composition, be sure to use the same assessment method each time. In addition, don’t become overly focused on precise values, because even the most accurate methods have a margin of error. The Bod Pod estimates body composition by air displacement and has a margin of error of about ±2–4%. Skinfold assessment is based on measurement of the thickness of several skinfolds, including the back of the arm, as shown here; equations translate these measurements into a percent body fat estimate, with about a ±4% margin of error.

**Bioelectrical Impedance Analysis (BIA)**  The BIA technique works by sending a small electrical current through the body and measuring the body’s resistance to it. Fat-free tissues, where most body water is located, are good conductors of electrical current, whereas fat is not (see the box “Using BIA at Home”). Thus, the amount of resistance to electrical current is related to the amount of fat-free tissue in the body (the lower the resistance, the greater the fat-free mass) and can be used to estimate percent body fat.

Bioelectrical impedance analysis has an error rate of about ±4–5%. To reduce error, follow the manufacturer’s instructions carefully and avoid overhydration or underhydration (more or less body water than normal). Because measurement varies with the type of BIA analyzer, use the same instrument to compare measurements over time.

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Scientists can use several techniques to accurately measure body composition. As described in the chapter, these techniques include underwater weighing, air displacement, and Dual-energy X-ray absorptiometry (DEXA). These methods, however, are costly and require technical expertise. You can estimate your body fat and fat-free weight simply and accurately, at home, without the help of a technician. All you need is a digital home scale with a built-in bioelectrical impedance analyzer (BIA) or a hand-held BIA unit. BIA works by measuring the resistance in the body to a small electric current. Electricity flows more slowly through fat tissue than through muscle, so the more fat you have, the more slowly such a current will flow through your body. Conversely, a current will pass through your body more quickly if you have more fat-free (muscle) weight.

To use a BIA scale or hand-held unit, just stand on the scale with bare feet or grasp the handles with each hand. As it checks your weight, the BIA unit sends a low-voltage electrical current through your body and analyzes the speed at which the current travels. Checking your weight and body composition takes no longer than checking your weight alone. Most BIA units can remember your last weight and body composition measurement, making it easy to compare the measurements from day to day or week to week. Some scales can remember measurements for multiple people, as well.

A study of 22 weight-trained men showed that BIA compared favorably to underwater weighing for measuring body composition. Measurements of fat and lean mass are most valuable for measuring changes in body composition during diet and exercise programs.

Popular BIA scales and hand-held BIA devices are manufactured by Taylor, Whynter, Omron, RemedyT, and Tanita. These scales and devices are available in most department stores and online, and cost between $30 and $200, depending on features.

After losing weight. Endomorphs often excel at weight lifting and might enjoy weight-supported aerobic exercises such as swimming or cycling. Conversely, they might find distance running difficult and painful.

Mesomorphs are lean and muscular and respond well to exercise. They have wedged-shaped bodies, broad shoulders, narrow hips, and little body fat. They gain fitness easily and usually excel at almost any kind of physical activity or sport.

Ectomorphs are thin and linear, with narrow hips and shoulders. They typically have little muscle or fat. Their light frame helps make them successful in activities such as distance running and gymnastics.

Few people have extreme body types—most of us are a mixture of all three. People with every body type can benefit from some form of physical activity.

**Setting Body Composition Goals**

If assessment tests indicate that fat loss would be beneficial for your health, your first step is to establish a goal. You can use the ratings in Table 6.1 or Table 6.2 to choose a target value for BMI or percent body fat (depending on which assessment you completed).

Set a realistic goal that will ensure good health. Heredity limits your capacity to change your body composition, and few people can expect to develop the body of a fashion model or competitive bodybuilder. However, you can improve your body composition through a program of regular exercise and a healthy diet. If your body composition is in or close to the recommended range, you may want to set a lifestyle goal rather than a specific percent body fat or BMI goal. For example, you might set a goal of increasing your daily

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Wellness Tip: Many body shapes and sizes are associated with good health. Focus on positive lifestyle behaviors rather than on unrealistic goals related to body weight or shape.
physical activity from 20 to 60 minutes or beginning a program of weight training, and then let any improvements in body composition occur as a secondary result of your primary target (physical activity). Remember, a lifestyle that includes regular exercise may be more important for health than trying to reach any ideal weight.

If you are significantly overfat or if you have known risk factors for disease (such as high blood pressure or high cholesterol), consult your physician to determine a body composition goal for your individual risk profile. For people who are obese, even small losses of body weight (5–15%) over a 6- to 12-month period can result in significant health improvements.

After you’ve established a body composition goal, you can then set a target range for body weight. Although body weight is not an accurate method of assessing body composition, it’s a useful method for tracking progress in a program to change body composition. If you’re losing a small or moderate amount of weight and exercising, you’re probably losing fat while building muscle mass. Lab 6.2 will help you determine a range for recommended body weight.

Using percent body fat or BMI will generate a fairly accurate target body weight for most people. However, it’s best not to stick rigidly to a recommended body weight calculated from any formula; individual genetic, cultural, and lifestyle factors are also important. Decide whether the body weight that the formulas generate for you is realistic, meets all your goals, is healthy, and is reasonable for you to maintain.

**MAKING CHANGES IN BODY COMPOSITION**

Chapter 9 includes specific strategies for losing or gaining weight and improving body composition. In general, lifestyle should be your focus—regular physical activity, endurance exercise, strength training, and a moderate energy intake. Making significant cuts in food intake in order to lose weight and body fat is a difficult strategy to maintain; focusing on increased physical activity is a better approach for many people. In studies of people who have lost weight and maintained the loss, physical activity was the key to long-term success.

You can track your progress toward your target body composition by checking your body weight regularly. Also, focus on how much energy you have and how your clothes fit.

To get a more accurate idea of your progress, you should directly reassess your body composition occasionally during your program: Body composition changes as weight changes. Losing a lot of weight usually includes losing some muscle mass no matter how hard a person exercises, partly because carrying less weight requires the muscular system to bear a smaller burden. Conversely, a large gain in weight without exercise still causes some gain in muscle mass because muscles are working harder to carry the extra weight.

**TIPS FOR TODAY AND THE FUTURE**

A wellness lifestyle can lead naturally to a body composition that is healthy and appropriate for you.

**RIGHT NOW YOU CAN**

- Find out what types of body composition assessment techniques are available at facilities on your campus or in your community.
- Do 30 minutes of physical activity five days per week—walk, jog, bike, swim, or climb stairs.
- Drink a glass of water instead of a soda, and include a high-fiber food such as whole-grain bread or cereal, popcorn, apples, berries, or beans in your next snack or meal.

**IN THE FUTURE YOU CAN**

- Think about your image of the ideal body type for your sex. Consider where your idea comes from, whether you use this image to judge your own body, and whether it is a realistic goal for you.
- Be aware of media messages (especially visual images) that make you feel embarrassed or insecure about your body. Remind yourself that these messages are usually designed to sell a product; they should not form the basis of your body image.

**SUMMARY**

- The human body is composed of fat-free mass (which includes bone, muscle, organ tissues, and connective tissues) and body fat.
- Having too much body fat has negative health consequences, especially in terms of cardiovascular disease and diabetes. Distribution of fat is also a significant factor in health.
- A fit and healthy looking body, with the right body composition for a particular person, develops from habits of proper nutrition and exercise.
- Measuring body weight alone is not an accurate way to assess body composition because this measure does not differentiate between muscle weight and fat weight.
- Body mass index (calculated from weight and height measurements) and waist circumference can help classify the health risks associated with being overweight. BMI is sometimes inaccurate, however, particularly in muscular people.
- Techniques for estimating percent body fat include underwater weighing, the Bod Pod, skinfold measurements, bioelectrical impedance analysis (BIA), dual-energy X-ray absorptiometry (DEXA), and total body electrical conductivity (TOBEC).
- Body fat distribution can be assessed through waist measurement or the waist-to-hip ratio.
Q **Is spot reducing effective?**

**A** Spot reducing refers to attempts to lose body fat in specific parts of the body by doing exercises for those parts. Danish researchers have shown that fat use increases in adipose tissue surrounding active muscle, but it is not known if short-term fat use helps reduce fat in specific sites. Most studies show that spot-reducing exercises contribute to fat loss only to the extent that they burn calories. The best way to reduce fat in any specific area is to create an overall negative energy balance: Take in less energy (food) than you use through exercise and metabolism.

Q **How does exercise affect body composition?**

**A** Cardiorespiratory endurance exercise burns calories, thereby helping create a negative energy balance. Weight training does not use many calories and therefore is of little use in creating a negative energy balance. However, weight training increases muscle mass, which maintains a higher metabolic rate (the body’s rate of energy use) and helps improve body composition. To minimize body fat and increase muscle mass, thereby improving body composition, combine cardiorespiratory endurance exercise and weight training (see figure above).

Q **Are people who have a desirable body composition physically fit?**

**A** Having a healthy body composition is not necessarily associated with overall fitness. For example, many bodybuilders have very little body fat but have poor cardiorespiratory capacity and flexibility. Some athletes, such as NFL linemen, weigh 300 pounds or more; they have to lose the weight when they retire if they don’t want to jeopardize their health. To be fit, you must rate high on all the components of fitness.

Q **What is cellulite, and how do I get rid of it?**

**A** Cellulite is the name commonly given to rippling, wavy fat deposits that collect just under the skin. The “cottage cheese” appearance stems from the breakdown of tissues supporting the fat. These rippling fat deposits are really the same as fat deposited anywhere else in the body. The only way to control them is to create a negative energy balance—that is, burn more calories than you take in. There are no creams or lotions that will rub away surface (subcutaneous) fat deposits, and spot reducing is also ineffective. The solution is sensible eating habits and exercise.
• Somatotype—endomorph (round), mesomorph (muscular), ectomorph (linear)—is a useful tool for describing basic body characteristics.

• You can determine a recommended body composition and weight by choosing a target BMI or target body fat percentage. Keep heredity in mind when setting a goal, and focus on positive changes in lifestyle.

**FOR FURTHER EXPLORATION**

American Diabetes Association. Provides information, a free newsletter, and referrals to local support groups; the website includes an online diabetes risk assessment.  
http://www.diabetes.org

American Heart Association: Body Composition Tests. Offers detailed information about body composition, testing and analysis, and the impact of body composition on heart health.  
http://www.heart.org/HEARTORG/GettingHealthy/NutritionCenter/Body-CompositionTests_UCM_305883_Article.jsp

Methods of Body Composition Analysis Tutorials. Provides information about body composition assessment techniques, including underwater weighing, BIA, and DEXA.  
http://nutrition.uvm.edu/bodycomp

National Heart, Lung, and Blood Institute: Obesity Education Initiative. Provides information on the latest federal obesity standards and a BMI calculator.  
http://www.nhlbi.nih.gov/about/oei/index.htm

National Institute of Diabetes and Digestive and Kidney Diseases Weight-Control Information Network. Provides information about adult obesity: how it is defined and assessed, the risk factors associated with it, and its causes.  
http://win.niddk.nih.gov

http://www.cdc.gov/nchs/nhanes/new_nhanes.htm

Robert Wood Johnson Foundation. Promotes the health and health care of Americans through research and distribution of information on healthy lifestyles. They publish an annual report on the status of the national obesity problem.  
http://www.rwjf.org

USDA Food and Nutrition Information Center: Weight and Obesity. Provides links to recent reports and studies on the issue of obesity among Americans.  

See also the listings for Chapters 2, 8, and 9.

**SELECTED BIBLIOGRAPHY**


LAB 6.1 Assessing Body Mass Index and Body Composition

Body Mass Index

**Equipment**

1. Weight scale
2. Tape measure or other means of measuring height

**Instructions**

Measure your height and weight, and record the results. Be sure to record the unit of measurement.

Height: ___________ Weight: ___________

**Calculating BMI (see also the shortcut chart of BMI values in Lab 6.2)**

1. Convert your body weight to kilograms by dividing your weight in pounds by 2.2.
   
   Body weight ___________ lb ÷ 2.2 lb/kg = body weight ___________ kg

2. Convert your height measurement to meters by multiplying your height in inches by 0.0254.
   
   Height ___________ in. × 0.0254 m/in. = height ___________ m

3. Square your height measurement.
   
   Height ___________ m × height ___________ m = height ___________ m²

4. BMI equals body weight in kilograms divided by height in meters squared (kg/m²).
   
   Body weight ___________ kg ÷ height ___________ m² = BMI ___________ kg/m²

**Rating Your BMI**

Refer to the table for a rating of your BMI. Record the results below and on the final page of this lab.

<table>
<thead>
<tr>
<th>Classification</th>
<th>BMI (kg/m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underweight</td>
<td>&lt;18.5</td>
</tr>
<tr>
<td>Normal</td>
<td>18.5–24.9</td>
</tr>
<tr>
<td>Overweight</td>
<td>25.0–29.9</td>
</tr>
<tr>
<td>Obesity (I)</td>
<td>30.0–34.9</td>
</tr>
<tr>
<td>Obesity (II)</td>
<td>35.0–39.9</td>
</tr>
<tr>
<td>Extreme obesity (III)</td>
<td>≥40.0</td>
</tr>
</tbody>
</table>

BMI ___________ kg/m²

Classification _________

**Skinfold Measurements**

**Equipment**

1. Skinfold caliper
2. Partner to take measurements
3. Marking pen (optional)
LABORATORY ACTIVITIES

Instructions

1. Select and locate the correct sites for measurement. All measurements should be taken on the right side of the body with the subject standing. Skinfolds are normally measured on the natural fold line of the skin, either vertically or at a slight angle. The skinfold measurement sites for males are chest, abdomen, and thigh; for females, triceps, suprailium, and thigh. If the person taking skinfold measurements is inexperienced, it may be helpful to mark the correct sites with a marking pen.

(a) Chest
Pinch a diagonal fold halfway between the nipple and the shoulder crease.

(b) Abdomen
Pinch a vertical fold about 1 inch to the right of the umbilicus (navel).

(c) Thigh
Pinch a vertical fold midway between the top of the hipbone and the kneecap.

(d) Triceps
Pinch a vertical skinfold on the back of the right arm midway between the shoulder and elbow. The arm should be straight and should hang naturally.

(e) Suprailium
Pinch a fold at the top front of the right hipbone. The skinfold here is taken slightly diagonally according to the natural fold tendency of the skin.

2. Measure the appropriate skinfolds. Pinch a fold of skin between your thumb and forefinger. Pull the fold up so that no muscular tissue is included; don’t pinch the skinfold too hard. Hold the calipers perpendicular to the fold and measure the skinfold about 0.25 inch away from your fingers. Allow the tips of the calipers to close on the skinfold and let the reading settle before marking it down. Take readings to the nearest half-millimeter. Continue to repeat the measurements until two consecutive measurements match, releasing and repinching the skinfold between each measurement. Make a note of the final measurement for each site.

Time of day of measurements: ____________

<table>
<thead>
<tr>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chest: ______ mm</td>
<td>Triceps: ______ mm</td>
</tr>
<tr>
<td>Abdomen: ______ mm</td>
<td>Suprailium: ______ mm</td>
</tr>
<tr>
<td>Thigh: ______ mm</td>
<td>Thigh: ______ mm</td>
</tr>
</tbody>
</table>

Determining Percent Body Fat

Add the measurements of your three skinfolds. Use this sum as a point of comparison for future assessments and/or to find the percent body fat that corresponds to your total in the appropriate table. For example, a 20-year-old female with measurements of 17 mm, 21 mm, and 22 mm would have a skinfold sum of 60 mm; according to the following table her percent body fat is 23.5. The table lists ages in increments of five. If your age is not listed on the table, use the column for the age closest to your own.

Sum of three skinfolds: ______ mm  Percent body fat: ______ %
**Prediction of Fat Percentage in Females from the Sum of Three Skinfolds**

<table>
<thead>
<tr>
<th>Sum of Skinfolds (mm)</th>
<th>Age (Years)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>20</td>
</tr>
<tr>
<td>20</td>
<td>9.3</td>
</tr>
<tr>
<td>25</td>
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<td>30</td>
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<tr>
<td>35</td>
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</tr>
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<td>85</td>
<td>31.1</td>
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<td>32.5</td>
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<tr>
<td>95</td>
<td>33.8</td>
</tr>
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<td>100</td>
<td>35.1</td>
</tr>
<tr>
<td>105</td>
<td>36.3</td>
</tr>
<tr>
<td>110</td>
<td>37.5</td>
</tr>
<tr>
<td>115</td>
<td>38.7</td>
</tr>
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<td>120</td>
<td>39.8</td>
</tr>
<tr>
<td>125</td>
<td>40.8</td>
</tr>
<tr>
<td>130</td>
<td>41.8</td>
</tr>
<tr>
<td>135</td>
<td>42.7</td>
</tr>
</tbody>
</table>

**NOTE:** Find the value on the chart that most closely corresponds to your age and the sum of measurement skinfolds. To calculate the value more precisely, plug your age and sum of skinfolds into the appropriate formula:

\[
\% \text{ Body Fat} = (4.95 - (1.0994921 \times \text{sum of skinfolds} + (0.00023 \times \text{the square of sum of skinfolds}) - (0.001392 \times \text{age}) - 4.5) \times 100),
\]

where the skinfold sites (measured in mm) are triceps, suprailium, and thigh.

# Laboratory Activities

## Prediction of Fat Percentage in Males from the Sum of Three Skinfolds

<table>
<thead>
<tr>
<th>Sum of Skinfolds (mm)</th>
<th>20</th>
<th>25</th>
<th>30</th>
<th>35</th>
<th>40</th>
<th>45</th>
<th>50</th>
<th>55</th>
<th>60 and over</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>1.6</td>
<td>2.1</td>
<td>2.7</td>
<td>3.2</td>
<td>3.7</td>
<td>4.3</td>
<td>4.8</td>
<td>5.3</td>
<td>5.9</td>
</tr>
<tr>
<td>15</td>
<td>3.2</td>
<td>3.8</td>
<td>4.3</td>
<td>4.8</td>
<td>5.4</td>
<td>5.9</td>
<td>6.4</td>
<td>7.0</td>
<td>7.5</td>
</tr>
<tr>
<td>20</td>
<td>4.8</td>
<td>5.4</td>
<td>5.9</td>
<td>6.4</td>
<td>7.0</td>
<td>7.5</td>
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**Note:** Find the value on the chart that most closely corresponds to your age and the sum of measurement skinfolds. To calculate the value more precisely, plug your age and sum of skinfolds into the appropriate formula:

\[
\text{% Body Fat} = \left(4.95 + \left(1.109380 \times \text{sum of skinfolds}\right) - \left(0.0000016 \times \text{square of the sum of skinfolds}\right) - \left(0.0008267 \times \text{age}\right) - 4.5\right) \times 100,
\]

where the skinfold sites (measured in mm) are chest, abdomen, and thigh.


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## Bioelectrical Impedance Analysis (BIA)

### Equipment

BIA analyzer such as Omron Body Fat Analyzer: The BIA device sends an extremely weak electrical current through your body to determine the amount of total body water. You will not feel the current during the test. The body fat percentage is calculated from a formula that uses body water, electric resistance, height, weight, age, and gender.
Instructions

1. Enter your height, weight, gender, and age into the BIA device.
2. Grasp the left and right handles and wrap your middle finger around the groove in the handle. With your thumbs facing up and resting on the unit, place the palms of your hands on the top and bottom electrodes.
3. Hold your arms straight out at a 90-degree angle to your body.
4. Confirm the ready to measure display and the READY indicator turns on. Push the start button and the display START turns on. The unit automatically detects that it is held and starts measurement. Do not move during measurement.
5. Record your fat, percent fat, and fat-free weight.
   Fat: ________________
   Percent fat: ________________
   Fat-free weight: ________________
6. Compare the BIA measurements with other techniques of assessing body composition.

U.S. Navy Circumference Method of Measuring Percent Fat

This method measures fat percentage from abdominal circumference, neck circumference, and height in men and from abdominal circumference, hip circumference, neck circumference, and height in women.

Equipment

1. Measuring tape
2. Stadiometer or tape on wall to measure height

Instructions

1. Measure height without shoes using a stadiometer or tape measure. A stadiometer is a height-measuring device that is often part of a scale found in a gym or physician’s office.
   Height (inches): ________________
2. Measure neck circumference below the larynx (Adam’s apple), with the tape sloping slightly downward at the front.
   Neck circumference (inches): ________________
3. Measure waist circumference at navel level for men and at the smallest point for women.
   Waist circumference (inches): ________________
4. Measure hip circumference (women only) at the largest point.
   Hip circumference (inches): ________________

Calculating percent fat using charts developed by the U.S. Navy

Men:

Calculate circumference value: Abdominal circumference − neck circumference: ________________

Read percent fat from the chart from where the circumference value intersects with height. Enter fat percentage: ________________

Women:

Calculate circumference value: Abdominal circumference + hip circumference − neck circumference (in inches): ________________

Read percent fat from the chart from where the circumference value intersects with height. Enter fat percentage: ________________
l a b o r ato r y ac t i v i t i e s
U.S. Navy Circumference Chart for Predicting Percent Fat in Men
Height (inches)
Circumference

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U.S. Navy Circumference Chart for Predicting Percent Fat in Women
Height (inches)
Circumference

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SOURCE S

196    C H A P T E R 6

B ody C omposition


Rating Your Body Composition

Refer to the chart below to rate your percent body fat. Record it below and in the chart at the end of this lab.

Rating: ___________________________

Percent Body Fat Classification

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</tr>
</tbody>
</table>

**NOTE:** The cutoffs for recommended, overfat, and obese ranges in this table are based on a study that linked body mass index classifications from the National Institutes of Health with predicted percent body fat (measured using dual-energy X-ray absorptiometry).

*Essential body fat is necessary for the basic functioning of the body.

**Percent body fat in the low/athletic range may be appropriate for some people as long as it is not the result of illness or disordered eating habits.

†Health risks increase as percent body fat exceeds the recommended range.


Other Methods of Assessing Percent Body Fat

If you use a different method, record the name of the method and the result below and in the chart at the end of this lab. Find your body composition rating on the chart above.

Method used: ___________ Percent body fat: ___________

% Rating (from chart above): ___________

Body Fat Distribution

Waist Circumference and Waist-to-Hip Ratio

**Equipment**

1. Tape measure
2. Partner to take measurements

**Preparation**

Wear clothes that will not add significantly to your measurements.

**Instructions**

Stand with your feet together and your arms at your sides. Raise your arms only high enough to allow for taking the measurements. Your partner should make sure the tape is horizontal around the entire circumference and pulled snugly against your skin. The tape shouldn’t be pulled so tight that it causes indentations in your skin. Record measurements to the nearest millimeter or one-sixteenth of an inch.

**Waist.** Measure at the smallest waist circumference. If you don’t have a natural waist, measure at the level of your navel.

Waist measurement: _______________

**Hip.** Measure at the largest hip circumference. Hip measurement: _______________

**Waist-to-Hip Ratio:** You can use any unit of measurement (for example, inches or centimeters) as long as you are consistent. Waist-to-hip ratio equals waist measurement divided by hip measurement.

Waist-to-hip ratio: ___________________________ + ___________________________ = ___________________________

\[
\text{Waist measurement} \div \text{Hip measurement}
\]
LABORATORY ACTIVITIES

Determining Your Risk

The table below indicates values for waist circumference and waist-to-hip ratio above which the risk of health problems increases significantly. If your measurement or ratio is above either cutoff point, put a check on the appropriate line below and in the chart at the end of this lab.

Waist circumference: ________________ (✓ high risk) Waist-to-hip ratio: ________________ (✓ high risk)

Body Fat Distribution

<table>
<thead>
<tr>
<th>Cutoff Points for High Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Waist Circumference</strong></td>
</tr>
<tr>
<td>Men</td>
</tr>
<tr>
<td>More than 40 in. (102 cm)</td>
</tr>
<tr>
<td>Women</td>
</tr>
<tr>
<td>More than 35 in. (88 cm)</td>
</tr>
<tr>
<td><strong>Waist-to-Hip Ratio</strong></td>
</tr>
<tr>
<td>More than 0.94</td>
</tr>
<tr>
<td>More than 0.82</td>
</tr>
</tbody>
</table>


Rating Your Body Mass Index, Body Composition, and Body Fat Distribution

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Value</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BMI</strong></td>
<td>___________ kg/m^2</td>
<td></td>
</tr>
<tr>
<td>Skinfold measurements or alternative method of determining percent body fat. Specify method: ___________ % body fat</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bioelectrical Impedance Analysis (BIA)</td>
<td>___________ % body fat</td>
<td></td>
</tr>
<tr>
<td>U.S. Navy Circumference Method</td>
<td>___________ % body fat</td>
<td></td>
</tr>
<tr>
<td>Waist circumference</td>
<td>___________ in. or cm</td>
<td>(✓ high risk)</td>
</tr>
<tr>
<td>Waist-to-hip ratio</td>
<td>___________ (ratio)</td>
<td>(✓ high risk)</td>
</tr>
</tbody>
</table>

Using Your Results

How did you score? Are you surprised by your ratings for body composition and body fat distribution? Are your current ratings in the range for good health? Are you satisfied with your current body composition? Why or why not?

If you’re not satisfied, set a realistic goal for improvement:

What should you do next? Enter the results of this lab in the Preprogram Assessment column in Appendix C. If you’ve determined that you need to improve your body composition, set a specific goal by completing Lab 6.2, and then plan your program using the labs in Chapters 8 and 9. After several weeks or months of an exercise and/or dietary change program, complete this lab again and enter the results in the Postprogram Assessment column of Appendix C. How do the results compare?
**LAB 6.2 Setting Goals for Target Body Weight**

This lab is designed to help you set body weight goals based on a target BMI or percent body fat. If the results of Lab 6.1 indicate that a change in body composition would be beneficial for your health, you may want to complete this lab to help you set goals.

Remember, though, that a wellness lifestyle—including a balanced diet and regular exercise—is more important for your health than achieving any specific body weight, BMI, or percent body fat. You may want to set goals for improving your diet and increasing physical activity and let your body composition change as a result. If so, use the labs in Chapters 3, 4, 8, and 9 as your guides.

**Equipment**

Calculator (or pencil and paper for calculations)

**Preparation**

Determine percent body fat and/or calculate BMI as described in Lab 6.1. Keep track of height and weight as measured for these calculations.

Height: ________ Weight: ________

**Instructions: Target Body Weight from Target BMI**

Use the chart below to find the target body weight that corresponds to your target BMI. Find your height in the left column, and then move across the appropriate row until you find the weight that corresponds to your target BMI. Remember, BMI is only an indirect measurement of body composition. It is possible to improve body composition without any significant change in weight. For example, a weight training program may result in increased muscle mass and decreased fat mass without any change in overall weight. For this reason, you may want to set alternative or additional goals, such as improving the fit of your clothes or decreasing your waist measurement.

<table>
<thead>
<tr>
<th>Height</th>
<th>&lt;18.5 Underweight</th>
<th>18.5–24.9 Normal</th>
<th>25–29.9 Overweight</th>
<th>30–34.9 Obesity (Class I)</th>
<th>35–39.9 Obesity (Class III)</th>
<th>≥40 Extreme Obesity</th>
</tr>
</thead>
<tbody>
<tr>
<td>4' 10&quot;</td>
<td>81 86</td>
<td>91 96 101 105</td>
<td>110 115</td>
<td>120 129 134 139</td>
<td>144 148 153 158 163</td>
<td>168 172 177 182 187 192</td>
</tr>
<tr>
<td>4' 11&quot;</td>
<td>84 89</td>
<td>94 99 104 109</td>
<td>114 119</td>
<td>124 129 134 139 144</td>
<td>149 154 159 163 168</td>
<td>173 178 183 188 193 198</td>
</tr>
<tr>
<td>5' 0&quot;</td>
<td>87 92</td>
<td>97 102 108 113</td>
<td>118 123</td>
<td>128 133 138 143 149</td>
<td>154 159 164 169 174 179</td>
<td>179 184 190 195 200 205</td>
</tr>
<tr>
<td>5' 1&quot;</td>
<td>90 95</td>
<td>101 106 111 117</td>
<td>122 127</td>
<td>132 138 143 148 154</td>
<td>159 164 169 175 180</td>
<td>185 191 196 201 207 212</td>
</tr>
<tr>
<td>5' 2&quot;</td>
<td>93 98</td>
<td>104 109 115 120</td>
<td>126 131</td>
<td>137 142 148 153 159</td>
<td>164 170 175 181 186</td>
<td>191 197 202 208 213 219</td>
</tr>
<tr>
<td>5' 3&quot;</td>
<td>96 102</td>
<td>107 113 119 124</td>
<td>130 136</td>
<td>141 147 153 158 164</td>
<td>169 175 181 186 192</td>
<td>198 203 209 215 220 226</td>
</tr>
<tr>
<td>5' 4&quot;</td>
<td>99 105</td>
<td>111 117 122 128</td>
<td>134 140</td>
<td>146 152 157 163 169</td>
<td>175 181 187 192 198</td>
<td>204 210 216 222 227 233</td>
</tr>
<tr>
<td>5' 5&quot;</td>
<td>102 108</td>
<td>114 120 126 132</td>
<td>138 144</td>
<td>150 156 162 168 174</td>
<td>180 186 192 198 204</td>
<td>210 216 222 229 235 241</td>
</tr>
<tr>
<td>5' 6&quot;</td>
<td>105 112</td>
<td>118 124 130 136</td>
<td>143 149</td>
<td>155 161 167 174 180</td>
<td>186 192 198 205 211</td>
<td>217 223 229 236 242 248</td>
</tr>
<tr>
<td>5' 7&quot;</td>
<td>109 115</td>
<td>121 128 134 141</td>
<td>147 153</td>
<td>160 166 173 179 185</td>
<td>192 198 204 211 217</td>
<td>224 230 236 243 249 256</td>
</tr>
<tr>
<td>5' 8&quot;</td>
<td>112 118</td>
<td>125 132 138 145</td>
<td>151 158</td>
<td>165 171 178 184 191</td>
<td>197 204 211 217 224</td>
<td>230 237 244 250 257 263</td>
</tr>
<tr>
<td>5' 9&quot;</td>
<td>115 122</td>
<td>129 136 142 149</td>
<td>156 163</td>
<td>169 176 183 190 197</td>
<td>203 210 217 224 230</td>
<td>237 244 251 258 264 271</td>
</tr>
<tr>
<td>5' 10&quot;</td>
<td>119 126</td>
<td>133 139 146 153</td>
<td>160 167</td>
<td>174 181 188 195 202</td>
<td>209 216 223 230 237</td>
<td>244 251 258 265 272 279</td>
</tr>
<tr>
<td>5' 11&quot;</td>
<td>122 129</td>
<td>136 143 151 158</td>
<td>165 172</td>
<td>179 187 194 201 208</td>
<td>215 222 230 237 244</td>
<td>251 258 265 273 280 287</td>
</tr>
<tr>
<td>6' 0&quot;</td>
<td>125 133</td>
<td>140 148 155 162</td>
<td>170 177</td>
<td>184 192 199 207 214</td>
<td>221 229 236 243 251</td>
<td>258 266 273 280 288 295</td>
</tr>
<tr>
<td>6' 1&quot;</td>
<td>129 137</td>
<td>144 152 159 167</td>
<td>174 182</td>
<td>190 197 205 212 220</td>
<td>228 235 243 250 258</td>
<td>265 273 281 288 296 303</td>
</tr>
<tr>
<td>6' 2&quot;</td>
<td>132 140</td>
<td>148 156 164 171</td>
<td>179 187</td>
<td>195 203 210 218 226</td>
<td>234 242 249 257 265</td>
<td>273 281 288 296 304 312</td>
</tr>
<tr>
<td>6' 3&quot;</td>
<td>136 144</td>
<td>152 160 168 176</td>
<td>184 192</td>
<td>200 208 216 224 232</td>
<td>240 248 256 264 272</td>
<td>280 288 296 304 312 320</td>
</tr>
<tr>
<td>6' 4&quot;</td>
<td>140 148</td>
<td>156 164 173 181</td>
<td>189 197</td>
<td>206 214 222 230 238</td>
<td>247 255 263 271 280</td>
<td>288 296 304 312 321 329</td>
</tr>
</tbody>
</table>

Current BMI: ________________ Target BMI: ________________ Target body weight (from chart): ________________
Alternative/additional goals: __________________________________________________________________________________________
_____________________________________________________________________________________________________________________

Note: You can calculate target body weight from target BMI more precisely by using the following formula: (1) convert your height measurement to meters, (2) square your height measurement, (3) multiply this number by your target BMI to get your target weight in kilograms, and (4) convert your target weight from kilograms to pounds:

1. Height __________ in. × 0.0254 m/in. = height __________ m
2. Height __________ m × height __________ m = __________ m²
3. Target BMI __________ × height __________ m = target weight __________ kg
4. Target weight __________ kg × 2.2 lb/kg = target weight __________ lb

Instructions: Target Body Weight from Target Body Fat Percentages
Use the formula below to determine the target body weight that corresponds to your target percent body fat.

Current percent body fat: _____________ Target percent body fat: _____________

Example: 180-lb male, current percent body fat of 24%, goal of 21%

1. To determine the fat weight in your body, multiply your current weight by percent body fat (determined through skinfold measurements and expressed as a decimal).
   \[180 \text{ lb} \times 0.24 = 43.2 \text{ lb}\]

2. Subtract the fat weight from your current weight to get your current fat-free weight.
   \[180 \text{ lb} - 43.2 \text{ lb} = 136.8 \text{ lb}\]

3. Subtract your target percent body fat from 1 to get target percent fat-free weight.
   \[1 - 0.21 = 0.79\]

4. To get your target body weight, divide your fat-free weight by your target percent fat-free weight.
   \[136.8 \text{ lb} \div 0.79 = 173 \text{ lb}\]

Note: You can express weight in either pounds or kilograms, as long as you use the unit of measurement consistently.

1. Current body weight _____________ × percent body fat _____________ = fat weight _____________
2. Current body weight _____________ − fat weight _____________ = fat-free weight _____________
3. \[1 - \text{target percent body fat} _____________ = \text{target percent fat-free weight} _____________\]
4. Fat-free weight _____________ \div \text{target percent fat-free weight} _____________ = \text{target body weight} _____________

Setting a Goal
Based on these calculations and other factors (including heredity, individual preference, and current health status), select a target weight or range of weights for yourself.

Target body weight: _________________
Putting Together a Complete Fitness Program

LOOKING AHEAD . . .

After reading this chapter, you should be able to

- List the steps you can follow to put together a successful personal fitness program.
- Describe strategies that can help you maintain a fitness program over the long term.
- Tailor a fitness program to accommodate different life stages.

TEST YOUR KNOWLEDGE

1. Which of the following physical activities is considered a high-intensity exercise?
   a. hiking uphill
   b. singles tennis
   c. jumping rope

2. Older adults should avoid exercise to protect themselves against falls and injuries. True or false?

3. Swimming is a total fitness activity that develops all the components of health-related fitness. True or false?

See answers on the next page.
Understanding the benefits of physical fitness, as explained in Chapters 1–6, is the first step toward creating a well-rounded exercise program. The next challenge is to choose activities and combine them into a program that develops all the components of fitness and helps you stay motivated. This chapter presents a step-by-step plan for creating and maintaining a well-rounded fitness program. At the end of this chapter, you’ll find sample programs based on popular activities. These programs provide structure that can be helpful if you’re beginning an exercise program for the first time.

DEVELOPING A PERSONAL FITNESS PLAN

If you’re ready to create a complete fitness program based on the activities you enjoy most, begin by preparing the program plan and agreement in Lab 7.1. By carefully developing your plan and signing an agreement, you’ll increase your chances of success. The step-by-step procedure outlined here will guide you through the steps of Lab 7.1 to create an exercise program that’s right for you. (See Figure 7.1 for a sample personal fitness program plan and agreement.)

If you’d like additional help in setting up your program, choose one of the sample programs at the end of this chapter. Sample programs are provided for walking/jogging, cycling, swimming, and rowing. They include detailed instructions for starting a program and developing and maintaining fitness.

1. Set Goals

Ask yourself, “What do I want from my fitness program?” Develop different types of goals—general and specific, long term and short term. General or long-term goals might include lowering your risk for chronic disease, improving posture, having more energy, or improving the fit of your clothes.

It’s also a good idea to develop some specific, short-term goals based on measurable factors. Specific goals might be:

- Raising cardiorespiratory capacity (VO₂max) by 10%.
- Reducing the time it takes you to jog two miles from 22 minutes to 19 minutes.
- Increasing the number of push-ups you can do from 15 to 25.
- Lowering your BMI from 26 to 24.5.

Answers (Test Your Knowledge)

1. All Three. According to the U.S. Department of Health and Human Services, you can perform any of these activities for 75 minutes per week to obtain health and wellness benefits.

2. False. Older adults receive the same health benefits from exercise as younger adults, including improvements in strength, body composition, cardiorespiratory health, flexibility, balance, stability, and cognitive functioning. A far greater danger is posed by inactivity.

3. False. Swimming is excellent for developing cardiorespiratory endurance and muscular endurance, but because it is not a weight-bearing activity, it does not enhance bone density. Swimmers are advised to include weight training in their exercise program to maintain bone mass.

Fitness Tip An overall fitness program includes activities to develop all the components of physical fitness. Remember that you don’t need to go to the gym for all your fitness activities. For example, research shows that, especially for young women, resistance bands are just as effective as weight machines or free weights for increasing muscular strength.

Having specific goals will allow you to track your progress and enjoy the measurable changes brought about by your fitness program. Break your specific goals into several smaller steps (mini-goals), such as those shown in Figure 7.1. For example, instead of dwelling on losing 20 or 30 pounds, try losing two pounds. Remember, yard by yard is hard; inch by inch is a cinch.

For detailed discussions of goals and goal setting in a behavior change or fitness program, refer back to Chapters 1 and 2.

Physical fitness assessment tests—as described in Chapters 3–6—are essential to determining your goals. They help you decide which types of exercise you should emphasize, and they help you understand the relative difficulty of attaining specific goals. If you have health problems, such as high blood pressure, heart disease, obesity, or serious joint or muscle disabilities, see your physician before taking assessment tests. Measure your progress by taking these tests about every three months.

2. Select Activities

If you have already chosen activities and created separate program plans for different fitness components in Chapters 3–5,
A. I am contracting with myself to follow a physical fitness program to work toward the following goals:

**Specific or short-term goals**

1. Improving cardiorespiratory fitness by raising my $\dot{V}O_2\text{max}$ from 34 to 37 ml/kg/min
2. Improving upper body muscular strength and endurance rating from fair to good
3. Improving body composition (from 28% to 25% body fat)
4. Improving my tennis game (hitting 20 playable shots in a row against the ball machine)

**General or long-term goals**

1. Developing a more positive attitude about myself
2. Improving the fit of my clothes
3. Building and maintaining bone mass to reduce my risk of osteoporosis
4. Increasing my life expectancy and reducing my risk for diabetes and heart disease

B. My program plan is as follows:

<table>
<thead>
<tr>
<th>Activities</th>
<th>Components (Check X)</th>
<th>Frequency (Check X)</th>
<th>Intensity*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swimming</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>X X X X X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tennis</td>
<td></td>
<td></td>
<td>RPE 13–16</td>
</tr>
<tr>
<td></td>
<td>X X X X X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight training</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>X X X X X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stretching</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>X X X X X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*List your target heart rate range or an RPE value if appropriate.

C. My program will begin on **Sept. 21**. My program includes the following schedule of mini-goals. For each step in my program, I will give myself the reward listed.

- Completing 2 full weeks of program (mini-goal 1)
- $\dot{V}O_2\text{max}$ of 35 ml/kg/min (mini-goal 2)
- Completing 10 full weeks of program (mini-goal 3)
- Percent body fat of 27% (mini-goal 4)
- $\dot{V}O_2\text{max}$ of 36 ml/kg/min (mini-goal 5)

D. My program will include the addition of physical activity to my daily routine (such as climbing stairs or walking to class):

1. Walking to and from campus job
2. Taking the stairs to dorm room instead of elevator
3. Bicycling to the library instead of driving
4. Taking a drop-in fitness class at the campus recreation center

E. My program will include the following strategies for reducing sedentary time:

1. Setting “move” reminders on phone and laptop
2. Moving during television commercial breaks or between programs
3. Standing or walking during phone calls

F. I will use the following tools to monitor my program and my progress toward my goals:

- I’ll use a chart that lists the number of laps and minutes I swim and the charts for strength and flexibility from Labs 4.3 & 5.2.

I sign this contract as an indication of my personal commitment to reach my goal.

______________________________  ______________________________
(name)  (your signature)

I have recruited a helper who will witness my contract and
swim with me three days per week
(list any way your helper will participate in your program)

______________________________  ______________________________
(witness's signature)  (witness's signature)

---

**FIGURE 7.1** A sample personal fitness program plan and agreement.
you can put those plans together into a single program. It’s usually best to include exercises to develop each of the health-related components of fitness. The components (with abbreviations used in Figure 7.1, section B) are as follows:

- **Cardiorespiratory endurance (CRE)** is developed by activities that use continuous rhythmic movements of large-muscle groups, like those in the legs (see Chapter 3).
- **Muscular strength and endurance (MS and ME)** are developed by strength training against resistance (see Chapter 4).
- **Flexibility (F)** is developed by stretching the major muscle groups (see Chapter 5).
- **Healthy body composition (BC)** can be developed by combining a sensible diet and a program of regular exercise, including cardiorespiratory endurance exercise to burn calories and resistance training to build muscle mass (see Chapter 6).

Table 7.1 shows the intensity levels of several popular activities that promote health. Check the intensity levels of the activities you’re considering to make sure the program you put together will help you achieve your goals.

If you select activities you enjoy and that support your commitment rather than activities that turn exercise into a chore, your program will provide plenty of incentive for continuing. Consider the following factors in making your choices:

- **Fun and interest.** Your fitness program is much more likely to be successful if you choose activities that you currently engage in and enjoy. Often you can modify your current activities to fit your fitness program. If you want to add a new activity to your program, try it for a while before committing to it.
- **Your current skill and fitness level.** Although many activities are appropriate for beginners, some sports and activities require a certain level of skill to obtain fitness benefits. For example, if you are a beginning tennis player, you will probably not be able to sustain rallies long enough to develop cardiorespiratory endurance. A better choice might be a walking program while you improve your tennis game. To build skill for a particular activity, consider taking a class or getting some instruction from a coach or fellow participant.
- **Time and convenience.** You are more likely to maintain a long-term exercise program if you can easily fit exercise into your daily routine. As you consider activities, think about whether a special location or facility is required. Can you participate in the activity close to your home, school, or job? Are the necessary facilities available at convenient times (see Lab 7.2)? Can you participate in the activity year-round, or will you need to find an alternative during the summer or winter? Would a home treadmill make you more likely to exercise regularly?
  - **Cost.** Some sports and activities require equipment, fees, or some type of membership investment. If you are on a tight budget, limit your choices to free or inexpensive activities. Investigate the facilities on your campus, which you may be able to use at little or no cost. Many activities require no equipment beyond an appropriate pair of shoes. Chapter 4 provides examples of resistance exercises you can do at home without equipment.
  - **Special health needs.** If you have a particular health problem, choose activities that will conform to your needs and enhance your ability to cope. Ask your physician how to tailor an exercise program to your needs and goals. Appendix B provides guidelines and safety tips for exercisers with common chronic conditions.

### 3. Set a Target Frequency, Intensity, and Time (Duration) for Each Activity

The next step is to apply the FITT principle and set a starting frequency, intensity, and time (duration) for each type of activity you’ve chosen (see the summary in Figure 7.2 and the sample in Figure 7.1).

**Cardiorespiratory Endurance Exercise** As noted in earlier chapters, based on more than 50 years of research on exercise and health, the U.S. Department of Health and Human Services concluded that most health benefits occur with at least 150 minutes per week of moderate-intensity physical activity (such as brisk walking) or 75 minutes per week of vigorous-intensity activity (such as jogging). Additional benefits occur with more exercise. An appropriate frequency for cardiorespiratory endurance exercise is three–five days per week. For intensity, note your target heart rate zone or RPE (rating of perceived exertion) value. Your target total workout time (duration) should
be about 20–60 minutes per day, depending on the intensity of the activity. You can exercise in a single session or in multiple sessions of 10 or more minutes. New research on high-intensity interval training suggests that you can exercise for shorter durations if you train at maximal intensities.

**Muscular Strength and Endurance Training** At least two nonconsecutive days per week of strength training is recommended. As described in Chapter 4, a general fitness strength training program includes one or more sets of 8–12 repetitions of 8–10 exercises that work all major muscle groups. For intensity, choose a weight that is heavy enough to fatigue your muscles but not so heavy that you cannot complete the full number of repetitions with proper form. Exercises that use body weight for resistance also build strength and muscle endurance. A note of caution: Years of weight training can lead to stiffer blood vessels. Some studies show that doing aerobics after weight training helps to prevent blood vessel stiffening.

**Flexibility Training** Stretches should be performed at least two–three days per week (five–seven days per week is ideal), when the muscles are warm. The stretches should work all major muscle groups. For each exercise, stretch to the point of slight tension or mild discomfort, and hold the stretch for 10–30 seconds; do 2–4 repetitions of each exercise.

**4. Set Up a System of Mini-Goals and Rewards**

To keep your program on track, set up a system of goals and rewards. Break your specific goals into several steps, and set a target date for each step. For example, if one of the goals of an 18-year-old male student’s program is to improve upper-body strength and endurance, he could use the push-up test in Lab 4.2 to set intermediate goals. If he can currently perform 15 push-ups (for a rating of “very poor”), he might set intermediate goals of 17, 20, 25, and 30 push-ups (for a final rating of “fair”). By allowing several weeks between mini-goals and by specifying rewards, he’ll be able to track his progress and reward himself as he moves toward his final goal. Reaching a series of small goals is more satisfying than working toward a single, more challenging goal that may take months to achieve. For more on choosing appropriate rewards, see Chapter 1 and Activity 4 in the Behavior Change Workbook at the end of the text.

**5. Include Lifestyle Physical Activity and Strategies to Reduce Sedentary Time in Your Program**

Daily physical activity is a simple but important way to improve your overall wellness. As part of your fitness program plan, specify ways to be more active during your daily routine, say by taking the stairs up to class rather than taking an elevator. In addition, develop specific strategies to reduce the amount of time you spend being sedentary (see the box “The Importance of Reducing Sedentary Time”). You may find it helpful to first use a health journal to track your activities for several days. Review the records in your journal, identify routine opportunities to be more active, and add these to your program plan in Lab 7.1.

**6. Develop Tools for Monitoring Your Progress**

A record that tracks your daily progress will help remind you of your ongoing commitment to your program and give you a sense of accomplishment. Figure 7.3 shows you how to create a general program log and record the activity type, frequency, and times (durations). Or you can complete specific activity logs like those in Labs 3.2, 4.3, and 5.2 in addition to, or instead of, a general log. Post your log in a place where you’ll see it often as a reminder and as an incentive for improvement. If you have specific, measurable goals, you can also graph your weekly or monthly progress toward each goal (Figure 7.4). To monitor the overall progress of your fitness program, you may choose to reassess your fitness every three months or so during the improvement phase of your program. Because the results of different fitness tests vary, be sure to compare results for the same assessments over time.

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Intensity</th>
<th>Time</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>3–5 days per week</td>
<td>55/65–90% of maximum heart rate</td>
<td>20–60 minutes in sessions lasting 10 minutes or more</td>
<td>Continuous rhythmic activities using large muscle groups</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Intensity</th>
<th>Time</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>2–3 nonconsecutive days per week</td>
<td>Sufficient resistance to fatigue muscles</td>
<td>8–12 repetitions of each exercise, 1 or more sets</td>
<td>Resistance exercises for all major muscle groups</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Intensity</th>
<th>Time</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>2–3 days per week (minimum); 5–7 days per week (ideal)</td>
<td>Stretch to the point of tension</td>
<td>2–4 repetitions of each exercise, held for 10–30 seconds, for a total of 60 seconds per stretch</td>
<td>Stretching exercises for all major joints</td>
</tr>
</tbody>
</table>

**FIGURE 7.2 A summary of the FITT principle for the health-related components of fitness.**
THE EVIDENCE FOR EXERCISE
The Importance of Reducing Sedentary Time

Does a 45-minute workout make up for the effects of 8 hours of sitting time? The answer to this question appears to be no. A complete exercise program focused on the health-related components of fitness provides many benefits. But researchers have found that too much sedentary time—sitting too much—is detrimental to health regardless of whether an individual meets the goals set by the Physical Activity Guidelines for Americans. A 2015 review found that sedentary time was associated with the following, independent of participation in physical activity:

- Deaths from all causes
- Cardiovascular disease
- Cancer (breast, colon, colorectal, endometrial, and certain types of ovarian cancers)
- Type 2 diabetes

The risk of negative outcomes from sedentary time was lower among people with higher levels of physical activity, but they were not eliminated.

How does sedentary time impact health? Although not completely understood, sedentary time is associated with markers of poor metabolic functioning, including unhealthy levels of blood glucose, insulin, and blood fats, as well as a large waist circumference. A study that looked at the impact of increased sedentary time in moderately active individuals found that sitting for more than 30 or 60 minutes at a time resulted in significantly elevated glucose and insulin levels. Sedentary time also affects blood fats and markers for inflammation. All these factors have the potential to contribute to the development of type 2 diabetes, metabolic syndrome, heart disease, and cancer.

What does this mean for an individual? Studies have found that the average American adult spends more than half her or his waking day in sedentary activities, such as using a computer or watching television. Luckily, evidence so far suggests that frequent breaks from sedentary time—2 minutes every 20 or 30 minutes, for example—are protective against some of the impacts of sedentary time. So, it is important to take frequent breaks when you are engaged in sedentary activities, whether at work or school or during leisure time. Try some of the strategies suggested in Chapter 2, “Move More, Sit Less” and invent your own. To help stick with your plan, include your strategies as part of your overall fitness program plan.


7. Make a Commitment

Your final step in planning your program is to make a commitment by signing an agreement. Find a witness for your agreement—preferably someone who will be actively involved in your program. Keep your agreement in a visible spot to remind you of your commitment.

PUTTING YOUR PLAN INTO ACTION

After you’ve developed a detailed plan and signed your agreement, you are ready to begin your fitness program. Refer to the specific training suggestions provided in Chapters 2–5 for advice on beginning and maintaining your program. Many
• Ask for support from others. Consistent exercise requires the support of important people in your life, such as parents, spouse, partner, and friends. Talk with them about your program, and let them know the importance of exercise and wellness in your life. Exercise needs to be a critical component of your day (just like sleeping and eating). Good communication will help others become more supportive of and enthusiastic about the time you spend on your wellness program.

• Vary your activities. You can make your program more fun over the long term if you participate in a variety of activities that you enjoy. You can also add interest by varying the routes you take when walking, playing with different tennis partners, or switching to a new volleyball or basketball court. Varying your activities, a strategy known as cross-training, has other benefits. It can help you develop balanced, total-body fitness. For example, by alternating running with swimming, you build both upper- and lower-body strength. Cross-training can reduce the risk of injury and overtraining because the same muscles, bones, and joints are not continuously subjected to the stresses of the same activity. You can cross-train either by choosing different activities on different days or by alternating activities within a single workout.

• Cycle the duration and intensity of your workouts. Olympic athletes use a technique called periodization of training, meaning that they vary the duration and intensity of their workouts. Sometimes they exercise very intensely; other times they train lightly or rest. You can use the same technique to improve fitness more quickly and make your training program more varied and enjoyable. For example, if your program consists of walking, weight training, and stretching, pick one day a week for each activity to train a little harder or longer than you normally do. If you usually walk two miles at 16 minutes per mile, increase the pace to 15 minutes per mile once a week. If you lift weights twice a week, train more intensely during one of the workouts by using more resistance or performing multiple sets.

• Adapt to changing environments and schedules. Most people are creatures of habit and have trouble adjusting to people find it easier to plan a program than to put their plan into action and stick with it over time. For that reason, adherence to healthy lifestyle programs has become an important area of study for psychologists and health researchers. The guidelines below and in the next section reflect research into strategies that help people stick with an exercise program.

• Start slowly and increase fitness gradually. Overzealous exercising can result in discouraging discomforts and injuries. Your program is meant to last a lifetime. The important first step is to break your established pattern of inactivity. Be patient and realistic. After your body has adjusted to your starting level of exercise, slowly increase the amount of overload. Small increases are the key—achieving a large number of small improvements will eventually result in substantial gains in fitness. It’s usually best to increase duration and frequency before increasing intensity.

• Find an exercise buddy. The social side of exercise is an important factor for many regular exercisers. Working out with a friend will make exercise more enjoyable and increase your chances of sticking with your program. Find an exercise partner who shares your goals and general fitness level. On days when a partner isn’t available, a smartphone or MP3 player can be your workout buddy; see the box “Digital Motivation” for more information.
alcohol. Be sure to stay hydrated with water or other healthy beverages (see the box “Choosing Healthy Beverages”). Don’t skimp on sleep, which has a mutually beneficial relationship with exercise. Physical activity improves sleep, and adequate sleep can improve physical performance.

**EXERCISE GUIDELINES FOR LIFE STAGES**

A fitness program may need to be adjusted to accommodate the requirements of different life stages.

**Children and Adolescents**

Lack of physical activity has led to alarming increases in overweight and obesity in children and adolescents. If you have
Lapses are a normal part of any behavior change program. The important point is to move on and avoid becoming discouraged. Try again and keep trying. Know that continued effort will lead to success. Here are some tips to help you keep going:

- Don’t judge yourself too harshly, especially in comparison with others. Some people make faster gains in fitness than others. Focus on the improvements you’ve already made from your program and how good you feel after exercise—both physically and mentally.
- Visualize what it will be like to reach your goals. Keep these images in mind as an incentive to stick with your program.
- Use your exercise journal to identify thoughts and behaviors that are causing noncompliance. Devise strategies to combat these problematic patterns. If needed, make additional changes in your environment or find more social support. For example, call a friend to walk with you, or keep exercise clothes in your car or backpack.

- Make changes in your plan and your reward system to help renew enthusiasm for and commitment to your program. Try changing fitness activities or your exercise schedule. Build in more opportunities to reward yourself.
- Plan ahead for difficult situations. Think about what circumstances might make it tough to keep up your fitness routine. Develop strategies to increase your chances of sticking with your program. For example, figure out ways to continue your program during vacation, travel, bad weather, and so on.
- If you’re in a bad mood or just don’t feel like exercising, remind yourself that physical activity is probably the one thing you can do that will make you feel better. Even if you can only do half your scheduled workout, you’ll boost your energy, improve your mood, and help keep your program on track.

Fitness Tip  People of all ages benefit from exercise. By including their children, parents not only set a positive example that can lead to a lifetime of physical activity, but both parent and child will have an exercise buddy.

Pregnancy

Exercise is important during pregnancy, but women should be cautious because some types of exercise can pose increased risk to the mother and the unborn child. The following guidelines
As discussed in other chapters, it’s important to stay hydrated at all times, but especially when you are exercising. Too little water intake can leave you feeling fatigued, reduce your body’s performance, and leave you vulnerable to heat-related sicknesses in hot weather. But what you drink is as significant as how much you drink, both when you are exercising and when you are going about your normal routine.

The Great Water Controversy

Wherever you see people exercising, you will see bottled water in abundance. For several years, a debate has been raging about the quality and safety of commercially bottled water. Recently, evidence has emerged showing that most bottled waters are no better for you than regular tap water, and some bottled waters may actually be bad for you. To make matters worse, bottled water costs up to 1,900 times more than tap water.

In a 2011 analysis of 173 bottled water products, the Environmental Working Group found 38 different contaminants in ten popular brands of bottled water. Contaminants included heavy metals such as arsenic, pharmaceutical residues and other pollutants commonly found in urban wastewater, and a variety of industrial chemicals. Bottled-water companies are notoriously secretive about their products. Overall, 18% of bottled waters failed to list the location of their source, and 32% disclosed nothing about the treatment or purity of the water.

Many commercially bottled water products are, in fact, tap water drawn from municipal water systems. Such revelations have caused the Food and Drug Administration (FDA) to require bottlers to put statements on their products’ labels, identifying them as having been drawn from a standard water supply. These products, priced many times higher than water from a residential tap, provide no benefit over standard tap water.

An even bigger issue is that plastic water bottles have become a huge environmental problem: Billions of bottles now pile up in landfills and float in the world’s oceans. Some types of plastic take years to biodegrade, and many kinds of plastic bottles will never decompose at all. Newer types of plastic bottles can decompose significantly faster than older bottles, but fast-degrading plastics have not yet come into widespread use in the bottled-water industry.

Experts say that when you’re exercising, the cheapest and safest way to stay hydrated is to drink filtered tap water. If you need to carry water with you, buy a reusable container (preferably made of stainless steel) that you can clean after each use. If you drink from plastic bottles, be sure they are recyclable and dispose of them by recycling.

Other Choices

Instead of water, many people choose to drink sodas, juice, tea, or flavored water. While these kinds of beverages have their place, it’s important not to drink them too often or in large amounts, especially if they are high in sugar or caffeine. Sugary drinks add empty calories to your diet, and caffeine is a psychoactive drug with a variety of side effects.

Regular (nondiet) sodas are now the leading source of calories in the American diet; most people don’t count the calories from beverages as part of their daily caloric intake, leading them to underestimate their total intake. For this reason and others, many experts believe that soda consumption is a major factor in the increasing levels of obesity, metabolic syndrome, diabetes, and other chronic diseases among Americans.

If you’re concerned that the liquid portion of your diet is not as healthy as it should be, choose water, fat-free milk, or unsweetened herbal tea more often. Avoid regular soda, sweetened bottled iced tea, flavored water, and fruit beverages made with little fruit juice. To make water more appealing, try adding slices of citrus fruit with sparkling water. With some imagination, you can make sure you stay hydrated without consuming excess calories, spending money unnecessarily, or hurting the environment.


connect

are consistent with the recommendations of the American College of Obstetrics and Gynecology:

- See your physician about possible modifications needed for your particular pregnancy.
- Continue mild to moderate exercise routines at least three times a week. (For most women, this means maintaining an exercise heart rate of 100–160 beats per minute.) Avoid exercising vigorously or to exhaustion, especially in the third trimester. Monitor exercise intensity by assessing how you feel rather than by monitoring your heart rate; RPE levels of 11–13 are appropriate.
- Favor non- or low-weight-bearing exercises such as swimming or cycling over weight-bearing exercises, which can carry increased risk of injury.
- Avoid exercise in a supine position—lying on your back—after the first trimester. This position restricts blood flow to the uterus. Also avoid prolonged periods of motionless standing.
- Avoid exercise that could cause loss of balance, especially in the third trimester, and exercise that might injure the abdomen, stress the joints, or carry a risk of falling (such as contact sports, vigorous racquet sports, skiing, and inline skating).
- Avoid activities involving extremes in barometric pressure, such as scuba diving and mountain climbing.
- Especially during the first trimester, drink plenty of fluids and exercise in well-ventilated areas to avoid heat stress.
**Should I exercise every day?**

Some daily exercise is beneficial, but if you train intensely every day without giving yourself a rest, you will likely injure yourself or overtrain. When strength training, for example, rest at least 48 hours between workouts before exercising the same muscle group. For cardiorespiratory endurance exercise, rest or exercise lightly the day after an intense or lengthy workout. Balancing the proper amount of rest and exercise will help you feel better and improve your fitness faster.

**If exercise is so good for my health, why hasn’t my physician ever mentioned it to me?**

A recent study by the American College of Sports Medicine (ACSM) suggests that most people would benefit from getting a physician’s advice about exercising. According to the study, 65% of patients said they would be more interested in exercising if their physicians suggested it. About 40% of physicians said they talk to their patients about exercise. To encourage physicians and patients to talk more often about exercise and its benefits, the ACSM and the American Medical Association have launched the Exercise Is Medicine program. The program advises physicians to give more guidance to patients about exercise and suggests that everyone try to exercise at least five days each week. For more information on the program, visit www.exerciseismedicine.org.

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**Older Adults**

Older people readily adapt to endurance exercise and strength training. Exercise principles are the same as for younger people, but some specific guidelines apply:

- Do three–five sets of 10 Kegel exercises daily. These exercises call for tightening the muscles of the pelvic floor for 5–15 seconds per repetition. Kegel exercises are thought to help prevent incontinence (involuntary loss of urine) and speed recovery after giving birth.
- After giving birth, resume prepregnancy exercise routines gradually, based on how you feel.

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**SUMMARY**

- Steps for putting together a complete fitness program include (1) setting realistic goals; (2) selecting activities to develop all the health-related components of fitness; (3) setting a target frequency, intensity, and time (duration) for each activity; (4) setting up a system of mini-goals and rewards; (5) making lifestyle physical activity and strategies to reduce sedentary time a part of the daily routine; (6) developing tools for monitoring progress; and (7) making a commitment.
- In selecting activities, consider fun and interest, your current skill and fitness levels, time and convenience, cost, and any special health concerns.
- Keys to beginning and maintaining a successful program include starting slowly, increasing intensity and duration gradually, finding a buddy, varying the activities and intensity of the program, and expecting fluctuations and lapses.
- Regular exercise is appropriate and beneficial for people in all stages of life, although program modifications may be necessary for safety.

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**FOR FURTHER EXPLORATION**

American Academy of Orthopaedic Surgeons. Provides information about injuries, treatment, and rehabilitation along with exercise guidelines for people with bone, muscle, and joint pain.
http://www.aaos.org

American Congress of Obstetricians and Gynecologists. Provides guidelines for promoting a healthy pregnancy and postpartum recovery, including exercise during pregnancy.
http://www.acog.org
SAMPLE PROGRAMS

SAMPLE PROGRAMS FOR POPULAR ACTIVITIES

The following sections present four sample programs based on different types of cardiorespiratory activities—walking/jogging, bicycling, swimming, and rowing. Each sample program includes regular cardiorespiratory endurance exercise, resistance training, and stretching. Read the descriptions of the programs you’re considering, and decide which will work best for you based on your present routine, the potential for enjoyment, and adaptability to your lifestyle. If you choose one of these programs, complete the personal fitness program plan in Lab 7.1, just as if you had created a program from scratch.

No program will produce enormous changes in your fitness level in the first few weeks. Follow the specifics of the program for three–four weeks. Then, if the exercise program doesn’t seem suitable, make adjustments to adapt it to your particular needs. But retain the basic elements of the program that make it effective for developing fitness.

GENERAL GUIDELINES

The following guidelines can help make the activity programs more effective for you:

- **Frequency and time.** To improve physical fitness, exercise for 20–60 minutes at least three times a week.
- **Intensity.** To work effectively for cardiorespiratory endurance training or to improve body composition, raise your heart rate into its target zone. Monitor your pulse or use rates of perceived exertion to monitor your intensity. If you’ve been sedentary, begin very slowly. Give your muscles a chance to adjust to their increased workload. It’s probably best to keep your heart rate below target until your body has had time to adjust to new demands. At first you may not need to work very hard to keep your heart rate in its target zone, but as your cardiorespiratory endurance improves, you will probably need to increase intensity.
- **Interval training.** Some of the sample programs involve continuous activity. Others rely on interval training, which calls for alternating a relief interval with exercise (walking after jogging, for example, or coasting after biking uphill). Interval training is an effective method of progressive overload and improves fitness rapidly (see Chapter 3).
- **Resistance training and stretching guidelines.** For the resistance training and stretching parts of the program, remember the general guidelines for safe and effective exercise. See the summary of guidelines in Figure 7.2.
- **Warm-up and cool-down.** Begin each exercise session with a 10-minute warm-up. Begin your activity at a slow pace, and work up gradually to your target heart rate. Always slow down gradually at the end of your exercise session to bring your system back to its normal state. It’s a good idea to do stretching exercises to increase your flexibility after cardiorespiratory exercise or strength training because your muscles will be warm and ready to stretch.

Follow the guidelines presented in Chapter 3 for exercising in hot or cold weather. Drink enough liquids to stay adequately hydrated, particularly in hot weather.

- **Record keeping.** After each exercise session, record your daily distance or time on a progress chart.

WALKING/JOGGING SAMPLE PROGRAM

Walking is the perfect exercise. It increases longevity; builds fitness; expends calories; prevents weight gain; and protects against heart disease, stroke, and back pain. You don’t need to join a gym, and you can walk almost anywhere. People who walk 30 minutes five times per week will lose an average of 5 pounds in 6–12 months—without dieting, watching what they eat, or exercising intensely.

Jogging takes walking to the next level. Jogging only 75 minutes per week will increase fitness, promote weight control, and provide health benefits that will prevent disease and increase longevity. Your ultimate goal for promoting wellness is to walk at a moderate intensity for 150–300 minutes per week or jog at 70% effort or more for 75–150 minutes per week.

It isn’t always easy to distinguish among walking, jogging, and running. For clarity and consistency, we’ll consider walking to be any on-foot exercise of less than 5 miles per hour, jogging any pace between 5 and 7.5 miles per hour, and running any pace faster than that. The faster your pace or the longer you exercise, the more calories you burn (Table 1). The greater the number of calories burned, the higher the potential training effects of these activities. Table 2 contains a sample walking/jogging program.

**Equipment and Technique**

These activities require no special skills, expensive equipment, or unusual facilities. Comfortable clothing, well-fitted walking or running shoes (see Chapter 3), and a stopwatch or ordinary watch with a second hand are all you need.

When you advance to jogging, use proper technique:

- **Run with your back straight and your head up. Look straight ahead, not at your feet. Shift your pelvis forward and tuck your buttocks in.**
- **Hold your arms slightly away from your body. Your elbows should be bent so that your forearms are parallel to the ground.** You may cup your hands, but do not clench your fists. Allow your arms to swing loosely and rhythmically with each stride.
- **Let your heel hit the ground first in each stride.** Then roll forward onto the ball of your foot and push off for the next stride. If you find this difficult, you can try a more flat-footed style, but don’t land on the balls of your feet. More of a forefoot landing is recommended in barefoot running or with minimal footwear.
Beginning a Walking/Jogging Program

Start slowly if you have not been exercising, are overweight, or are recovering from an illness or surgery. At first, walk for 15 minutes at a slow pace, below your target heart rate zone. Gradually increase to 30-minute sessions. You will probably cover 1 to 2 miles. At the beginning, walk every other day. You can gradually increase to walking five days per week or more if you want to expend more calories (which is helpful if you want to change body composition). Depending on your weight, you will expend (“burn”) 90–135 calories during each 30-minute walking session. To increase the calories that you expend, walk for a longer time or for a longer distance instead of sharply increasing speed.

Start at the level of effort that is most comfortable for you. Maintain a normal, easy pace and stop to rest as often as you need to. Never prolong a walk past the point of comfort. When walking with a friend (a good motivator), let a comfortable conversation be your guide to pace. If you find that you cannot

- Keep your steps short by allowing your foot to strike the ground in line with your knee. Keep your knees bent at all times.
- Breathe deeply through your mouth. Try to use your abdominal muscles rather than just your chest muscles to take deep breaths.
- Stay relaxed.

Find a safe, convenient place to walk or jog. Exercise on a trail, path, or sidewalk to stay clear of bicycles and cars. Make sure your clothes are brightly colored so others can see you easily.

### Table 1

**Estimated Calories Expended by a 165-Pound Adult at Different Intensities of Walking and Jogging for 150 and 300 Minutes per Week (min/wk)**

<table>
<thead>
<tr>
<th></th>
<th>SPEED (MILES PER HOUR)</th>
<th>SPEED (MINUTES PER MILE)</th>
<th>CALORIES EXPENDED EXERCISING 150 MIN/WK</th>
<th>CALORIES EXPENDED EXERCISING 300 MIN/WK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walking</td>
<td>Rest</td>
<td>-</td>
<td>190</td>
<td>380</td>
</tr>
<tr>
<td></td>
<td>2.5</td>
<td>24</td>
<td>565</td>
<td>1130</td>
</tr>
<tr>
<td></td>
<td>3.0</td>
<td>20</td>
<td>620</td>
<td>1240</td>
</tr>
<tr>
<td></td>
<td>4.0</td>
<td>15</td>
<td>940</td>
<td>1880</td>
</tr>
<tr>
<td></td>
<td>4.3</td>
<td>14</td>
<td>1125</td>
<td>2250</td>
</tr>
<tr>
<td></td>
<td>5.0</td>
<td>12</td>
<td>1500</td>
<td>3000</td>
</tr>
<tr>
<td></td>
<td>6.0</td>
<td>10</td>
<td>1875</td>
<td>3750</td>
</tr>
<tr>
<td></td>
<td>7.0</td>
<td>8.6</td>
<td>2155</td>
<td>4310</td>
</tr>
<tr>
<td></td>
<td>8.0</td>
<td>6.7</td>
<td>2530</td>
<td>5060</td>
</tr>
<tr>
<td></td>
<td>10.0</td>
<td>6</td>
<td>3000</td>
<td>6000</td>
</tr>
</tbody>
</table>

**NOTE:** Heavier people will expend slightly more calories, while lighter people will expend slightly fewer.


### Table 2

**Sample Walking/Jogging Fitness Program**

<table>
<thead>
<tr>
<th>DAY</th>
<th>ACTIVITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday</td>
<td>• <strong>Walking/Jogging:</strong> Walk briskly for 30 minutes or jog for 25 minutes.</td>
</tr>
<tr>
<td></td>
<td>• <strong>Stretching:</strong> Stretch major muscle groups for 10 minutes after exercise. Do each exercise two times; hold stretch for 10–30 seconds.</td>
</tr>
<tr>
<td>Tuesday</td>
<td>• <strong>Resistance workout:</strong> Using body weight for resistance, perform the following exercises:</td>
</tr>
<tr>
<td></td>
<td>• Push-ups: 2 sets, 20 reps per set</td>
</tr>
<tr>
<td></td>
<td>• Pull-ups: 2 sets, 5 reps per set</td>
</tr>
<tr>
<td></td>
<td>• Unloaded squats: 2 sets, 10 reps per set</td>
</tr>
<tr>
<td></td>
<td>• Curl-ups: 2 sets, 20 reps per set</td>
</tr>
<tr>
<td></td>
<td>• Side bridges: 3 sets, 10-second hold (left and right sides)</td>
</tr>
<tr>
<td></td>
<td>• Spine extensions: 3 sets, 10-second hold (left and right sides)</td>
</tr>
<tr>
<td>Wednesday</td>
<td>• Repeat Monday activities.</td>
</tr>
<tr>
<td>Thursday</td>
<td>• Repeat Tuesday activities.</td>
</tr>
<tr>
<td>Friday</td>
<td>• Repeat Monday activities.</td>
</tr>
<tr>
<td>Saturday</td>
<td>• Rest.</td>
</tr>
<tr>
<td>Sunday</td>
<td>• Rest.</td>
</tr>
</tbody>
</table>
carry on a conversation without getting out of breath, you are walking too quickly.

Once your muscles have become adjusted to the exercise program, increase the duration of your sessions by no more than 10% each week. Keep your heart rate just below your target zone. Don’t be discouraged by a lack of immediate progress, and don’t try to speed things up by overdoing it. Remember that pace and heart rate can vary with the terrain, the weather, and other factors.

Advanced Walking

Advanced walking involves walking more quickly for longer times. You should feel an increased perception of effort, but the exercise intensity should not be too stressful. Vary your pace to allow for intervals of slow, medium, and fast walking. Keep your heart rate toward the lower end of your target zone with brief periods in the upper levels. At first, walk for 30 minutes and increase your walking time gradually until eventually you reach 60 minutes at a brisk pace and can walk 2–4 miles. Try to walk at least five days per week. Vary your program by changing the pace and distance or by walking routes with different terrains and views. You can expect to burn 200–350 calories or more during each advanced walking session.

Making the Transition to Jogging

Increase the intensity of exercise by gradually introducing jogging into your walking program. During a 2-mile walk, for example, periodically jog for 100 yards and then resume walking. Increase the number and distance of your jogging segments until you can jog continuously for the entire distance. More physically fit people may be capable of jogging without walking first. However, people unaccustomed to jogging should initially combine walking with short bouts of jogging.

A good strategy is to exercise on a 400-meter track at a local high school or college. Begin by covering 800 meters—jogging the straightaways and walking the turns. Progress to walking 200 meters (half lap) and jogging 200 meters; jogging 400 meters and walking 200 meters; jogging 800 meters, walking 200 meters; and jogging 1200 meters, walking 200 meters. Continue until you can jog 2 miles without stopping.

During the transition to jogging, adjust the ratio of walking to jogging to keep within your target heart rate zone as much as possible. Most people who sustain a continuous jogging or running program will find that they can stay within their target heart rate zone with a speed of 5.5–7.5 miles per hour (8–11 minutes per mile). Exercise at least every other day. Increasing frequency by doing other activities on alternate days will place less stress on the weight-bearing parts of your lower body than will a daily program of walking/jogging.

Developing Muscular Strength and Endurance and Flexibility

Walking, jogging, and running provide muscular endurance workouts for your lower body; they also develop muscular strength of the lower body to a lesser degree. If you’d like to increase your speed and performance, you might want to focus your program on lower-body exercises. (Don’t neglect upper-body strength. It is important for overall wellness.) For flexibility, pay special attention to the hamstrings and quadriceps, which are not worked through their complete range of motion during walking or jogging. Strength training, particularly bodybuilding, can sometimes decrease flexibility, so stretching is particularly important for people who lift weights.

Staying with Your Walking/Jogging Program

Health experts have found that simple motivators such as using a pedometer, walking a dog, parking farther from the office or grocery store, or training for a fun run help people stay with their programs. Use a pedometer or GPS exercise device to track your progress and help motivate you to increase distance and speed. Accurate pedometers for walking, such as those made by Omron, Yamax, and New Lifestyles, cost $20–$40 and are accurate to about 5%. Sophisticated GPS-based devices and apps made by Polar, Garmin, and Nike keep track of your exercise speed and distance via satellite, monitor heart rate, and store data that can be downloaded wirelessly to your computer or their own websites. Several of these units can be plugged into programs such as Google Earth, which give you a satellite view of your walking or jogging route.

A pedometer can also help you increase the number of steps you walk each day. Most sedentary people take only 2000 to 3000 steps per day. Adding 1000 steps per day and increasing gradually until you reach 10,000 steps can increase fitness and help you manage your weight. The nonprofit organization Shape Up America! has developed the 10,000 Steps program to promote walking as a fitness activity (www.shapeup.org).

BICYCLING SAMPLE PROGRAM

Bicycling can also lead to large gains in physical fitness. For many people, cycling is a pleasant and economical alternative to driving and a convenient way to build fitness.

Equipment and Technique

Cycling has its own special array of equipment, including helmets, lights, safety gear, and biking shoes. The bike is the most expensive item, ranging from about $100 to $1000 or more. Avoid making a large investment until you’re sure you’ll use your bike regularly. While investigating what the marketplace has to offer, rent or borrow a bike. Consider your intended use of the bike. Most cyclists who are interested primarily in fitness are best served by a sturdy 10-speed rather than a mountain bike or sport bike. Stationary cycles are good for rainy days and areas that have harsh winters.

Clothing for bike riding shouldn’t be restrictive or binding; nor should it be so loose that it catches the wind and slows you down. Shirts that wick moisture away from your skin and padded biking shorts make a ride more comfortable. Wear glasses...
or goggles to protect your eyes from dirt, small objects, and irritation from wind. Wear a pair of well-padded gloves if your hands tend to become numb while riding or if you begin to develop blisters or calluses.

To avoid saddle soreness and injury, choose a soft or padded saddle, and adjust it to a height that allows your legs to almost reach full extension while pedaling. To prevent backache and neck strain, warm up thoroughly and periodically shift the position of your hands on the handlebars and your body in the saddle. Keep your arms relaxed and don’t lock your elbows. To protect your knees from strain, pedal with your feet pointed straight ahead or very slightly inward, and don’t pedal in high gear for long periods.

Bike riding requires a number of precise skills that practice makes automatic. If you’ve never ridden before, consider taking a course. In fact, many courses are not just for beginners. They’ll help you develop skills in braking, shifting, and handling emergencies, as well as teach you ways of caring for and repairing your bike. For safe cycling, follow these rules:

- Always wear a helmet.
- Keep on the correct side of the road. Bicycling against traffic is usually illegal and always dangerous.
- Obey all the same traffic signs and signals that apply to autos.
- On public roads, ride in single file, except in low-traffic areas (if the law permits). Ride in a straight line; don’t swerve or weave in traffic.
- Be alert; anticipate the movements of other traffic and pedestrians. Listen for approaching traffic that is out of your line of vision.
- Slow down at street crossings. Check both ways before crossing.
- Use hand signals—the same as for automobile drivers—if you intend to stop or turn. Use audible signals to warn those in your path.
- Maintain full control. Avoid anything that interferes with your vision. Don’t jeopardize your ability to steer by carrying anything (including people) on the handlebars.
- Keep your bicycle in good shape. Brakes, gears, saddle, wheels, and tires should always be in good condition.
- See and be seen. Use a headlight at night and equip your bike with rear reflectors. Use side reflectors on pedals, front and rear. Wear light-colored clothing or use reflective tape at night; wear bright colors or use fluorescent tape by day.
- Be courteous to other road users. Anticipate the worst and practice preventive cycling.
- Use a rear-view mirror.

Developing Cardiorespiratory Endurance

Cycling is an excellent way to develop and maintain cardiopulmonary endurance and a healthy body composition.

FIT—frequency, intensity, and time:

If you’ve been inactive for a long time, begin your cycling program at a heart rate that is 10–20% below your target zone. Beginning cyclists should pedal at about 80–100 revolutions per minute; adjust the gear so you can pedal at that rate easily. You can equip your bicycle with a cycling computer that displays different types of useful information, such as speed, distance traveled, heart rate, altitude, and revolutions per minute.

Once you feel at home on your bike, try cycling 1 mile at a comfortable speed, and then stop and check your heart rate. Increase your speed gradually until you can cycle at 12–15 miles per hour (4–5 minutes per mile), a speed fast enough to bring most new cyclists’ heart rate into their target zone. Allow your pulse rate to be your guide: More highly fit individuals may need to ride faster to achieve their target heart rate. Cycling for at least 20 minutes three days per week will improve your fitness.

At the beginning:

It may require several outings to get the muscles and joints of your legs and hips adjusted to this new activity. Begin each outing with a 10-minute warm-up. When your muscles are warm, stretch your hamstrings and your back and neck muscles. Until you become a skilled cyclist, select routes with the fewest hazards and avoid heavy automobile traffic.

As you progress:

Interval training is also effective with bicycling. Simply increase your speed for periods of 4–8 minutes or for specific distances, such as 1–2 miles. Then coast for 2–3 minutes. Alternate the speed intervals and slow intervals for a total of 20–60 minutes, depending on your level of fitness. Biking over hilly terrain is also a form of interval training.

Developing Muscular Strength and Endurance and Flexibility

Bicycling develops a high level of endurance and a moderate level of strength in the muscles of the lower body. If one of your goals is to increase your cycling speed and performance, be sure to include exercises for the quadriceps, hamstrings, and buttocks muscles in your strength training program. For flexibility, pay special attention to the hamstrings and quadriceps, which are not worked through their complete range of motion during bike riding, and to the muscles in your lower back, shoulders, and neck.

SWIMMING SAMPLE PROGRAM

Swimming works every major muscle group in the body. It increases upper- and lower-body strength, promotes cardiovascular fitness, and is excellent for rehabilitating athletic injuries and preventing day-to-day aches and pains. It promotes weight control; builds powerful lungs, heart, and blood vessels; and promotes metabolic health. People weigh only 6–10 pounds in the water, so swimming places less stress on the knees, hips, and back than jogging, hiking, volleyball, or basketball.

Swimming is one of the most popular recreational and competitive sports in the world. More than 120 million Americans swim regularly. More than 165,000 of these are competitive
Training Methods
Improved fitness from swimming depends on the quantity, quality, and frequency of training. Most swimmers use interval training to increase swimming fitness, speed, and endurance. Interval training calls for repeated fast swims at fixed distances followed by rest. Continuous distance or endurance training builds stamina and mental toughness. Interval and distance training each play important and different roles in improving fitness for swimming. Interval training improves overall swimming speed and the ability to swim fast at the beginning of a swim. Endurance training helps to maintain a faster average pace during a swim without becoming overly fatigued. Endurance training becomes more important when you want to compete in long, open-water swims or triathlons.

In swimming workouts, however, quality is better than quantity. Thirty years ago, elite swimmers from East Germany sometimes swam as much as 20,000 meters in a single workout (more than 12 miles). Recent studies found that competitive athletes who swim 4000 to 6000 meters per workout produced results similar to those who swim much farther. Likewise, recreational swimmers can improve fitness, strength, and power by swimming 1000–2000 meters (approximately 1100–2200 yards) per workout. Swim fast to get maximum benefits, but maintain good technique to maximize efficiency and minimize the risk of injury.

Interval training:  
Interval training increases sprinting speed so you can accelerate faster at the beginning of a swim. It also helps the body cope with metabolic waste products so you can maintain your speed during the workout. To increase speed, swim intervals between 25 and 200 meters (or yards) at 80–90% effort. An example of a beginning program might be to swim 4 sets of 50 meters using the sidestroke at 70% of maximum effort, with a 1-minute rest between sets. A more advanced program would be to swim 10 sets of 100 meters using the freestyle stroke at 85–95% maximum effort with 30 seconds of rest between sets.

Endurance training:  
Include longer swims—1000 meters or more at a time—to build general stamina for swimming. Endurance training will improve aerobic capacity and help your cells use fuels and clear metabolic wastes. This will allow you to swim faster and longer. Longer swims promote metabolic health and build physical fitness.

Cross-training:  
Cross-training combines more than one type of endurance exercise, such as swimming and jogging, in your program at a time. It also includes exercises that build strength, power, and skill. It is a good training method for people who prefer swimming but don’t have daily access to a swimming pool or open water. Including multiple exercises, such as swimming and running, stair stepping, cycling, weight training exercises, and calisthenics, adds variety to the program. It also prepares you for a greater variety of physical challenges. See Chapter 3 for a discussion of cross-training and a description of typical workouts.

Technique: The Basic Swimming Strokes for General Conditioning
The best strokes for conditioning are the freestyle and sidestroke. Competitive athletes also swim the breaststroke, butterfly, and backstroke (but not the sidestroke). Learning efficient swimming strokes helps increase enjoyment and results in better workouts. Take a class from the Red Cross, local recreation department, or private coach if you are not a strong swimmer or need help with the basic strokes.

Freestyle:  
While freestyle technically includes any unregulated stroke (such as the sidestroke), it generally refers to the front (Australian) crawl or overhand stroke. Freestyle is the fastest stroke and is best for general conditioning. Swim this stroke in a prone (face-down) position with arms stretched out in front and legs extended to the back. Move through the water by pulling first with the right arm and then with the left, while performing a kicking motion generated from the hips. During the stroke, rotate the thumb and palm 45 degrees toward the bottom of the pool. Pull in a semicircle downward toward the center of the body with the elbow higher than the hand. When the hand reaches the beginning of the ribcage, push the palm backward underneath the body as far as possible. Don’t begin to stroke with the other hand until the first stroke is completed. Maximize the distance with each stroke by pulling fully and maintaining good posture.

The crawl uses a flutter kick, which involves moving the legs alternately with the force generated from the hips and a slight bend of the knees. Maintain a neutral spine during the stroke. A strong kick is important to minimize body roll during the stroke. For this reason, some of your training should include kicking without using the arms.

Breathing is almost always a problem for novice swimmers. Don’t hold your breath! You will fatigue rapidly if you have poor air exchange during swimming. Breathe by turning the head to the side of a recovering stroke. Do not lift the head out of the water. Exhale continuously through the nose and mouth between breaths. Beginners should breathe on the same side following each stroke cycle (left and right arm strokes).

Sidestroke:  
Even novices can get a good workout with minimal skill using the sidestroke. This is a good choice for beginners because you keep your head out of water and can swim great distances without fatigue. Lie in the water on your right side and stretch your right arm and hand in front of you in the direction you want to swim and place your left hand across your chest. Draw
your right arm toward you, pulling at the water until your hand reaches your waist. At the same time, make a scissors kick with your legs. Repeat the stroke as your forward speed slows. Swim half the distance on your right side and the rest on your left side.

**Beginning Swim Program**

Take swimming lessons from a certified teacher or coach if you are a nonswimmer or have not used swimming as your primary form of exercise. A swim teacher can help you develop good technique, make more rapid progress, and avoid injuries.

To assess your starting fitness, take the 12-minute swim test described in Lab 3.1. Use the swim test table to help you measure progress in your program. Take the test every one or two months to help establish short-term goals.

Start your program by swimming one length (one-half lap) at a time, using either freestyle or sidestroke. If you can’t swim the length of a standard pool (25 meters or yards), begin by swimming the width. As soon as you can, swim one length of the pool, rest for 30 seconds, and then repeat. Build up your capacity until you can swim 20 lengths with a short rest interval between each length. If you start your program with the sidestroke, try to switch to the freestyle stroke as quickly as you can.

Increase the distance of each swim to a full lap (50 meters or yards) with 30–60 seconds of rest between laps. Build up until you can swim 20 sets of 50-meter swims with 30 seconds of rest between sets. Gradually increase the distance of each set to 100-meter swims. You are ready for the next level when you can swim 10 sets of 100 meters with 30 seconds of rest between sets.

**Swimming Program for Higher Levels of Fitness**

This program includes a warm-up, specific conditioning drills for strokes and kicking, and a cool-down. It involves interval training three days a week and distance training two days per week.

Warm up before each workout by swimming 2–4 laps at an easy pace. It is also a good idea to warm up your legs and hips by holding on to the side of the pool and gently moving your legs using a flutter-kick motion. At the end of the workout, cool down by swimming 100–200 meters at a slow pace.

On Monday, Wednesday, and Friday, do interval training. Your goal is to swim intervals totaling 2000 meters per workout (20 sets of 100 meters each) at a fast pace with 30 seconds of rest between each set, or interval. (i.e., swim 100 meters, rest, swim 100 meters, rest, etc.) Every fifth interval, swim 25 meters using your legs alone, with your arms extended in front of you. Have someone watch you during the legs-only swims to make sure you are kicking mainly from the hips and maintaining a neutral spine. Add variety to your interval training workouts by using gloves, swim paddles, or fins.

If you are unable to do the interval workout at first, modify it by increasing rest intervals, decreasing speed, or decreasing the number of sets as you gradually increase the volume and intensity.

On Tuesday and Thursday, do distance training. Swim 1000–2000 meters continuously at a comfortable pace. Although distance days will help develop endurance, they are used mainly to help you recover from intense interval training days.

Rest on Saturday and Sunday. Rest is very important to help your muscles and metabolism recover and build fitness. Rest will also prevent overtraining and overuse injuries. Include two rest days per week. Rest days can be consecutive (such as Saturday and Sunday) or interspersed during the normal workout schedule.

**Integrating Swimming into a Total Fitness Program**

You will develop fitness best and maintain interest in continuing your exercise program by varying the structure of your workouts. Incorporate kick boards, pull-buoys, hand paddles, and fins into some of your training sessions. Cross-training is a good option for developing well-rounded fitness. Swimming results in moderate gains in strength and large gains in endurance.

Because swimming is not a weight-bearing activity and is not done in an upright position, it elicits a lower heart rate per minute. Therefore, swimmers need to adjust their target heart rate zone. To calculate your target heart rate for swimming, use this formula:

Maximum swimming heart rate (MSHR) = 205 − age

Target heart rate zone = 65–90% of MSHR

For example, a 19-year-old swimmer would calculate his or her target heart rate zone for swimming as follows:

MSHR: 205 − 19 = 186 bpm

65% intensity: 0.65 × 186 = 121 bpm

90% intensity: 0.90 × 186 = 167 bpm

Swimming does not preserve bone density as you age, so swimmers are advised to include weight training in their exercise program. Perform at least one set of 10 repetitions for 8–10 exercises that use the major muscle groups in the body. To improve swimming performance, include exercises that work key muscles. For example, if you primarily swim the freestyle stroke, include exercises to increase strength in your shoulders, arms, upper back, and hips. Training the muscles you use during swimming can also help prevent injuries. In your flexibility training, pay special attention to the muscles you use during swimming, particularly the shoulders, hips, and back. Table 3 shows a basic sample swimming program that incorporates all these types of exercises.

**ROWING MACHINE SAMPLE PROGRAM**

Rowing is a whole-body exercise that overloads the cardiorespiratory system and strengthens the major muscles of the body. The beauty and serenity of rowing on flat water in the morning is indescribable, but few people have access to a lake and rowing shell. Fortunately, sophisticated rowing machines simulate the rowing motion and make it possible to do this exercise at the fitness center or at a health club.

Modern rowing machines are very much like the real thing. They provide resistance with hydraulic pistons, magnets, air, or
Most people enjoy rowing at about 70% of maximum heart rate. Interval training involves a series of exercise bouts followed by rest. The method manipulates distance, intensity, repetitions, and rest. An example of an interval workout would be to row for 8 sets of 4-minute exercise bouts at 85% effort with 2 minutes of rest between intervals, or sets. During interval training, changing one factor affects the others. For example, if you increase the intensity of exercise, you will need more rest between intervals and won’t be able to do as many repetitions. High-intensity exercise builds fitness best but also increases the risk of injury and loss of motivation. Make intervals challenging but not so difficult that you get injured or discouraged.

**Beginning Rowing Program**

During the first few workouts, start conservatively by rowing for 10 minutes at a rate of about 20 strokes per minute with a moderate resistance. Exercise at about 60% effort. Do this workout three times during the first week. The movement is deceptively easy and invigorating. You are, however, using all the major muscle groups in the body and are probably not ready for a more intense exercise program.

The rowing movement includes the following phases:

- **The catch.** The catch involves sliding the seat forward on the track with arms straight as far as you can while keeping the spine neutral.
- **The drive.** The drive begins by pushing with the legs and keeping your arms straight.
- **The finish.** Finish by leaning back slightly (still maintaining a neutral spine) and pulling the handle to your abdomen.
- **The recovery.** Recover by extending your arms forward, hinging forward at the hips with a neutral spine, and sliding forward again on the seat for another “catch.”

**Training Methods**

Your rowing program should include both continuous training and interval training. Continuous training calls for rowing for a specific amount of time—typically 20–90 minutes without stopping. Most people enjoy rowing at about 70% of maximum heart rate.

Interval training involves a series of exercise bouts followed by rest. The method manipulates distance, intensity, repetitions, and rest. An example of an interval workout would be to row for 8 sets of 4-minute exercise bouts at 85% effort with 2 minutes of rest between intervals, or sets. During interval training, changing one factor affects the others. For example, if you increase the intensity of exercise, you will need more rest between intervals and won’t be able to do as many repetitions. High-intensity exercise builds fitness best but also increases the risk of injury and loss of motivation. Make intervals challenging but not so difficult that you get injured or discouraged.

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After the first workout, do a series of 5-minute intervals during the first few weeks of training. For example, row for 5 minutes, rest 3 minutes, row 5 minutes, then rest 3 minutes. Build up until you can do 4–6 repetitions of 5-minute exercise intervals, resting only 1 minute between sets. Gradually, increase the time for each interval to 15 minutes and vary the rowing cadence from 20 to 25 strokes per minute. Your first short-term goal is to complete 30 minutes of continuous rowing without stopping.

**Rowing Program for Higher Levels of Fitness**

Vary your training methods after you can row continuously for 30 minutes, gain some fitness, and are used to the technique.

### Table 3: Sample Swimming Program

<table>
<thead>
<tr>
<th>DAY</th>
<th>ACTIVITIES</th>
</tr>
</thead>
</table>
| Monday | - **Warm-up:** Swim 100–200 meters (2–4 laps of a standard pool) at an easy pace.  
- **Intervals:** Swim 10–20 sets of 100-meter swims at 90% effort, with 30 seconds of rest between sets. After every 5 sets, swim 25 meters using your legs alone.  
- **Cool-down:** Swim 100–200 meters at a slow pace.  
- **Weight training:** Do at least 1 set of 10 repetitions of 8–10 exercises that work the body’s major muscle groups.  
- **Flexibility:** Do standard stretching exercises for the shoulders, chest, back, hips, and thighs. |
| Tuesday| - **Distance:** Swim 1000–2000 meters continuously at a comfortable pace. |
| Wednesday| - Repeat Monday activities.         |
| Thursday| - Repeat Tuesday activities.        |
| Friday | - Repeat Monday activities.         |
| Saturday| - Rest.                             |
| Sunday  | - Rest.                             |
Alternate between interval training and distance training. Doing both will help you develop fitness rapidly and improve rowing efficiency. A good strategy is to row continuously at about 70% effort for 30–60 minutes three days per week and practice interval training at 80–90% effort for two days per week. Do resistance and flexibility training two–three days per week. A basic but complete rowing machine program that includes continuous and interval training as well as resistance and flexibility exercises is shown in Table 4.

### Table 4: Sample Rowing Machine Fitness Program

<table>
<thead>
<tr>
<th>DAY</th>
<th>ACTIVITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday</td>
<td>• <strong>Warm-up:</strong> Row at low intensity for 2 minutes.</td>
</tr>
<tr>
<td></td>
<td>• <strong>Continuous rowing:</strong> Row for 30 minutes at 70% effort (20–22 strokes per minute).</td>
</tr>
<tr>
<td></td>
<td>• <strong>Weight training (1–2 sets of 10 repetitions):</strong> Squats, leg curls, bench press, lat pulls, raises, biceps curls, triceps extensions, curl-ups, side bridge (10 seconds per side), spine extensions (10 seconds per side).</td>
</tr>
<tr>
<td></td>
<td>• <strong>Stretching:</strong> Do static stretching exercises for the shoulders, chest, back, hips, and thighs. Hold each stretch for 10–30 seconds.</td>
</tr>
<tr>
<td>Tuesday</td>
<td>• <strong>Warm-up:</strong> Row at low intensity for 2 minutes.</td>
</tr>
<tr>
<td></td>
<td>• <strong>Continuous rowing:</strong> Row at 60–70% of maximum effort for 5 minutes. Rest for 3 minutes.</td>
</tr>
<tr>
<td></td>
<td>• <strong>Interval rowing:</strong> Row 6 sets, for 5 minutes per set, at 25 strokes per minute (90% effort). Rest for 3 minutes between intervals.</td>
</tr>
<tr>
<td>Wednesday</td>
<td>• <strong>Warm-up:</strong> Row at low intensity for 2 minutes.</td>
</tr>
<tr>
<td></td>
<td>• <strong>Continuous rowing:</strong> Row for 45 minutes at 70% effort (20–22 strokes per minute).</td>
</tr>
<tr>
<td></td>
<td>• <strong>Stretching:</strong> Repeat Monday stretches.</td>
</tr>
<tr>
<td>Thursday</td>
<td>• <strong>Warm-up:</strong> Row at low intensity for 2 minutes.</td>
</tr>
<tr>
<td></td>
<td>• <strong>Continuous rowing:</strong> Row for 30 minutes at 70% effort (20–22 strokes per minute).</td>
</tr>
<tr>
<td></td>
<td>• <strong>Weight training (1–2 sets of 10 repetitions):</strong> Repeat Monday weight training exercises.</td>
</tr>
<tr>
<td>Friday</td>
<td>• <strong>Warm-up:</strong> Row at low intensity for 2 minutes.</td>
</tr>
<tr>
<td></td>
<td>• <strong>Continuous rowing:</strong> Row for 30 minutes at 70% effort (20–22 strokes per minute).</td>
</tr>
<tr>
<td></td>
<td>• <strong>Stretching:</strong> Repeat Monday stretches.</td>
</tr>
<tr>
<td>Saturday</td>
<td>• <strong>Rest.</strong></td>
</tr>
<tr>
<td>Sunday</td>
<td>• <strong>Rest.</strong></td>
</tr>
</tbody>
</table>
LAB 7.1 A Personal Fitness Program Plan and Agreement

A. I, ________________________________________________________, am making an agreement with myself to follow a physical fitness program to work toward the following goals:

Specific or short-term goals (include current status for each):
1. __________________________________________________________
2. __________________________________________________________
3. __________________________________________________________
4. __________________________________________________________

General or long-term goals:
1. __________________________________________________________
2. __________________________________________________________
3. __________________________________________________________
4. __________________________________________________________

B. My program plan is as follows:

<table>
<thead>
<tr>
<th>Components (Check ✓)</th>
<th>Frequency (Check ✓)</th>
<th>Intensity*</th>
<th>Time (duration)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activities</td>
<td>CRE</td>
<td>MS</td>
<td>ME</td>
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</tr>
</tbody>
</table>

*Conduct activities for achieving CRE goals in your target range for heart rate or RPE.

C. My program will begin on ___________________. My program includes the following schedule of mini-goals. For each step in my program, I will give myself the reward listed.

<table>
<thead>
<tr>
<th>Mini-goal 1</th>
<th>(date)</th>
<th>(reward)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mini-goal 2</td>
<td>(date)</td>
<td>(reward)</td>
</tr>
<tr>
<td>Mini-goal 3</td>
<td>(date)</td>
<td>(reward)</td>
</tr>
<tr>
<td>Mini-goal 4</td>
<td>(date)</td>
<td>(reward)</td>
</tr>
<tr>
<td>Mini-goal 5</td>
<td>(date)</td>
<td>(reward)</td>
</tr>
</tbody>
</table>
LABORATORY ACTIVITIES

D. My program will include the addition of physical activity to my daily routine (such as climbing stairs or walking to class):

1. _______________________________________________________________________________________________________
2. _______________________________________________________________________________________________________
3. _______________________________________________________________________________________________________
4. _______________________________________________________________________________________________________

E. My program will include the following strategies for reducing sedentary time:

1. _______________________________________________________________________________________________________
2. _______________________________________________________________________________________________________
3. _______________________________________________________________________________________________________
4. _______________________________________________________________________________________________________

F. I will use the following tools to monitor my program and my progress toward my goals:

__________________________________________________________________________________________________________________________
__________________________________________________________________________________________________________________________
__________________________________________________________________________________________________________________________

I sign this agreement as an indication of my personal commitment to reach my goal.

__________________________________________________________________________  __________
(your signature)  (date)

I have recruited a helper who will witness my agreement and _________________________________________________________________________
__________________________________________________________________________________________________________________________
__________________________________________________________________________________________________________________________

__________________________________________________________________________  __________
(witness’s signature)  (date)

(list any charts, graphs, or journals you plan to use)

(list any way your helper will participate in your program)
LAB 7.2 Getting to Know Your Fitness Facility

To help create a successful training program, take time to learn more about the fitness facility you plan to use.

Basic Information

Name and location of facility: __________________________________________________________

Hours of operation: _________________________________________________________________

Times available for general use: _____________________________________________________

Times most convenient for your schedule: _____________________________________________

Can you obtain an initial session or consultation with a trainer to help you create a program? yes no

If so, what does the initial planning session involve? ______________________________________

Are any of the staff certified? Do any have special training? If yes, list/describe: ______________

What types of equipment are available for the development of cardiorespiratory endurance? Briefly list/describe: ____________________________________________________________

Are any group activities or classes available? If so, briefly describe: _______________________

What types of weight training equipment are available for use? ______________________________

Yes No

Is there a fee for using the facility? If so, how much? $ _________________________________

Is a student ID required for access to the facility? _________________________________

Do you need to sign up in advance to use the facility or any of the equipment? ________

Is there typically a line or wait to use the equipment during the times you use the facility? _______

Is there a separate area with mats for stretching and/or cool-down? ________________

Do you need to bring your own towel? ______________________________

Are lockers available? If so, do you need to bring your own lock? yes no ____________

Are showers available? If so, do you need to bring your own soap and shampoo? yes no ____________

Is drinking water available? (If not, be sure to bring your own bottle of water.) ______________
LABORATORY ACTIVITIES

What other amenities, such as vending machines or saunas, are available at the facility? Briefly list/describe: ____________________________________________
____________________________________________________________________________________________________________________________
____________________________________________________________________________________________________________________________

Information about Equipment

Fill in the specific equipment and exercise(s) that you can use to develop cardiorespiratory endurance and each of the major muscle groups. For cardiorespiratory endurance, list the type(s) of equipment and a sample starting workout: frequency, intensity, time, and other pertinent information (such as a setting for resistance or speed). For muscular strength and endurance, list the equipment and exercises, and indicate the order in which you’ll complete them during a workout session. Remember, you don’t have to use equipment—you can use body weight or elastic bands as resistance.

Cardiorespiratory Endurance Equipment

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Sample Starting Workout</th>
</tr>
</thead>
<tbody>
<tr>
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</table>

Muscular Strength and Endurance Equipment

<table>
<thead>
<tr>
<th>Order</th>
<th>Muscle Groups</th>
<th>Equipment</th>
<th>Exercise(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Neck</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Chest</td>
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<tr>
<td></td>
<td>Shoulders</td>
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<tr>
<td></td>
<td>Upper back</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Front of arms</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Back of arms</td>
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<tr>
<td></td>
<td>Buttocks</td>
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<tr>
<td></td>
<td>Abdomen</td>
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<tr>
<td></td>
<td>Lower back</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Front of thighs</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Back of thighs</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Calves</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Other:</td>
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<tr>
<td></td>
<td>Other:</td>
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</tbody>
</table>
LOOKING AHEAD...
After reading this chapter, you should be able to

- List the essential nutrients and describe the functions they perform in the body.
- Describe the guidelines that have been developed to help people choose a healthy diet, avoid nutritional deficiencies, and reduce their risk of diet-related chronic diseases.
- Describe guidelines for vegetarians and special population groups.
- Explain how to use food labels and other consumer tools to make informed choices about foods.
- Create a personal food plan based on affordable foods that you enjoy and that will promote wellness, today and in the future.

TEST YOUR KNOWLEDGE

1. It is recommended that all adults consume one serving each of fruits and vegetables every day. True or false?

2. Candy is the leading source of added sugars in the American diet. True or false?

3. Which of the following is not a whole grain?
   a. brown rice
   b. wheat flour
   c. popcorn

See answers on the next page.
In your lifetime, you will spend about six years eating—about 70,000 meals and 60 tons of food. What you eat affects your energy level, well-being, and overall health. Your nutritional habits help determine your risk of major chronic diseases, including heart disease, cancer, stroke, and diabetes. Choosing a dietary pattern that provides the nutrients you need while limiting the substances linked to risk factors for disease should be an important part of your daily life.

Choosing a healthy diet is a two-part process. First, you have to know which nutrients you need and in what amounts. Second, you have to translate those requirements into a diet consisting of foods you like that are available, affordable, and fit into your lifestyle. After you know what constitutes a healthy diet for you, you can adjust your current diet to bring it into line with your goals.

This chapter explains the basic principles of nutrition. It introduces the six classes of essential nutrients, explaining their role in the functioning of the body. It also provides guidelines that you can use to design a healthy eating plan. Finally, it offers practical tools and advice to help you apply the guidelines to your life.

Answers (Test Your Knowledge)

1. False. For someone consuming 2000 calories per day, 2½ cups of vegetables and 2 cups of fruit are recommended daily.

2. False. Regular (nondiet) sodas are the leading source of added sugars. Together with other beverages, they account for 47% of the added sugars in the American diet, and added sugars contribute an average of 13% of the total calories in American diets. Each 12-ounce soda supplies about 10 teaspoons of sugar, or nearly 10% of the calories in a 2000-calorie diet.

3. b. Unless labeled “whole wheat,” wheat flour is processed to remove the bran and germ and is not a whole grain.

### NUTRITIONAL REQUIREMENTS: COMPONENTS OF A HEALTHY DIET

You probably think about your diet in terms of the foods you like to eat. More important for your health, though, are the nutrients contained in those foods. Your body requires proteins, fats, carbohydrates, vitamins, minerals, and water—about 45 essential nutrients. In this context, the word essential means that you must get these substances from food because your body is unable to manufacture them, or at least not fast enough or in sufficient amounts to meet your physiological needs. The six classes of nutrients, along with their functions and major sources, are listed in Table 8.1

The body needs some essential nutrients in relatively large amounts; these macronutrients include protein, fat, carbohydrate, and water. Micronutrients, such as vitamins and minerals, are required in much smaller amounts. Your body obtains nutrients through the process of digestion, which breaks down food into compounds that the gastrointestinal tract can absorb and the body can use (Figure 8.1). A diet that provides enough essential nutrients is vital because they provide energy, help build and maintain body tissues, and help regulate body functions.

Food is partially broken down by being chewed and mixed with saliva in the mouth. After traveling to the stomach via the esophagus, food is broken down further by stomach acids and other secretions. As food moves through the digestive tract, it is mixed by muscular contractions and broken down by chemicals. Most absorption of nutrients occurs in the small intestine, aided by secretions from the pancreas, gallbladder, and intestinal lining. The large intestine reabsorbs excess water; the remaining solid wastes are collected in the rectum and excreted through the anus.

### Calories

The energy in foods is expressed as kilocalories. One kilocalorie represents the amount of heat it takes to raise the temperature...
When consumed, proteins also provide energy (4 calories per gram) for the body.

**Amino Acids** The building blocks of proteins are called amino acids. Twenty common amino acids are found in food. Nine of these are essential (or indispensable). As long as foods supply certain nutrients, the body can produce the other 11 amino acids.

**Complete and Incomplete Proteins** Individual protein sources are considered “complete” if they supply all the essential amino acids in adequate amounts and “incomplete” if they do not. Meat, fish, poultry, eggs, milk, cheese, and soy provide complete proteins. Incomplete proteins, which come from plant sources such as nuts and legumes (dried beans and peas), are good sources of most essential amino acids but are usually low in one or more.

Certain combinations of vegetable proteins, such as wheat and peanuts in a peanut butter sandwich or rice and beans, allow each vegetable protein to make up for the amino acids missing in the other protein. The combination yields a complete protein.

It was once believed that vegetarians had to complement their proteins at each meal in order to receive the benefit of a complete protein. It is now known, however, that proteins consumed throughout the course of the day can complement each other to form a pool of amino acids the body can draw from to produce proteins. Vegetarians should include a variety of vegetable protein sources in their diets to make sure they get all the essential amino acids in adequate amounts. (Healthy vegetarian diets are discussed later in the chapter.)

Alcohol, though not an essential nutrient, also supplies energy, providing 7 calories per gram.

Just meeting energy needs is not enough. Our bodies need enough of the essential nutrients to function properly. Practically all foods contain combinations of nutrients, although foods are commonly classified according to their predominant nutrients. For example, spaghetti is considered a carbohydrate food, although it contains small amounts of other nutrients. The following sections discuss the functions and sources of each class of nutrients.

**Proteins—The Basis of Body Structure**

Proteins form important parts of the body’s main structural components: muscles and bones. Proteins also form important parts of blood, enzymes, cell membranes, and some hormones.
Recommended Protein Intake. The Food and Nutrition Board of the Institute of Medicine has established goals to help ensure adequate intake of protein as well as the other macronutrients (Table 8.2). For protein, adequate intake is set at 0.8 gram per kilogram (0.36 gram per pound) of body weight. So, if you weigh 125 pounds, you should eat 42 grams of protein per day. Someone who weighs 180 pounds would eat 65 grams. Table 8.3 lists some popular food items and the amount of protein each provides; labels on packaged foods show how much protein there is in each serving.

Most Americans meet or exceed the protein intake needed for adequate nutrition. A little extra protein is not harmful, but it can contribute excess energy and fat to the diet because protein-rich foods, especially those from animal sources, can be high in fat and calories.

The Food and Nutrition Board also recommends how much protein (and other nutrients) to consume as a percentage of total daily energy intake. These recommendations, called Acceptable Macronutrient Distribution Ranges (AMDRs), aim to ensure adequate intake of essential nutrients and to reduce the risk of chronic diseases. The Food and Nutrition Board recommends that the amount of protein adults age 19 and over eat should fall within the range of 10–35% of total daily calories. Because most people in the United States meet the recommendations for sufficient protein intake, nutrition experts recommend that Americans focus on a variety of low-fat protein choices to obtain adequate protein while reducing calorie intake. The recommended dietary patterns described later in the chapter, if followed, ensure adequate intake of all key nutrients.

Fats—Essential in Small Amounts

Fats, also known as lipids, are the most concentrated source of energy, at 9 calories per gram. The fats stored in your body represent usable energy, help insulate your body, and support and cushion your organs. Fats in the diet help your body absorb fat-soluble vitamins, and they add flavor and texture to foods. Fats are the major fuel for the body during rest and light activity.

Two fats—linoleic acid and alpha-linolenic acid—the essential fatty acids—are necessary components of the diet. They are used to make compounds that are key regulators of body functions such as the maintenance of blood pressure, vision, and the progress of a healthy pregnancy.

Types and Sources of Fats. Food fats are usually composed of both saturated and unsaturated fatty acids (Table 8.4). The dominant type of fatty acid determines the fat’s characteristics. Saturated fats come mostly from animal products—red meats (hamburger, steak, roasts), whole milk, cheese, hot dogs, and lunchmeats—but are also found in tropic oils (coconut and palm oils). They are usually solid at room

Table 8.2 Goals for Protein, Fat, and Carbohydrate Intake for Adults

<table>
<thead>
<tr>
<th>ITEM</th>
<th>PROTEIN (GRAMS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 ounces lean meat, poultry, or fish</td>
<td>20–27</td>
</tr>
<tr>
<td>½ cup tofu</td>
<td>20</td>
</tr>
<tr>
<td>1 cup baked/black cooked beans</td>
<td>13–15</td>
</tr>
<tr>
<td>1 container (6 oz) yogurt</td>
<td>6–8</td>
</tr>
<tr>
<td>1 ounce blue/camembert cheese</td>
<td>6</td>
</tr>
<tr>
<td>1/2–1 cup cereals</td>
<td>1–6</td>
</tr>
<tr>
<td>1 egg cooked</td>
<td>6</td>
</tr>
<tr>
<td>1 cup ricotta cheese</td>
<td>28</td>
</tr>
<tr>
<td>1 cup milk</td>
<td>9</td>
</tr>
<tr>
<td>1 ounce nuts</td>
<td>2–6</td>
</tr>
</tbody>
</table>

*Protein intake goals can be calculated more specifically by multiplying your body weight in pounds by 0.36.

NOTE: Individuals can allocate total daily energy intake among the three classes of macronutrients to suit individual preferences. To translate percentage goals into daily intake goals expressed in calories and grams, multiply the appropriate percentages by total daily energy intake and then divide the results by the corresponding calories per gram. For example, a fat limit of 35% applied to a 2,200-calorie diet would be calculated as follows: 0.35 × 2200 = 770 calories of total fat; 770 ÷ 9 calories per gram = 86 grams of total fat.

temperature. Most unsaturated fats in foods come from plant sources and are liquid at room temperature.

Depending on their structure, unsaturated fatty acids can be further divided into monounsaturated and polyunsaturated fats. Olive, canola, safflower, and peanut oils contain mostly monounsaturated fatty acids. Soybean, corn, and cottonseed oils contain mostly polyunsaturated fatty acids. You may sometimes also see polyunsaturated fats described more specifically by chemical structure as either omega-3 or omega-6 fats.

Hydrogenation When unsaturated vegetable oils undergo the process of hydrogenation, a mixture of saturated and unsaturated fatty acids is produced, creating a more solid fat from a liquid oil. Hydrogenation also changes some unsaturated fatty acids into trans fatty acids (trans fats), unsaturated fatty acids with an atypical shape that affects their behavior in the body.

Food manufacturers use hydrogenation to increase the stability of an oil so that it can be reused for deep frying, to improve the texture of certain foods (to make pie crusts flakier, for example), and to extend the shelf life of foods made with oil. Hydrogenation is also used to transform liquid oil into margarine or vegetable shortening.

Small amounts of trans fats occur naturally in animal fat, particularly beef, lamb, and dairy products, but the majority of trans fats in the American diet are artificial, from partially hydrogenated oils. Many baked and fried foods are prepared with hydrogenated vegetable oils, so they can be relatively high in saturated and trans fatty acids. However, in 2013, the Food and Drug Administration (FDA) made a preliminary determination that trans fats were no longer generally recognized as safe, because they are linked to a significant increase in coronary heart disease. In 2015, the FDA required all food manufacturers to stop using trans fats, allowing a three-year compliance period. At this time, trans fats are still used in many processed foods, such as crackers, cookies, cakes, frozen baked goods, snack foods such as microwave popcorn, stick margarines, and coffee creamers. Even with the new law, it is important to check ingredient labels for partially hydrogenated oils: as long as a product has no more than half a gram of trans fats, the label may claim zero.

In general, the more solid a hydrogenated oil is, the more saturated or trans fats it contains. For example, stick margarines typically contain more saturated and trans fats than tub or squeeze margarines.
Hydrogenated vegetable oils are not the only plant fats that contain saturated fats. Palm and coconut oils, although derived from plants, are also highly saturated. Yet fish oils, derived from an animal source, are rich in polyunsaturated fats.

**Fats and Health** Scientists are still unraveling the complex effects that individual types of fats and overall dietary patterns have on health and the risk for specific diseases. Recently, most health experts have agreed on the dangers of artificial trans fats because of their double-negative effect on heart health—they raise levels of low-density lipoprotein (LDL)—“bad” cholesterol—and they also lower high-density lipoprotein (HDL)—“good” cholesterol. Consuming trans fats appears to increase the risk of both cardiovascular disease and type 2 diabetes. In recent years, as awareness of these health risks has grown, cities and states have banned the use of trans fats in restaurants and food prepared for retail sale, and food manufacturers have reduced the amount of trans fats they use. And the 2015 ban by the FDA signals that this type of dangerous fat will be removed from the food supply.

What about other types of fats? Many studies have examined the effects of dietary fat intake on blood cholesterol levels and the risk of heart disease. Longstanding advice has been to limit saturated fat; however, a 2014 analysis published in *Annals of Internal Medicine* challenged the widely accepted saturated fat hypothesis that butter and other sources of saturated fat cause coronary heart disease. A Cambridge University analysis looked at 27 prior clinical trials and 49 observational studies, consisting of more than 600,000 participants. It concluded that “current evidence does not clearly support cardiovascular guidelines that encourage high consumption of polyunsaturated fatty acids and low consumption of total saturated fats.” Other scientists challenged the methods and findings of the study, and the recommendations from the American Heart Association and American College of Cardiology strongly advise lowering saturated fat intake for reducing cardiovascular risk, especially for those people with risk factors for heart disease. Continued research on the health risks and benefits of individual fats is ongoing. For example, do saturated fats in beef, butter, milk, and chocolate all have the same effect on heart disease risk? And what are the health effects of shifts in the intake of particular fats within the overall context of the diet?

Dietary fat affects health in other ways besides heart disease risk. Diets high in fatty red meat are associated with an increased risk of certain forms of cancer, especially colon cancer. A high-fat diet can also make weight management more difficult, because fat is a concentrated source of calories. If you are trying to limit overall energy intake, consuming a high-fat diet can make it more difficult to consume all essential nutrients at your target calorie level.

What does all this mean for you? Although more research is needed on the precise effects of different types and amounts of fat on overall health, evidence suggests that most people benefit from keeping their overall fat and saturated fat intake at recommended levels. Dietary patterns are more important for health than a focus on a single nutrient. The fats in your diet are found in foods that contain other nutrients, and the foods you consume are in the context of your overall diet. Increased body weight, aging, and gender are more important for predicting negative health events than eating one kind of dietary fat rather than another. The U.S. Department of Agriculture recommends that Americans limit their intake of saturated fat to less than 10 percent of total calories per day—but that they do so in the context of a healthy dietary pattern that emphasizes vegetables, fruits, whole grains, low- or non-fat dairy, seafood, legumes, and nuts; is lower in red and processed meat; and is low in sugar-sweetened foods and drinks and refined grains. Don’t replace one less-than-healthy choice with another. Healthy dietary patterns are described in detail later in the chapter.
Carbohydrates—A Key Source of Energy

Carbohydrates (“carbs”) supply energy to body cells. Some cells, such as those in the brain and other parts of the nervous system and in the blood, use only the carbohydrate glucose for fuel. During high-intensity exercise, muscles use carbohydrates for fuel.

Simple and Complex Carbohydrates Carbohydrates are classified into two groups: simple and complex (Table 8.5). Simple carbohydrates are the single sugar molecules (monosaccharides) and the double sugars (disaccharides). Three monosaccharides are glucose, fructose, and galactose. Glucose, the most common of the sugars, is used by both animals and plants for energy. Fructose is a very sweet sugar that is found in fruits, and galactose is the sugar in milk.

The disaccharides, pairs of single sugars, include sucrose (table sugar: fructose + glucose), maltose (malt sugar: glucose + glucose), and lactose (milk sugar: galactose + glucose). Simple carbohydrates add sweetness to foods. They are found naturally in fruits and milk and are added to soft drinks, fruit drinks, candy, and desserts. There is no evidence that any type of simple carbohydrate is more nutritious than others.

Complex carbohydrates include starches and most types of dietary fiber. Starches are found in a variety of plants, especially grains (wheat, rye, rice, oats, barley, and millet), legumes (dried beans, peas, and lentils), and tubers (potatoes and yams). Most other vegetables contain a mix of complex and simple carbohydrates. Fiber, which is discussed later in this chapter, is found in fruits, vegetables, and grains.

During digestion, your body breaks down carbohydrates into simple sugar molecules, such as glucose, for absorption. When glucose is in the bloodstream, the pancreas releases the hormone insulin, which allows cells to take up glucose and use it for energy. The liver and muscles also take up glucose and store it in the form of a starch called glycogen. The muscles use glucose from glycogen as fuel during endurance events or long workouts.

Refined Carbohydrates versus Whole Grains

Complex carbohydrates can be further divided into refined, or processed, carbohydrates and unrefined carbohydrates, or whole grains. Before they are processed, all grains are whole grains, consisting of an inner layer of germ, a middle layer called the endosperm, and an outer layer of bran (Figure 8.2). During processing, the germ and bran are often removed, leaving just the starchy endosperm. The refinement of whole grains transforms whole-wheat flour into white flour, brown rice into white rice, and so on.

Refined carbohydrates usually retain all the calories of their unrefined counterparts, but they tend to be much lower in fiber, vitamins, minerals, and other beneficial compounds. Refined grain products are often enriched or fortified with vitamins and minerals, but many of the nutrients lost in processing are not replaced.

Unrefined carbohydrates tend to take longer to chew and digest than refined ones; they also generally enter the bloodstream more slowly. This slower digestive pace makes you feel full sooner and for a longer period. Also, a slower rise in blood glucose levels following consumption of complex carbohydrates may help in the management of diabetes. Whole grains are also high in dietary fiber (discussed later).

Consumption of whole grains has been linked to a reduced risk of heart disease, diabetes, and cancer, and plays an important role in gastrointestinal health and body weight management. For all these reasons, whole grains are recommended over those that have been refined. See the box “Choosing More Whole-Grain Foods” for tips on increasing your intake of whole grains.

**Table 8.5 Simple and Complex Carbohydrates in Foods**

<table>
<thead>
<tr>
<th>SIMPLE CARBOHYDRATES (“SUGARS”)</th>
<th>COMPLEX CARBOHYDRATES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single sugar molecules (monosaccharides)</td>
<td>Starches (long, complex chains of sugar molecules)</td>
</tr>
<tr>
<td>– Glucose (common in foods)</td>
<td>– grains (wheat, rye, rice, oats, barley, millet)</td>
</tr>
<tr>
<td>– Fructose (fruits)</td>
<td>– legumes (dry beans, peas, and lentils)</td>
</tr>
<tr>
<td>– Galactose (milk)</td>
<td>– tubers and other vegetables (potatoes, yams, corn)</td>
</tr>
<tr>
<td>Double sugar molecules (disaccharides; pairs of single sugars)</td>
<td>Fiber (nondigestible carbohydrates)</td>
</tr>
<tr>
<td>– Sucrose or table sugar (fructose + glucose)</td>
<td>– soluble (oats, barley, legumes, some fruits and vegetables)</td>
</tr>
<tr>
<td>– Maltose or malt sugar (glucose + glucose)</td>
<td>– insoluble (wheat bran, vegetables, whole grains)</td>
</tr>
</tbody>
</table>

**FIGURE 8.2 The parts of a whole grain kernel.**

*Germ* Provides nourishment for the seed
Contains antioxidants, vitamin E, B vitamins

*Endosperm* Provides energy
Contains carbohydrates, protein

*Bran* “Outer shell” protects seed
Contains fiber, B vitamins, trace minerals

*NUTRITIONAL REQUIREMENTS: COMPONENTS OF A HEALTHY DIET*
Attempting to base food choices on glycemic index is a difficult task; however, for people with particular health concerns, such as diabetes, glycemic index may be an important consideration in choosing foods. In addition to the type of carbohydrate in the food, the total amount of carbohydrate in the diet is important for diabetes management. Your best bet, therefore, is to choose a variety of vegetables daily and limit refined grains as well as foods that are high in added sugars and low in other nutrients.

Glycemic Index and Glycemic Response  Insulin and glucose levels rise following a meal or snack containing any type of carbohydrate. Some foods cause a quick and dramatic rise in glucose and insulin levels, while others have a slower, more moderate effect. A food that has a rapid effect on blood glucose levels is said to have a high glycemic index. The glycemic index of a food indicates the type of carbohydrate in that food. Unrefined complex carbohydrates, high-fiber foods, and high-fat foods tend to have a lower glycemic index.

Glycemic Index

**glycemic index**  A measure of how a particular food affects blood glucose levels.

**dietary fiber**  Nondigestible carbohydrates and lignin that are intact in plants.

**functional fiber**  Nondigestible carbohydrates either isolated from natural sources or synthesized; these may be added to foods and dietary supplements.

**total fiber**  The total amount of dietary fiber and functional fiber in the diet.

**soluble (viscous) fiber**  Fiber that dissolves in water or is broken down by bacteria in the large intestine.

**insoluble fiber**  Fiber that does not dissolve in water and is not broken down by bacteria in the large intestine.

**vitamins**  Carbon-containing substances needed in small amounts to help promote and regulate chemical reactions and processes in the body.

Wellness Tip  To reduce the risk of chronic disease and maintain intestinal health, daily fiber intake of 38 grams for men and 25 grams for women is recommended. Americans currently consume about half this amount. Fruits, vegetables, and whole grains are excellent sources of carbohydrates and fiber. Drink plenty of water to get the most health benefits from the fiber you consume.
**Added Sugars** Added sugars are sugars that are added to foods by food manufacturers or individuals; they include white sugar, brown sugar, high-fructose corn syrup, and other sweeteners added to most processed foods. (Naturally occurring sugars in fruit and milk are not considered added sugars.) Foods high in added sugar are generally high in calories and low in nutrients and fiber, thus providing “empty calories.” High intake of added sugars from foods and sugar-sweetened beverages is associated with dental caries (“cavities”), excess body weight, and increased risk of type 2 diabetes, and may also increase risk for hypertension, stroke, and heart disease.

Added sugars currently contribute about 250–300 calories in the typical daily American diet, representing about 13–17% of total energy intake. A limit of 10% is suggested by the USDA and other organizations; even lower intakes may be needed to meet all nutrient needs at a given level of calorie intake. Remember, added sugars are empty calories and do not supply any essential nutrients.

Sweetened beverages supply nearly half of all the added sugars consumed by Americans, followed by snacks and sweets. To decrease intake from added sugars, reduce your consumption of sugar-sweetened beverages (soft drinks, sweetened fruit drinks, sweetened sports beverages), sweet snacks, and desserts. In particular, choose water in place of sweetened beverages. Water is a readily available, low-cost, zero-calorie option. The sugars in your diet should be mostly those that are naturally occurring: from fruits, which are excellent sources of vitamins and minerals, and from low-fat or fat-free dairy products, which are high in protein, calcium, and other nutrients.

**Fiber—A Closer Look**

Fiber is the term given to nondigestible carbohydrates in plants. Instead of being digested, like starch, fiber moves through the intestinal tract and provides bulk for feces in the large intestine, which in turn facilitates elimination. In the large intestine, some types of fiber are broken down by bacteria into acids and gases, which explains why eating too much fiber-rich food can lead to intestinal gas. Even though humans don’t digest fiber, it is necessary for good health.

**Types of Fiber** Dietary fiber refers to the nondigestible carbohydrates (and the noncarbohydrate substance lignin) that are naturally present in plants such as grains, fruits, legumes, and vegetables. There are two types of dietary fiber: soluble and insoluble. Both types are important for health.

- **Soluble (viscous) fiber**, such as that found in oat bran or legumes, can delay stomach emptying, slow the movement of glucose into the blood after eating, and reduce absorption of cholesterol.
- **Insoluble fiber**, such as that found in wheat bran or psyllium seed, increases fecal bulk and helps prevent constipation, hemorrhoids, and other digestive disorders.

**Functional fiber** refers to nondigestible carbohydrates that have been either isolated from natural sources or synthesized in a laboratory and then added to a food product or dietary supplement. Total fiber is the sum of dietary and functional fiber in your diet.

A high-fiber diet can help reduce the risk of type 2 diabetes, heart disease, and pulmonary disease, as well as improve gastrointestinal health and aid in the management of metabolic syndrome and body weight. Some studies have linked high-fiber diets with a reduced risk of colon and rectal cancer.

**Sources of Fiber** All plant foods contain some dietary fiber. Fruits, legumes, oats (especially oat bran), and barley all contain the viscous types of fiber that help lower blood glucose and cholesterol levels. Wheat (especially wheat bran), cereals, grains, and vegetables are all good sources of cellulose and other fibers that help prevent constipation. Psyllium, which is often added to cereals or used in fiber supplements and laxatives, improves intestinal health and also helps control glucose and cholesterol levels. The processing of packaged foods can remove fiber, so it’s important to depend on fresh fruits and vegetables and foods made from whole grains as your main sources of fiber.

**Vitamins—Organic Micronutrients**

Vitamins are organic (carbon-containing) substances required in small amounts to regulate various processes within living cells (Table 8.6). Humans need 13 vitamins; of these, four are fat-soluble (A, D, E, and K), and nine are water-soluble (C and the B vitamins; thiamin, riboflavin, niacin, vitamin B-6, folate, vitamin B-12, biotin, and pantothentic acid).

Solubility affects how a vitamin is absorbed, transported, and stored in the body. The water-soluble vitamins are absorbed directly into the bloodstream, where they travel freely. Excess amounts of water-soluble vitamins are generally removed by the kidneys and excreted in urine. Fat-soluble vitamins require a more complex absorptive process. They are usually carried in the blood by special proteins and are stored in the liver and in fat tissues rather than excreted.

**Wellness Tip** Vitamin and mineral supplements are popular, but they are not usually necessary for healthy people who eat a balanced diet.
## Table 8.6  Facts about Vitamins

<table>
<thead>
<tr>
<th>VITAMIN AND RECOMMENDED INTAKES*</th>
<th>IMPORTANT DIETARY SOURCES</th>
<th>MAJOR FUNCTIONS</th>
<th>SIGNS OF PROLONGED DEFICIENCY</th>
<th>TOXIC EFFECTS OF MEGADOSSES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FAT-SOLUBLE</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vitamin A</td>
<td>Liver, milk, butter, cheese, fortified margarine; carrots, spinach, and other orange and deep green vegetables and fruits</td>
<td>Maintenance of vision, skin, linings of the nose, mouth, digestive, and urinary tracts, immune function</td>
<td>Night blindness; dry, scaling skin; increased susceptibility to infection; loss of appetite; anemia; kidney stones</td>
<td>Liver damage, miscarriage and birth defects, headache, vomiting and diarrhea, vertigo, double vision, bone abnormalities</td>
</tr>
<tr>
<td>Men: 900 µg</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Women: 700 µg</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vitamin D</td>
<td>Fortified milk and margarine, fish oils, butter, egg yolks (sunlight on skin also produces vitamin D)</td>
<td>Development and maintenance of bones and teeth; promotion of calcium absorption</td>
<td>Rickets (bone deformities) in children; bone softening, loss, fractures in adults</td>
<td>Kidney damage, calcium deposits in soft tissues, depression, death</td>
</tr>
<tr>
<td>Men: 15 µg</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Women: 15 µg</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vitamin E</td>
<td>Vegetable oils, whole grains, nuts and seeds, green leafy vegetables, asparagus, peaches</td>
<td>Protection and maintenance of cellular membranes</td>
<td>Red blood cell breakage and anemia, weakness, neurological problems, muscle cramps</td>
<td>Relatively nontoxic but may cause excess bleeding or formation of blood clots</td>
</tr>
<tr>
<td>Men: 15 mg</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Women: 15 mg</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vitamin K</td>
<td>Green leafy vegetables, smaller amounts widespread in other foods</td>
<td>Production of factors essential for blood clotting and bone metabolism</td>
<td>Hemorrhaging</td>
<td>None reported</td>
</tr>
<tr>
<td>Men: 120 µg</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Women: 90 µg</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>WATER-SOLUBLE</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biotin</td>
<td>Cereals, yeast, egg yolks, soy flour, liver; widespread in foods</td>
<td>Synthesis of fat, glycogen, and amino acids</td>
<td>Rash, nausea, vomiting, weight loss, depression, fatigue, hair loss</td>
<td>None reported</td>
</tr>
<tr>
<td>Men: 30 µg</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Women: 30 µg</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Folate</td>
<td>Green leafy vegetables, yeast, oranges, whole grains, legumes, liver</td>
<td>Amino acid metabolism, synthesis of RNA and DNA, new cell synthesis</td>
<td>Anemia, weakness, fatigue, irritability, shortness of breath, swollen tongue</td>
<td>Masking of vitamin B-12 deficiency</td>
</tr>
<tr>
<td>Men: 400 µg</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Women: 400 µg</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Niacin</td>
<td>Eggs, poultry, fish, milk, whole grains, nuts, enriched breads and cereals, meats, legumes</td>
<td>Conversion of carbohydrates, fats, and proteins into usable forms of energy</td>
<td>Pellagra (symptoms include diarrhea, dermatitis, inflammation of mucous membranes, dementia)</td>
<td>Flushing of skin, nausea, vomiting, diarrhea, liver dysfunction, glucose intolerance</td>
</tr>
<tr>
<td>Men: 16 mg</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Women: 14 mg</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Pantothenic acid</td>
<td>Animal foods, whole grains, broccoli, potatoes; widespread in foods</td>
<td>Metabolism of fats, carbohydrates, and proteins</td>
<td>Fatigue, numbness and tingling of hands and feet, gastrointestinal disturbances</td>
<td>None reported</td>
</tr>
<tr>
<td>Men: 5 mg</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Women: 5 mg</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Riboflavin</td>
<td>Dairy products, enriched breads and cereals, lean meats, poultry, fish, green vegetables</td>
<td>Energy metabolism; maintenance of skin, mucous membranes, nervous system structures</td>
<td>Cracks at corners of mouth, sore throat, skin rash, hypersensitivity to light, purple tongue</td>
<td>None reported</td>
</tr>
<tr>
<td>Men: 1.3 mg</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Women: 1.1 mg</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Thiamin</td>
<td>Whole-grain and enriched breads and cereals, organ meats, lean pork, nuts, legumes</td>
<td>Conversion of carbohydrates into usable forms of energy; maintenance of appetite and nervous system function</td>
<td>Beriberi (symptoms include muscle wasting, mental confusion, anorexia, enlarged heart, nerve changes)</td>
<td>None reported</td>
</tr>
<tr>
<td>Men: 1.2 mg</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Women: 1.1 mg</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Vitamin B-6</td>
<td>Eggs, poultry, fish, whole grains, nuts, soybeans, liver, kidney, pork</td>
<td>Metabolism of amino acids and glycogen</td>
<td>Anemia, convulsions, cracks at corners of mouth, dermatitis, nausea, confusion</td>
<td>Neurological abnormalities and damage</td>
</tr>
<tr>
<td>Men: 1.3 mg</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Women: 1.3 mg</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Vitamin B-12</td>
<td>Meat, fish, poultry, fortified cereals, cheese, eggs, milk</td>
<td>Synthesis of blood cells; other metabolic reactions</td>
<td>Anemia, fatigue, nervous system damage, sore tongue</td>
<td>None reported</td>
</tr>
<tr>
<td>Men: 2.4 µg</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Women: 2.4 µg</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Vitamin C</td>
<td>Peppers, broccoli, brussels sprouts, spinach, citrus fruits, strawberries, tomatoes, potatoes, cabbage, other fruits and vegetables</td>
<td>Maintenance and repair of connective tissue, bones, teeth, cartilage; promotion of healing; aid in iron absorption</td>
<td>Scurvy, anemia, reduced resistance to infection, loosened teeth, joint pain, poor wound healing, hair loss, poor iron absorption</td>
<td>Urinary stones in some people, acid stomach from ingesting supplements in pill form, nausea, diarrhea, headache, fatigue</td>
</tr>
<tr>
<td>Men: 90 mg</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Women: 75 mg</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

*Recommended Intakes for adults ages 19-30; to calculate your personal DRIs based on age, sex, and other factors, visit the Interactive DRI website: http://fnic.nal.usda.gov/fnic/interactiveDRI

Functions of Vitamins Many vitamins help chemical reactions take place. They provide no energy to the body directly but help release the energy stored in carbohydrates, proteins, and fats. Other vitamins are critical in the production of red blood cells and the maintenance of the nervous, skeletal, and immune systems. Some vitamins act as antioxidants, which help preserve the health of cells. Key vitamin antioxidants include vitamin E, vitamin C, and the vitamin A precursor beta-carotene. (Antioxidants are described later in the chapter.)

Sources of Vitamins The human body must obtain most of the vitamins it requires from foods. Vitamins are abundant in fruits, vegetables, and grains. In addition, many processed foods, such as flour and breakfast cereals, contain added vitamins. A few vitamins are made in the body: The skin makes vitamin D when it is exposed to sunlight, and intestinal bacteria make vitamin K. Nonetheless, you still need to get vitamin D and vitamin K from foods (see Table 8.6).

Vitamin Deficiencies and Excesses If your diet lacks a particular vitamin, characteristic symptoms of deficiency can develop (see Table 8.6). For example, vitamin A deficiency can cause night blindness, and people whose diets lack vitamin B-12 can develop anemia. Vitamin deficiency diseases are relatively rare in the United States because vitamins are readily available from our food supply. However, many Americans consume lower-than-recommended amounts of several vitamins. Nutrient intake that is consistently below recommended levels can have adverse effects on health even if it is not low enough to cause a deficiency disease. For example, low intake of folate increases a woman’s chance of giving birth to a baby with a neural tube defect (a congenital malformation of the central nervous system). Low intake of folate and vitamins B-6 and B-12 has been linked to increased heart disease risk. Recent research suggests that vitamin D supplementation can reduce the risk of cardiovascular disease and of several cancers. As important as vitamins are, however, many Americans consume less-than-recommended amounts of some vitamins, especially vitamins A, D, E, and C, as well as folate.

Extra vitamins in the diet can be harmful, especially when taken as supplements. Megadoses of fat-soluble vitamins are particularly dangerous because the excess is stored in the body rather than excreted, increasing the risk of toxicity. Even when supplements are not taken in excess, relying on them for an adequate intake of vitamins can be problematic. There are many substances in foods other than vitamins and minerals that have important health effects. Later, this chapter discusses specific recommendations for vitamin intake and when a supplement is advisable. For now, keep in mind that it’s best to get most of your vitamins from foods rather than supplements.

The vitamins and minerals in foods can be easily lost or destroyed during storage or cooking. To retain their value, eat or process vegetables immediately after buying them. If you can’t do this, store them in a cool place, covered to retain moisture—either in the refrigerator (for a few days) or in the freezer (for a longer term). To reduce nutrient losses during food preparation, minimize the amount of water used and the total cooking time. Develop a taste for a crunchier texture in cooked vegetables. Baking, steaming, broiling, grilling, and microwaving are all good methods of preparing vegetables.

Minerals—Inorganic Micronutrients Minerals are inorganic (non-carbon-containing) elements you need in relatively small amounts to help regulate body functions, aid in the growth and maintenance of body tissues, and help release energy (Table 8.7). There are about 17 essential minerals. The major minerals, those that the body needs in amounts exceeding 100 milligrams (mg) per day, include calcium, phosphorus, magnesium, sodium, potassium, and chloride. The essential trace minerals, which you need in minute amounts, include copper, fluoride, iodine, iron, selenium, and zinc.

Characteristic symptoms develop if an essential mineral is consumed in a quantity too small or too large for good health. The minerals commonly lacking in the American diet are iron, calcium, magnesium, and potassium. Low potassium intake is considered a public health concern because it is linked to high blood pressure and heart disease; you can improve your potassium intake by choosing a healthy dietary pattern rich in fruits, vegetables, and legumes. Iron-deficiency anemia is a problem in some age groups, and researchers fear poor calcium intakes in childhood are sowing the seeds for future osteoporosis, especially in women. See the box “Eating for Healthy Bones” to learn more.

Water—Vital but Often Ignored Water is the major component in both foods and the human body: You are composed of about 50–60% water. Your need for other nutrients, in terms of weight, is much less than your need for water. You can live up to 50 days without food but only a few days without water.

Water is distributed all over the body, among lean and other tissues and in blood and other body fluids. Water is used in the digestion and absorption of food and is the medium in which most chemical reactions take place within the body. Some water-based fluids, such as blood, transport substances around the body; other fluids serve as lubricants or cushions. Water also helps regulate body temperature.

antioxidant A substance that protects against the breakdown of food or body constituents by free radicals; antioxidants' actions include binding oxygen, donating electrons to free radicals, and repairing damage to molecules.

minerals Inorganic compounds needed in relatively small amounts for the regulation, growth, and maintenance of body tissues and functions.

anemia A deficiency in the oxygen-carrying material in the red blood cells.

osteoporosis A condition in which the bones become extremely thin and brittle and break easily, due largely to insufficient calcium intake.
Water is contained in almost all foods, particularly in liquids, fruits, and vegetables. The foods and beverages you consume provide 80–90% of your daily water intake; the remainder is generated through metabolism. You lose water in urine, feces, and sweat and through evaporation from your lungs.

Most people can maintain a healthy water balance by consuming beverages at meals and drinking fluids in response to thirst. The Food and Nutrition Board has set levels of adequate water intake to maintain hydration. All beverages, including those containing caffeine, can count toward your total daily fluid intake, although it is better to drink water than sweetened beverages. Under these guidelines, men need to consume about 3.7 total liters of water, with 3.0 liters (about 13 cups) coming from beverages; women need 2.7 total liters, with 2.2 liters (about 9 cups) coming from beverages. About 20% of daily water intake comes from food. If you exercise vigorously or live

### Table 8.7 Facts about Selected Minerals

<table>
<thead>
<tr>
<th>MINERAL AND RECOMMENDED INTAKES*</th>
<th>IMPORTANT DIETARY SOURCES</th>
<th>MAJOR FUNCTIONS</th>
<th>SIGNS OF PROLONGED DEFICIENCY</th>
<th>TOXIC EFFECTS OF MEGADOSES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Calcium</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men: 1,000 mg</td>
<td>Milk and milk products, tofu, fortified orange juice and bread, green leafy vegetables, bones in fish</td>
<td>Formation of bones and teeth; control of nerve impulses, muscle contraction, blood clotting</td>
<td>Stunted growth in children, bone mineral loss in adults; urinary stones</td>
<td>Kidney stones, calcium deposits in soft tissues, inhibition of mineral absorption, constipation</td>
</tr>
<tr>
<td>Women: 1,000 mg</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Fluoride</strong></td>
<td>Fluoridated water, tea, marine fish eaten with bones</td>
<td>Maintenance of tooth and bone structure</td>
<td>Higher frequency of tooth decay</td>
<td>Increased bone density, mottling of teeth, impaired kidney function</td>
</tr>
<tr>
<td>Men: 4 mg</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Women: 3 mg</td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>Iodine</strong></td>
<td>Iodized salt, seafood, processed foods</td>
<td>Essential part of thyroid hormones, regulation of body metabolism</td>
<td>Goiter (enlarged thyroid), cretinism (birth defect)</td>
<td>Depression of thyroid activity, hyperthyroidism in susceptible people</td>
</tr>
<tr>
<td>Men: 150 μg</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Women: 150 μg</td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>Iron</strong></td>
<td>Meat and poultry, fortified grain products, dark green vegetables, dried fruit</td>
<td>Component of hemoglobin, myoglobin, and enzymes</td>
<td>Iron-deficiency anemia, weakness, impaired immune function, gastrointestinal distress</td>
<td>Nausea, diarrhea, liver and kidney damage, joint pains, sterility, disruption of cardiac function, death</td>
</tr>
<tr>
<td>Men: 8 mg</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Women: 18 mg</td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>Magnesium</strong></td>
<td>Widespread in foods and water (except soft water); especially found in grains, legumes, nuts, seeds, green vegetables, milk</td>
<td>Transmission of nerve impulses, energy transfer, activation of many enzymes</td>
<td>Neurological disturbances, cardiovascular problems, kidney disorders, nausea, growth failure in children</td>
<td>Nausea, vomiting, diarrhea, central nervous system depression, coma; death in people with impaired kidney function</td>
</tr>
<tr>
<td>Men: 400 mg</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Women: 310 mg</td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>Phosphorus</strong></td>
<td>Present in nearly all foods, especially milk, cereal, peas, eggs, meat</td>
<td>Bone growth and maintenance, energy transfer in cells</td>
<td>Impaired growth, weakness, kidney disorders, cardio-respiratory and nervous system dysfunction</td>
<td>Drop in blood calcium levels, calcium deposits in soft tissues, bone loss</td>
</tr>
<tr>
<td>Men: 700 mg</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Women: 700 mg</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td><strong>Potassium</strong></td>
<td>Meats, milk, fruits, vegetables, grains, legumes</td>
<td>Nerve function and body water balance</td>
<td>Muscular weakness, nausea, drowsiness, paralysis, confusion, disruption of cardiac rhythm</td>
<td>Cardiac arrest</td>
</tr>
<tr>
<td>Men: 4,700 mg</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Women: 4,700 mg</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Selenium</strong></td>
<td>Seafood, meat, eggs, whole grains</td>
<td>Defense against oxidative stress; regulation of thyroid hormone action</td>
<td>Muscle pain and weakness, heart disorders</td>
<td>Hair and nail loss, nausea and vomiting, weakness, irritability</td>
</tr>
<tr>
<td>Men: 55 μg</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Women: 55 μg</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Sodium</strong></td>
<td>Salt, soy sauce, fast food, processed foods, especially lunch meats, canned soups and vegetables, salty snacks, processed cheese</td>
<td>Body water balance, acid-base balance, nerve function</td>
<td>Muscle weakness, loss of appetite, nausea, vomiting; deficiency rarely seen</td>
<td>Edema, hypertension in sensitive people</td>
</tr>
<tr>
<td>Men: 1,500 mg</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Women: 1,500 mg</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Zinc</strong></td>
<td>Whole grains, meat, eggs, liver, seafood (especially oysters)</td>
<td>Synthesis of proteins, RNA, and DNA; wound healing; immune response; ability to taste</td>
<td>Growth failure, loss of appetite, impaired taste acuity, skin rash, impaired immune function, poor wound healing</td>
<td>Vomiting, impaired immune function, decline in blood HDL levels, impaired copper absorption</td>
</tr>
<tr>
<td>Men: 11 mg</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Women: 8 mg</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

*Recommended Intakes for adults ages 19-30; to calculate your personal DRIs based on age, sex, and other factors, visit the Interactive DRI website: http://fnic.nal.usda.gov/fnic/interactiveDRI.

Osteoporosis is a condition in which the bones become dangerously thin and fragile over time. An estimated 10 million Americans over age 50 have osteoporosis, and another 34 million are at risk. Women account for about 80% of osteoporosis cases.

Most of adult bone mass is built by age 18 in girls and 20 in boys. Bone density peaks between ages 25 and 35; after that, bone mass is lost over time. To prevent osteoporosis, the best strategy is to build as much bone as possible during your youth and do everything you can to maintain it as you age. Up to 50% of bone loss is determined by controllable lifestyle factors such as diet and exercise. Key nutrients for bone health include the following:

- **Calcium.** Getting enough calcium is important throughout life to build and maintain bone mass. Milk, yogurt, and calcium-fortified orange juice, bread, and cereals are all good sources.

- **Vitamin D.** Vitamin D is necessary for bones to absorb calcium; a daily intake of 600 IU (15 μg) is recommended for individuals ages 1–70. Vitamin D can be obtained from foods and is manufactured by the skin when exposed to sunlight. Candidates for vitamin D supplements include people who don’t eat many foods rich in vitamin D; those who don’t expose their face, arms, and hands to the sun for 5–15 minutes a few times each week; and those who live north of an imaginary line drawn across the United States from Boston to the Oregon-California border (where sunlight is weaker).

- **Vitamin K.** Vitamin K promotes the synthesis of proteins that help keep bones strong. Broccoli and leafy green vegetables are rich in vitamin K.

- **Other nutrients.** Other nutrients that may play an important role in bone health include vitamin C, magnesium, potassium, phosphorus, fluoride, manganese, zinc, copper, and boron.

Several dietary substances may have a negative effect on bone health, especially if consumed in excess. These include alcohol, sodium, caffeine, and retinol (a form of vitamin A). Drinking lots of soda, which often replaces milk in the diet, has been shown to increase the risk of bone fracture in teenage girls.

The effect of protein intake on bone mass depends on other nutrients: Protein helps build bone as long as calcium and vitamin D intake are adequate. But if intake of calcium and vitamin D is low, high protein intake can lead to bone loss.

Weight-bearing aerobic exercise helps maintain bone mass throughout life, and strength training improves bone density, muscle mass, strength, and balance. Drinking alcohol only in moderation, refraining from smoking, and managing depression and stress are also important for maintaining strong bones. For people who develop osteoporosis, a variety of medications are available to treat the condition.


**Other Substances in Food**

Many substances in food are not essential nutrients but may influence health.

**Antioxidants** When the body uses oxygen or breaks down certain fats or proteins as a normal part of metabolism, substances called **free radicals** are produced. A free radical is a chemically unstable molecule that reacts with fats, proteins, and DNA, damaging cell membranes and mutating genes. Free radicals have been implicated in aging, cancer, cardiovascular disease, and other degenerative diseases like arthritis. Environmental factors such as cigarette smoke, exhaust fumes, radiation, excessive sunlight, certain drugs, and stress can increase free radical production.

Antioxidants found in foods can block the formation and action of free radicals and repair the damage they cause. Some antioxidants, such as vitamin C, vitamin E, and selenium, are also essential nutrients. Others—such as carotenoids, found in yellow, orange, and dark green leafy vegetables—are not. In general, fruits and vegetables and foods that contain them have a high antioxidant value, as do herbs, spices, berries, nuts and chocolate.

**Phytochemicals** Antioxidants fall into the broader category of **phytochemicals**, substances found in plant foods that may help prevent chronic disease. For example, certain substances found in soy foods may help lower cholesterol levels. Sulforaphane, a compound isolated from broccoli and other **cruciferous vegetables**, may render some carcinogenic substances found in tobacco smoke inactive.

**TERMS**

- **free radical** An electron-seeking compound that can react with fats, proteins, and DNA, damaging cell membranes and mutating genes in its search for electrons; produced through chemical reactions in the body and by exposure to environmental factors such as sunlight and tobacco smoke.

- **phytochemical** A naturally occurring substance found in plant foods that may help prevent and treat chronic diseases such as heart disease and cancer; *phyto* means “plant.”

- **cruciferous vegetables** Vegetables of the cabbage family, including cabbage, broccoli, Brussels sprouts, kale, and cauliflower; the flower petals of these plants form the shape of a cross, hence the name.
compounds harmless. Allyl sulfides, a group of chemicals found in garlic and onions, appear to boost the activity of immune cells. Phytochemicals found in whole grains are associated with a reduced risk of cardiovascular disease, diabetes, and cancer. Carotenoids found in green vegetables may help preserve eyesight with age. Further research on phytochemicals may extend the role of nutrition to the prevention and treatment of many chronic diseases.

To increase your intake of phytochemicals, eat a variety of fruits, vegetables, and grains rather than relying on supplements. Like many vitamins and minerals, isolated phytochemicals may be harmful if taken in high doses. In many cases, their health benefits may be the result of chemical substances working in combination. The role of phytochemicals in disease prevention is discussed further in Chapters 11 and 12.

### NUTRITIONAL GUIDELINES: PLANNING YOUR DIET

Scientific and government groups have created a number of useful tools to help people design healthy diets:

- The **Dietary Reference Intakes (DRIs)** are standards for nutrient intake designed to prevent nutritional deficiencies and reduce the risk of chronic diseases.
- The **Dietary Guidelines for Americans** were established to promote health and reduce the risk of major chronic diseases through diet and physical activity.

#### Dietary Reference Intakes (DRIs)

An umbrella term for four types of nutrient standards: Adequate Intake (AI), Estimated Average Requirement (EAR), and Recommended Dietary Allowance (RDA) are levels of intake considered adequate to prevent nutrient deficiencies and reduce the risk of chronic disease; Tolerable Upper Intake Level (UL) is the maximum daily intake that is unlikely to cause health problems.

#### Dietary Guidelines for Americans

General principles of good nutrition intended to help prevent certain diet-related diseases.

#### MyPlate

A food-group plan that provides practical advice to ensure a balanced intake of the essential nutrients.

#### Daily Values

A simplified version of the RDAs used on food labels; also included are values for nutrients with no established RDA.

- **MyPlate** is the USDA food guidance system developed to help Americans make healthy food choices consistent with the Dietary Guidelines for Americans.
- The **Daily Values** is a simplified version of the RDAs used on food labels.

### Dietary Reference Intakes (DRIs)

The Food and Nutrition Board establishes dietary standards, or recommended intake levels, for Americans of all ages. The current set of standards, called Dietary Reference Intakes (DRIs), was introduced in 1997. The DRIs are frequently reviewed and are updated as substantial new nutrition-related information becomes available. The DRIs present different categories of nutrients in easy-to-read table format. The DRIs have a broad focus: They are based on research that looks not just at the prevention of nutrient deficiencies but also at the role of nutrients in promoting health and preventing chronic diseases such as cancer, osteoporosis, and heart disease.

The DRIs includes a set of four reference values used as standards for both recommended intakes and maximum safe intakes. The recommended intake of each nutrient is expressed as either a **Recommended Dietary Allowance (RDA)** or as **Adequate Intake (AI)**. An AI is set when there is not enough information available to set an RDA value; regardless of the type of standard used, however, the DRI represents the best available estimate of intake for optimal health. Used primarily in nutrition policy and research, the **Estimated Average Requirement (EAR)** is the average daily nutrient intake level estimated to meet the requirement of half the healthy individuals in a particular life stage and gender group. The **Tolerable Upper Intake Level (UL)** is the maximum daily intake that is unlikely to cause health problems in a healthy person. For example, the RDA for calcium for an 18-year-old female is 1300 mg per day; the UL is 3000 mg per day.

Because of a lack of data, ULs have not been set for all nutrients. This does not mean that people can tolerate long-term intakes of these vitamins and minerals above recommended levels. Like all chemical agents, nutrients can produce adverse effects if intakes are excessive. There is no established benefit from consuming nutrients at levels above the RDA or AI. The DRIs for many nutrients are found in Tables 8.2, 8.6, and 8.7. For a personalized DRI report for your sex and life stage, visit the Interactive DRI website: [http://fnic.nal.usda.gov/fnic/interactiveDRI](http://fnic.nal.usda.gov/fnic/interactiveDRI).

#### Daily Values

Because the DRIs are too cumbersome to use as a basis for food labels, the FDA developed another set of dietary standards, the **Daily Values**. The Daily Values are based on several different sets of guidelines and include standards for fat, cholesterol, carbohydrate, dietary fiber, and selected vitamins and minerals. The Daily Values represent appropriate intake levels for a 2000-calorie diet. The percent Daily Value shown on a food label shows how well that food contributes to your recommended daily intake. Food labels are described in detail later in the chapter.
Should You Take Supplements?  The aim of the DRIs, the Dietary Guidelines for Americans, and MyPlate is to guide you in meeting your nutritional needs primarily with food, rather than with vitamin and mineral supplements. Supplements lack the potentially beneficial synergistic balance of nutrients, phytochemicals, and fiber that is found only in whole foods. Most Americans can get the vitamins and minerals they need by eating a varied, nutritionally balanced diet.

Over the past two decades, high-dose supplement use has been promoted as a way to prevent or delay the onset of many diseases, including heart disease and several forms of cancer. These claims remain controversial. According to the latest research, a balanced diet of whole foods—not high-dose supplementation—is the best way to promote health and prevent disease.

In setting the DRIs, the Food and Nutrition Board recommended supplements of particular nutrients for the following groups:

- **Women who are capable of becoming pregnant** should take 400 micrograms (μg) per day of folic acid (the synthetic form of the vitamin folate) from fortified foods and/or supplements in addition to folate from a varied diet. Research indicates that this level of folate intake will reduce the risk of neural tube defects. Enriched breads, flours, corn meals, rice, noodles, and other grain products are fortified with folic acid. Folate is found naturally in green leafy vegetables, legumes, oranges, and strawberries.

- **People over age 50** should eat foods fortified with vitamin B-12, take B-12 supplements, or both to meet the majority of the DRI of 2.4 μg of B-12 daily. Up to 30% of people over 50 may have problems absorbing protein-bound B-12 in foods.

- **Because of the oxidative stress caused by smoking, smokers should get 35 mg more** vitamin C per day than the RDA set for their age and sex. However, supplements are not usually needed because this extra vitamin C can easily be found in foods. For example, an 8-ounce glass of orange juice has about 100 mg of vitamin C.

Supplements may also be recommended in other cases. Women with heavy menstrual flows may need extra iron. Older people, people with dark skin, and people exposed to little sunlight may need extra vitamin D. Some vegetarians may need supplemental calcium, iron, zinc, and vitamin B-12, depending on their food choices. Other people may benefit from supplementation based on their lifestyle, physical condition, medicines, or dietary habits.

Although dietary supplements are sold over the counter, the question of whether to take supplements is a serious one. Some vitamins and minerals are dangerous when ingested in excess, as described previously in Tables 8.4 and 8.5. Large doses of particular nutrients can also cause health problems by affecting the absorption of other vitamins and minerals or interacting with medications. For all these reasons, you should think carefully about whether to take high-dose supplements; and consult a physician or registered dietitian.

Fitness Tip A pound of body fat is equal to 3,500 calories. If you eat 100 calories more than you expend every day (36,500 extra calories), you will gain more than 10 pounds in a year. Food choices and portion control are key factors in weight management.

Dietary Guidelines for Americans

To provide general guidance for choosing a healthy diet, the USDA and the U.S. Department of Health and Human Services (DHHS) jointly issue the Dietary Guidelines for Americans, which are updated and revised every five years. The guidelines are supported by an extensive review of scientific and medical evidence. Following these guidelines promotes health and reduces the risk of chronic diseases, including heart disease, cancer, diabetes, stroke, osteoporosis, and obesity.

At the time this text was written, the final 2015 Guidelines were not yet released to the public. However, key findings from the 2015 Advisory Committee’s Scientific Report, which is used to develop the Guidelines, included the following:

- **About half of all American adults have one or more preventable chronic diseases that are related to poor eating habits and inactivity; these diseases include high blood pressure, type 2 diabetes, cardiovascular disease, and certain forms of cancer. Further increasing health risks is the fact that more than two-thirds of adults and nearly one-third of children and adolescents are overweight or obese.**

- **On average, Americans consume a dietary pattern that is too low in vegetables, fruits, and whole grains and too high in sodium, saturated fat, refined grains, added sugars, and calories. This dietary pattern is associated with increased risk for chronic diseases as well as under-consumption of essential nutrients.**

- **A healthy dietary pattern is higher in vegetables, fruits, whole grains, low-fat or fat-free dairy, seafood, legumes, and nuts; moderate in alcohol (for adults who consume alcohol); lower in red and processed meats; and low in refined grains and sugar-sweetened foods and drinks. There is no one best diet; people can combine foods in a variety of ways to create a healthy dietary pattern. Regular physical activity is also strongly recommended.**

- **People can make changes in eating and physical activity behaviors to help improve their lifestyles (see the box**
Key recommendations for individuals and families from the 2015 Dietary Guidelines Advisory Committee Report include the following:

**Take stock:** Assess and monitor your health risks, set personal goals, and take action to promote positive lifestyle changes.

*Focus on gradual and sustainable changes to achieve a healthy dietary pattern:*

- Improve your food and menu choices, watch your portion sizes, and modify recipes and food preparation techniques.
- Include more vegetables, fruits, whole grains, seafood, nuts, legumes, low-fat or fat-free dairy or dairy alternatives. Choose foods without added sugars, fats, or salt.
- Reduce your consumption of red and processed meat, refined grains, added sugars, sodium, and saturated fat. Choose polyunsaturated fats, nontropical vegetable oils, and nuts in place of saturated fats and solid animal fats. Reduce added sugars by shifting beverage choices and limiting other sweetened processed foods. Limit saturated fat to 10% of total daily calories, added sugars to 10% of daily calories, and sodium to 2,400 mg per day (or 1,500 mg for those who would benefit from blood pressure lowering).

*Move more and sit less:* Achieve and maintain a healthy weight, and follow physical activity guidelines. Limit your sedentary activities, and get adequate sleep.

*Be a positive force in your community:* Help create and support community efforts and policy changes that promote healthy eating and activity patterns for all Americans—for example, creating safe places to exercise and making healthy food choices more widely available in low-income neighborhoods; changing food labeling and food manufacturing practices; and adding insurance coverage for nutritional counseling. Support efforts to reinforce healthy dietary and physical activity patterns for young children to help promote lifelong healthy habits.


“Making Positive Dietary Changes”). Individual changes should be supported by policies and programs targeting environmental factors that impact dietary choices—including things like nutrition standards, food labeling, and school lunch programs.

**Healthy Dietary Patterns** The 2015 Dietary Guidelines Advisory Committee developed three general dietary patterns that can be used as the basis for creating a healthy diet (Table 8.8). All three dietary patterns are associated with reduced rates of chronic disease:

- **Healthy U.S.-Style Pattern**—an updated version of the existing USDA food pattern.
- **Healthy Vegetarian Pattern**—includes more legumes, processed soy products, nuts and seeds, and whole grains; it contains no meat, poultry, or seafood, but is close to the Healthy U.S.-Style Pattern in amounts of all other food groups.
- **Healthy Mediterranean-Style Pattern**—reflecting a dietary pattern associated with many cultures bordering the Mediterranean Sea, which includes more fruit and seafood and less dairy than the Healthy U.S.-Style Pattern.

All three patterns are based on amounts of food from different foods groups (and subgroups) according to energy intake. Also shared by all the patterns is the general principle that people should eat nutrient-dense foods—foods with significant amounts of vitamins, minerals, and other nutrients with relatively few calories, especially empty calories (solid fats and added sugars). See the Nutrition Resources section at the end of the chapter for a more detailed breakdown of the recommendations for the three healthy dietary patterns.

**Too Little of This, Too Much of That** In addition to emphasizing dietary patterns, the Dietary Guidelines Advisory Committee identified nutrients that Americans tend to over- or under-consume. For example, we eat too much salt, added sugar, and saturated fat and too little of a number of vitamins and minerals. Selected nutrients of concern are described in the sections that follow.

**ADDED SUGARS** For the first time, the Advisory Committee recommended that Americans limit added sugars to no more than 10 percent of daily calories—roughly a quarter cup of sugar per day for someone consuming a 2,000-calorie diet (12 teaspoons = 1/4 c sugar = ~200 calories).

Americans consume 22 to 30 teaspoons (~1/2 to 5/8 cup) of added sugar daily, half of which comes from soda, juices, and other sugary drinks. The Committee suggested removing sugary drinks from schools and requiring a distinct line in food labels quantifying added sugars, a rule already proposed by the Food and Drug Administration that the food and sugar industries have aggressively fought. Individuals can choose to drink water in place of sugar-sweetened beverages.

**FATS** In keeping with the emphasis on overall dietary patterns, the Advisory Committee focused fat guidelines on limiting saturated and trans fats rather than reducing overall fat intake. Although saturated fats should be limited to less than 10% of total calories per day, individuals should focus on healthy replacements—unsaturated fats rather than refined carbohydrates and added sugars, which can worsen cardiovascular
cholesterol is found only in animal foods, including eggs, chicken, beef, and dairy products.)

- **Caffeine:** The Committee looked at caffeine for the first time and stated that moderate amounts of coffee (3 to 5 cups per day or up to 400 mg caffeine) can be part of a healthy dietary pattern. Consistent evidence indicates that coffee consumption is associated with reduced risk of type 2 diabetes and cardiovascular disease in healthy adults, and possibly reduced risk of Parkinson’s disease.

- **Sustainability:** The Committee also recommended consideration of sustainability in terms of environmental outcomes and food security. A healthy dietary pattern that is higher in plant-based foods and lower in calories and animal-based foods has a lower environmental impact—more favorable use of land, water, and energy and lower production of greenhouse gases—than the current typical American dietary pattern.

**A Culture of Health** To support and encourage widespread healthy living in the United States, the Advisory Committee recommended the following actions:

- Establish local, state, and federal policies to make healthy foods accessible and affordable and to limit access to high-calorie, nutrient-poor foods and sugar-sweetened beverages in public buildings and facilities.
- Improve retail food environments and make healthy foods accessible and affordable in underserved neighborhoods and communities.
- Implement the comprehensive school meal guidelines (National School Lunch Program) from the USDA that increase intake of vegetables (without added salt), fruits (without added sugars), and whole grains.

<table>
<thead>
<tr>
<th>FOOD GROUP</th>
<th>HEALTHY U.S.-STYLE PATTERN</th>
<th>HEALTHY VEGETARIAN PATTERN</th>
<th>HEALTHY MEDITERRANEAN-STYLE PATTERN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruit</td>
<td>2 c per day</td>
<td>2 c per day</td>
<td>2-1/2 c per day</td>
</tr>
<tr>
<td>Vegetables</td>
<td>2-1/2 c per day</td>
<td>2-1/2 c per day</td>
<td>2-1/2 c per day</td>
</tr>
<tr>
<td>Legumes</td>
<td>1-1/2 c per wk</td>
<td>3 c per wk</td>
<td>1-1/2 c per wk</td>
</tr>
<tr>
<td>Grains</td>
<td>6 oz eq per day</td>
<td>6-1/2 oz eq per day</td>
<td>6 oz eq per day</td>
</tr>
<tr>
<td>Whole Grains</td>
<td>3 oz eq per day</td>
<td>3-1/2 oz eq per day</td>
<td>3 oz eq per day</td>
</tr>
<tr>
<td>Dairy</td>
<td>3 c per day</td>
<td>3 c per day</td>
<td>2 c per day</td>
</tr>
<tr>
<td>Protein Foods</td>
<td>5-1/2 oz eq per day</td>
<td>3-1/2 oz eq per day</td>
<td>6-1/2 oz eq per day</td>
</tr>
<tr>
<td>Meat</td>
<td>12-1/2 oz eq/wk</td>
<td>—</td>
<td>12-1/2 oz eq/wk</td>
</tr>
<tr>
<td>Poultry</td>
<td>10-1/2 oz eq/wk</td>
<td>—</td>
<td>10-1/2 oz eq/wk</td>
</tr>
<tr>
<td>Seafood</td>
<td>8 oz eq/wk</td>
<td>—</td>
<td>15 oz eq/wk</td>
</tr>
<tr>
<td>Eggs</td>
<td>3 oz eq/wk</td>
<td>3 oz eq/wk</td>
<td>3 oz eq/wk</td>
</tr>
<tr>
<td>Nuts/seeds</td>
<td>4 oz eq/wk</td>
<td>7 oz eq/wk</td>
<td>4 oz eq/wk</td>
</tr>
<tr>
<td>Processed soy</td>
<td>1/2 oz eq/wk</td>
<td>7 oz eq/wk</td>
<td>1/2 oz eq/wk</td>
</tr>
<tr>
<td>Oils</td>
<td>27 g per day</td>
<td>27 g per day</td>
<td>27 g per day</td>
</tr>
</tbody>
</table>

**SHORTFALL NUTRIENTS** Americans consume too few fruits, vegetables, whole grains, and low-fat dairy foods, which leads to lower-than-recommended intakes of a number of key nutrients. Deficits of calcium, vitamin D, potassium, and fiber are of particular concern because they are linked to adverse health outcomes. Iron is also of special concern for adolescent and premenopausal women because of the potential for iron deficiency. To increase intake of these nutrients, follow the recommendations in the healthy dietary patterns to consume a range of nutrient-dense choices within each food group.

**Changing Perspectives** The 2015 Advisory Committee Report retained many key recommendations from earlier Dietary Guidelines for Americans, especially the focus on fruits, vegetables, and whole grains. However, there were some differences from earlier Guidelines:

- **Dietary cholesterol:** The Committee chose to not bring forward a specific limit on dietary cholesterol, stating that there is no clear relationship between the amount of cholesterol in the diet and blood cholesterol levels. (Dietary cholesterol is found only in animal foods, including eggs, chicken, beef, and dairy products.)
a diet and physical activity planner that allows users to set personal calorie and physical activity goals and track progress.

Table 8.9 provides guidance for determining an appropriate calorie intake for weight maintenance. Use the table to identify an energy intake that is about right for you, and then refer to ChooseMyPlate.gov for personalized recommendations; healthy food patterns based on different calorie levels can also be found in the Nutrition Resources section at the end of the chapter. Each food group is described briefly in the following sections. Many Americans have trouble identifying serving sizes, so recommended daily intakes from each group are given in terms of cups and ounces; see the box “Judging Portion Sizes” for additional advice.

MyPlate On Campus is an initiative to allow students to become ambassadors of healthy eating and healthy lifestyles. My Plate On Campus provides resources and practical guidelines for promoting health and wellness uniquely customized for students and campus lifestyle.

Wellness Tip Farmers’ markets are an important way to bring healthy food choices to residents of inner cities. Support the establishment of farmers’ markets in your community.

USDA’s MyPlate

To help consumers put the Dietary Guidelines for Americans into practice, the USDA also issues the food guidance system known as MyPlate. MyPlate is designed to allow individuals to take advantage of the customization made possible by the Internet (Figure 8.3).

Key Messages of MyPlate MyPlate reminds consumers to make healthy food choices and to be active every day. Key messages include the following:

- **Personalization** is an important element of the MyPlate program and the ChooseMyPlate.gov site, which includes individualized recommendations, interactive assessments of food intake and physical activity, weight-management tools, and tips for success.
- **Daily physical activity** is imperative for maintaining a healthy weight and reducing the risk of chronic disease.
- **Tracking and planning** are important tools to help find out what and how much to eat; track foods, physical activities, and weight; and personalize with goal setting, virtual coaching, and journaling. The MyPlate SuperTracker is a diet and physical activity planner that allows users to set personal calorie and physical activity goals and track progress.

Table 8.9 provides guidance for determining an appropriate calorie intake for weight maintenance. Use the table to identify an energy intake that is about right for you, and then refer to ChooseMyPlate.gov for personalized recommendations; healthy food patterns based on different calorie levels can also be found in the Nutrition Resources section at the end of the chapter. Each food group is described briefly in the following sections. Many Americans have trouble identifying serving sizes, so recommended daily intakes from each group are given in terms of cups and ounces; see the box “Judging Portion Sizes” for additional advice. MyPlate On Campus is an initiative to allow students to become ambassadors of healthy eating and healthy lifestyles. My Plate On Campus provides resources and practical guidelines for promoting health and wellness uniquely customized for students and campus lifestyle.

Whole and Refined Grains Grains are divided into two groups: whole grains, which contain the entire grain kernel, and refined grains, which have been milled to remove the bran and germ. Refining leaves a smoother texture and improves shelf life, but it also removes the dietary fiber, iron, and many B vitamins. Foods from this group are usually low in fat and rich in complex carbohydrates, dietary fiber (if grains are unrefined), and many vitamins and minerals. A 2,000-calorie diet should include 6-ounce-equivalent servings each day, and half of those servings should be whole grains, such as whole-grain bread,
whole-wheat pasta, high-fiber cereal, or brown rice. The following count as 1-ounce-equivalent:

- 1 slice of bread
- 1 small (2½-inch diameter) muffin
- 1 cup ready-to-eat cereal flakes
- ½ cup cooked cereal, rice, grains, or pasta
- 1 6-inch tortilla

Choose foods that are typically made with little fat or added sugar (bread, rice, pasta) over those that are high in fat and added sugar (croissants, chips, cookies, doughnuts). The key message is to make at least half your grains whole grains.

### Vegetables
Vegetables contain carbohydrates, dietary fiber, and many other nutrients, and they are naturally low in fat. A 2,000-calorie diet should include 2½ cups of vegetables daily. Each of the following counts as ½ cup or equivalent of vegetables:

- ½ cup raw or cooked vegetables
- 1 cup raw leafy salad greens
- ½ cup vegetable juice

Because vegetables vary in the nutrients they provide, MyPlate recommends weekly servings from five different subgroups within the vegetables group. Choose vegetables from several subgroups each day. For clarity, MyPlate patterns show servings from the subgroups in terms of weekly consumption. For a 2,000-calorie diet:

- 1.5 cups per week dark-green vegetables (examples: broccoli, bok choy, romaine lettuce, spinach, collard, kale)
- 5.5 cups per week red and orange vegetables (Examples: carrots, sweet potatoes, red peppers, winter squash)
- 1.5 cups per week legumes (dried peas and beans—split and black-eyed peas; lentils; black, kidney, navy, pinto, white, and soy beans)
- 5 cups per week starchy vegetables (corn, potatoes, green peas)
- 4 cups per week other vegetables (artichokes, asparagus, beets, cauliflower, green beans, head lettuce, onions, mushrooms, zucchini)

The key message is to fill half your plate with fruits and vegetables.

### Fruits
Fruits are rich in carbohydrates, dietary fiber, and many vitamins, especially vitamin C. A 2,000-calorie diet should include 2 cups of fruits daily. Each of the following counts as ½ cup or equivalent of fruit:

- ½ cup fresh, canned, or frozen fruit
- ½ cup fruit juice (100% juice)
- ½ large (3½-inch diameter) whole fruit
- ¼ cup dried fruit

Choose whole fruits often; they are higher in fiber and often lower in calories than fruit juices. Fruit juices typically contain more nutrients and less added sugar than fruit drinks. Choose canned fruits packed in 100% fruit juice or water rather than in syrup. Again, MyPlate’s key message for consumers is to fill half your plate with fruits and vegetables.

### Dairy
This group includes all milk and milk products such as yogurt and cheeses, as well as lactose-free and lactose-reduced products. Soymilk (calcium-fortified) is also part of the dairy group. Those consuming 2,000 calories per day should include 3 cups of milk or the equivalent daily. Each of the following counts as the equivalent of 1 cup:

- 1 cup milk or yogurt
- ½ cup ricotta cheese
Choose lean meats and skinless poultry, and watch your serving sizes carefully. Choose at least one serving of plant proteins, such as black beans, lentils, or tofu, every day. Include at least 8 ounces of cooked seafood per week and select a variety of protein foods to improve nutrient intake and health benefits.

Oils Oils and soft margarines include vegetable oils and soft vegetable oil table spreads that have no trans fats. These are major sources of vitamin E and unsaturated fatty acids, including the essential fatty acids. Oils and fats that are liquid at room temperature and come from many plants and fish sources are included in this list. A 2,000-calorie diet should include 6 teaspoons of oils per day. One teaspoon is the equivalent of the following:

- 1 teaspoon vegetable oil or soft margarine
- 1 medium fruit (apple or orange) = a baseball
- 1–2 ounces natural cheese
- 1½ ounce processed cheese

For the healthiest option and to limit calories and saturated fat in your diet, MyPlate’s key message for consumers is to switch to fat-free or low-fat (1%) milk and dairy products.

Protein Foods (Meat and Beans) This group includes meat, poultry, fish, dried beans and peas, eggs, nuts, seeds, and processed soy products. A 2,000-calorie diet should include 5½ ounce-equivalents daily. Each of the following counts as equivalent to 1 ounce:

- 1 ounce cooked lean meat, poultry, or fish
- ¼ cup cooked beans (legumes) or tofu
- 1 egg
- 1 tablespoon peanut butter
- ½ ounce nuts or seeds

For quick estimates, use the following equivalents:

- 1 teaspoon of margarine = one die
- 1½ ounce of cheese = your thumb, four dice stacked together
- 3 ounces of chicken or meat = a deck of cards
- ½ cup of cooked rice, pasta, or potato = ½ baseball
- 1 cup of cereal flakes = a fist
- 2 tablespoons of peanut butter = a ping-pong ball
- 1 medium potato = a computer mouse
- 1–2 ounce muffin or roll = a plum or large egg
- 2-ounce bagel = a hockey puck or yo-yo
- 1 medium fruit (apple or orange) = a baseball
- ¼ cup nuts = a golf ball
- small cookie or cracker = a poker chip

Wellness Tip Research shows that some protein-rich foods can give you a quick mental boost, which can be helpful before an exam.

Solid Fats and Added Sugars If you consistently choose nutrient-dense foods that are fat-free or low-fat and that contain no added sugars, you can also have a small amount of additional calories in the form of solid fats and added sugars (SoFAS). For recommended limits on solid fats and added sugars for different calorie intakes, refer to your MyPlate program or to the dietary patterns in the Nutrition Resources section at the end of the chapter.

People who are trying to lose weight may choose not to use SoFAS calories. As described earlier, making better beverage choices is a key strategy for reducing intake of added sugars. Sodas, energy drinks, and sports drinks contribute added sugars but few nutrients to the American diet. The
differences in nutrients between soda and other beverages are shown in Figure 8.4. For those wanting to maintain weight, these calories may be used to increase the amount of food from a food group; to consume foods that are not in the lowest-fat form or that contain added sugars; to add oil, fat, or sugars to foods; or to consume alcohol.

The current American diet includes higher levels of calories in the form of solid fats and added sugars (SoFAS) than recommended.

Physical Activity Like the Dietary Guidelines and other plans, MyPlate encourages physical activity for improving health, preventing chronic diseases, and managing weight. If you meet the Department of Health and Human Services’ guidelines of 150 minutes per week of moderate physical activity, you will meet the recommendations found in MyPlate. To get the most health benefits, choose moderate physical activity such as brisk walking, cycling, and dancing, or vigorous activity such as running, swimming, basketball, or aerobics.

DASH Eating Plan

Other food-group plans have been proposed by a variety of experts and organizations, some to address the needs of special populations. One well-studied alternative is DASH, which stands for Dietary Approaches to Stop Hypertension. As its name suggests, the DASH eating plan was developed to help people control high blood pressure and it is tailored with special attention to sodium, potassium, and other nutrients of concern for blood pressure. Refer to Figure 4 in the Nutrition Resources at the end of the chapter for more information on DASH.

The Vegetarian Alternative

Vegetarians choose a diet with one essential difference from the diets described previously—they eliminate or restrict foods of animal origin (meat, poultry, fish, eggs, milk). Many people choose such diets for health reasons; vegetarian diets tend to be lower in total calories and calories from fat, saturated fat, cholesterol, and animal protein and higher in complex carbohydrates, dietary fiber, potassium, folate, vitamins C and E, carotenoids, and phytochemicals. Some people adopt a vegetarian diet out of concern for the environment, for financial considerations, or for reasons related to ethics or religion. Individuals who follow a vegetarian diet generally have a lower body mass index than those who do not.

Types of Vegetarian Diets There are various vegetarian styles. The wider the variety of the diet eaten, the easier it is to meet nutritional needs.

- **Vegans** eat only plant foods.
- **Lacto-vegetarians** eat plant foods and dairy products.
- **Lacto-ovo-vegetarians** eat plant foods, dairy products, and eggs.

Others can be categorized as partial vegetarians, semivegetarians, or pescovegetarians. These people eat plant foods, dairy

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**Recommended Daily Intake***

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Daily</th>
<th>Nutrient Value</th>
<th>% Daily</th>
<th>Nutrient Value</th>
<th>% Daily</th>
<th>Nutrient Value</th>
<th>% Daily</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbohydrate</td>
<td>300 g</td>
<td>14%</td>
<td>40.5 g</td>
<td>6%</td>
<td>18 g</td>
<td>13%</td>
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<tr>
<td>Added sugars</td>
<td>32 g</td>
<td>6%</td>
<td>3.9 g</td>
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<td>38 g</td>
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<td>Fat</td>
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<td></td>
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<td>Protein</td>
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<td>22%</td>
<td>12 g</td>
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<tr>
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<td>Vitamin A</td>
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<td>30 µg</td>
<td>31%</td>
<td>216 µg</td>
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<tr>
<td>Vitamin C</td>
<td>75 mg</td>
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<td>145.5 mg</td>
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<tr>
<td>Vitamin D</td>
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<td>3.7 µg</td>
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<td>160 µg</td>
<td>5%</td>
<td>20 µg</td>
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</tr>
</tbody>
</table>

*Recommended intakes and limits appropriate for a 19-year-old woman consuming 2,000 calories per day.

**FIGURE 8.4** Nutrient density of 12-ounce portions of selected beverages. Color bars represent percentage of recommended daily intake or limit for each nutrient.
products, eggs, and usually a small selection of poultry, fish, and other seafood. Many other people choose vegetarian meals frequently but are not strictly vegetarian. Including some animal protein (such as dairy products) in a mostly vegetarian diet makes meal planning easier, but it is not necessary.

A Food Plan for Vegetarians Table 8.8 outlines the USDA’s Healthy Vegetarian diet plan. Also, MyPlate can be adapted for use by vegetarians with only a few key modifications (refer to Figure 2 in Nutrition Resources at the end of the chapter). For the meat and beans group, vegetarians can focus on the non-meat choices of dry beans and peas, nuts, seeds, eggs, and soy foods like tofu. Vegans and other vegetarians who do not eat or drink any dairy products must find other rich sources of calcium (see the following list). Fruits, vegetables, and whole grains are healthy choices for people following all types of vegetarian diets.

A healthy vegetarian diet, emphasizing a wide variety of plant foods, will supply all the essential amino acids. Choosing minimally processed and unrefined foods will maximize nutrient value and provide ample dietary fiber. Daily consumption of a variety of plant foods in amounts that meet total energy needs can provide all needed nutrients except vitamin B-12 and possibly vitamin D, calcium, iron, and zinc. Strategies for getting these and other nutrients include the following:

- **Vitamin B-12** is found naturally only in animal foods. If dairy products and eggs are limited or avoided, B-12 can be found in fortified foods such as ready-to-eat cereals, soy beverages, meat substitutes, special yeast products, and supplements.
- **Vitamin D** can be obtained by spending 5–15 minutes a day in the sun, by consuming vitamin D–fortified products like ready-to-eat cereals and soy or rice milk, or by taking a supplement.
- **Calcium** is found in legumes, tofu processed with calcium, dark-green leafy vegetables, nuts, tortillas made from lime-processed corn, fortified orange juice, soy milk, bread, and other foods.
- **Iron** is found in whole grains, fortified bread and breakfast cereals, dried fruits, leafy green vegetables, nuts and seeds, legumes, and soy foods. The iron in plant foods is more difficult for the body to absorb than the iron from animal sources. Eating or drinking a good source of vitamin C with most meals is helpful because vitamin C improves iron absorption.
- **Zinc** is found in whole grains, nuts, legumes, and soy foods.

If you are a vegetarian, remember that it’s especially important to eat as wide a variety of foods as possible to ensure that all your nutritional needs are satisfied. Consulting with a registered dietitian will make your planning easier. Vegetarian diets for children, teens, and pregnant and lactating women warrant professional guidance.

**Functional Foods**

The American diet already contains numerous functional foods. Two of the earliest functional foods introduced in the United States were iodized salt and milk fortified with Vitamins A and D. More recently, manufacturers began fortifying breads and grains with folic acid to reduce the incidence of neural tube defects.

Although experts suggest that all foods are functional, functional foods are defined as foods to which health-promoting or disease-preventing components have been added. They include foods that are fortified, enriched, or enhanced or that contain dietary components with additional potential to benefit health. Some examples of functional foods are calcium-fortified orange juice, margarine enriched with sterols or stanols to lower the risk of heart disease, sports bars for energy and improved athletic performance, and vitamin B-12-enriched soy milk for vegetarians.

**Dietary Challenges for Various Population Groups**

MyPlate and the Dietary Guidelines for Americans provide a basis that nearly everyone can use to create a healthy diet. However, different population groups should be aware of special dietary challenges.

**Children and Teenagers** The best approach for parents with young children is to provide a variety of foods. For example, parents can add vegetables to casseroles and fruit to cereal, or they can offer fruit and vegetable juices or homemade yogurt or fruit shakes instead of sugary drinks. Many children and teenagers enjoy eating at fast-food restaurants, but they should be encouraged to select the healthiest menu choices and to balance the day’s diet with low-fat, nutrient-rich foods. Allowing children to help prepare meals is another good way to encourage good eating habits.

**College Students** Foods that are convenient for college students are not always the healthiest choices. Students who
To reduce the risk of neural tube defects in the fetus, the U.S. Public Health Service recommends that all women of childbearing age get 400 μg of folic acid daily from fortified foods or supplements.

**Eating Wherever**
- Eat a colorful, varied diet. The more colorful your diet is, the more varied and rich in fruits and vegetables it will be. Fruits and vegetables are typically inexpensive, delicious, nutritious, and low in fat and calories.
- Eat breakfast. You’ll have more energy in the morning and be less likely to grab an unhealthy snack later on.
- Choose healthy snacks—fruits, vegetables, whole grains, and cereals.
- Drink nonfat milk, water, mineral water, or 100% fruit juice more often than soft drinks or sweetened beverages.
- Pay attention to portion sizes.
- Combine physical activity with healthy eating.

**Eating in the Dining Hall**
- Choose a meal plan that includes breakfast.
- Decide what you want to eat before you get in line, and stick to your choices.
- Build your meals around whole grains and vegetables. Ask for small servings of meat and high-fat main dishes.
- Choose leaner poultry, fish, or bean dishes rather than high-fat meats and fried entrees.
- Ask that gravies and sauces be served on the side; limit your intake.
- Choose broth-based or vegetable soups rather than cream soups.
- At the salad bar, load up on leafy greens, beans, and fresh vegetables. Avoid mayonnaise-coated salads, bacon, croutons, and high-fat dressings. Put dressing on the side; dip your fork into it rather than pouring it over the salad.
- Choose fruit for dessert rather than cookies or cakes.

**Eating in Fast-Food Restaurants**
- Most fast-food chains can provide a brochure with the nutritional content of their menu items. Ask for it, or check the restaurant’s website for nutritional information. Order small single burgers with no cheese instead of double burgers with many toppings. If possible, get them broiled instead of fried.
- Ask for items to be prepared without mayonnaise, tartar sauce, sour cream, or other high-fat sauces. Ketchup, mustard, and fat-free mayonnaise or sour cream are better choices and are available at many fast-food restaurants.
- Choose whole-grain buns or bread for sandwiches.
- Choose chicken items made from chicken breast, not processed chicken.
- Order vegetable pizzas without extra cheese.
- If you order french fries or onion rings, get the smallest size and/or share them with a friend. Better yet, get a salad or a fruit cup instead.

**Eating on the Run**
- When you need to eat in a hurry, remember that you can carry healthy foods in your backpack or a small insulated lunch sack (with a frozen gel pack to keep fresh food from spoiling).
- Carry items that are small and convenient but nutritious, such as fresh fruits or vegetables, whole-wheat buns or muffins, snack-size cereal boxes, and water.
- Make healthy choices at vending machines such as water or 100% fruit juice for beverages and whole grain crackers or pretzels, nuts, seeds, baked chips, low-fat popcorn, and low-fat granola bars as snacks.

**Pregnant and Breastfeeding Women** Good nutrition is essential to a healthy pregnancy. Nutrition counseling before conception can help a women establish a balanced eating plan and healthy body weight for a healthy pregnancy. During pregnancy and while breastfeeding, women have special nutritional needs. Pregnant or breastfeeding women are often advised to take a nutrient supplement in addition to following a special diet, as recommended by MyPlate’s Daily Food Plan for Moms.

To reduce the risk of neural tube defects in the fetus, the U.S. Public Health Service recommends that all women of childbearing age get 400 μg of folic acid daily from fortified foods or supplements.
Older Adults Nutrient needs do not change much as people age, but because older adults tend to become less active, they don’t need as many calories to maintain body weight. At the same time, the absorption of some nutrients tends to be lower in older adults because of age-related changes in the digestive tract. For these reasons, older adults should focus on eating nutrient-dense foods. For example, foods fortified with vitamin B-12 and/or B-12 supplements are recommended for people over age 50. Calcium and vitamin D intake can be inadequate; therefore, physicians may suggest supplementation to reduce bone loss and risk of osteoporosis. Antioxidants from fruits and vegetables are important in older adults to reduce age-related changes in vision and cognitive functioning. Because constipation is a common problem, consuming foods high in dietary fiber and drinking enough fluids are important goals.

Athletes Key dietary concerns for athletes are meeting increased energy and fluid requirements for training and making healthy food choices throughout the day. For more on this topic, see the box “Do Athletes Need a Different Diet?”

People with Special Health Concerns Many Americans have special health concerns that affect their dietary needs. For example, people with diabetes benefit from a well-balanced diet that is low in simple sugars, high in complex carbohydrates, and relatively rich in monounsaturated fats. People with high blood pressure need to limit their sodium consumption and control their weight. If you have a health problem or concern that may require a special diet, discuss your situation with a physician or registered dietitian.

Food Labels

All processed foods regulated by either the FDA or the USDA include standardized nutrition information on their labels. Every food label shows serving sizes and the amount of many nutrients in each serving—including saturated fat, protein, dietary fiber, and sodium. In 2014, the FDA proposed significant changes to food labels, which may begin to take effect in 2016. See the box “Using Food Labels” for suggestions on what to look for on food labels, in both the current and proposed new formats.

Food label regulations also require that foods meet strict definitions if their packaging includes terms such as light, low-fat, or high-fiber (Table 8.10). Health claims such as “good source of dietary fiber” or “low in saturated fat” on packages are also regulated and can be signals that a product can be wisely included in your diet. Overall, the food label is an important tool to help you choose a healthy dietary pattern.

Food labels are not required on fresh meat, poultry, fish, fruits, and vegetables (many of these products are not packaged). You can get information on the nutrient content of these items from basic nutrition books, registered dietitians, nutrient analysis computer software, the Web, and the companies that

<table>
<thead>
<tr>
<th>Table 8.10</th>
<th>Food Package Nutrient Claims</th>
</tr>
</thead>
<tbody>
<tr>
<td>Healthy</td>
<td>A food that is low in fat, is low in saturated fat, has no more than 360–480 mg of sodium and 60 mg of cholesterol, and provides 10% or more of the Daily Value for vitamin A, vitamin C, protein, calcium, iron, or dietary fiber</td>
</tr>
<tr>
<td>Light or lite</td>
<td>33% fewer calories or 50% less fat than a similar product</td>
</tr>
<tr>
<td>Reduced or fewer</td>
<td>At least 25% less of a nutrient than a similar product; can be applied to fat (“reduced fat”), saturated fat, cholesterol, sodium, and calories</td>
</tr>
<tr>
<td>Extra or added</td>
<td>10% or more of the Daily Value per serving when compared to what a similar product has</td>
</tr>
<tr>
<td>Good source</td>
<td>10–19% of the Daily Value for a particular nutrient per serving</td>
</tr>
<tr>
<td>High, rich in, or excellent source of</td>
<td>20% or more of the Daily Value for a particular nutrient per serving</td>
</tr>
<tr>
<td>Low calorie</td>
<td>40 calories or less per serving</td>
</tr>
<tr>
<td>High fiber</td>
<td>5 grams or more of fiber per serving</td>
</tr>
<tr>
<td>Good source of fiber</td>
<td>2.5–4.9 grams of fiber per serving</td>
</tr>
<tr>
<td>Fat-free</td>
<td>Less than 0.5 gram of fat per serving</td>
</tr>
<tr>
<td>Low-fat</td>
<td>3 grams of fat or less per serving</td>
</tr>
<tr>
<td>Saturated or trans fat-free</td>
<td>Less than 0.5 gram of saturated fat and 0.5 gram of trans fatty acids per serving</td>
</tr>
<tr>
<td>Low saturated fat</td>
<td>1 gram or less of saturated fat per serving and no more than 15% of total calories</td>
</tr>
<tr>
<td>Low sodium</td>
<td>140 mg or less of sodium per serving</td>
</tr>
<tr>
<td>Very low sodium</td>
<td>35 mg or less of sodium per serving</td>
</tr>
<tr>
<td>Lean</td>
<td>Cooked seafood, meat, or poultry with less than 10 grams of fat, 4.5 grams or less of saturated fat, and less than 95 mg of cholesterol per serving</td>
</tr>
<tr>
<td>Extra lean</td>
<td>Cooked seafood, meat, or poultry with less than 5 grams of fat, 2 grams of saturated fat, and 95 mg of cholesterol per serving</td>
</tr>
</tbody>
</table>

**NOTE:** The FDA has not yet defined nutrient claims relating to carbohydrates, so foods labeled low- or reduced-carbohydrate do not conform to any approved standard.
If you exercise vigorously and frequently, or if you are an athlete in training, you likely have increased energy and fluid requirements. Research supports the following recommendations for athletes:

- **Energy intake:** Someone engaged in a vigorous training program may have energy needs as high as 6,000 calories per day—far greater than the energy needs of a moderately active person. For athletes, the Academy of Nutrition and Dietetics (formerly the American Dietetic Association) recommends a diet with 60–65% of calories coming from carbohydrates, 10–15% from protein, and no more than 30% from fat.

  Athletes who need to maintain low body weight and fat (such as gymnasts, skaters, and wrestlers) need to get enough calories and nutrients while avoiding unhealthy eating patterns such as bulimia. The combination of low body fat, high physical activity, disordered eating habits—and, in women, amenorrhea—is associated with osteoporosis, stress fractures, and other injuries. If keeping your weight and body fat low for athletic reasons is important to you, seek dietary advice from a qualified dietitian and make sure your physician is aware of your eating habits.

- **Carbohydrates:** Endurance athletes involved in competitive events lasting longer than 90 minutes may benefit from increasing carbohydrate intake to 65–70% of their total calories. Specifically, the American College of Sports Medicine (ACSM) recommends that athletes consume 2.7–4.5 grams per pound of body weight daily, depending on their weight, sport, and other nutritional needs. This increase should come in the form of complex carbohydrates.

  High carbohydrate intake builds and maintains glycogen stores in the muscles, resulting in greater endurance and delayed fatigue during competitive events. The ACSM recommends that before exercise an active adult or athlete eat a meal or snack that is relatively high in carbohydrates, moderate in protein, and low in fat and fiber. Eating carbohydrates 30 minutes, two hours, and four hours after exercise can help replenish glycogen stores in the liver and muscles.

- **Fat:** The ACSM recommends that all athletes get 20–35% of calories from fat in their diets. This is in line with the daily intake suggested by the Food and Nutrition Board. Reducing fat intake to less than 20% of daily calories can negatively affect performance and be harmful to health.

- **Protein:** For endurance and strength-trained athletes, the ACSM recommends eating 0.5–0.8 gram of protein per pound of body weight each day, which is considerably higher than the standard DRI of 0.36 gram per pound. This level of protein is easily obtainable from foods; in fact, most Americans eat more protein than they need every day. A balanced, moderate-protein diet can provide the protein most athletes need.

  There is no evidence that consuming supplements containing vitamins, minerals, protein, or specific amino acids builds muscle or improves sports performance. Strength and muscle are built with exercise, not extra protein, and carbohydrates provide the fuel needed for muscle-building exercise.

- **Fluids:** If you exercise heavily or live in a hot climate, you should drink extra fluids to maximize performance and prevent heat illness. For a strenuous endurance event, prepare yourself the day before by drinking plenty of fluids. The ACSM recommends drinking 2–3 milliliters of fluid per pound of body weight about four hours before the event. During the event, take in enough fluids to compensate for fluid loss due to sweating; the amount required depends on the individual and his or her sweat rate. Afterward, drink enough to replace lost fluids—about 16–24 ounces for every pound of weight lost.

  Water is a good choice for fluid replacement for events lasting 60–90 minutes. For longer workouts or events, a sports drink can be a good choice. These contain water, electrolytes, and carbohydrates and can provide some extra energy as well as replace electrolytes like sodium lost in sweat.

CRITICAL CONSUMER
Using Food Labels

The “Nutrition Facts” section of a food label is designed to help consumers make food choices based on the nutrients that are most important to good health. In addition to listing nutrient content by weight, the current label puts the information in the context of a daily diet of 2,000 calories that includes no more than 65 grams of fat (approximately 30% of total calories). For example, if a serving of a particular product has 13 grams of fat, the label will show that the serving represents 20% of the daily fat allowance. If your daily diet contains fewer or more than 2000 calories, you need to adjust these calculations accordingly.

Food labels use uniform serving sizes. This means that if you look at different brands of salad dressing, for example, you can compare calories and fat content based on the serving amount. Food label serving sizes may be larger or smaller than USDA serving size equivalents, however.

The current Nutrition Facts label has been in use since the 1990s. Based on research into how consumers use food labels as well as changes to the nutrients of most concern to Americans, the FDA has proposed changes to the look and content of the label. After it is finalized, you could begin to see the new style of labels on foods you purchase, but food manufacturers will have two years to change their labels. Some of the key proposed changes to the food label are the following:

- Requiring added sugars, vitamin D, and potassium on all labels
- Revising Daily Values for certain nutrients
- Updating serving size labeling for certain packages to be more realistic and to reflect amounts typically eaten at one time
- Refreshing the design to highlight calorie content and serving size and to make other parts of the label easier to read


<table>
<thead>
<tr>
<th>Current Label: What to Look For</th>
<th>Proposed Label: What’s Different</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Serving size and calories: Determine how many servings there are in the food package and compare it to how much you actually eat. You may need to adjust the rest of the nutrient values—especially calories—based on your typical serving size.</td>
<td>1. Servings sizes and calories: Information larger and bolder; some serving sizes also updated.</td>
</tr>
<tr>
<td>2. Daily Values: Based on a 2000-calorie diet, Daily Value percentages tell you whether the nutrients in a serving of food contribute a lot or a little to your total daily diet. 5% or less is low; 20% or more is high.</td>
<td>2. Daily Values: Updated, layout changed.</td>
</tr>
<tr>
<td>3. Limit these nutrients: Look for foods low in saturated fat, trans fat, and sodium.</td>
<td>3. New nutrients required: Look for foods low in added sugars and high in vitamin D and potassium; actual amounts of each nutrient listed.</td>
</tr>
<tr>
<td>4. Get enough of these nutrients: Look for foods high in dietary fiber, vitamin A, vitamin C, calcium, and iron.</td>
<td></td>
</tr>
</tbody>
</table>

**Nutrition Facts**

**Serving Size 1 cup (265g) Servings per Container 2**

<table>
<thead>
<tr>
<th>Amount per Serving</th>
<th>% Daily Value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calories 235</td>
<td>5%</td>
</tr>
<tr>
<td>Fat 9g</td>
<td>5%</td>
</tr>
<tr>
<td>Saturated Fat 1g</td>
<td>5%</td>
</tr>
<tr>
<td>Trans Fat 0.5g</td>
<td>5%</td>
</tr>
<tr>
<td>Cholesterol 30mg</td>
<td>10%</td>
</tr>
<tr>
<td>Sodium 775mg</td>
<td>32%</td>
</tr>
<tr>
<td>Total Carbohydrate 34g</td>
<td>11%</td>
</tr>
<tr>
<td>Dietary Fiber 9g</td>
<td>36%</td>
</tr>
<tr>
<td>Sugars 5g</td>
<td>10%</td>
</tr>
<tr>
<td>Protein 18g</td>
<td>20%</td>
</tr>
</tbody>
</table>

**Vitamin A 25%**  
**Vitamin C 0%**  
**Calcium 12%**  
**Iron 20%**

*Percent Daily Values are based on a 2,000-calorie diet. Your daily values may be higher or lower depending on your calorie needs.

**Footnote:** This section shows recommended daily intake for two levels of calorie consumption and values for dietary calculations. It’s the same on all labels.
produce or distribute these foods. Also, supermarkets may also have posters or pamphlets listing the nutrient contents of these foods. In Lab 8.3, you compare foods using the information on their labels.

**Calorie Labeling: Restaurants and Vending Machines**

In 2014, the FDA issued new regulations requiring that calorie information be provided on restaurant menus and vending machines; these new rules were required as part of the 2010 Affordable Care Act and are set to go into effect by December 2016. Calorie information is required on menus and menu boards in chain restaurants and similar retail food establishments (those with 20 or more locations). If no menus or boards are available, calories must be shown on signs near the foods. In addition, chain restaurants are also required to provide more detailed nutrition information on their menu items—on posters, tray liners, signs, handouts, or another similar location—so look for it!

Calorie labels are also now required for vending machine operators who own or operate 20 or more machines. Calories will be shown on a sign or digital display near the food items or selection button. Use the information to help consider your options and to monitor your calorie intake.

**Dietary Supplements**

Dietary supplements include vitamins, minerals, amino acids, herbs, enzymes, and other compounds. Although dietary supplements are sold over the counter and often thought of as safe and natural, they may contain powerful bioactive chemicals that have the potential for harm. About one-quarter of all pharmaceutical drugs are derived from botanical sources, and even essential vitamins and minerals can have toxic effects if consumed in excess.

In the United States, dietary supplements are not legally considered drugs and are not regulated like drugs. Before they are approved by the FDA and put on the market, drugs undergo clinical studies to determine safety, effectiveness, side effects and risks, possible interactions with other substances, and appropriate dosages. The FDA does not authorize or test dietary supplements, and manufacturers are not required to demonstrate either safety or effectiveness before they are marketed. Although dosage guidelines exist for some of the compounds in dietary supplements, dosages for many are not well established.

Large doses of some dietary supplements can cause health problems by affecting the absorption of certain vitamins or minerals or interacting with medications. Garlic supplements, for example, can cause bleeding if taken with anticoagulant (blood-thinning) medications. Some supplements can have side effects. St. John’s wort, for example, increases the skin’s sensitivity to sunlight and may decrease the effectiveness of oral contraceptives, drugs used to treat HIV infection, and many other medications. For this reason, ask your doctor or a dietitian before taking any high-dosage supplement.

There are also key differences in the way drugs and supplements are manufactured: FDA-approved medications are standardized for potency, and quality control and proof of purity are required. Dietary supplement manufacture is not as closely regulated, and there is no guarantee that a product contains a given ingredient at all, let alone in the appropriate amount. The potency of herbal supplements can vary widely due to differences in growing and harvesting conditions, preparation methods, and storage. Contamination and misidentification of plant compounds are also potential problems.

In an effort to provide consumers with more reliable and consistent information about supplements, the FDA has developed labeling regulations. Labels similar to those found on foods are now required for dietary supplements; for more information, see the box “Using Dietary Supplement Labels.”

**Food Additives**

Today, approximately 3000 substances are intentionally added to foods to maintain or improve nutritional quality, to maintain freshness, to help in processing or preparation, or to alter taste or appearance. The most widely used additives in foods are sugar, salt, and corn syrup; these three, plus citric acid, baking soda, vegetable colors, mustard, and pepper, account for 98% by weight of all food additives used in the United States.

Food additives pose no significant health hazard to most people because the levels used are well below any that could produce toxic effects. Two additives of potential concern for some people are sulfites, used to keep vegetables from turning brown, and monosodium glutamate (MSG), used as a flavor enhancer. Sulfites can cause severe reactions in some people, and the FDA strictly limits their use and requires clear labeling on any food containing them. MSG may cause some people to experience episodes of sweating and increased blood pressure. If you have any sensitivity to an additive, check food labels when you shop and ask questions when you eat out.

**Foodborne Illness**

Many people worry about additives or pesticide residues in their food, but a greater threat comes from microorganisms that cause foodborne illnesses. Raw or undercooked animal products, such as chicken, hamburger, and oysters, pose the greatest risk, although in recent years contaminated fruits and vegetables have been catching up.

The Centers for Disease Control and Prevention (CDC) estimates that 48 million illnesses, 128,000 hospitalizations, and 3,000 deaths occur each year in the United States due to foodborne contaminants. One out of six people contract a foodborne disease each year. Symptoms include diarrhea, vomiting, fever, pain, headache, and weakness. Although the effects of foodborne illness are usually not serious, some groups, such as children, pregnant women, and elderly people, are more at risk for severe complications such as rheumatic diseases, seizures, blood poisoning, and death. Young children and older adults are more likely to have severe complications or to die.
Since 1999, specific types of information have been required on the labels of dietary supplements. In addition to basic information about the product, labels include a “Supplement Facts” panel, modeled after the “Nutrition Facts” panel used on food labels (see the figure below). Under the Dietary Supplement Health and Education Act (DSHEA) and food labeling laws, supplement labels can make three types of health-related claims:

- **Nutrient-content claims**, such as “high in calcium,” “excellent source of vitamin C,” or “high potency.” The claims “high in” and “excellent source of” mean the same as they do on food labels. A “high potency” single-ingredient supplement must contain 100% of its Daily Value; a “high potency” multi-ingredient product must contain 100% or more of the Daily Value of at least two-thirds of the nutrients present for which Daily Values have been established.

- **Health claims**, if they have been authorized by the FDA or another authoritative scientific body. The association between adequate calcium intake and lower risk of osteoporosis is an example of an approved health claim. The FDA also allows so-called **qualified health claims** for situations in which there is emerging but as yet inconclusive evidence for a particular claim. Such claims must include qualifying language such as “scientific evidence suggests but does not prove” the claim.

- **Structure-function claims**, such as “antioxidants maintain cellular integrity” or “this product enhances energy levels.” Because these claims are not reviewed by the FDA, they must carry a disclaimer (see the sample label).

### Tips for Choosing and Using Dietary Supplements

- Check with your physician before taking a supplement. Many are not meant for children, older people, women who are pregnant or breastfeeding, people with chronic illnesses or upcoming surgery, or people taking prescription or over-the-counter medications. When you visit your doctor, bring a list of all dietary supplements you are taking. Do not take megadoses (more than double the daily recommended intake) without your doctor’s approval.
- Follow the cautions, instructions for use, and dosage given on the label.
- Look for the United States Pharmacopeia (USP) verification mark on the label, indicating that the product meets minimum safety and purity standards developed under the Dietary Supplement Verification Program by the USP. The USP mark means that the product (1) contains the ingredients stated on the label, (2) has the declared amount and strength of ingredients, (3) will dissolve effectively, (4) has been screened for harmful contaminants, and (5) has been manufactured using safe, sanitary, and well-controlled procedures. The National Nutritional Foods Association has a self-regulatory testing program for its members; other, smaller associations and labs, including http://www.ConsumerLab.com, also test and rate dietary supplements.
- Choose brands made by nationally known food and drug manufacturers or “house brands” from large retail chains. Due to their size and visibility, such sources are likely to have high manufacturing standards.
- If you experience side effects, stop using the product and contact your physician. Report any serious reactions to the FDA’s MedWatch monitoring program (1-800-FDA-1088 or online at http://www.fda.gov/Safety/MedWatch/default.htm).

### For More Information about Dietary Supplements

- ConsumerLab.Com: http://www.consumerlab.com
- Food and Drug Administration: http://www.fda.gov/Food/DietarySupplements/default.htm
- Natural Products Association: http://www.npainfo.org
- U.S. Pharmacopeia: http://www.usp.org/USPVerified/DietarySupplements

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### MODD ENHANCER DIETARY SUPPLEMENT

<table>
<thead>
<tr>
<th>Supplement Facts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serving Size: 1 capsule</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Vitamin B&lt;sub&gt;6&lt;/sub&gt; (as pyridoxine hydrochloride)</td>
</tr>
<tr>
<td>Folic acid</td>
</tr>
<tr>
<td>Vitamin B&lt;sub&gt;12&lt;/sub&gt; (as cyanocobalamine)</td>
</tr>
<tr>
<td>St. John’s wort aerial parts extract</td>
</tr>
<tr>
<td>Kava root extract</td>
</tr>
<tr>
<td>Siberian ginseng root extract</td>
</tr>
<tr>
<td>Phenytoilamine (as phenylalanine hydrochloride)</td>
</tr>
</tbody>
</table>

*Percent Daily Values are based on a 2000 calorie diet.

Other ingredients: Rice flour, gelatin, water.

**Standardization levels:** St. John’s wort: 0.3% hypericin; kava: 30% kavalactones; Siberian ginseng: 1% eleutheroc- sides.

Made by JKS Herbal Supplements, P.O. Box 2000, San Francisco, CA 94444.
from foodborne illnesses. Thirteen percent of infections, 24% of hospitalizations, and 57% of deaths due to food-borne illnesses occurred among adults age 65 and over.

**Causes of Foodborne Illnesses** Most cases of foodborne illness are caused by pathogens, disease-causing microorganisms that contaminate food, usually from improper handling. According to the CDC, 31 pathogens are known to cause foodborne illness, and the majority of illnesses, hospitalizations, and deaths are due to 8 pathogens, notably *Salmonella* (most often found in eggs, on vegetables, and on poultry); norovirus (most often found in salad ingredients and shellfish); *Campylobacter jejuni* (most often found in meat and poultry); *Toxoplasma* (most often found in meat); *Escherichia coli* (E. coli) O157:H7 (most often found in meat and water); *Listeria monocyto genes* (most often found in lunch meats, sausages, and hot dogs); and *Clostridium perfringens* (most often found in meat and gravy). The most frequent cause of infection was *Salmonella*, which accounted for 38% of reported infections. The second most frequent cause was *Campylobacter* (35%). *Vibrio* accounted for 1.3% of reported infections. Although the incidence of disease caused by food-borne bacteria, especially *Salmonella*, is slowly declining, approximately 80 people died as a result of food-borne illness in the United States in 2013.

Although pathogens are usually destroyed during cooking, the U.S. government is taking steps to bring down levels of contamination by improving national testing and surveillance. Raw meat and poultry products are now sold with safe-handling and cooking instructions, and all packaged, unpasteurized fresh fruit and vegetable juices carry warnings about potential contamination. To ensure that the U.S. food supply is safe, the FDA Food Safety Modernization Act (FSMA) was signed into law on January 4, 2011, to reform the food safety system. The FSMA enables the FDA to focus more on preventing food safety problems rather than primarily on reacting to problems after they occur.

Although foodborne illness outbreaks associated with food-processing plants make headlines, most cases of illness trace back to poor food handling in the home or in restaurants. The FDA encourages people to follow four basic food safety principles:

- **Clean** hands, food contact surfaces, and vegetables and fruits.
- **Separate** raw, cooked, and ready-to-eat foods while shopping, storing, and preparing foods.
- **Cook** foods to a safe temperature.
- **Chill** (refrigerate) perishable foods promptly.

The FDA also advises people to avoid certain high-risk foods, including raw (unpasteurized) milk, cheeses, and juices; raw or undercooked animal foods, such as seafood, meat, poultry, and eggs; and raw sprouts. These precautions are especially important for pregnant women, young children, older adults, and people with weakened immune systems or certain chronic diseases. For more information on food safety, see the box “Safe Food Handling.”

**Treating Foodborne Illness** If you think you may be having a bout of foodborne illness, drink plenty of clear fluids to prevent dehydration, and rest to speed recovery. To prevent further contamination, wash your hands often and always before handling food until you recover. A fever higher than 102°F, blood in the stool, or dehydration deserves a physician’s evaluation, especially if the symptoms persist for more than 2 to 3 days. In cases of suspected botulism—characterized by symptoms such as double vision, paralysis, dizziness, and vomiting—consult a physician immediately.

**Irradiated Foods**

**Food irradiation** is the treatment of foods with gamma rays, X-rays, or high-voltage electrons to kill potentially harmful pathogens, including bacteria, parasites, insects, and fungi that cause foodborne illness. It also reduces spoilage and extends shelf life. Even though irradiation has been generally endorsed by agencies such as the World Health Organization, the CDC, and the American Medical Association, few irradiated foods are currently on the market due to consumer resistance and skepticism. Studies indicate that when consumers are given information about the process of irradiation and the benefits of irradiated foods, most want to purchase them.

All primary irradiated foods (meat, vegetables, and so on) are labeled with the flowerlike radura symbol and a brief information label; spices and foods that are merely ingredients do not have to be labeled. Proper handling of irradiated foods is still critical for preventing foodborne illness.

**Environmental Contaminants and Organic Foods**

Contaminants are present in the food-growing environment. Environmental contaminants include various minerals, antibiotics, hormones, pesticides, and industrial chemicals. Safety regulations attempt to keep our exposure to contaminants at safe levels, but monitoring is difficult, and many substances (such as pesticides) persist in the environment long after being banned from use.

**Organic Foods** Some people who are concerned about pesticides and other environmental contaminants choose to buy foods that are organic. To be certified as organic, foods must meet strict production, processing, handling, and labeling criteria. Organic crops must meet limits on pesticide residues.

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**pathogen** A microorganism that causes disease.

**food irradiation** The treatment of foods with gamma rays, X-rays, or high-voltage electrons to kill potentially harmful pathogens and increase shelf life.

**organic** A designation applied to foods grown and produced according to strict guidelines limiting the use of pesticides, nonorganic ingredients, hormones, antibiotics, genetic engineering, irradiation, and other practices.
SAFE FOOD HANDLING

Shopping

- Don’t buy food in containers that leak, bulge, or are severely dented. Refrigerated foods should be cold, and frozen foods should be solid.
- Check the food label for an expiration date and for safe-handling instructions.
- Place meat, poultry, and seafood in plastic bags, and separate foods in your grocery cart.
- Select cold and frozen foods last to ensure they stay refrigerated until just before checkout.

Storing Food

- Store raw meat, poultry, fish, and shellfish in containers in the refrigerator so the juices don’t drip onto other foods. Keep these items away from other foods, surfaces, utensils, and serving dishes to prevent cross-contamination.
- Store eggs in the coldest part of the refrigerator, not in the door, and use them within three–five weeks.
- Keep hot foods hot (140°F or above) and cold foods cold (40°F or below); harmful bacteria can grow rapidly between these two temperatures. Refrigerate foods within two hours of purchase or preparation and within one hour if the air temperature is above 90°F. Freeze foods at or below 0°F. Use or freeze fresh meats within three–five days and fresh poultry, fish, and ground meat within one–two days. Use refrigerated leftovers within three–four days.

Preparing Food

- Thaw frozen food in the refrigerator, in cold water, or in the microwave, not on the kitchen counter. Cook foods immediately after thawing.
- Cook foods thoroughly, especially beef, poultry, fish, pork, and eggs; cooking kills most microorganisms. Use a food thermometer to ensure that foods are cooked to a safe temperature. Hamburgers should be cooked to 160°F. Turn or stir microwaved food to make sure it is heated evenly throughout.
- Cook stuffing separately from poultry; or wash poultry thoroughly, stuff immediately before cooking, and transfer the stuffing to a clean bowl immediately after cooking. The temperature of cooked stuffing should reach 165°F.
- Cook eggs until they’re firm, and fully cook foods containing eggs.
- To protect against Listeria, reheat ready-to-eat foods like hot dogs and cold cuts until steaming hot.
- Because of possible contamination with E. coli 0157:H7 and Salmonella; avoid raw sprouts.

According to the USDA, “When in doubt, throw it out.” Even if a food looks and smells fine, it may not be safe. If you aren’t sure that a food has been prepared, served, and stored safely, don’t eat it. For more information, visit Foodsafety.gov.
For meat, milk, eggs, and other animal products to be certified organic, animals must be given organic feed and access to the outdoors and may not be given antibiotics or growth hormones. The use of genetic engineering, ionizing radiation, and sewage sludge is prohibited. Products can be labeled “100% organic” if they contain all organic ingredients and “organic” if they contain at least 95% organic ingredients; all such products may carry the USDA organic seal. A product with at least 70% organic ingredients can be labeled “made with organic ingredients” but cannot use the USDA seal.

Organic foods, however, are not necessarily free of chemicals. They may be contaminated with pesticides used on neighboring lands or on foods transported in the same train or truck. However, they tend to have lower levels of pesticide residues than conventionally grown crops. Some experts recommend that consumers who want to buy organic fruits and vegetables spend their money on those that carry lower pesticide residues than their conventional counterparts (the “dirty dozen”): apples, bell peppers, celery, cherries, imported grapes, nectarines, peaches, pears, potatoes, red raspberries, spinach, and strawberries. Experts also recommend buying organic beef, poultry, eggs, dairy products, and baby food. Fruits and vegetables that carry little pesticide residue whether grown conventionally or organically include asparagus, avocados, bananas, broccoli, cauliflower, corn, kiwi, mangoes, onions, papaya, pineapples, and peas. All foods are subject to strict pesticide limits; the debate about the health effects of small amounts of residue is ongoing.

Whether organic foods are better for your health cannot be said for certain, but organic farming is better for the environment. It helps maintain biodiversity of crops and replenish the Earth’s resources. It is less likely to degrade soil, contaminate water, or expose farm workers to toxic chemicals. As multinational food companies get into the organic food business, however, consumers who want to support environmentally friendly farming methods should look for foods that are not only organic but also locally grown.

**Guidelines for Fish Consumption**

A specific area of concern has been possible mercury contamination in fish. Overall, fish and shellfish are healthy sources of protein, omega-3 fats, and other nutrients, and experts continue to encourage consumption of both wild-caught and farmed fish. Prudent choices can minimize the risk of any possible negative health effects. High mercury concentrations are most likely to be found in predator fish—large fish that eat smaller fish. Mercury can cause brain damage to fetuses and young children. According to FDA and Environmental Protection Agency (EPA) guidelines, women who are or who may become pregnant and nursing mothers should follow these guidelines to minimize their exposure to mercury:

- Do not eat shark, swordfish, king mackerel, or tilefish.
- Eat 8–12 ounces a week of a variety of fish and shellfish that are lower in mercury, such as shrimp, canned light tuna, salmon, pollock, and catfish. Limit consumption of albacore tuna to 6 ounces per week.
- Check advisories about the safety of recreationally caught fish from local lakes, rivers, and coastal areas. If no information is available, limit consumption to 6 ounces per week.

The same guidelines apply to children, although they should consume smaller servings.

**A Personal Plan: Applying Nutritional Principles**

Based on your particular nutrition and health status, there probably is an ideal diet for you, but no single type of diet provides optimal health for everyone. Many cultural dietary patterns can meet people’s nutritional requirements (see the box “Ethnic Foods”). Customize your food plan based on your age, gender, weight, activity level, medical risk factors, and personal tastes.

**Assessing and Changing Your Diet**

The first step in planning a healthy diet is to examine what you currently eat. Labs 8.1 and 8.2 help you analyze your current diet and compare it with optimal dietary goals. (This analysis can be completed using a nutritional analysis software program or one of several websites.)

To put your plan into action, use the behavioral self-management techniques and tips described in Chapter 1. If you identify several changes you want to make, focus on one at a time. You might start, for example, by substituting water for sugar-sweetened beverages. When you become used to that, you can try substituting whole-wheat bread for white bread. The information on eating behavior in Lab 8.1 will help you identify and change unhealthy patterns of eating.

**Staying Committed to a Healthy Diet**

Beyond knowledge and information, you also need support in difficult situations. Keeping to your plan is easiest when you choose and prepare your own food at home. Advance planning is the key: mapping out meals and shopping appropriately, cooking in advance when possible, and preparing enough food for leftovers. A tight budget does not necessarily make it difficult to eat healthy meals. It makes good health sense and good budget sense to use only small amounts of meat and to have a few meatless meals each week.

In restaurants, sticking to food plan goals becomes somewhat more difficult. Portion sizes in restaurants tend to be larger than MyPlate serving size equivalents, but by remaining focused on your goals, you can eat only part of your meal and take the rest home for a meal later in the week. Don’t hesitate to ask questions when you’re eating in a restaurant. Most restaurant personnel are glad to explain how menu selections are prepared and to make small adjustments, such as serving salad dressings and sauces on the side so they can be avoided or used sparingly.
**DIVERSITY MATTERS**

**Ethnic Foods**

Every diet has advantages and disadvantages, and within each cuisine, some foods are more healthful choices. As the table below shows, the dietary guidelines described in this chapter can be applied to any ethnic cuisine.

<table>
<thead>
<tr>
<th>Choose More Often</th>
<th>Choose Less Often</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Chinese</strong></td>
<td></td>
</tr>
<tr>
<td>Dishes that are steamed, poached (jum), boiled (chu),</td>
<td>Fried wontons or egg rolls</td>
</tr>
<tr>
<td>roasted (kow), barbecued (shu), or lightly stir-fried</td>
<td>Crab rangoon</td>
</tr>
<tr>
<td>Hoisin sauce, oyster sauce, wine sauce, plum sauce,</td>
<td>Crispy (Peking) duck or chicken</td>
</tr>
<tr>
<td>velvet sauce, or hot mustard</td>
<td>Sweet-and-sour dishes made with breaded and deep-fried</td>
</tr>
<tr>
<td>Fresh fish and seafood, skinless chicken, tofu</td>
<td>meat, poultry, or fish</td>
</tr>
<tr>
<td>Mixed vegetables, Chinese greens</td>
<td>Fried or crispy noodles</td>
</tr>
<tr>
<td>Steamed rice, steamed spring rolls, soft noodles</td>
<td>Fried rice</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>French</strong></td>
<td></td>
</tr>
<tr>
<td>Dishes prepared au vapeur (steamed), en brochette</td>
<td>Dishes prepared à la crème (in cream sauce), au gratin</td>
</tr>
<tr>
<td>(skewered and broiled), or grillé (grilled)</td>
<td>or gratinée (baked with cream and cheese), or en croûte</td>
</tr>
<tr>
<td>Fresh fish, shrimp, scallops, mussels, or skinless</td>
<td>Drawn butter, hollandaise sauce, and remoulade</td>
</tr>
<tr>
<td>chicken, without sauces</td>
<td>(mayonnaise-based sauce)</td>
</tr>
<tr>
<td>Clear soups</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Greek</strong></td>
<td></td>
</tr>
<tr>
<td>Dishes that are stewed, broiled, or grilled, including</td>
<td>Moussaka, saganaki (fried cheese)</td>
</tr>
<tr>
<td>shish kabobs (souvlaki)</td>
<td>Vegetable pies such as spanakopita and tyropita</td>
</tr>
<tr>
<td>Dolmas (grape leaves) stuffed with rice</td>
<td>Baba ghanoush (eggplant and olive oil)</td>
</tr>
<tr>
<td>Tzatziki (yogurt, cucumbers, and garlic)</td>
<td>Deep-fried falafel (chickpea patties)</td>
</tr>
<tr>
<td>Tabouli (bulgur-based salad)</td>
<td>Gyros stuffed with ground meat</td>
</tr>
<tr>
<td>Pita bread, especially whole wheat</td>
<td>Baklava</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Indian</strong></td>
<td></td>
</tr>
<tr>
<td>Dishes prepared masala (curry), tandoori (roasted in a</td>
<td>Ghee (clarified butter)</td>
</tr>
<tr>
<td>clay oven), or tikke (pan roasted), kabobs</td>
<td>Korma (in cream sauce)</td>
</tr>
<tr>
<td>Raita (yogurt and cucumber salad) and other yogurt-based</td>
<td>Samosas, pakoras (fried dishes)</td>
</tr>
<tr>
<td>dishes and sauces</td>
<td>Molee and other coconut milk-based dishes</td>
</tr>
<tr>
<td>Dal (lentils), pullao or pilau (basmati rice)</td>
<td>Poori, bhatura, or paratha (fried breads)</td>
</tr>
<tr>
<td>Chapati (baked bread)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Italian</strong></td>
<td></td>
</tr>
<tr>
<td>Pasta primavera or pasta, polenta, risotto, or gnocchi</td>
<td>Antipasto (cheese, smoked meats)</td>
</tr>
<tr>
<td>with marinara, red or white wine, white or red clam, or</td>
<td>Dishes that are prepared alfredo, frito (fried), crema</td>
</tr>
<tr>
<td>light mushroom sauce</td>
<td>(creamed), alla panna (with cream), or carbonara</td>
</tr>
<tr>
<td>Dishes that are grilled or prepared cacciatorre (tomato-</td>
<td>Veal scaloppini</td>
</tr>
<tr>
<td>based sauce), marsala (broth and wine sauce), or piccata</td>
<td>Chicken, veal, or eggplant parmigiana</td>
</tr>
<tr>
<td>(lemon sauce)</td>
<td>Italian sausage, salami, and prosciutto</td>
</tr>
<tr>
<td>Cioppino (seafood stew)</td>
<td>Buttered garlic bread</td>
</tr>
<tr>
<td>Vegetable soup, minestrone or fagioli (beans)</td>
<td>Cannoli</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Japanese</strong></td>
<td></td>
</tr>
<tr>
<td>Dishes prepared nabemono (boiled), shabu-shabu (in</td>
<td>Tempura (battered and fried)</td>
</tr>
<tr>
<td>boiling broth), mushimono (steamed), nimono (simmered),</td>
<td>Agemono (deep fried)</td>
</tr>
<tr>
<td>yaki (broiled), or yakimono (grilled)</td>
<td>Katsu (fried pork cutlet)</td>
</tr>
<tr>
<td>Sushi or domburi (mixed rice dish)</td>
<td>Sukiyaki</td>
</tr>
<tr>
<td>Steamed rice or soba (buckwheat), udon (wheat), or rice</td>
<td>Fried tofu</td>
</tr>
<tr>
<td>noodles</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Mexican</strong></td>
<td></td>
</tr>
<tr>
<td>Soft corn or wheat tortillas</td>
<td>Crispy, fried tortillas</td>
</tr>
<tr>
<td>Burritos, fajitas, enchiladas, soft tacos, and tamales</td>
<td>Dishes that are fried, such as chile rellenos, chimichangas, flautas, and tostadas</td>
</tr>
<tr>
<td>filled with beans, vegetables, or lean meats</td>
<td>Nachos and cheese, chili con queso, and other dishes made with cheese or cheese sauce</td>
</tr>
<tr>
<td>Refried beans, nonfat or low-fat, rice and beans</td>
<td>Refried beans made with lard</td>
</tr>
<tr>
<td>Ceviche (fish marinated in lime juice)</td>
<td>Fried ice cream</td>
</tr>
<tr>
<td>Gazpacho, menudo, or black bean soup</td>
<td></td>
</tr>
<tr>
<td>Fruit or flan for dessert</td>
<td></td>
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<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Thai</strong></td>
<td></td>
</tr>
<tr>
<td>Dishes that are barbecued, sautéed, broiled, boiled,</td>
<td>Coconut milk soup</td>
</tr>
<tr>
<td>steamed, braised, or marinated</td>
<td>Peanut sauce or dishes topped with nuts</td>
</tr>
<tr>
<td>Sàte (skewered and grilled meats)</td>
<td>Mee-krob (crispy noodles)</td>
</tr>
<tr>
<td>Fish sauce, basil sauce, chili or hot sauces</td>
<td>Red, green, and yellow curries, which typically contain coconut milk</td>
</tr>
<tr>
<td>Bean thread noodles, Thai salad</td>
<td></td>
</tr>
</tbody>
</table>
Strategies like these are helpful, but small changes cannot change a fundamentally high-fat, high-calorie meal into a moderate, healthful one. Often, the best advice is to bypass a large steak with potatoes au gratin for a flavorful but low-fat entree. Many of the selections offered in ethnic restaurants are healthy choices (refer to the “Ethnic Foods” box for suggestions).

### TIPS FOR TODAY AND THE FUTURE

Opportunities to improve your diet present themselves every day, and small changes add up.

**RIGHT NOW YOU CAN**

- Substitute a healthy snack for an unhealthy one.
- Drink a glass of water and put a bottle of water in your backpack for tomorrow.
- Plan to make healthy selections when you eat out, such as steamed vegetables instead of french fries or salmon instead of steak.

**IN THE FUTURE YOU CAN**

- Visit the MyPlate website at http://www.choosemyplate.gov and use the online tools to create a personalized nutrition plan and begin tracking your eating habits.
- Learn to cook healthier meals. There are hundreds of free websites and low-cost cookbooks that provide recipes for healthy dishes.

### SUMMARY

- The six classes of nutrients are proteins, fats, carbohydrates, vitamins, minerals, and water.
- The nutrients essential to humans are released into the body through digestion. Nutrients in foods provide energy, measured in kilocalories (commonly called calories), build and maintain body tissues, and regulate body functions.
- Protein, an important component of body tissue, is composed of amino acids; nine are essential to good health. Foods from animal sources provide complete proteins. Plants provide incomplete proteins.
- Fats, a major source of energy, also insulate the body and cushion the organs. Just 3–4 teaspoons of vegetable oil per day supply the essential fats. Unsaturated fats should be favored over saturated fats. Trans fats should be avoided.
- Carbohydrates provide energy to the brain, nervous system, and blood and to muscles during high-intensity exercise. Naturally occurring simple carbohydrates and unrefined complex carbohydrates should be favored over added sugars and refined carbohydrates.
- Fiber includes plant substances that are impossible for the human body to digest. It helps reduce cholesterol levels and promotes the passage of wastes through the intestines.
- The 13 essential vitamins are organic substances that promote specific chemical and cell processes and act as antioxidants. The 17 known essential minerals are inorganic substances that regulate body functions, aid in growth and tissue maintenance, and help in the release of energy from food. Deficiencies in vitamins and minerals can cause severe symptoms over time, but excess doses are also dangerous.
- Water aids in digestion and food absorption, allows chemical reactions to take place, serves as a lubricant or cushion, and helps regulate body temperature.
- Foods contain other substances, such as phytochemicals, that may not be essential nutrients but may protect against chronic diseases.
- The Dietary Reference Intakes, Dietary Guidelines for Americans, and MyPlate food guidance system provide standards and recommendations for getting all essential nutrients from a varied, balanced diet and for eating in ways that protect against chronic disease.
- The Dietary Guidelines for Americans advise us to reduce consumption of sodium, solid fats, added sugars, and refined grains; increase consumption of fruits, vegetables, and whole grains; and follow a healthy eating pattern.
- Choosing the right amount of foods from each group in MyPlate every day helps ensure the appropriate amounts of calories and necessary nutrients.
- A vegan diet requires special planning but can meet all human nutritional needs.
- Different population groups, such as college students and athletes, face special dietary challenges and should plan their diets to meet their particular needs.
- Consumers can get help applying nutritional principles by reading the standardized labels that appear on all packaged foods and on dietary supplements.
- Although nutritional basics are well established, no single diet provides wellness for everyone. Individuals should focus on their particular needs and adapt general dietary principles to meet them.

### FOR FURTHER EXPLORATION

*Academy of Nutrition and Dietetics.* Provides a wide variety of educational materials on nutrition.  
http://www.eatright.org

*American Heart Association: Delicious Decisions.* Provides basic information about nutrition, tips for shopping and eating out, and heart-healthy recipes.  
http://www.heart.org/HEARTORG/GettingHealthy/NutritionCenter/Recipes/Delicious-Decisions-Cookbooks-and-Recipes-from-American-Heart-Association_UCM_452733_SubHomePage.jsp
**COMMON QUESTIONS ANSWERED**

**Q** MyPlate recommends such large amounts of vegetables and fruit. How can I possibly eat that many servings without gaining weight?

**A** First, consider your typical portion sizes; you may be closer to meeting the recommendations than you think. Many people consume large servings of foods and underestimate the size of their portions. For example, a large banana may contain the equivalent of a cup of fruit. Likewise, a small salad may easily contain one cup of leafy greens and count as one-half cup of vegetables. Use a measuring cup or a food scale for a few days to train your eye to accurately estimate food portion sizes. The [http://www.ChooseMyPlate.gov](http://www.choosemyplate.gov) website includes charts of portion-size equivalents for each food group.

If you need to increase your overall intake of fruits and vegetables, look for healthy substitutions. If you are like most Americans, you are consuming more than the recommended number of calories from added sugars and solid fats; trim some of these calories to make room for additional servings of fruits and vegetables. Your beverage choices may be a good place to start. Do you routinely consume regular sodas, sweetened energy or fruit drinks, or whole milk? One regular 12-ounce soda contains the equivalent of about 150 calories of added sugars; an 8-ounce glass of whole milk provides about 75 calories as discretionary fats. Substituting water or low-fat milk would free up calories for additional servings of fruits and vegetables. A half-cup of carrots, tomatoes, apples, or melon has only about 25 calories; you could consume six cups of these foods for the calories in one can of regular soda. Substituting lower-fat condiments for full-fat butter, mayonnaise, and salad dressing is another good way to trim calories to make room for additional servings of nutrient-rich fruits and vegetables.

Also consider your portion sizes and/or the frequency with which you consume foods high in discretionary calories: You may not need to eliminate a favorite food—instead, just cut back. For example, cut your consumption of fast-food fries from four times a week to once a week, or reduce the size of your ice cream dessert from a cup to one-half cup. Treats should be consumed infrequently and in small amounts.


**Q** What exactly are genetically modified foods? Are they safe? How can I recognize them on the shelf, and how can I know when I’m eating them?

**A** Genetic engineering involves altering the characteristics of a plant, animal, or microorganism by adding, rearranging, or replacing genes in its DNA; the result is a genetically modified (GM) organism. New DNA may come from related species of organisms or from entirely different types of organisms. Many GM crops are already grown in the United States: About 94% of the current U.S. soybean crop and more than 79% of the cotton crop have been genetically modified. Products made with GM organisms include juice, soda, nuts, tuna, frozen pizza, spaghetti sauce, canola oil, chips, salad dressing, and soup.

The potential benefits of GM foods cited by supporters include improved yields overall and in difficult growing conditions, increased disease resistance, improved nutritional content, lower prices, and less use of pesticides. Critics of biotechnology argue that unexpected effects may occur: Gene manipulation could elevate levels of naturally occurring toxins or

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**FDA: Food.** Offers information and interactive tools about topics such as food labeling, food additives, dietary supplements, and foodborne illness.  
[http://www.fda.gov/food/default.htm](http://www.fda.gov/food/default.htm)

**Food Safety Hotlines.** Provide information on the safe purchase, handling, cooking, and storage of food.  
1-888-723-3366

**Forks over Knives.** Shares articles by doctors from Cleveland Clinic and Cornell on plant-based diets; also includes recipe ideas.  
[http://www.forksoverknives.com](http://www.forksoverknives.com)

**Fruits and Veggies—More Matters.** Hosted by the Produce for Better Health Foundation; promotes the consumption of fruits and vegetables every day.  

**Gateways to Government Nutrition Information.** Provides access to government resources relating to food safety, including consumer advice and information on specific pathogens.  

**Harvard School of Public Health: The Nutrition Source.** Provides knowledge and advice for healthy eating, including advice on interpreting news on nutrition; and suggestions for building a healthy diet.  
[http://www.hsph.harvard.edu/nutritionsource](http://www.hsph.harvard.edu/nutritionsource)

**International Food Information Council. Food Insight.** Provides information on food safety and nutrition for consumers, journalists, and educators.  

**MedlinePlus: Nutrition.** Provides links to information from government agencies and major medical associations on a variety of nutrition topics.  

**MyPlate.** Provides personalized dietary plans and interactive food and activity tracking tools.  
[http://www.choosemyplate.gov](http://www.choosemyplate.gov)
allergens, permanently change the gene pool and reduce biodiversity, and produce pesticide-resistant insects through the transfer of genes. In 2000, a form of GM corn approved for use only in animal feed was found to have commingled with other varieties of corn and to have been used in human foods; this mistake sparked fears of allergic reactions and led to recalls. Opposition to GM foods is particularly strong in Europe; in many developing nations that face food shortages, responses to GM crops have tended to be more positive.

In April 2000, the National Academy of Sciences released a report stating that there is no proof that GM food on the market is unsafe but that changes are needed to better coordinate regulation of GM foods and to assess potential problems.

At the time this text was written, the National Academy report was scheduled to be updated in 2016.

Labeling has been another major concern. Surveys indicate that the majority of Americans want to know if their foods contain GM organisms. However, under current rules, the FDA requires special labeling only when a food’s composition is changed significantly or when a known allergen is introduced. For example, soybeans that contain a gene from a peanut allergen is introduced. For example, soybeans that contain a gene from a peanut allergen are now required to state the presence of these eight allergens in plain language in the list of ingredients on food labels.

Many people who believe they have food allergies may actually suffer from a food intolerance, a much more common source of adverse food reactions that typically involves problems with metabolism rather than with the immune system. The body may not be able to adequately digest a food or the body may react to a particular food compound. Food intolerances have been attributed to lactose (milk sugar), gluten (a protein in some grains), tartrazine (yellow food coloring), sulfite (a food additive), MSG, and the sweetener aspartame. Although symptoms of a food intolerance may be similar to those of a food allergy, they are typically more localized and not life-threatening. Many people with food intolerance can safely and comfortably consume small amounts of the food that affects them.

If you suspect you have a food allergy or intolerance, a good first step is to keep a food diary. Note everything you eat or drink, any symptoms you develop, and how long after eating the symptoms appear. Then make an appointment with your physician to go over your diary and determine if any additional tests are needed. People at risk for severe allergic reactions must diligently avoid trigger foods and carry medications to treat anaphylaxis.

**Q** How can I tell if I’m allergic to a food?

**A** A true food allergy is a reaction of the body’s immune system to a food or food ingredient, usually a protein. This immune reaction can occur within minutes of ingesting the food, resulting in symptoms such as hives, diarrhea, difficulty breathing, or swelling of the lips or tongue. The most severe response is a systemic reaction called anaphylaxis, which involves a potentially life-threatening drop in blood pressure.

Food allergies affect only about 2% of the adult population and approximately 5% of infants and young children. People with food allergies, especially children, are more likely to have asthma or other allergic conditions.

Just eight foods account for more than 90% of the food allergies in the United States: cow’s milk, eggs, peanuts, tree nuts (walnuts, cashews, and so on), soy, wheat, fish, and shellfish. Food manufacturers are now required to state the presence of these eight allergens in plain language in the list of ingredients on food labels.

Many people who believe they have food allergies may actually suffer from a food intolerance, a much more common source of adverse food reactions that typically involves problems with metabolism rather than with the immune system. The body may not be able to adequately digest a food or the body may react to a particular food compound. Food intolerances have been attributed to lactose (milk sugar), gluten (a protein in some grains), tartrazine (yellow food coloring), sulfite (a food additive), MSG, and the sweetener aspartame. Although symptoms of a food intolerance may be similar to those of a food allergy, they are typically more localized and not life-threatening. Many people with food intolerance can safely and comfortably consume small amounts of the food that affects them.

If you suspect you have a food allergy or intolerance, a good first step is to keep a food diary. Note everything you eat or drink, any symptoms you develop, and how long after eating the symptoms appear. Then make an appointment with your physician to go over your diary and determine if any additional tests are needed. People at risk for severe allergic reactions must diligently avoid trigger foods and carry medications to treat anaphylaxis.


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**National Academies’ Food and Nutrition Board.** Provides information about the Dietary Reference Intakes and related guidelines.

[http://www.iom.edu/About-IOM/Leadership-Staff/Boards/Food-and-Nutrition-Board.aspx](http://www.iom.edu/About-IOM/Leadership-Staff/Boards/Food-and-Nutrition-Board.aspx)

**National Institutes of Health: Osteoporosis and Related Bone Diseases’ National Resource Center.** Provides information about osteoporosis prevention and treatment; includes a special section on men and osteoporosis.


**National Osteoporosis Foundation.** Provides information on the causes, prevention, detection, and treatment of osteoporosis.

[http://www.nof.org](http://www.nof.org)

**USDA Food and Nutrition Information Center.** Provides a variety of materials relating to the Dietary Guidelines, food labels, MyPlate, and many other topics.


**USDA Hotline.** Use this hotline for questions about meat and poultry.

800-535-4555

**Vegetarian Resource Group.** Provides information and links for vegetarians and people interested in learning more about vegetarian diets.

[http://www.vrg.org](http://www.vrg.org)

**USDA Nutrient Data Laboratory.** Provides nutrient breakdowns of individual food items.


See also the resources listed in Chapters 9, 11, and 12.


### NUTRITION RESOURCES

#### FIGURE 1  Healthy US-Style Food Patterns

<table>
<thead>
<tr>
<th>Calorie level of pattern</th>
<th>1600</th>
<th>1800</th>
<th>2000</th>
<th>2200</th>
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<th>2600</th>
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<td>2 c</td>
<td>2.5 c</td>
<td>2.5 c</td>
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<td>2.5 c</td>
<td>3 c</td>
<td>3 c</td>
<td>3.5 c</td>
<td>3.5 c</td>
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</tr>
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<td>2 c/wk</td>
<td>2 c/wk</td>
<td>2.5 c/wk</td>
<td>2.5 c/wk</td>
<td>2.5 c/wk</td>
<td>4 c/wk</td>
</tr>
<tr>
<td>Red/Orange veg</td>
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<td>5.5 c/wk</td>
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<td>6 c/wk</td>
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<td>1.5 c/wk</td>
<td>2 c/wk</td>
<td>2 c/wk</td>
<td>2.5 c/wk</td>
<td>2.5 c/wk</td>
<td>3 c/wk</td>
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<tr>
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<td>5 c/wk</td>
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<td>6 c/wk</td>
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<td>4 c/wk</td>
<td>5 c/wk</td>
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<td>7 oz eq</td>
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<td>5.5 oz eq</td>
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<td>6.5 oz eq</td>
<td>6.5 oz eq</td>
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<td>7 oz eq</td>
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<td>Meat poultry, eggs</td>
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<td>28 oz eq/wk</td>
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<td>10 oz eq/wk</td>
</tr>
<tr>
<td>Nuts, seeds, soy</td>
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<td>4 oz eq/wk</td>
<td>5 oz eq/wk</td>
<td>5 oz eq/wk</td>
<td>5 oz eq/wk</td>
<td>5 oz eq/wk</td>
<td>6 oz eq/wk</td>
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<td>3 c</td>
<td>3 c</td>
<td>3 c</td>
<td>3 c</td>
<td>3 c</td>
<td>3 c</td>
</tr>
<tr>
<td>Oils</td>
<td>22 g</td>
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<td>27 g</td>
<td>29 g</td>
<td>31 g</td>
<td>34 g</td>
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<td>44 g</td>
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<td>Limits for solid fats</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>and added sugars</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>18 g</td>
<td>18 g</td>
<td>23 g</td>
<td>25 g</td>
<td>26 g</td>
<td>31 g</td>
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<tr>
<td>Added sugars</td>
<td>14 g</td>
<td>19 g</td>
<td>30 g</td>
<td>32 g</td>
<td>39 g</td>
<td>43 g</td>
<td>45 g</td>
<td>53 g</td>
</tr>
</tbody>
</table>

Food group amounts shown in cup (c) or ounce equivalents (oz eq). Oils, solid fats, and added sugars are shown in grams (g). Quantity equivalents for each food group are:

- **Grains,** 1 ounce equivalent is: ½ cup cooked rice, pasta, or cooked cereal; 1 ounce dry pasta or rice; 1 slice bread; 1 cup ready-to-eat cereal flakes.
- **Fruits and vegetables,** 1 cup equivalent is: 1 cup raw or cooked fruit or vegetable, 1 cup fruit or vegetable juice, 2 cups leafy salad greens.
- **Protein Foods,** 1 ounce equivalent is: 1 ounce lean meat, poultry, or seafood; 1 egg; ¼ cup cooked beans or tofu; 1 Tbsp peanut butter; ½ ounce nuts/seeds.
- **Dairy,** 1 cup equivalent is: 1 cup milk or yogurt, ½ ounces natural cheese such as cheddar cheese or 2 ounces of processed cheese.

**FIGURE 1**  Healthy US-Style Food Patterns

### FIGURE 2  Healthy Vegetarian Patterns


#### Table: Healthy Vegetarian Patterns

<table>
<thead>
<tr>
<th>Calorie level of pattern</th>
<th>Food Group</th>
<th>Daily amount(^a) of food from each group (vegetable and protein foods subgroup amounts are per week)</th>
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<tbody>
<tr>
<td></td>
<td>Fruits</td>
<td>1.5 c</td>
</tr>
<tr>
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<td>Vegetables</td>
<td>2 c</td>
</tr>
<tr>
<td></td>
<td>Dark green veg</td>
<td>1.5 c/wk</td>
</tr>
<tr>
<td></td>
<td>Red/Orange veg</td>
<td>4 c/wk</td>
</tr>
<tr>
<td></td>
<td>Beans and peas</td>
<td>1 c/wk</td>
</tr>
<tr>
<td></td>
<td>Starchy veg</td>
<td>4 c/wk</td>
</tr>
<tr>
<td></td>
<td>Other veg</td>
<td>3.5 c/wk</td>
</tr>
<tr>
<td></td>
<td>Grains</td>
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<td></td>
<td>Whole grains</td>
<td>3.5 oz eq</td>
</tr>
<tr>
<td></td>
<td>Other grains</td>
<td>2 oz eq</td>
</tr>
<tr>
<td></td>
<td>Protein foods</td>
<td>2.5 oz eq</td>
</tr>
<tr>
<td></td>
<td>Beans and peas(^b)</td>
<td>4 oz eq/wk</td>
</tr>
<tr>
<td></td>
<td>Eggs</td>
<td>3 oz eq/wk</td>
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<tr>
<td></td>
<td>Nuts and seeds</td>
<td>5 oz eq/wk</td>
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<td></td>
<td>Tofu/processed soy</td>
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<td></td>
<td>Dairy</td>
<td>3 c</td>
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<tr>
<td></td>
<td>Oils</td>
<td>22 g</td>
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</table>

\(^a\)Food group amounts shown in cup (c) or ounce equivalents (oz eq). Oils, solid fats, and added sugars are shown in grams (g).

Quantity equivalents for each food group are:
- Grains, 1 ounce equivalent is: ½ cup cooked rice, pasta, or cooked cereal; 1 ounce dry pasta or rice; 1 slice bread; 1 cup ready-to-eat cereal flakes.
- Fruits and vegetables, 1 cup equivalent is: 1 cup raw or cooked fruit or vegetable, 1 cup fruit or vegetable juice, 2 cups leafy salad greens.
- Protein Foods, 1 ounce equivalent is: 1 ounce lean meat, poultry, or seafood; 1 egg; ½ cup cooked beans or tofu; 1 tbsp peanut butter; ½ ounce nuts/seeds.
- Dairy, 1 cup equivalent is: 1 cup milk or yogurt, 1½ ounces natural cheese (e.g. cheddar cheese) or 2 ounces of processed cheese.

\(^b\)About half of total beans and peas are shown as vegetables, in cup eqs, and half as protein foods, in ounce eqs. Total beans and peas in cup eq is amount in vegetables plus the amount in protein foods/4.

<table>
<thead>
<tr>
<th>Calorie level of pattern</th>
<th>Limits for solid fats and added sugars</th>
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</tr>
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<td>23 g</td>
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<table>
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<td>2800</td>
<td>5 c eq/wk</td>
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<tr>
<td>3000</td>
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### Healthy Mediterranean-Style Patterns

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<th>Calorie level of pattern</th>
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<th>1800</th>
<th>2000</th>
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<td></td>
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<td></td>
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<tr>
<td>Fruits</td>
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<td>2.5 c</td>
<td>2.5 c</td>
<td>2.5 c</td>
<td>3 c</td>
<td>3 c</td>
<td>3 c</td>
</tr>
<tr>
<td>Vegetables</td>
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<td>2.5 c</td>
<td>3 c</td>
<td>3 c</td>
<td>3.5 c</td>
<td>3.5 c</td>
<td>4 c</td>
</tr>
<tr>
<td>Dark green veg</td>
<td>1.5 c/wk</td>
<td>1.5 c/wk</td>
<td>1.5 c/wk</td>
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<td>2 c/wk</td>
<td>2.5 c/wk</td>
<td>2.5 c/wk</td>
<td>2.5 c/wk</td>
</tr>
<tr>
<td>Red/Orange veg</td>
<td>4 c/wk</td>
<td>5.5 c/wk</td>
<td>5.5 c/wk</td>
<td>6 c/wk</td>
<td>6 c/wk</td>
<td>7 c/wk</td>
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<td>7.5 c/wk</td>
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<tr>
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<tr>
<td>Other grains</td>
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<td>3 oz eq</td>
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<td>4 oz eq</td>
<td>4.5 oz eq</td>
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<td>7 oz eq</td>
<td>7.5 oz eq</td>
<td>7.5 oz eq</td>
<td>8 oz eq</td>
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<td>5 oz eq/wk</td>
<td>6 oz eq/wk</td>
<td>6 oz eq/wk</td>
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</tr>
<tr>
<td>Dairy</td>
<td>2 c</td>
<td>2 c</td>
<td>2 c</td>
<td>2 c</td>
<td>2 c</td>
<td>2.5 c</td>
<td>2.5 c</td>
<td>2.5 c</td>
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<td>22 g</td>
<td>24 g</td>
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<td>29 g</td>
<td>31 g</td>
<td>34 g</td>
<td>36 g</td>
<td>44 g</td>
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</tbody>
</table>

**Limits for solid fats and added sugars**

| Solid fats               | 12 g | 11 g | 17 g | 18 g | 20 g | 22 g | 23 g | 28 g |
| Added sugars             | 21 g | 18 g | 29 g | 31 g | 34 g | 37 g | 40 g | 48 g |

Food group amounts shown in cup (c) or ounce equivalents (oz eq). Oils, solid fats, and added sugars are shown in grams (g).

Quantity equivalents for each food group are:

- **Grains**: 1 ounce equivalent is: ½ cup cooked rice, pasta, or cooked cereal; 1 ounce dry pasta or rice; 1 slice bread; 1 cup ready-to-eat cereal flakes.
- **Fruits and vegetables**: 1 cup equivalent is: 1 cup raw or cooked fruit or vegetable, 1 cup fruit or vegetable juice, 2 cups leafy salad greens.
- **Protein foods**: 1 ounce equivalent is: 1 ounce lean meat, poultry, or seafood; 1 egg; ½ cup cooked beans or tofu; 1 Tbsp peanut butter; ½ ounce nuts/seeds.
- **Dairy**: 1 cup equivalent is: 1 cup milk or yogurt, ½ ounces natural cheese such as cheddar cheese or 2 ounces of processed cheese.

**FIGURE 3 Healthy Mediterranean-Style Patterns**

### FIGURE 4  The DASH Eating Plan.


<table>
<thead>
<tr>
<th>Food groups</th>
<th>1600 calories</th>
<th>2000 calories</th>
<th>2600 calories</th>
<th>3100 calories</th>
<th>Serving sizes and notes</th>
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</thead>
<tbody>
<tr>
<td>Grains</td>
<td>6</td>
<td>6–8</td>
<td>10–11</td>
<td>12–13</td>
<td>1 slice bread, 1 oz dry cereal, 1/2 cup cooked rice, pasta, or cereal; choose whole grains</td>
</tr>
<tr>
<td>Vegetables</td>
<td>3–4</td>
<td>4–5</td>
<td>5–6</td>
<td>6</td>
<td>1 cup raw leafy vegetables, 1/2 cup cooked vegetables, 1/2 cup vegetable juice</td>
</tr>
<tr>
<td>Fruits</td>
<td>4</td>
<td>4–5</td>
<td>5–6</td>
<td>6</td>
<td>1/2 cup fruit juice, 1 medium fruit, 1/4 cup dried fruit, 1/2 cup fresh, frozen, or canned fruit</td>
</tr>
<tr>
<td>Low-fat or fat-free dairy foods</td>
<td>2–3</td>
<td>2–3</td>
<td>3</td>
<td>3–4</td>
<td>1 cup milk; 1 cup yogurt, 1/2 oz cheese; choose fat-free or low-fat types</td>
</tr>
<tr>
<td>Meat, poultry, fish</td>
<td>3–6</td>
<td>6 or less</td>
<td>6</td>
<td>6–9</td>
<td>1 oz cooked meats, poultry, or fish: select only lean; trim away visible fats; broil, roast, or boil instead of frying; remove skin from poultry</td>
</tr>
<tr>
<td>Nuts, seeds, legumes</td>
<td>3 servings per week</td>
<td>4–5 servings per week</td>
<td>1</td>
<td>1</td>
<td>1/3 cup or 1/2 oz nuts, 2 Tbsp or 1/2 oz seeds, 1/2 cup cooked dry beans/peas, 2 Tbsp peanut butter</td>
</tr>
<tr>
<td>Fats and oils</td>
<td>2</td>
<td>2–3</td>
<td>3</td>
<td>4</td>
<td>1 tsp soft margarine, 1 Tbsp low-fat mayonnaise, 2 Tbsp light salad dressing, 1 tsp vegetable oil; DASH has 27% of calories as fat (low in saturated fat)</td>
</tr>
<tr>
<td>Sweets</td>
<td>0</td>
<td>5 servings/week or less</td>
<td>2</td>
<td>2</td>
<td>1 Tbsp sugar, 1 Tbsp jelly or jam, 1/2 cup sorbet, 1 cup lemonade; sweets should be low in fat</td>
</tr>
</tbody>
</table>
LAB 8.1  Your Daily Diet versus MyPlate

Make three photocopies of the worksheet in this lab and use them to keep track of everything you eat for three consecutive days. Break down each food item into its component parts, and list them separately in the column labeled “Food.” Then enter the portion size you consumed in the correct food-group column. For example, a turkey sandwich might be listed as follows: whole-wheat bread, 2 oz-eq of whole grains; turkey, 2 oz-eq of meat/beans; tomato, ¼ cup other vegetables; romaine lettuce, ½ cup dark green vegetables; 1 tablespoon mayonnaise dressing, 1 teaspoon (4.5 g) oils. It can be challenging to track values for added sugars and oils and fats, but use food labels to be as accurate as you can. Additional guidelines for counting discretionary calories can be found at http://www.ChooseMyPlate.gov.

For vegetables, enter your portion sizes in both the “Total” column and the column corresponding to the correct subgroup; for example, the spinach in a spinach salad would be entered under “Dark Green” and carrots would be entered under “Orange.” For the purpose of this three-day activity, you will compare only your total vegetable consumption against MyPlate guidelines; as described in the chapter, vegetable subgroup recommendations are based on weekly consumption. However, it is important to note which vegetable subgroups are represented in your diet; over a three-day period, you should consume several servings from each of the subgroups.

Date: ______________________

<table>
<thead>
<tr>
<th>Date:</th>
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<tr>
<td>Date:</td>
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</tr>
</tbody>
</table>
**LABORATORY ACTIVITIES**

Next, average your daily intake totals for the three days and enter them in the chart below. For example, if your three daily totals for the fruit group were 1 cup, 1 ½ cups, and 2 cups, your average daily intake would be 1 ½ cups. Fill in the recommended intake totals that apply to you from ChooseMyPlate.gov or your chosen dietary pattern from the Nutrition Resources section.

<table>
<thead>
<tr>
<th>MyPlate Food Group</th>
<th>Recommended Daily Amounts or Limits</th>
<th>Your Actual Average Daily Intake</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grains (total)</td>
<td>oz-eq</td>
<td>oz-eq</td>
</tr>
<tr>
<td>Whole grains</td>
<td>oz-eq</td>
<td>oz-eq</td>
</tr>
<tr>
<td>Other grains</td>
<td>oz-eq</td>
<td>oz-eq</td>
</tr>
<tr>
<td>Vegetables (total)</td>
<td>cups</td>
<td>cups</td>
</tr>
<tr>
<td>Fruits</td>
<td>cups</td>
<td>cups</td>
</tr>
<tr>
<td>Milk</td>
<td>cups</td>
<td>cups</td>
</tr>
<tr>
<td>Meat and beans</td>
<td>oz-eq</td>
<td>oz-eq</td>
</tr>
<tr>
<td>Oils</td>
<td>g</td>
<td>g</td>
</tr>
<tr>
<td>Solid fats</td>
<td>g</td>
<td>g</td>
</tr>
<tr>
<td>Added sugars</td>
<td>g</td>
<td>g</td>
</tr>
</tbody>
</table>

**Using Your Results**

*How did you score?* How close is your diet to that recommended by MyPlate? Are you surprised by the amount of food you are consuming from each food group or from added sugars and solid fats?

*What should you do next?* If the results of the assessment indicate that you could boost your level of wellness by improving your diet, set realistic goals for change. Do you need to increase or decrease your consumption of any food groups? List any areas of concern below, along with a goal for change and strategies for achieving the goal you've set. If you see that you are falling short in one food group, such as fruits or vegetables but have many foods that are rich in discretionary calories from solid fats and added sugars, try decreasing those items in favor of an apple, a bunch of grapes, or some baby carrots. Think carefully about the reasons behind your food choices. For example, if you eat doughnuts for breakfast every morning because you feel rushed, make a list of ways to save time to allow for a healthier breakfast.

<table>
<thead>
<tr>
<th>Problem:</th>
<th>Goal:</th>
</tr>
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<tbody>
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</table>

Strategies for change:

<table>
<thead>
<tr>
<th>Problem:</th>
<th>Goal:</th>
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Strategies for change:

<table>
<thead>
<tr>
<th>Problem:</th>
<th>Goal:</th>
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</table>

Strategies for change:

Enter the results of this lab in the Preprogram Assessment column in Appendix C. If you’ve set goals and identified strategies for change, begin putting your plan into action. After several weeks of your program, complete this lab again and enter the results in the Postprogram Assessment column of Appendix C. How do the results compare?
LAB 8.2 Dietary Analysis

You can complete this activity using either a nutrition analysis software program or information about the nutrient content of foods available online; see the For Further Exploration section and page A–1 for recommended websites. (This lab asks you to analyze one day’s diet. For a more complete and accurate assessment of your diet, analyze the results from several different days, including a weekday and a weekend day.)

<table>
<thead>
<tr>
<th>FOOD</th>
<th>AMOUNT</th>
<th>CALORIES</th>
<th>PROTEIN (g)</th>
<th>CARBOHYDRATE (g)</th>
<th>DIETARY FIBER (g)</th>
<th>FAT TOTAL (g)</th>
<th>SATURATED FAT (g)</th>
<th>SODIUM (mg)</th>
<th>VITAMIN A (RE)</th>
<th>VITAMIN C (mg)</th>
<th>CALCIUM (mg)</th>
<th>IRON (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tr>
</tbody>
</table>

Recommended totals*

- 10–35% 10–35% 45–65% 25–38 g 20–35% <10% ≤2300 mg RE mg mg mg

Actual totals**

- cal g g % g g % g % mg RE mg mg mg

*Fill in the appropriate DRI values for vitamin A, vitamin C, calcium, and iron from Tables 8.6 and 8.7 or by visiting the Interactive DRI website: http://fnic.nal.usda.gov/fnic/InteractiveDRI

**Total the values in each column. Protein and carbohydrate provide 4 calories per gram; fat provides 9 calories per gram. For example, if your day’s total energy intake was 2,000 calories, including 270 grams of carbohydrate, you would calculate your percentage of total calories from carbohydrate as follows: (270 g X 4 cal/g) ÷ 2,000 = 54%. Percentages may not total 100% due to rounding.
**Using Your Results**

*How did you score?* How close is your diet to that recommended in this chapter? Are you surprised by any of the results of this assessment?

*What should you do next?* Enter the results of this lab in the Preprogram Assessment column in Appendix C. If your daily diet meets all the recommended intakes, congratulations—and keep up the good work. If the results of the assessment pinpoint areas of concern, then work with your food record on the previous page to determine what changes you could make to meet all the guidelines. Make changes, additions, and deletions until it conforms to all or most of the guidelines. Or, if you prefer, start from scratch to create a day’s diet that meets the guidelines. Use the chart below to experiment and record your final, healthy sample diet for one day. Then put what you learned from this exercise into practice in your daily life. After several weeks of your program, complete this lab again and enter the results in the Postprogram Assessment column of Appendix C. How do the results compare?

<table>
<thead>
<tr>
<th>DATE</th>
<th>M</th>
<th>Tu</th>
<th>W</th>
<th>Th</th>
<th>F</th>
<th>Sa</th>
<th>Su</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food</td>
<td>Amount</td>
<td>Calories</td>
<td>Protein (g)</td>
<td>Carbohydrate (g)</td>
<td>Dietary fiber (g)</td>
<td>Fat, total (g)</td>
<td>Saturated fat (g)</td>
</tr>
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<td></td>
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</tr>
</tbody>
</table>

**Recommended totals***
- 10–35%
- 45–65%
- 25–38 g
- 20–35%
- <10%
- ≤2300 mg
- RE
- mg
- mg

**Actual totals***
- cal
- %
- g
- %
- g
- %
- %
- mg
- RE
- mg
- mg
- mg
LAB 8.3  Informed Food Choices

Part I  Using Food Labels

Choose three food items to evaluate. You might want to select three similar items, such as regular, low-fat, and nonfat salad dressing, or three very different items. Record the information from their food labels in the table below.

<table>
<thead>
<tr>
<th>Food Items</th>
<th>Serving size</th>
<th>cal</th>
<th>cal</th>
<th>cal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total calories</td>
<td>g</td>
<td>%</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>Total fat—grams</td>
<td>g</td>
<td>%</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>Saturated fat—grams</td>
<td>g</td>
<td>%</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>Trans fat—grams</td>
<td>g</td>
<td>%</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>Sodium—milligrams</td>
<td>mg</td>
<td>%</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>Carbohydrates (total)—grams</td>
<td>g</td>
<td>%</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>Dietary fiber—grams</td>
<td>g</td>
<td>%</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>Sugars—grams</td>
<td>g</td>
<td>%</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>Protein—grams</td>
<td>g</td>
<td>%</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>Vitamin A—% Daily Value</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>Vitamin C—% Daily Value</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>Calcium—% Daily Value</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>Iron—% Daily Value</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td></td>
</tr>
</tbody>
</table>

How do the items you chose compare? You can do a quick nutrient check by totaling the Daily Value percentages for nutrients you should limit (saturated fat, sodium) and the nutrients you should favor (dietary fiber, vitamin A, vitamin C, calcium, iron) for each food. Which food has the largest percent Daily Value sum for nutrients to limit? For nutrients to favor?

<table>
<thead>
<tr>
<th>Food Items</th>
<th>Calories</th>
<th>cal</th>
<th>cal</th>
<th>cal</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Daily Value total for nutrients to limit (saturated fat, sodium)</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>% Daily Value total for nutrients to favor (fiber, vitamin A, vitamin C, calcium, iron)</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td></td>
</tr>
</tbody>
</table>
**Part II Evaluating Fast Food**

Use the nutritional information available from fast-food restaurants to complete the chart on this page for the last fast-food meal you ate. Add up your totals for the meal. Compare the values for fat, protein, carbohydrate, and sodium content for each food item and for the meal as a whole with the levels suggested by the Dietary Guidelines for Americans. Calculate the percent of total calories derived from fat, saturated fat, protein, and carbohydrate using the formulas given.


If you haven’t recently been to a fast-food restaurant, fill in the chart for any sample meal you might eat.

**FOOD ITEMS**

<table>
<thead>
<tr>
<th>Dietary Guidelines</th>
<th>Total**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serving size (g)</td>
<td></td>
</tr>
<tr>
<td>Calories</td>
<td>g</td>
</tr>
<tr>
<td>Total fat—grams</td>
<td>g</td>
</tr>
<tr>
<td>—% calories*</td>
<td>20–35%</td>
</tr>
<tr>
<td>Saturated fat—grams</td>
<td>g</td>
</tr>
<tr>
<td>—% calories*</td>
<td>&lt;10%</td>
</tr>
<tr>
<td>Protein—grams</td>
<td>g</td>
</tr>
<tr>
<td>—% calories*</td>
<td>10–35%</td>
</tr>
<tr>
<td>Carbohydrate—grams</td>
<td>g</td>
</tr>
<tr>
<td>—% calories*</td>
<td>45–65%</td>
</tr>
<tr>
<td>Sodium†</td>
<td>800 mg</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*To calculate the percent of total calories from each food energy source (fat, carbohydrate, protein), use the following formula:

\[
\text{Percent of total calories} = \left( \frac{\text{number of grams of energy source} \times \text{number of calories per gram of energy source}}{\text{total calories in serving of food item}} \right) \times 100\%
\]

(Note: Fat and saturated fat provide 9 calories per gram; protein and carbohydrate provide 4 calories per gram.) For example, the percent of total calories from protein in a 150-calorie dish containing 10 grams of protein is

\[
\frac{10 \text{ grams of protein} \times 4 \text{ calories per gram}}{150 \text{ calories}} = \frac{40}{150} = 0.27, \text{ or } 27\% \text{ of total calories from protein}
\]

**For the Total column, add up the total grams of fat, carbohydrate, and protein contained in your sample meal and calculate the percentages based on the total calories in the meal. (Percentages may not total 100% due to rounding.) For cholesterol and sodium values, add up the total number of milligrams.

†Recommended daily limit of sodium is divided by 3 here to give an approximate recommended limit for a single meal.

LOOKING AHEAD...

After reading this chapter, you should be able to

■ Explain the health risks associated with overweight and obesity.
■ Explain the factors that may contribute to a weight problem, including genetic, physiological, lifestyle, and psychosocial factors.
■ Describe lifestyle factors that contribute to weight gain and loss, including the role of diet, exercise, and emotions.
■ Identify and describe the symptoms of eating disorders and the health risks associated with them.
■ Design a personal plan for successfully managing body weight.

TEST YOUR KNOWLEDGE

1. About what percentage of American adults are overweight?
   a. 20%
   b. 40%
   c. 70%

2. The consumption of low-calorie sweeteners has helped Americans control their weight. True or false?

3. Approximately what percentage of female high school and college students have either anorexia or bulimia?
   a. <1%
   b. 2–4%
   c. 7–10%

See answers on the next page.
Achieving and maintaining a healthy body weight is a serious public health challenge and a source of distress for many people. According to current national data, about 69% of American adults are overweight (2 of every 3 adults), and about half of these overweight adults are obese (Table 9.1 and Figure 9.1); nearly one-third of children and adolescents are also overweight or obese. And while millions struggle to lose weight, some fall into dangerous eating patterns such as binge eating or self-starvation. Being overweight or obese is linked to serious health problems, such as heart disease and type 2 diabetes, and it is linked to rising health-care costs. It is not total weight but body composition—the proportion of fat to fat-free mass—that is critical for health (see Chapter 6). Most people who are “overweight” are also “overfat,” and the health risks they face are due to being overfat.

Although this chapter uses the common terms weight management and weight loss, the goal for wellness is to adopt healthful behaviors that achieve an appropriate body composition, not to conform to rigid standards of total body weight. A reasonable goal for body composition—body weight in relation to body shape—must take into account heredity, sex, weight history, social circumstances, metabolic rate, and psychological well-being. Adopting a wellness lifestyle that includes regular exercise and a healthy dietary pattern can help you achieve and maintain a healthy body weight and shape.

Managing body weight is not a mysterious process. The “secret” is balancing calories consumed with calories expended in daily activities—in other words, eating a moderate diet and using up that energy in regular physical activity and body processes. Although individuals can and do take many actions to manage weight, larger social and environmental contexts influence individual efforts. Public policy, community design, transportation networks, and the economics of the food supply at all levels are among the many factors that can impact lifestyle choices for weight management.

This chapter explores the factors that contribute to the development of overweight and obesity as well as to eating disorders. It also takes a closer look at weight management through lifestyle and suggests specific strategies for reaching and maintaining a healthy weight.

### Health Implications of Overweight and Obesity

As rates of overweight and obesity have risen in the United States, so has the prevalence of associated health conditions. Obesity doubles mortality rates and can reduce life expectancy by 10–20 years. In fact, if current trends in overweight and obesity (and their related health problems) continue, some experts predict that the American life expectancy may soon decline by 5 years.

### Defining Overweight and Obesity

As described in Chapter 6, overweight is usually defined as total body weight above the recommended range for good health. The Healthy People 2020 initiative sets a target obesity prevalence of not greater than 15% of all adults.
health, as determined by large-scale population surveys. **Obesity** is defined as a more serious degree of overweight that carries multiple health risks. Both terms are used to identify weight ranges that are associated with increased risk of certain diseases and health problems. When looking at body composition, the most important consideration is the proportion of the body’s total weight that is fat—the percent body fat. For example, two men may both be 5 feet, 8 inches tall and weigh 170 pounds. But the two men may differ in percent body fat—one might have 12% body fat, and the other 22% body fat; only the second man would be considered overfat. Assessment methods based on body weight are less accurate than those based on body fat, but they are commonly used because body weight is easier to measure than body fat.

Body mass index (BMI) is a measure of body weight that is useful for estimating a person’s weight status and for classifying the health risks of body weight if more sophisticated methods aren’t available. BMI is often used in surveys and studies, and it is the basis for the population statistics presented in this chapter. BMI is a fairly accurate measure of the health risks of body weight for most average people; it is less accurate for muscular athletes, people under 5 feet tall, older adults with little muscle mass, and certain other groups. BMI is calculated by dividing your body weight (in kilograms) by the square of your height (in meters); an alternative equation based on pounds and inches is the following:

\[
\text{BMI} = \left(\frac{\text{weight}}{\text{height} \times \text{height}}\right) \times 703
\]

(Space for calculations and a complete BMI chart appear in Labs 6.1 and 6.2.)

BMI is combined with waist measurement to more accurately assess health risks. Waist measurement helps provide an assessment of body fat distribution; **visceral fat**, fat stored around the internal organs, is more harmful to health than **subcutaneous fat**, fat stored under the skin. For classifying your health risks, use the combination of BMI and waist measurement in Table 9.2, or complete one of the more sophisticated body composition assessment methods presented in Chapter 6.

### Table 9.2  Body Mass Index, Waist Circumference, and Disease Risk

<table>
<thead>
<tr>
<th>DISEASE RISK* RELATIVE TO NORMAL WEIGHT AND WAIST CIRCUMFERENCE</th>
<th>MEN: WAIST 40 IN (102 CM) OR LESS WOMEN: WAIST 35 IN (88 CM) OR LESS</th>
<th>MEN: WAIST &gt;40 IN (102 CM) WOMEN: WAIST &gt;35 IN (88 CM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMI (KG/M²)</td>
<td>OBESITY CLASS</td>
<td></td>
</tr>
<tr>
<td>Underweight</td>
<td>&lt;18.5</td>
<td>–</td>
</tr>
<tr>
<td>Normal</td>
<td>18.5–24.9</td>
<td>–</td>
</tr>
<tr>
<td>Overweight</td>
<td>25.0–29.9</td>
<td>Increased</td>
</tr>
<tr>
<td>Obesity</td>
<td>30.0–34.9</td>
<td>I</td>
</tr>
<tr>
<td></td>
<td>35.0–39.9</td>
<td>II</td>
</tr>
<tr>
<td>Extreme Obesity</td>
<td>40.0+</td>
<td>III</td>
</tr>
</tbody>
</table>

*Disease risk for type 2 diabetes, hypertension, and CVD.

**NOTE:** Increased waist circumference also can be a marker for increased risk, even in persons of normal weight.


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**Overweight, Obesity, and Specific Health Risks**

Many studies have confirmed that obesity and—to a lesser extent—overweight shorten lives. Obesity is one of six major controllable risk factors for heart disease, and it also increases the risk for other forms of cardiovascular disease (CVD), hypertension, certain forms of cancer, gallbladder disease, respiratory problems, joint diseases, skin problems, impaired immune function, and sleep disorders. Obesity is strongly linked to the development of insulin resistance and type 2 diabetes; nearly 90% of people with type 2 diabetes are overweight when diagnosed.

Gaining weight over the years has also been found to be dangerous. A recent study showed that women who gained more than 22 pounds since they were 18 years old had a sevenfold increase in the risk of heart disease. Gaining weight, especially as a young adult, is also strongly linked to risk for type 2 diabetes.

Is obesity itself a disease? The 2013 decision by the American Medical Association to declare obesity a disease has benefits as well as disadvantages. Medical care providers must now exert greater focus on the problem and may help more people lose more weight. However, although obese people may get better care, they will also have to pay for it. As the disease label stirs up controversy, attention paid to the health risks of obesity will continue to increase.

**Terms**

- **visceral fat**  Fat located around the major organs, also called *intra-abdominal fat*.
- **subcutaneous fat**  Fat located under the skin.
- **overweight**  Body weight above the recommended range for good health.
- **obesity**  Severely overweight, characterized by an excessive accumulation of body fat; may also be defined in terms of some measure of total body weight.
Benefits of Weight Loss

Even modest weight loss can have a significant positive impact on health. Modest weight loss improves blood levels of good cholesterol (HDL), triglycerides, and glucose, as well as blood pressure. A weight loss of just 5–10% in obese individuals can reduce the risk of weight-related health conditions and increase life expectancy.

FACTORs CONTRIBUTING TO EXCESS BODY FAT

Several factors determine body weight and composition. These factors can be grouped into genetic, physiological, lifestyle, psychosocial, and environmental factors.

Genetic Factors

Estimates of the genetic contribution to obesity vary widely, about 25–40% of an individual’s body fat. More than 600 genes have been linked to obesity, but their actions are still under study. Genes influence body size and shape, body fat distribution, and metabolic rate. Genetic factors also affect the ease with which weight is gained as a result of overeating and where on the body extra weight is added.

If both parents are obese, their children have an 80% risk of being obese; children with one obese parent face a 50% risk of becoming obese. In studies that compared adoptees and their biological parents, the weights of the adoptees were found to be more like those of the biological parents than the adoptive parents, indicating a strong genetic link.

Hereditary influences, however, must be balanced against the contribution of environmental factors. Not all children of obese parents become obese, and normal-weight parents can have overweight children. Environmental factors like diet and exercise are probably responsible for such differences. Thus, the tendency to develop obesity may be inherited, but the expression of this tendency is affected by environmental influences.

Physiological Factors

Metabolism is a key physiological factor in the regulation of body fat and body weight. Hormones also play a role. A few other physiological factors have been proposed as causes for weight gain, such as carbohydrate craving due to low levels of the neurotransmitter serotonin, but research on this and other theories has so far been inconclusive.

Metabolism and Energy Balance

Metabolism is the sum of all the vital processes by which food energy and nutrients are made available to and used by the body. The largest component of metabolism, resting metabolic rate (RMR), is the energy required to maintain vital body functions while the body is at rest, including respiration, heart rate, body temperature, and blood pressure. As shown in Figure 9.2, RMR accounts for about 65–70% of daily energy expenditure. The energy required to digest food accounts for up to an additional 10% of daily energy expenditure. The remaining 20–30% is expended during physical activity.

Both heredity and behavior affect metabolic rate. Men, who have a higher proportion of muscle mass than women, have a higher RMR (muscle tissue is more metabolically active than fat). Also, some individuals inherit a higher or lower RMR than others. A higher RMR means that a person burns more calories while at rest and can therefore take in more calories without gaining weight.

Weight loss or gain also affects metabolic rate. When a person loses weight, both RMR and the energy required to perform physical tasks decrease. The reverse occurs when weight is gained. One reason exercise is so important during a weight-loss program is that exercise, especially resistance training, helps maintain muscle mass and metabolic rate.

Exercise has a positive effect on metabolism. When people exercise, they slightly increase their RMR—the number of calories their bodies burn at rest. In fact, a 2011 study of college-age men showed that following 45 minutes of vigorous exercise, the participants’ resting metabolic rate remained elevated for 14 hours—during which the men burned an additional 200 calories while at rest or performing normal, everyday activities. People who regularly exercise also increase their muscle mass, which is associated with a higher metabolic rate. The exercise itself also burns calories, raising total energy expenditure. The higher the energy expenditure, the more the person can eat without gaining weight.
The energy-balance equation is the key to weight management. If you burn the same amount of energy as you take in (a neutral energy balance), your weight remains constant. If you consume more calories than you expend (a positive energy balance), your weight increases. If you burn more calories than you consume (a negative energy balance), your weight decreases.

To create a negative energy balance and lose weight and body fat, you can increase the amount of energy you burn by increasing your level of physical activity and/or decrease the amount of energy you take in by consuming fewer calories.

**Hormones** Hormones clearly play a role in the accumulation of body fat, especially for women. Hormonal changes at puberty, during pregnancy, and at menopause contribute to the amount and location of fat accumulation. For example, during puberty, hormones cause the development of secondary sex characteristics, including larger breasts, wider hips, and a fat layer under the skin. This addition of body fat at puberty is normal and healthy.

One hormone thought to be linked to obesity is leptin. Secreted by the body’s fat cells, leptin is carried to the brain, where it appears to let the brain know how big or small the body’s fat stores are. With this information, the brain can regulate appetite and metabolic rate. Researchers hope to use leptin and other hormones to develop treatments for obesity based on appetite control. As most of us will admit, however, hunger is often not the primary reason we overeat. Cases of obesity based solely or primarily on hormone abnormalities do exist, but they are rare.

**Lifestyle Factors**

Genetic and physiological factors may increase the risk for excess body fat, but they are not sufficient to explain the increasingly high rate of obesity in the United States. The gene pool has not changed dramatically in the past 60 years, but the rate of obesity among Americans has more than doubled. Clearly, other factors are at work—particularly lifestyle factors such as increased energy intake and decreased physical activity.

**Eating** Americans have access to plenty of calorie-dense foods, and many people have eating habits that contribute to weight gain. Most overweight adults will admit to eating more than they should of high-fat, high-sugar, high-calorie foods. Americans eat out more frequently now than in the past, and we rely more heavily on fast food and packaged convenience foods. Restaurant and convenience food portion sizes tend to be large, and the foods themselves are likely to be high in fat, sugar, and calories and low in nutrients.

Studies have consistently found that people underestimate portion sizes by as much as 25%. When participants in one study were asked to report their food intake over the previous 24 hours, the majority underestimated their intake by about 600 calories. A recent study showed that when people ordered from a restaurant menu that included calorie labels, they ate less.

Americans’ average calorie intake has increased by 18% since 1983. Many of those extra calories come from carbohydrates, such as refined sugars, including soft drinks. As the food industry has pushed ultra-processed foods high in sugar, salt, fat, and additives, children are especially vulnerable to such marketing. Because children have a stronger preference for sweets than adults do, children have been targeted from a young age and are encouraged to make unhealthy choices.

**Physical Activity** Activity levels among Americans are declining, beginning in childhood and continuing throughout life. Many schools have cut back on physical education classes and even recess. Most adults drive to work, sit all day, and then relax in front of the TV (or continue working) at night. Incidence of overweight is consistently linked to excessive
Many people have learned to use food as a means of coping with stress and negative emotions. Eating can provide a powerful distraction from difficult feelings—loneliness, anger, boredom, anxiety, shame, sadness, inadequacy. It can be used to combat low moods, low energy levels, and low self-esteem. When eating becomes the primary means of regulating emotions, binge eating or other unhealthy eating patterns can develop.

Obesity is strongly associated with socioeconomic status. The prevalence of obesity goes down as income level goes up, especially among women and children. These differences may reflect the greater sensitivity and concern for a slim physical appearance among upper-income women, as well as greater access to information about nutrition and to low-fat and low-calorie foods. It may also reflect the greater acceptance of larger body types among certain ethnic groups, as well as different cultural values related to food choices.

In some families and cultures, food is used as a symbol of love and caring. It is an integral part of social gatherings and celebrations. In such cases, it may be difficult to change established eating patterns because they are linked to cultural and family values.

**Cultural Factors**

Our culture of obesity is just that—a culture, a set of practices and structures larger than any one person. Individual actions are critical for maintaining healthy dietary patterns and levels of activity, but we all act within a broad social context.

Food marketing and pricing, food production and distribution systems, and national agricultural policies all impact individual food choices. The food industry promotes the sale of high-calorie processed foods at every turn (for example, vending machines that offer mainly chocolate bars and unhealthy snacks, airlines that offer complimentary soft drinks, and restaurants that provide all-you-can-eat fried food buffets). Many experts observe that U.S. agricultural policy encourages farmers to produce corn and its byproduct, high fructose corn syrup, at the expense of fruits and vegetables. As a result, over the past 30 years, the price of fruits and vegetables rose much faster than the prices of other consumer goods, while the price of sugar, sweets, and carbonated drinks declined. Issues of price and availability of healthy food can have a profound impact on food choices. It is estimated that more than 2 million U.S. households have no access to a supermarket. Low-income neighborhoods often have only fast-food venues offering high-calorie, highly processed foods.

Public policies can also have a positive influence. For example, the new regulations requiring chain restaurants and vending machine operators to post calorie information should help consumers make more informed choices. Food labels, school lunch requirements, limits on advertising during children’s programming, food assistance programs, and taxing policies are all areas in which public policy can encourage positive lifestyle choices for weight management.

Look around your community, school, and workplace: What aspects of the environment make it easier or more difficult to make healthy choices? What foods are available for purchase—and where and at what cost? Does the community environment and transportation system support walking or cycling, or is driving the only practical way to get around? Public health studies encourage people to mobilize grassroots campaigns against the way food is currently distributed and marketed and not leave all discussion to policy makers and public health professionals.

### Adopting a Healthy Lifestyle for Successful Weight Management

When all the research is assessed, it becomes clear that most weight problems are lifestyle problems. Even though more and more young people are developing weight problems, most arrive at early adulthood with the advantage of having a normal body weight—neither too fat nor too thin. In fact, many young adults get away with very poor eating and exercise habits and don’t develop a weight problem. But as the rapid growth of

### Terms

- **binge eating**: A pattern of eating in which normal food consumption is interrupted by episodes of high consumption.
- **energy density**: Number of calories per ounce or gram of food; foods with low energy density have high volume or bulk with few calories, whereas those with high energy density provide many calories in a very small portion.
adolescence slows and family and career obligations increase, maintaining a healthy weight becomes a greater challenge. Slow weight gain is a major cause of overweight and obesity, so weight management is important for everyone, not just for people who are currently overweight. A good time to develop a lifestyle for successful weight management is during early adulthood, when healthy behavior patterns have a better chance of taking hold.

Permanent weight loss is not something you start and stop. You need to adopt healthy behaviors that you can maintain throughout your life, including eating habits, physical activity and exercise, an ability to think positively and manage your emotions effectively, and the coping strategies you use to deal with the stresses and challenges in your life.

Diet and Eating Habits

In contrast to dieting, which involves some form of food restriction, the term diet refers to your daily food choices. Everyone has a diet, but not everyone is dieting. It’s important to develop a diet that you enjoy and that enables you to maintain a healthy body composition.

Use MyPlate, DASH, or another healthy dietary pattern discussed in Chapter 8, and choose the healthiest options within each food group. For weight management, you may need to pay special attention to total calories, portion sizes, energy density, fat and carbohydrate intake, and eating habits.

Total Calories The USDA suggests approximate daily energy intakes based on gender, age, and activity level. However, the precise number of calories needed to maintain weight will vary from one person to another based on heredity, fitness status, level of physical activity, and other factors. Focus more on individual energy balance than on a general recommendation for daily calorie intake. To calculate your approximate daily caloric needs, complete Lab 9.1.

The best approach for weight loss is combining an increase in physical activity with moderate calorie restriction (see the box, “Is Any Diet Best for Weight Loss?”). Don’t go on a crash diet. You need to eat and drink enough to meet your need for essential nutrients. To maintain weight loss, you will probably have to maintain some degree of the calorie restriction you used to lose the weight. Therefore, it is important that you adopt a level of food intake that you can live with over the long term. For most people, maintaining weight loss is more difficult than losing the weight in the first place. To identify weight-loss goals and ways to meet them, complete Lab 9.2.

Portion Sizes Overconsumption of total calories is closely tied to portion sizes. Many Americans are unaware that the portion sizes of packaged foods and of foods served at restaurants have increased, and most of us significantly underestimate the amount of food we eat (Figure 9.3). Studies have found that the larger the meal, the greater the underestimation of calories. Limiting portion sizes is critical for weight management. For many people, concentrating on portion sizes is easier than counting calories. See Chapter 8 for more information and hints on choosing appropriate portion sizes.

Energy Density Experts also recommend that you pay attention to energy density—the number of calories per ounce or gram of weight in a food. Studies suggest that it isn’t consumption of a certain amount of fat or calories in food that reduces hunger and leads to feelings of fullness and satisfaction. Rather, it is consumption of a certain weight of food. Foods that are low in energy density have more volume and bulk; that is, they are relatively heavy but have few calories (Table 9.3). For example, for the same 100 calories, you could eat 20 baby carrots or four pretzel twists. You are more likely to feel full after eating the serving of carrots because it weighs ten times as much as the serving of pretzels.

Fresh fruits and vegetables, with their high water and fiber content, are low in energy density, as are whole-grain foods. Fresh fruits contain fewer calories and more fiber than fruit juices or drinks. Meat, ice cream, potato chips, croissants, crackers, and cakes and cookies are examples of foods high in energy density. Strategies for lowering the energy density of your diet include the following:

- Eat fruit with breakfast and for dessert.
- Add extra vegetables to sandwiches, casseroles, stir-fry dishes, pizza, pasta dishes, and fajitas.
- Start meals with a bowl of broth-based soup; include a green salad or fruit salad.
- Snack on fresh fruits and vegetables rather than crackers, chips, or other energy-dense snack foods.
Limit serving sizes of energy-dense foods such as butter, mayonnaise, cheese, chocolate, fatty meats, croissants, and snack foods that are fried, are high in added sugars (including reduced-fat products), or contain trans fat.

Avoid processed foods, which can be high in fat and sodium. Even processed foods labeled “fat-free” or “reduced fat” may be high in calories. Such products may contain sugar and fat substitutes, which often include as many calories as the nutrients they replace.

Eating Habits Equally important to weight management is eating small, frequent meals—four to five meals per day, including breakfast and snacks—on a regular schedule. Skipping meals leads to excessive hunger, feelings of deprivation, and increased vulnerability to binge eating or snacking. Establish a regular pattern of eating, and set some rules governing food choices. Rules governing breakfast might be these, for example: Choose a low-sugar, high-fiber cereal with nonfat milk and fruit most of the time; save pancakes and waffles for special occasions. For effective weight management, it is better to consume the majority of calories during the day rather than in the evening.

Decreasing some foods off-limits generally sets up a rule to be broken. A more sensible rule is “everything in moderation.” No foods need to be entirely off-limits, though some should be eaten judiciously.

### Physical Activity and Exercise

Making significant cuts in food intake in order to lose weight is a difficult strategy to maintain; increasing your physical activity is a much better approach. Physical activity and exercise burn calories and keep the metabolism geared to using food for energy instead of storing it as fat. Regular physical activity protects against weight gain and is essential for maintaining weight loss.

### Physical Activity

All physical activity will help you manage your weight. The first step in becoming more active is to incorporate more physical activity into your daily life. If you are currently sedentary, start by accumulating short bouts of moderate-intensity physical activity—walking, gardening, doing housework, and so on—for a total of 150 minutes or more per week. Even a small increase in activity level can help maintain your current weight or help you lose a moderate amount of weight. In fact, research suggests that fidgeting—stretching, squirming, standing up, and so on—may help prevent weight gain in some people. Short bouts of activity spread throughout the day can produce many of the same health benefits as continuous physical activity.

If you are overweight and want to lose weight, or if you are trying to maintain a lower weight following weight loss, a greater amount of physical activity can help. Researchers have found that people who lose weight and don’t regain it typically burn about 2,800 calories per week in physical activity—the equivalent of about one hour of brisk walking per day.

**Exercise** After you become more active every day, begin a formal exercise program that includes cardiorespiratory endurance exercise, resistance training, and stretching exercises (see the box “What Is the Best Way to Exercise for Weight Loss?”). Moderate-intensity endurance exercise, if performed frequently for a relatively long duration, can burn a significant number of calories. Endurance training also increases the rate at which your body uses calories after your exercise session is over—burning an additional 5–180 extra calories, depending on the intensity of exercise. Resistance training builds muscle mass, and more muscle translates into a higher metabolic rate. Resistance training can also help you maintain your muscle mass during a period of weight loss, helping you avoid the significant drop in RMR associated with weight loss.

Regular physical activity, maintained throughout life, makes weight management easier. The sooner you establish good habits, the better. The key to success is making exercise an integral part of a lifestyle you can enjoy now and will enjoy in the future.

### Thoughts and Emotions

The way you think about yourself and your world influences, and is influenced by, how you feel and how you act. In fact, research on people who have a weight problem indicates that low self-esteem and the negative emotions that accompany it are significant problems. People with low self-esteem mentally compare the actual self to an internally held picture of the “ideal self,” an image based on perfectionist goals and beliefs about how they and others should be. The more these two pictures
Many popular weight loss plans promote specific food choices and macronutrient combinations. Research findings have been mixed, but two points are clear: total calorie intake matters, and the best diet is probably the one you can stick with.

**Low-Carbohydrate Diets**

Some low-carb diets advocate fewer than 10% of total calories from carbohydrates, compared to the 45–65% recommended by the Food and Nutrition Board. Some suggest daily carbohydrate intake below the 130 grams needed to provide essential carbohydrates in the diet. Low-carb diets that advocate switching to complex carbohydrates are better for you than the more extreme versions, which may eliminate cereals or grains.

**Low-Fat Diets**

Many experts advocate diets that are relatively low in fat, high in carbohydrates, and moderate in protein. If you try a low-fat, high-carb diet, you still need to pay attention to the quality of the carbohydrates you consume, focusing on whole grains and your total calorie intake. A low-fat diet is not a license to consume excess calories, even in low-fat foods.

**High-Protein Diets**

High-protein diets advocate high protein, moderate fat, and low carbohydrate intakes. These diets can be low in fiber, whole grains, vegetables, and fruits and so may lack some essential nutrients. Diets high in protein and saturated fat have been linked to an increased risk of heart disease, high blood pressure, and cancer. One study found that following a diet with a normal protein-to-carbohydrate ratio (1 gram of protein to 2 grams of carbohydrate) promoted more improvements in body fat, waist circumference, and waist-to-hip ratio than following either a low-protein diet (1 gram of protein to 4 grams of carbohydrate) or a high-protein diet (1 gram of protein to 1 gram of carbohydrate). A normal protein-to-carbohydrate ratio is probably superior in reducing long-term chronic disease risk.

**How Do Different Diets Measure Up?**

A study comparing weight loss among adults assigned to one of four reduced-calorie diets differing in percentages of protein, carbohydrate, and fat found that weight loss at two years was similar for all four diets (about 9 pounds). Weight loss was strongly associated with attendance at group sessions. Other studies have also found little difference in weight loss among popular reduced-calorie diets; most resulted in modest weight loss and reduced heart disease risk factors. The more closely people adhered to each diet, the more weight they lost.

Adding exercise helps people lose weight and improve disease risk factors. A study found that when overweight and obese people added exercise and weight loss to the DASH Eating Plan, they experienced greater reductions in blood pressure and greater improvements in insulin sensitivity and lipid levels than those who followed the DASH diet alone or regular diet plans.

**Energy Balance Counts: The National Weight Control Registry**

Future research may determine that certain macronutrient patterns are somewhat more helpful for disease reduction in people with particular risk profiles. In terms of weight loss, however, such differences among diets are likely overshadowed by the importance of total calorie intake and physical activity. Important lessons about energy balance can be drawn from the National Weight Control Registry—an ongoing study of people who have lost significant amounts of weight and kept it off. The average participant in the registry has lost 71 pounds and kept the weight off for more than five years. Nearly all participants use a combination of diet and exercise to manage their weight. Greater weight regain in this group of individuals comes as a result of decreases in physical activity, having fewer dietary restraints, less individual monitoring of body weight, and increases in percentage of energy intake from fat. This study illustrates that to lose weight and keep it off, you must decrease daily calorie intake and increase daily physical activity—and continue to do so over your lifetime.


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**Thoughts and Emotions**

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**Thoughts and Emotions**

Coping Strategies

Appropriate coping strategies help you deal with the stresses of life; they are also an important lifestyle factor in weight
THE EVIDENCE FOR EXERCISE

What Is the Best Way to Exercise for Weight Loss?

If weight loss is your primary goal, the guidelines for planning a fitness program can vary depending on your weight, body composition, and current level of fitness. For example, there is some dispute among fitness experts about the best target heart rate (THR) zone to use when exercising for weight loss. Some experts recommend exercising at a moderate THR (55–69% of maximum heart rate) because the body burns fat at a slightly more efficient rate at this level of exertion. Others recommend exercising vigorously (70–90% of maximum heart rate) because exercise at this intensity burns more calories overall. According to some estimates, for example, a 30-minute workout at 80–85% of maximum heart rate burns about 30% more calories than a 30-minute workout at 60–65% maximum heart rate—but the lower-intensity workout burns roughly 20% more fat calories than the higher-intensity workout.

Regardless, if you are obese or your fitness level is very low, start with a lower-intensity workout (55% of maximum heart rate), and stick with it until your cardiorespiratory fitness level improves enough to support short bouts of higher-intensity exercise. This way, you will burn more fat, reduce the risk of injury and strain on your heart, and improve your chances of staying with your program. Even if your primary goal is to lose weight, you are also improving your cardiorespiratory fitness. Any amount of exercise, even at low to moderate intensity, will help you achieve both goals. But patience is required, especially if you need to lose a great deal of weight.

For weight loss to occur, exercise at lower intensities has to be offset by longer and/or more frequent exercise sessions. Experts recommend 60–90 minutes of daily exercise for anyone who needs to lose weight or maintain weight loss. If you cannot fit such a large block of activity into your daily schedule, break your workouts into short segments—as little as 10–15 minutes each. This approach is probably best for someone who has been sedentary because it allows the body to become accustomed to exercise at a gradual pace while preventing injury and avoiding strain on the heart.

Many research studies have shown that walking is an ideal form of exercise for losing weight and avoiding weight gain. A landmark 15-year study by the University of North Carolina at Charlotte showed that, over time, people who did not walk gained 18 pounds more than people who walked just 30 minutes per day. Those who regularly walked farther were better able to lose or maintain weight. Other studies found that people who walked 30 minutes five times per week lost an average of 5 pounds in 6–12 months, without dieting, watching what they ate, or exercising intensely. You can lose even more weight if you eat sensibly and walk farther and faster.

A 165-pound adult who walks at a speed of 3 miles per hour for 60 minutes a day, 5 days a week, can lose about one-half pound of body weight per week. Regular walking is the simplest and most effective health habit for controlling body weight and promoting health. Even if you’re sedentary, a few months of walking can increase your fitness level to the point where more vigorous types of exercise—and even greater health benefits—are possible.

diets. (In general, a low-calorie diet provides 1,200–1,500 calories per day, whereas an average adult calorie diet provides 1,800–3,000 calories.) By achieving a negative energy balance of 250–1,000 calories per day, you’ll produce the recommended weight loss of ½–2 pounds per week.

Most low-calorie diets cause a rapid loss of body water at first. When this phase passes, weight loss declines. As a result, dieters are often misled into believing that their efforts are not working. They give up, not realizing that smaller losses later in the diet are actually more significant than the initial big losses because later loss is mostly fat loss, whereas initial loss is primarily fluid. For someone who is overweight, reasonable weight loss is 8–10% of body weight over six months.

For many Americans, maintaining weight loss is a bigger challenge than losing weight. Most weight loss during a period of dieting is regained. When planning a weight-management program, you need to include strategies that you can maintain over the long term, both for food choices and for physical activity. Weight management is a lifelong project. A registered dietitian or nutritionist can recommend an appropriate plan for you when you want to lose weight on your own. For more tips on losing weight on your own, see the box “Lifestyle Strategies for Successful Weight Management.”

**Diet Books**

Many people who try to lose weight by themselves fall prey to one or more of the dozens of diet books on the market. Although some books contain useful advice and motivational tips, most make empty promises. Accept books that advocate a balanced approach to diet plus exercise and sound nutritional advice but reject any book that

- Advocates an unbalanced way of eating, such as a high-carbohydrate-only diet or a low-carbohydrate, high-protein diet, or that promotes a single food, such as cabbage or grapefruit.
- Claims to be based on a “scientific breakthrough” or to have the “secret to success.”
- Uses gimmicks, such as matching eating to blood type, hyping insulin resistance as the cause of obesity, or combining foods in special ways to achieve weight loss.
- Promises quick weight loss or limits the selection of foods.

Many diets cause weight loss if maintained. The real difficulty is finding a safe and healthy pattern of food choices and physical activity that results in long-term maintenance of a healthy body weight and reduced risk of chronic disease (see the box “High-Tech Weight Management”).

**Dietary Supplements and Diet Aids**

The number of dietary supplements and other weight-loss aids on the market has also increased in recent years. Promoted in advertisements, magazines, direct mail campaigns, infomercials, and on websites, these products typically promise a quick and easy path to weight loss. Most of these products are marketed as dietary supplements and so are subject to fewer regulations than over-the-counter (OTC) medications. According to the Federal Trade Commission (FTC), more than half of advertisements for weight loss products make representations that are likely to be false. And although the FTC will order companies to stop making baseless and bogus product claims when monitors become aware of them, consumers are urged to critically evaluate any product that sounds too good to be true.

Hidden and undisclosed ingredients are increasingly becoming problems in products promoted for weight loss. An emerging trend identified by the FDA is hidden active ingredients that can potentially be harmful. Consumers may unknowingly take a diet product that contains varying quantities of approved prescription drug ingredients. The product could also have untested and unstudied pharmaceutically active ingredients or controlled substances (substances whose use is strictly regulated by the government, e.g., marijuana in California). All of these ingredients could have harmful effects. Such situations are becoming more common because the FDA cannot test all products on the market that contain potentially harmful hidden ingredients. Also, consumer advisories for tainted products identify only a small proportion of the potentially harmful products on the market.

Public notifications available on the FDA website reveal that even some products labeled “Natural and Safe” contain prescription medications, including sibutramine (a weight-loss medication sold under the brand name Meridia) and phenyltoin (an antiseizure medication). In its consumer alert, the FDA noted that a number of the recalled supplements contained pharmaceuticals in amounts far exceeding FDA-recommended levels. Some of the supplements contained substances that are not approved for sale in the United States, including lorcaserin (a controlled substance), and phenolphthalein, which is thought to be a carcinogen. The use of these drugs could lead to complications such as heart attack, stroke, suicide, and even cancer. The prescription medications were not listed on any of the supplements’ labels, meaning consumers could be taking lethal doses of prescription drugs without knowing it.
TAKE CHARGE
Lifestyle Strategies for Successful Weight Management

Food Choices
- Focus on making good choices from each food group.
- Favor foods with a low energy (calorie) density and a high nutrient density.
- Check labels for serving sizes, calories, and nutrients. See Chapter 8 for more on food labeling.
- Watch for hidden calories. Reduced-fat foods often have as many calories as their full-fat versions.
- Drink fewer calories in the form of soda, fruit drinks, sports drinks, alcohol, and specialty coffees and teas. Water and non-fat or low-fat milk are good beverage choices.

Planning and Serving
- Keep a log of what you eat, as described earlier in the text.
- Eat four to five meals/snacks daily, including breakfast, to distribute calories throughout your day.
- Fix more meals yourself and eat out less often.
- Keep low-calorie snacks on hand to combat the “munchies.” Fresh fruits and vegetables are good choices.
- When shopping, make a list and stick to it. Don’t shop when you’re hungry. Avoid aisles that contain problem foods.
- Consume the majority of your daily calories during the day, not in the evening.
- Pay attention to portion sizes. Use measuring cups and spoons and a food scale to become familiar with portion sizes.
- Serve meals on small plates and in small bowls to help you eat smaller portions without feeling deprived. (Research has shown that using a larger plate makes food portions appear smaller, so people serve themselves more food and overeat.)
- Eat only in specifically designated spots. Remove food from other areas of your home.
- When you eat, just eat. Don’t do anything else.
- Avoid late-night eating, a behavior specifically associated with weight gain among college students.

- Eat slowly. It takes time for your brain to get the message that your stomach is full. Take small bites and chew food thoroughly. Pay attention to every bite, and enjoy your food.

Special Occasions
- When you eat out, choose a restaurant where you can make healthy food choices. Ask the server not to put bread and butter on the table before the meal, and request that sauces and salad dressings be served on the side. If portion sizes are large, take half your food home for a meal later in the week. Don’t choose supersized meals.
- If you’re eating at a friend’s home, eat a little and leave the rest. Don’t eat to be polite.

Physical Activity and Stress Management
- Increase your level of daily physical activity as slowly as necessary based on your current fitness level.
- Begin an exercise program that includes cardiorespiratory endurance exercise, strength training, and stretching.
- Develop techniques for handling stress. See Chapter 10 for more on stress management.
- Develop strategies for coping with nonhunger cues to eat, such as boredom, sleepiness, or anxiety. Try calling a friend, taking a shower, or reading a magazine.
- Tell family members and friends that you’re changing your eating and exercise habits. Ask them to be supportive.

The following sections describe some commonly marketed OTC products for weight loss.

Formula Drinks and Food Bars Canned diet drinks, powders used to make shakes, and diet food bars and snacks are meal replacements. They are designed to help you lose weight by substituting for some or all of your daily food intake. Meal replacements are convenient. However, most people find it difficult to use these products for long periods, and although they sometimes result in rapid short-term weight loss, the weight is typically regained because users don’t learn to change their eating and lifestyle behaviors.

Herbal Supplements As described in Chapter 8, herbs are marketed as dietary supplements, and there is little information about effectiveness, proper dosage, drug interactions,
Technology is making inroads into the area of weight management at an ever-quicker pace. Once the domain of clinical weight-loss programs, digital tools are now available for consumers who want to lose weight or keep it off.

At the clinical level, new research shows that overweight patients who are equipped with high-tech monitoring devices (which monitor their energy intake and output) lose at least as much weight as patients who participate only in in-person weight-management counseling sessions. When person-to-person counseling is added to the use of digital monitors, patients lose even more weight and manage to keep it off longer.

A wide and ever-growing range of portable devices and weight-loss applications is also available to consumers. There are dozens of smartphone apps that can help you keep a nutrition journal and calculate your daily intake of calories and nutrients. Such apps often pair with other programs that can help track your physical activity level and calculate the number of calories you burn throughout the day. Some of these apps can upload your daily data to a website that lets you track energy intake and output over the course of time. Many such programs can also help you set goals, provide dietary or exercise advice, or let you join communities of users who are also trying to manage their weight.

Internet-based weight-loss programs have proliferated over the last decade. Most such websites offer a cross between self-help and group support through chat rooms, bulletin boards, and e-newsletters. Many sites offer online self-assessment for diet and physical activity habits as well as a meal plan; some provide access to a staff professional for individualized help. Many are free, but some charge a weekly or monthly fee.

An example of a particularly successful online weight-management program is the National Weight Control Registry. This site is part of an ongoing study of people who have lost significant amounts of weight and kept it off. Most follow moderate-calorie diets that are relatively low in fat and fried foods, and users monitor their body weight and their food intake frequently. Participants engage in an average of 60 minutes of moderate physical activity daily.

Even with the help of digital devices and programs, weight management is still primarily a matter of personal effort, perseverance, and a commitment to lifestyle changes that last for life.


Other Supplements

Fiber is another common ingredient in OTC diet aids, promoted for appetite control. However, dietary fiber acts as a bulking agent in the large intestine, not the stomach, so it doesn’t have a pronounced effect on appetite. In addition, many diet aids contain only 3 or fewer grams of fiber, which do not contribute much toward the recommended daily intake of 25–38 grams.

Other popular dietary supplements include conjugated linoleic acid, carnitine, chromium, pyruvate, calcium, B vitamins, chitosan, and a number of products labeled “fat absorbers,” “fat blockers,” or “starch blockers.” Research has not found these products to be effective, and many have potentially adverse side effects.
Weight-Loss Programs

Weight-loss programs come in a variety of types, including noncommercial support organizations, commercial programs, websites, and clinical programs.

An interesting phenomenon regarding weight-loss interventions among college students has recently been observed: Groups of students who shared certain characteristics did better at losing and managing weight than groups of dissimilar students. The study grouped students according to common psychosocial factors (such as emotional eating), which contributed to weight gain. These clusters of similar students were able to lose more weight and keep more weight off than were groups of students who did not share common dietary or psychosocial characteristics. The findings of this study may help shape group-oriented weight-loss programs in the future, whether such programs are commercial, noncommercial, or clinical.

Noncommercial Weight-Loss Programs Noncommercial programs such as TOPS (Take Off Pounds Sensibly) and Overeaters Anonymous (OA) mainly provide group support. They do not advocate any particular diet, but they do recommend seeking professional advice for creating an individualized diet and exercise plan. Like Alcoholics Anonymous, OA is a 12-step program with a spiritual orientation that promotes abstinence from compulsive overeating. These types of programs are generally free. Your physician or a registered dietitian can also provide information and support for weight loss.

Commercial Weight-Loss Programs Commercial weight-loss programs typically provide group support, nutrition education, physical activity recommendations, and behavior modification advice. Some also make packaged foods available to assist in following dietary advice.

A responsible and safe weight-loss program should have the following features:

- The recommended diet should be safe and balanced, include all the food groups, and meet the Dietary Reference Intakes (DRIs) for all nutrients. Physical activity and exercise should be strongly encouraged.
- The program should promote slow, steady weight loss averaging ½–2 pounds per week. (There may be rapid weight loss initially due to fluid loss.)

<table>
<thead>
<tr>
<th>INGREDIENT</th>
<th>PROPOSED MECHANISM OF ACTION</th>
<th>EVIDENCE OF EFFICACY</th>
<th>REPORTED ADVERSE EFFECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alli (OTC form of orlistat)</td>
<td>Decreases absorption of dietary fat</td>
<td>Possible modest benefit; less effective than prescription strength form (Xenical)</td>
<td>Loose stools, gas with oily spotting, more frequent and hard to control bowel movements; reduced absorption of some nutrients; rare cases of liver damage</td>
</tr>
<tr>
<td>Bitter orange (synephrine)</td>
<td>Increased energy expenditure, mild appetite suppressant</td>
<td>Possible effect on resting metabolic rate; inconclusive effects on weight loss</td>
<td>Chest pain, anxiety, increased blood pressure and heart rate</td>
</tr>
<tr>
<td>Caffeine (as added caffeine or from guarana, kola nut, yerba mate, or other herbs)</td>
<td>Stimulates central nervous system, increases fat oxidation</td>
<td>Possible modest effect on body weight or decreased weight gain over time</td>
<td>Nervousness, jitteriness, vomiting, and tachycardia</td>
</tr>
<tr>
<td>Chitosan</td>
<td>Binds dietary fat in the digestive tract</td>
<td>Minimal effect on body weight</td>
<td>Bloating, flatulence, indigestion, constipation, nausea, heartburn</td>
</tr>
<tr>
<td>Chromium</td>
<td>Increases lean muscle mass; promotes fat loss; reduced hunger and fat cravings</td>
<td>Minimal effect on body weight and body fat</td>
<td>Headache, watery stools, constipation, weakness, vertigo, nausea, vomiting, hives</td>
</tr>
<tr>
<td>Conjugated linoleic acid</td>
<td>Promotes reduction in fat cells</td>
<td>Minimal effect on body weight and body fat</td>
<td>Abdominal pain, constipation, diarrhea, indigestion, and (possibly) adverse effects on blood lipid levels</td>
</tr>
<tr>
<td>Green tea extract</td>
<td>Increases energy expenditure and fat use, reduces fat absorption</td>
<td>Possible modest effect on body weight</td>
<td>Abdominal pain, constipation, nausea, increased blood pressure, liver damage</td>
</tr>
<tr>
<td>Guar gum</td>
<td>Acts as bulking agent in the gut, increases feelings of fullness</td>
<td>No effect on body weight</td>
<td>Abdominal pain, flatulence, diarrhea, nausea, cramps</td>
</tr>
<tr>
<td>Hoodia</td>
<td>Suppresses appetite, reduces food intake</td>
<td>Limited research, but no apparent effect on energy intake or body weight</td>
<td>Headache, dizziness, nausea, and vomiting</td>
</tr>
<tr>
<td>Pyruate</td>
<td>Increases fat burning and energy expenditure</td>
<td>Possible minimal effect on body weight and body fat</td>
<td>Diarrhea, gas, bloating, and (possibly) decreased “good” cholesterol (HDL).</td>
</tr>
<tr>
<td>Raspberry ketone</td>
<td>Alters fat metabolism</td>
<td>Insufficient research to draw firm conclusions</td>
<td>None known</td>
</tr>
</tbody>
</table>


Table 9.4 Safety and Effectiveness of Common Over-the-Counter Weight-Loss Pills
• If a participant plans to lose more than 20 pounds, has any health problems, or is taking medication on a regular basis, the program should offer physician evaluation and monitoring. The program’s staff should include qualified counselors and health professionals.

• The program should include plans for weight maintenance after the weight-loss phase is over.

• The program should provide information on all fees and costs, including those of supplements and prepackaged foods, as well as data on risks and expected outcomes of participating in the program.

You should also consider whether a program fits your lifestyle and whether you are truly ready to make a commitment to it. A strong commitment and a plan for maintenance are especially important because only 10–15% of program participants maintain their weight loss; the rest gain back all or more than they had lost. One study of participants found that regular exercise was the best predictor of maintaining weight loss, and frequent television viewing was the best predictor of weight gain.

**Clinical Weight-Loss Programs** Medically supervised clinical programs are usually located in a hospital or other medical setting. Designed to help those who are severely obese, these programs typically involve a closely monitored very-low-calorie diet. The cost of a clinical program is usually high, but insurance often covers part of the fee.

**Prescription Drugs**

For a medicine to cause weight loss, it must reduce energy consumption, increase energy expenditure, and/or interfere with energy absorption. The medications most often prescribed for weight loss are appetite suppressants that reduce feelings of hunger or increase feelings of fullness. Appetite suppressants usually work by increasing levels of catecholamine or serotonin, two brain chemicals that affect mood and appetite.

All prescription weight-loss drugs have potential side effects. Those that affect catecholamine levels, including phentermine (Ionamin, Obenix, Fastin, and Adipex-P), diethylpropion (Tenuate), and mazindol (Sanorex), may cause sleeplessness, nervousness, and euphoria.

Most appetite suppressants are approved by the FDA only for short-term use. Although they come with side effect warnings, three drugs—orlistat (Xenical), Belviq, and Qsymia—are approved for longer-term use. Orlistat lowers calorie consumption by blocking fat absorption in the intestines; it prevents about 30% of the fat in food from being digested. Similar to the fat substitute olestra, orlistat also reduces the absorption of fat-soluble vitamins and antioxidants. Therefore, taking a vitamin supplement is highly recommended if taking orlistat. Side effects include severe liver injury, diarrhea, cramping, and other gastrointestinal problems if users do not follow a low-fat diet. Because of the side effect warnings, the FDA requires substantial safety information on the label. In 2007, the FDA approved Alli, a lower-dose version of orlistat that is sold over the counter.

Both Belviq (lorcaserin) and Qsymia (phentermine and topiramate extended-release) are appetite suppressants and also intended for long-term use. Belviq works in the same way as fenfluramine, which was withdrawn from the market because it damaged heart valves. Although there is no evidence that Belviq damages heart valves, it may increase heart rate. People taking it should have their heart rate checked. Qsymia (phentermine and topiramate) increases the risk of birth defects, information which the manufacturer must give to women who might become pregnant. In addition, Qsymia is considered a controlled substance because one of its ingredients, phentermine, has the potential for abuse.

All these medications work best in conjunction with behavior modification. Appetite suppressants produce modest weight loss—about 5–22 pounds above the loss expected with nondrug obesity treatments. Individuals respond differently, however, and some lose more weight than others. Weight loss tends to level off or reverse after four–six months on a medication, and many people regain the weight they’ve lost when they stop taking the drug.

Prescription weight-loss drugs are not for people who just want to lose a few pounds. The latest federal guidelines advise people to try lifestyle modification for at least six months before trying drug therapy. Prescription drugs are recommended only in certain cases: for people who have been unable to lose weight with nondrug options and who have a BMI over 30 (or over 27 if an additional risk factor such as diabetes or high blood pressure is present). For severely obese
people who have been unable to lose weight by other methods, prescription drugs may provide a good option.

**Surgery**

It is estimated that 6% of adult Americans have a BMI greater than 40, qualifying them as severely or morbidly obese. The number of severely obese people has nearly doubled in the last two decades. Severe obesity is a serious medical condition that is often complicated by other health problems such as diabetes, sleep disorders, heart disease, and arthritis. Surgical intervention—known as *bariatric surgery*—may be necessary as a treatment of last resort. Bariatric surgery may be recommended for patients with a BMI greater than 40, or greater than 35 with obesity-related illnesses.

Due to the increasing prevalence of severe obesity, surgical treatment of obesity is growing worldwide. Obesity-related health conditions, as well as risk of premature death, generally improve after surgical weight loss. Surgery, however, carries risks. Patients with poor cardiopulmonary fitness prior to surgery experience more postoperative complications, including stroke, kidney failure, and even death, than patients with higher fitness levels.

Bariatric surgery reduces the size of the stomach. One method partitions the stomach with staples or a band, and another modifies the way the stomach drains (gastric bypass). In either type of surgical intervention, the goal is to promote weight loss by reducing the amount of food the patient can eat. Potential complications from surgery include nutritional deficiencies, fat intolerance, nausea, vomiting, and reflux. As many as 10–20% of patients may require follow-up surgery to address complications.

Weight loss from surgery generally ranges between 40%–70% of total body weight over the course of a year. The key to success is to have adequate follow-up and to stay motivated so that life behaviors and eating patterns are changed permanently.

The surgical technique of liposuction involves the removal of small amounts of fat from specific locations. Liposuction is not a method for treating obesity.

**Psychological Help**

When concerns about body weight and shape have developed into an eating disorder, professional help is recommended. Therapists who help people with these disorders should have experience in weight management, body image issues, eating disorders, addictions, and abuse issues.

**Ask Yourself**

QUESTIONS FOR CRITICAL THINKING AND REFLECTION

Why do you think people continue to buy into fad diets and weight-loss gimmicks, even though they are constantly reminded that the key to weight management is lifestyle change? Have you ever tried a fad diet or dietary supplement? If so, what were your reasons for trying it? What were the results?

**BODY IMAGE**

The collective picture of the body as seen through the mind’s eye, *body image* consists of perceptions, images, thoughts, attitudes, and emotions. A negative body image is characterized by dissatisfaction with the body in general or some part of the body in particular.

Developing a positive body image is an important aspect of psychological wellness and successful weight management. Dissatisfaction with body size and shape comes from external, cultural forces as well as internal, psychological perceptions that are specific to life stages. For example, a cultural ideal of female body shape in Western society has become progressively thinner, whereas actual female body size continues to increase. How we individually perceive these norms and act on them, for example, not eating enough or avoiding appearing in a bathing suit, represents our psychological response.

**Severe Body Image Problems**

Poor body image can cause significant psychological distress. A person can become preoccupied by a perceived defect in appearance, thereby damaging self-esteem and interfering with relationships. Adolescents and adults who have a negative body image are more likely to diet restrictively, eat compulsively, or develop some other form of disordered eating.

When dissatisfaction becomes extreme, the condition is called *body dysmorphic disorder (BDD)*. BDD affects about 2% of Americans, males and females in equal numbers. BDD usually begins before age 18 but can begin in adulthood. Sufferers are overly concerned with physical appearance, often focusing on slight flaws that are not obvious to others. Individuals with BDD may spend hours every day thinking about their flaws and looking at themselves in mirrors; they may desire and seek repeated cosmetic surgeries. BDD is related to obsessive-compulsive disorder and can lead to depression, social phobia, and suicide if left untreated. Medication and therapy can help people with BDD.

In some cases, body image may bear little resemblance to fact. A person with the eating disorder anorexia nervosa typically has a severely distorted body image, believing herself to be fat even when she has become emaciated (see the next section for more on anorexia). Distorted body image is also a hallmark of *muscle dysmorphia*, a disorder experienced by some bodybuilders and other active people who see themselves as small and out of shape despite being very muscular. People with muscle dysmorphia may let obsessive weight training interfere with their work and relationships. They may also use potentially dangerous muscle-building drugs.

To assess your body image, complete the body image self-test in Lab 9.3.

**Acceptance and Change**

There are limits to the changes that can be made to body weight and body shape, both of which are influenced by heredity. Knowing when the limits to healthy change have been
Eating Disorders

Problems with body weight and weight control are not limited to excessive body fat. A growing number of people, especially adolescent girls and young women, experience eating disorders, characterized by severe disturbances in body image, eating patterns, and eating-related behavior. In the United States, up to 24 million people of all ages and genders suffer from an eating disorder (anorexia, bulimia, and binge-eating disorder). Many more people have abnormal eating habits and attitudes about food that disrupt their lives, even though these habits do not meet the criteria for a major eating disorder. To assess your eating habits, complete Lab 9.3.

Although many different explanations for the development of eating disorders have been proposed, they share one central feature: a dissatisfaction with body image and body weight. Such dissatisfaction is created by distorted thinking, including perfectionist beliefs, unreasonable demands for self-control, and excessive self-criticism. Dissatisfaction with body weight leads to dysfunctional attitudes about eating, such as fear of fat, preoccupation with food, and problematic eating behaviors. Eating disorders are classified as mental disorders.

Anorexia Nervosa

People with anorexia nervosa have an intense fear of gaining weight or becoming fat. Although they may express a great interest in food, they do not eat enough food to maintain a reasonable body weight. They may engage in compulsive behaviors or rituals that help them keep from eating. An estimated 0.5—3.7% of women suffer from anorexia nervosa in their lifetime. Although it can occur earlier or later, anorexia typically develops during puberty and the late teenage years, with an average onset age of about 19 years.

People with anorexia are typically introverted, emotionally reserved, and socially insecure. Their entire sense of self-esteem may be tied up in their evaluation of their body shape and weight.

Anorexia nervosa has been linked to a variety of medical complications, including disorders of the cardiovascular, gastrointestinal, and endocrine systems. Because of extreme weight loss, females with anorexia often stop menstruating. When body fat is virtually gone and muscles are severely wasted, the body turns to its organs in a desperate search for protein. Death can occur from heart failure caused by electrolyte imbalances. About one in ten women with anorexia dies of starvation, cardiac arrest, or other medical complications—one of the highest death rates for any psychiatric disorder. Depression is also a serious risk, and about half the fatalities relating to anorexia are suicides.

Bulimia Nervosa

A person with bulimia nervosa engages in recurrent episodes of binge eating followed by purging. Bulimia is often difficult to recognize because sufferers conceal their eating habits and

Fitness Tip Exercise is a healthy practice, but people with eating disorders or body image problems sometimes exercise excessively, building their lives around their workouts. Compulsive exercise can lead to injuries, low body fat, and other health problems. Track your exercise habits for a week; if they seem excessive and you can’t seem to cut back, talk to a professional counselor or your doctor to find out if you have a body image problem.

Body image The mental representation a person holds about her or his body at any given moment in time, consisting of perceptions, images, thoughts, attitudes, and emotions about the body.

Eating disorder A serious disturbance in eating patterns or eating-related behavior, characterized by a negative body image and concerns about body weight or body fat.

Anorexia nervosa An eating disorder characterized by a refusal to maintain body weight at a minimally healthy level and an intense fear of gaining weight or becoming fat; self-starvation.

Bulimia nervosa An eating disorder characterized by recurrent episodes of binge eating and then purging to prevent weight gain.

Purging The use of vomiting, laxatives, excessive exercise, restrictive dieting, enemas, diuretics, or diet pills to compensate for food that has been eaten and that the person fears will produce weight gain.
Body Image and Gender

Women are much more likely than men to be dissatisfied with their bodies, often wanting to be thinner than they are. Body weight perception has been found to begin in girls as young as 7 years old. Approximately 50% of girls and undergraduate women report being dissatisfied with their bodies. Girls and women are much more likely than boys and men to diet, develop eating disorders, and be obese.

The image of the ideal woman presented in the media is often unrealistic and even unhealthy. In a review of BMI data for Miss America pageant winners since 1922, researchers noted a significant decline in BMI over time, with an increasing number of recent winners having BMIs in the “underweight” category. The average fashion model is 4–7 inches taller and almost 50 pounds lighter than the average American woman. Most fashion models are thinner than 98% of American women.

Our culture may be promoting an unattainable masculine ideal as well. Researchers have found that males who form their ideals from media-generated images show a preference for thinness and muscularity. Researchers studying male action figures note that they have become increasingly muscular. Such media messages can be demoralizing; boys and men also suffer from body image problems, although not as commonly as girls and women.

Body Image and Ethnicity

Although some groups espouse thinness as an ideal body type, others do not. In many traditional African societies, for example, full-figured women’s bodies are seen as symbols of health, prosperity, and fertility. African American teenage girls have a more positive body image than European American girls; in one survey, two-thirds of them defined beauty as “the right attitude,” whereas European American girls were more preoccupied with weight and body shape. In another study about pressure to look like idealized images, Latina women reported the greatest pressure (over white or black women) to be physically attractive.

Nevertheless, recent evidence indicates that African American women are as likely to engage in disordered eating behavior—especially binge eating and vomiting—as their Latina, Native American, and European American counterparts. This finding underscores the complex nature of eating disorders and body image.

Avoiding Body-Image Problems

To minimize your risk of developing a body-image problem, keep the following strategies in mind:

- Focus on healthy habits and good physical health.
- Put concerns about physical appearance in perspective. Your worth as a human being does not depend on how you look.
- Practice body acceptance. You can influence your body size and type through lifestyle to some degree, but the fact is that some people are genetically designed to be bigger or heavier than others.
- Find things to appreciate in yourself besides an idealized body image. People who can learn to value other aspects of themselves are more accepting of the physical changes that occur naturally with age.
- View eating as a morally neutral activity—eating dessert isn’t “bad” and doesn’t make you a bad person.
- See the beauty and fitness industries for what they are. Realize that their goal is to prompt dissatisfaction with yourself so that you will buy their products.

A bulimic person may rapidly consume thousands of calories during a binge. This is followed by an attempt to get rid of the food by purging, usually by vomiting or using laxatives or diuretics. During a binge, bulimics feel as though they have lost control and cannot stop or limit how much they eat. Some binge and purge only occasionally; others do so many times every day. Binges may be triggered by a major life change or other stressful event. Binge eating and purging may become a way of dealing with difficult feelings such as anger and disappointment.

The binge-purge cycle of bulimia places a tremendous strain on the body and can have serious health effects, including tooth decay, esophageal damage and chronic hoarseness, menstrual irregularities, depression, liver and kidney damage, and cardiac arrhythmia.

**Binge-Eating Disorder**

**Binge-eating disorder (BED)** affects 3% to 5% of American women and 2% of men. It is characterized by uncontrollable eating without any compensatory purging behaviors. Common eating patterns are eating more rapidly than normal, eating until uncomfortably full, eating when not hungry, and preferring to eat alone. Uncontrolled eating is usually followed by weight gain and feelings of guilt, shame, and depression. Many people with binge-eating disorder mistakenly see rigid dieting as the only solution to their problem, but this usually causes feelings of deprivation and a return to overeating.

Compulsive overeaters rarely eat because of hunger. Instead, they use food to cope with stress, conflict, and other difficult emotions or to provide solace or entertainment. Binge eaters are almost always obese, so they face all the health risks associated with obesity. In addition, binge eaters may have higher-than-average rates of depression and anxiety.

**Borderline Disordered Eating**

People with *borderline disordered eating* have some symptoms of eating disorders—for example, excessive dieting or occasional bingeing or purging—but do not meet the full diagnostic criteria for anorexia, bulimia, or binge-eating disorder.

Meaningful statistics about borderline disordered eating are hard to come by, in part because it is difficult to define exactly when eating habits cross the line between normal and disordered. However, many experts feel that the majority of Americans, particularly women, have at least some unhealthy attitudes and behaviors in relation to food and self-image.

**TIPS FOR TODAY AND THE FUTURE**

Many approaches work, but the simplest formula for weight management is moderate food intake coupled with regular exercise.

**RIGHT NOW YOU CAN**

- Assess your weight-management needs. Do you need to gain weight, lose weight, or stay at your current weight?
- List five things you can do to add more physical activity (not exercise) to your daily routine.
- Identify the foods you regularly eat that may be sabotaging your ability to manage your weight.

**IN THE FUTURE YOU CAN**

- Make an honest assessment of your body image. Is it accurate and fair, or is it unduly negative and unhealthy? If your body image presents a problem, consider getting professional advice on how to view yourself realistically.
- Keep track of your energy needs to determine whether your energy-balance equation is correct. Use this information as part of your long-term weight-management efforts.
Includes a variety of interactive calculators, including an Exercise Calculator that estimates the calories burned from various forms of physical activity.  
http://www.caloriecontrol.org

Centers for Disease Control and Prevention: Healthy Weight. Provides a variety of information and tools to help people assess their weight and plan healthy lifestyle changes.  
http://www.cdc.gov/healthyweight

Frontline: Fat. Information from a PBS Frontline special that looked at how society, genetics, and biology have influenced our relationship with food and at current problems with obesity and eating disorders.  
http://www.pbs.org/wgbh/pages/frontline/shows/fat

SUMMARY

- Excess body weight increases the risk of numerous diseases, particularly cardiovascular disease, cancer, and diabetes.
- The influence of heredity on weight can in many cases be overcome.
- Physiological factors involved in the regulation of body weight and body fat include metabolic rate and hormones.
- Energy-balance components that an individual can control are calories taken in and calories expended in physical activity.
- Nutritional guidelines for weight management and wellness include controlling consumption of total calories, unhealthy fats and carbohydrates, and protein; monitoring portion sizes and caloric density; increasing consumption of whole grains, fruits, and vegetables; and developing an eating schedule based on rules.
- Activity guidelines for weight control emphasize engaging in moderate-intensity physical activity for 60–90 minutes or more per day; regular, prolonged endurance exercise and weight training can burn a significant number of calories while maintaining muscle mass.
- The sense of well-being that results from a well-balanced diet can reinforce commitment to weight control; improve self-esteem; and lead to realistic, as opposed to negative, self-talk. Successful weight management results in not using food as a means of coping with stress.
- In cases of extreme obesity, weight loss requires medical supervision; in less extreme cases, people can set up individual programs, perhaps getting guidance from reliable books or by joining a formal weight-loss program.
- Dissatisfaction with body image and body weight can lead to physical problems and serious eating disorders, including anorexia nervosa, bulimia nervosa, and binge-eating disorder.
How can I safely gain weight?

Just as for losing weight, a program for weight gain should be gradual and should include both exercise and dietary changes. The foundation of a successful and healthy program for weight gain is a combination of strength training and a high-carbohydrate, high-calorie diet. Strength training will help you add weight as muscle rather than fat.

Energy balance is also important in a program for gaining weight. You need to consume more calories than your body requires in order to gain weight, but you need to choose those extra calories wisely. Fatty, high-calorie foods may seem like an obvious choice, but consuming additional calories as fat can jeopardize your health and your weight-management program. A diet high in fat carries health risks, and your weight-management program.

A better strategy is to consume additional calories as complex carbohydrates from whole grains, fruits, and vegetables.

A diet for weight gain should contain about 60–65% of total daily calories from carbohydrates. You probably do not need to be concerned with protein. Although protein requirements increase when you exercise, the protein consumption of most Americans is already well above the DRI.

In order to gain primarily muscle weight instead of fat, a gradual program of weight gain is your best bet. Try these strategies for consuming extra calories:

- Don’t skip any meals.
- Add two or three snacks to your daily eating routine.
- Try a sports drink or supplement that has at least 60% of calories from carbohydrates, as well as significant amounts of protein, vitamins, and minerals. (But don’t use supplements to replace meals because they don’t contain all of the components of food.)

How can I achieve a “perfect” body?

The current cultural ideal of an ultratoned, ultrafit body is impossible for most people to achieve. A reasonable goal for body weight and body shape must take into account your heredity, weight history, social circumstances, metabolic rate, and psychological well-being. Don’t set goals based on movie stars or fashion models. Modern photographic techniques can make people look much different on film or in magazines than they do in person. Many of these people are also genetically endowed with body shapes that are impossible for most of us to emulate. The best approach is to work with what you’ve got. Adopting a wellness lifestyle that includes regular exercise and a healthy diet will naturally result in the best possible body shape for you. Obsessively trying to achieve unreasonable goals can lead to problems such as eating disorders, overtraining, and injuries.

MedlinePlus: Obesity and Weight Loss. Provides reliable information from government agencies and key professional associations.

National Heart, Lung, and Blood Institute (NHLBI): Aim for a Healthy Weight. Provides information and tips on diet and physical activity, as well as a BMI calculator.

Weight-control Information Network (WIN). A service of the National Institute of Diabetes and Digestive and Kidney Diseases, serves as an online clearinghouse of weight-management information.
http://win.niddk.nih.gov/

WHO: Obesity and Overweight. Provides information on the World Health Organization’s global strategy on diet and physical activity.
http://www.who.int/dietphysicalactivity/en

There are also many resources for people concerned about body image and eating disorders:

MedlinePlus: Eating Disorders

National Association of Anorexia Nervosa and Associated Disorders
http://www.anad.org

National Eating Disorders Association
http://www.nationaleatingdisorders.org

Women’s Body Image and Health
http://www.womenshealth.gov/body-image/

See also the listings in Chapters 1, 6, and 8.

SELECTED BIBLIOGRAPHY


LAB 9.1 Calculating Daily Energy Needs

Part I Estimating Current Energy Intake from a Food Record
If your weight is stable, your current daily energy intake is the number of calories you need to consume to maintain your weight at your current activity level. For women, average calorie requirements are 1600 to 2400 calories per day; for men, 2000 to 3000. The low end of the range is for sedentary individuals, the high end for active individuals. In addition, caloric needs tend to decrease with age.

If you completed Lab 8.2, you should have a record of your current energy intake; if you didn’t complete the lab, keep a careful and complete record of everything you eat for one day, and then total the calories in all the foods and beverages you consumed. Record your total energy intake below:

Current energy intake (from food record): ________ calories per day

Part II Estimating Daily Energy Requirements Using Food and Nutrition Board Formulas
Many people underestimate the size of their food portions, and so energy goals based on estimates of current calorie intake from food records can be inaccurate. You can estimate your daily energy needs using the formulas listed below. To use the appropriate formula for your sex, you’ll need to plug in the following:

• Age (in years)
• Weight (in pounds)
• Height (in inches)
• Physical activity coefficient (PA) from the table below.

To help estimate your physical activity level, consider the following guidelines: Someone who typically engages in 30 minutes of moderate-intensity activity, equivalent to walking two miles in 30 minutes, in addition to the activities involved in maintaining a sedentary lifestyle, is considered “low active”; someone who typically engages in the equivalent of 90 minutes of moderate-intensity activity is rated as “active.” You might find it helpful to refer back to Lab 2.2 to estimate your physical activity level.

<table>
<thead>
<tr>
<th>Physical Activity Level</th>
<th>Physical Activity Coefficient (PA)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Men</strong></td>
</tr>
<tr>
<td>Sedentary</td>
<td>1.00</td>
</tr>
<tr>
<td>Low active</td>
<td>1.12</td>
</tr>
<tr>
<td>Active</td>
<td>1.27</td>
</tr>
<tr>
<td>Very active</td>
<td>1.54</td>
</tr>
</tbody>
</table>

Estimated Daily Energy Requirement for Weight Maintenance in Men

\[
864 - (9.72 \times \text{age (years)}) + (\text{PA} \times [(6.39 \times \text{weight (pounds)}) + (12.78 \times \text{height (inches)})])
\]

1. \(9.72 \times \) ______ age (years) = ______
2. \(864 - \) ______ result from step 1 = ______ \([\text{result may be a negative number}]\)
3. \(6.39 \times \) ______ weight (pounds) = ______
4. \(12.78 \times \) ______ height (inches) = ______
5. ______ result from step 3 + ______ result from step 4 = ______
6. ______ PA (from table) \(\times\) ______ result from step 5 = ______
7. ______ result from step 2 + ______ result from step 6 = ______ calories per day
LABORATORY ACTIVITIES

Estimated Daily Energy Requirement for Weight Maintenance in Women

\[ 387 - (7.31 \times \text{age} \text{ (years)}) + (\text{PA} \times [(4.91 \times \text{weight}) + (16.78 \times \text{height})]) \]

1. \[ 7.31 \times \text{________ age (years)} = \text{________} \]
2. \[ 387 - \text{________, result from step 1 = ________} \] [result may be a negative number]
3. \[ 4.91 \times \text{________ weight (pounds)} = \text{________} \]
4. \[ 16.78 \times \text{________ height (inches)} = \text{________} \]
5. \[ \text{________, result from step 3 + ________}, result from step 4 = ________ \]
6. \[ \text{________, PA (from table) \times ________ result from step 5 = ________} \]
7. \[ 
\text{________, result from step 2 + ________}, result from step 6 = ________ calories per day} \]

Daily energy needs for weight maintenance (from formula): ________ calories/day

Part III Determining an Individual Daily Energy Goal for Weight Maintenance

If you calculated values for daily energy needs based on both methods, examine the two values. Some difference is likely—people tend to underestimate their food intake and overestimate their level of physical activity—but if the two values are very far off, check your food record and your physical activity estimate for accuracy, and make any necessary adjustments. For an individualized estimate of daily calorie needs, average the two values:

\[ \text{Daily energy needs} = (\text{food record result ________ calories/day} + \text{formula result ________ calories/day}) \div 2 \text{ ________ calories/day} \]

Using Your Results

How did you score? Are you surprised by the value you calculated for your approximate daily energy needs? If so, is the value higher or lower than you expected?

What should you do next? Enter the results of this lab in the Preprogram Assessment column in Appendix C. If you want to change your energy balance to lose weight, complete Lab 9.2 to set goals and develop specific strategies for change. (If your goal is weight gain, see p. 293 for basic guidelines.) One of the best ways to tip your energy balance toward weight loss is to increase your daily physical activity. If you include increases in activity as part of your program, then you can use the results of this lab to chart changes in your daily energy expenditure (and needs). Look for ways to increase the amount of time you spend in physical activity, thus increasing your physical activity coefficient. After several weeks of your program, complete this lab again, and enter the results in the Postprogram Assessment column of Appendix C. How do the results compare? Did your program for increasing physical activity show up as an increase in your daily energy expenditure and need?

LAB 9.2  Identifying Weight-Loss Goals

Negative Calorie Balance

Complete the following calculations to determine your weekly and daily negative calorie balance goals and the number of weeks to achieve your target weight.

Current weight \[ \text{lb} \] − target weight (from Lab 6.2) \[ \text{lb} \] = total weight to lose \[ \text{lb} \]

Total weight to lose \[ \text{lb} \] ÷ weight to lose each week \[ \text{lb} \] = time to achieve target weight \[ \text{weeks} \]

Weight to lose each week \[ \text{lb} \] × 3500 \( \text{cal/lb} \) = weekly negative calorie balance \[ \text{cal/week} \]

Weekly negative calorie balance \[ \text{cal/week} \] ÷ 7 days/week = daily negative calorie balance \[ \text{cal/day} \]

To keep your weight-loss program on schedule, you must achieve the daily negative calorie balance by either decreasing your calorie consumption (eating less) or increasing your calorie expenditure (being more active). Combining the two strategies may be most successful.

Changes in Activity Level

Adding a few minutes of exercise every day is a good way of expending calories. Use the calorie costs for different activities listed in the following table.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Cal/lb/min</th>
<th>×</th>
<th>Body weight</th>
<th>×</th>
<th>min</th>
<th>=</th>
<th>Total calories</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aerobic dance</td>
<td>.046</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basketball (half ct.)</td>
<td>.045</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bicycling (casual)</td>
<td>.049</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bicycling (13 mph)</td>
<td>.071</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elliptical exercise</td>
<td>.049</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Football (touch)</td>
<td>.049</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hiking</td>
<td>.051</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Housework</td>
<td>.029</td>
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</tr>
<tr>
<td>Jogging</td>
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<td>Rope skipping</td>
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<td>Soccer</td>
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<td>Swimming</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Walking (normal pace)</td>
<td>.029</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walking (briskly)</td>
<td>.048</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Activity | Duration | Calories Used
----------|----------|-----------------
LABORATORY ACTIVITIES

Changes in Diet

Look closely at your diet from one day, as recorded in Lab 8.2. Identify ways to cut calorie consumption by eliminating certain items or substituting lower-calorie choices. Be realistic in your cuts and substitutions; you need to develop a plan you can live with.

<table>
<thead>
<tr>
<th>Food Item</th>
<th>Substitute Food Item</th>
<th>Calorie Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
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<td></td>
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</tr>
</tbody>
</table>

Total calories cut: ____________________________________

Total calories expended + total calories cut = total negative calorie balance

Common Problem Eating Behaviors

For each of the groups of statements that appear below, check those that are true for you. If you check several statements for a given pattern or problem, it will probably be a significant factor in your weight-management program. One possible strategy for dealing with each type of problem is given. For those eating problems you identify as important, add your own ideas to the strategies listed.

1. ______ I often skip meals.
   ______ I often eat a number of snacks in place of a meal.
   ______ I don’t have a regular schedule of meal and snack times.
   ______ I make up for missed meals and snacks by eating more at the next meal.

Problem: Irregular eating habits

Possible solutions:

* Write out a plan for each day’s meals in advance. Carry it with you and stick to it.
* ____________________________
* ____________________________

2. ______ I eat more than one sweet dessert or snack each day.
   ______ I usually snack on foods high in calories and fat (chips, cookies, ice cream).
   ______ I drink regular (not sugar-free) soft drinks.
   ______ I choose types of meat that are high in fat.
   ______ I consume more than one alcoholic beverage a day.

Problem: Poor food choices

Possible solutions:

* Keep a supply of raw fruits and vegetables handy for snacks.
* ____________________________
* ____________________________

3. ______ I always eat everything on my plate.
   ______ I often go back for seconds and thirds.
   ______ I take larger helpings than most people.
   ______ I eat up leftovers instead of putting them away.

Problem: Portion sizes too large

Possible solutions:

* Measure all portions with a scale or measuring cup.
* ____________________________
* ____________________________
LAB 9.3  Checking for Body Image Problems and Eating Disorders

Assessing Your Body Image

Score Interpretation

The lowest possible score is 0, and this indicates a positive body image. The highest possible score is 36, and this indicates an unhealthy body image. A score higher than 14 suggests a need to develop a healthier body image.


Eating Attitudes Test to Evaluate Eating Disorder Risk

To help determine whether you might have an eating disorder that needs professional attention, answer the questions as accurately, honestly, and completely as possible; there are no right or wrong answers.

Part 1. Eating Attitudes Test (EAT-26)

Circle a response for each of the following statements.

1. Am terrified about being overweight.
   - Always
   - Usually
   - Often
   - Some times
   - Rarely
   - Never

2. Avoid eating when I am hungry.
   - Always
   - Usually
   - Often
   - Some times
   - Rarely
   - Never

3. Find myself preoccupied with food.
   - Always
   - Usually
   - Often
   - Some times
   - Rarely
   - Never

4. Have gone on eating binges where I feel that I may not be able to stop.
   - Always
   - Usually
   - Often
   - Some times
   - Rarely
   - Never

5. Cut my food into small pieces.
   - Always
   - Usually
   - Often
   - Some times
   - Rarely
   - Never

6. Aware of the calorie content of foods that I eat.
   - Always
   - Usually
   - Often
   - Some times
   - Rarely
   - Never

7. Particularly avoid food with a high carbohydrate content (i.e. bread, rice, potatoes, etc.)
   - Always
   - Usually
   - Often
   - Some times
   - Rarely
   - Never
LABORATORY ACTIVITIES

<table>
<thead>
<tr>
<th></th>
<th>Always</th>
<th>Usually</th>
<th>Often</th>
<th>Some times</th>
<th>Rarely</th>
<th>Never</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.</td>
<td>3</td>
<td>2</td>
<td>1</td>
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<td>1</td>
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<td>0</td>
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<td>1</td>
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<td>19.</td>
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<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<td>0</td>
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<td>1</td>
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<tr>
<td>24.</td>
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<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
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<td>25.</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>26.</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Total the points for your responses to determine your EAT-26 score: _____

Part 2. Behavioral Questions

Answer the following questions according to your behavior in the past 6 months. Circle the most appropriate response.

<table>
<thead>
<tr>
<th>In the past 6 months have you:</th>
<th>Never</th>
<th>Once a month or less</th>
<th>2-3 times a month</th>
<th>Once a week</th>
<th>2-6 times a week</th>
<th>Once a day or more</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Gone on eating binges where you feel that you may not be able to stop?*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>Ever made yourself sick (vomited) to control your weight or shape?</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>C</td>
<td>Ever used laxatives, diet pills or diuretics (water pills) to control your weight or shape?</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>D</td>
<td>Exercised more than 60 minutes a day to lose or to control your weight?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>Lost 20 pounds or more in the past 6 months</td>
<td>Yes</td>
<td>✓</td>
<td>No</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Defined as eating much more than most people would under the same circumstances and feeling that eating is out of control

Interpreting Your Results

If you meet one or more of the following criteria, evaluation by a qualified professional is recommended:

- A score of 20 or higher on EAT-26,
- A score in any of the checked boxes in the Behavioral Questions section, or
- A body mass index (BMI) that classifies you as underweight or very underweight using norms for sex and age (see the following table).
This screening is not designed to make a diagnosis of an eating disorder or take the place of a professional consultation. A high score on the EAT-26 assessment does not mean that you have an eating disorder, but it does indicate that you should seek the advice of a qualified mental health professional who has experience with treating eating disorders. If you have a low score on the EAT-26, you still could have problems with eating behavior or body image; if you are suffering from feelings that are causing you concern or interfering with your daily functioning, seek help.

Body Mass Index (BMI) Cutoffs for Classification of Underweight

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>females</th>
<th>males</th>
</tr>
</thead>
<tbody>
<tr>
<td>18</td>
<td>19</td>
<td>20</td>
</tr>
<tr>
<td>Very underweight</td>
<td>≤ 17.5</td>
<td>≤ 17.5</td>
</tr>
<tr>
<td>Underweight</td>
<td>17.6–18.0</td>
<td>17.6–18.0</td>
</tr>
</tbody>
</table>

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Using Your Results

How did you score? Are you surprised by your scores? Do the results of either assessment indicate that you may have a problem with body image or disordered eating?

What should you do next? If your results are borderline, consider trying some of the self-help strategies suggested in the chapter. If body image or disordered eating is a significant problem for you, get professional advice; a physician, therapist, and/or registered dietitian can help. Make an appointment today.
Looking Ahead...

After reading this chapter, you should be able to

- Explain what stress is and how people react to it—physically, emotionally, and behaviorally.
- Describe the relationship between stress and disease.
- Describe techniques for preventing and managing stress.
- Put together a plan for successfully managing the stress in your life.

Test Your Knowledge

1. Which of the following events can cause stress?
   a. taking out a loan
   b. failing a test
   c. graduating from college

2. Exercise stimulates which of the following?
   a. analgesia (pain relief)
   b. birth of new brain cells
   c. relaxation

3. Which of the following can be a result of chronic stress?
   a. violence
   b. heart attack
   c. stroke

See answers on the next page.
ike the term fitness, stress is a word many people use without really understanding its precise meaning. Stress is popularly viewed as an uncomfortable response to a negative event, which probably describes nervous tension more than the cluster of physical and psychological responses that actually constitutes stress. In fact, stress is not limited to negative situations: It is also a response to pleasurable physical challenges and the achievement of personal goals.

Whether stress is experienced as pleasant or unpleasant depends largely on the situation and the individual. Because learning effective responses to stress can enhance psychological health and help prevent a number of serious diseases, stress management can be an important part of daily life.

This chapter explains the physiological and psychological reactions that make up the stress response and describes how these reactions can be risks to good health. The chapter also presents methods of managing stress.

**WHAT IS STRESS?**

In common usage, the term stress refers to two different things: situations that trigger physical and emotional reactions **and** the reactions themselves. This text uses the more precise term stressor for a situation that triggers physical and emotional reactions and the term stress response for those reactions.

### Terms

**stressor** Any physical or psychological event or condition that produces physical and emotional reactions.

**stress response** The physical and emotional reactions to a stressor.

**stress** The general physical and emotional state that accompanies the stress response.

**autonomic nervous system** The branch of the nervous system that controls basic body processes; consists of the sympathetic and parasympathetic divisions.

**parasympathetic division** A division of the autonomic nervous system that moderates the excitatory effect of the sympathetic division, slowing metabolism and restoring energy supplies.

**sympathetic division** A division of the autonomic nervous system that reacts to danger or other challenges by almost instantly accelerating body processes.

A first date and a final exam are examples of stressors; sweaty palms and a pounding heart are symptoms of the stress response. We’ll use the term stress to describe the general physical and emotional state that accompanies the stress response. So, a person taking a final exam experiences stress.

### Physical Responses to Stressors

Imagine a near miss: As you step off the curb, a car speeds toward you. With just a fraction of a second to spare, you leap safely out of harm’s way. In that split second of danger and in the moments following it, you experience a predictable series of physical reactions. Your body goes from a relaxed state to one prepared for physical action to cope with a threat to your life.

Two systems in your body are responsible for your physical response to stressors: the nervous system and the endocrine system. Through rapid chemical reactions affecting almost every part of your body, these systems allow you to act quickly and appropriately in time.

#### Actions of the Nervous System

The nervous system consists of the brain, spinal cord, and nerves. Part of the nervous system is under voluntary control, as when you tell your arm to reach for a chocolate. The part that is not under conscious supervision—for example, the part that controls the digestion of the chocolate—is the autonomic nervous system. In addition to digestion, it controls your heart rate, breathing, blood pressure, and hundreds of other involuntary functions.

The autonomic nervous system consists of two divisions:

- **The parasympathetic division** is in control when you are relaxed. It aids in digesting food, storing energy, and promoting growth.
- **The sympathetic division** is activated during times of arousal, including exercise, and when there is an emergency, such as severe pain, anger, or fear.

Sympathetic nerves use the neurotransmitter norepinephrine (or noradrenaline) to affect nearly every organ, sweat gland, blood vessel, and muscle to enable your body to handle an emergency. In general, the sympathetic division commands your body to stop storing energy and to use it in response to a crisis.

#### Actions of the Endocrine System

During stress, the sympathetic nervous system triggers the endocrine system. This system of glands, tissues, and cells helps control body functions by releasing hormones and other chemical messengers into the bloodstream to influence metabolism and other body processes. These chemicals act on a variety of targets throughout the body. Along with the nervous system, the endocrine system prepares the body to respond to a stressor.

### The Two Systems Together

How do both systems work together in an emergency? Let’s go back to your near-collision
Pupils dilate to admit extra light for more sensitive vision.

Mucous membranes of nose and throat shrink, while muscles force a wider opening of passages to allow easier airflow.

Secretion of saliva and mucus decreases; digestive activities halt in an emergency.

Bronchi dilate to allow more air into lungs.

Perspiration increases, especially in armpits, groin, hands, and feet, to flush out waste and cool overheating system by evaporation.

Liver releases sugar into bloodstream to provide energy for muscles and brain.

Muscles of intestines stop contracting because digestion has halted.

Bladder relaxes. Emptying of bladder contents releases excess weight, making it easier to flee.

Blood vessels in skin and viscera contract; those in skeletal muscles dilate. This increases blood pressure and delivery of blood to where it is most needed.

Endorphins are released to block any distracting pain.

Heart rate accelerates and strength of contraction increases to allow more blood flow where it is needed.

Digestion, an unnecessary activity during an emergency, halts.

Spleen releases more red blood cells to meet an increased demand for oxygen and to replace any blood lost from injuries.

Adrenal glands stimulate secretion of epinephrine, increasing blood sugar, blood pressure, and heart rate; also spur increase in amount of fat in blood. These changes provide an energy boost.

Pancreas decreases secretions because digestion has halted.

Fat is removed from storage and broken down to supply extra energy.

Voluntary (skeletal) muscles contract throughout the body, readying them for action.

**FIGURE 10.1 The fight-or-flight reaction.**

with a car. Both reflexes and higher cognitive (thinking) areas in your brain quickly make the decision that you are facing a threat, and your body prepares to meet the danger. Chemical messages and actions of sympathetic nerves cause the release of key hormones, including cortisol and epinephrine. These hormones trigger the physiological changes shown in Figure 10.1, including these:

- Heart and respiration rates accelerate to speed oxygen through the body.
- Hearing and vision become more acute.
- The liver releases extra sugar into the bloodstream to boost energy.
- Perspiration increases to cool the skin.
- The brain releases endorphins—chemicals that can inhibit or block sensations of pain—in case you are injured.

**TERMS**

**norepinephrine** A neurotransmitter released by the sympathetic nervous system onto specific tissues to increase their function in the face of increased activity; when released by the brain, causes arousal (increased attention, awareness, and alertness); also called noradrenaline.

**endocrine system** The system of glands, tissues, and cells that secretes hormones into the bloodstream to influence metabolism and other body processes.

**hormone** A chemical messenger produced in the body and transported in the bloodstream to targeted cells or organs for specific regulation of their activities.

**cortisol** A hormone secreted by the cortex (outer layer) of the adrenal gland; also called hydrocortisone.

**epinephrine** A hormone secreted by the medulla (inner core) of the adrenal gland that affects the functioning of organs involved in responding to a stressor; also called adrenaline.

**endorphins** Brain secretions that have pain-inhibiting effects.
The fight-or-flight reaction is a part of our biological heritage, and it’s a survival mechanism that has served both humans and animals well. In modern life, however, it is often absurdly inappropriate. Many stressors we face in everyday life—such as an exam, a mess left by a roommate, or a stop light—do not require a physical response. The fight-or-flight reaction prepares the body for physical action regardless of whether such action is a necessary or appropriate response to a particular stressor.

**Emotional and Behavioral Responses to Stressors**

We all experience a similar set of physical responses to stressors, which makes up the fight-or-flight reaction. These responses, however, vary from person to person and from one situation to another. People’s perceptions of potential stressors—and their reactions to such stressors—also vary greatly. For example, you may feel confident about taking exams but be nervous about talking to people you don’t know, while your roommate may love challenging social situations but be nervous about taking tests. Many factors, some external and some internal, help explain these differences.

Your cognitive appraisal of a potential stressor strongly influences how you respond to it. Two factors that can reduce the magnitude of the stress response are successful prediction and the perception of control. For instance, receiving course syllabi at the beginning of the term allows you to predict the timing of major deadlines and exams. This gives you some control over your study plans and can help reduce the stress caused by exams.

The way we appraise potentially stressful situations is highly individual and strongly related to emotions. The facts of a situation—Who? What? Where? When?—are typically evaluated in the same way by each person involved. However, different people can evaluate the potential personal outcomes of a situation very differently: What does this mean for me? Can I do anything about it? Will it get better or worse? If you think you can’t cope with a situation, you may respond negatively and with an inappropriate stress response. If, on the other hand, you think of a situation as a challenge you can manage, you are likely to have a more positive and appropriate response. A moderate level of stress, if coped with appropriately, can help promote optimal performance (Figure 10.2).

**Effective and Ineffective Responses**

Common emotional responses to stressors include anxiety, depression, and fear. Although emotional responses are determined in part by inborn personality or temperament, we often can moderate or learn to control them. Coping techniques are discussed later in the chapter.

Behavioral responses to stressors—controlled by the somatic nervous system, which manages our conscious actions—are entirely under our control. Effective behavioral responses such as talking, laughing, exercising, meditating, learning time-management skills, and becoming more assertive can promote wellness and enable us to function at our best. Ineffective behavioral responses to stressors include overeating; expressing hostility; and using tobacco, alcohol, or other drugs.
Personality and Stress Some people seem to be nervous, irritable, and easily upset by minor annoyances; others are calm and composed even in difficult situations. Scientists remain unsure just why this is or how the brain’s complex emotional mechanisms work. But personality—the sum of behavioral, cognitive, and emotional tendencies—clearly affects how people perceive and react to stressors. To investigate the links among personality, stress, and wellness, researchers have looked at different clusters of characteristics, or “personality types.”

- **Type A.** People with Type A personality are described as ultracompetitive, controlling, impatient, aggressive, and even hostile. Type A people have a higher perceived stress level and more problems coping with stress. They react explosively to stressors and are upset by events that others would consider only annoyances. Studies indicate that certain characteristics of the Type A pattern—anger, cynicism, and hostility—increase the risk of heart disease.

- **Type B.** The Type B personality is relaxed and contemplative. Type B people are less frustrated by daily events and more tolerant of the behavior of others.

- **Type C.** The Type C personality is characterized by anger suppression, difficulty expressing emotions, feelings of hopelessness and despair, and an exaggerated response to minor stressors.

- **Type D.** The Type D personality tends toward negative emotional states such as anxiety, depression, and irritability. Type D people also avoid social interactions, worrying that others will react negatively toward them. Having this kind of personality predicts a number of poor health outcomes, including cardiovascular disease.

Depending on the situation, most of us display some of the behaviors characteristic of one or more of the types described.

Researchers have also looked for personality traits that enable people to deal more successfully with stress. One such trait is hardness, a particular form of optimism. People with a hardy personality view potential stressors as challenges and opportunities for growth and learning, rather than as burdens. Hardy people perceive fewer situations as stressful, and their reaction to stressors tends to be less intense. They are committed to their activities, have a sense of inner purpose and an inner locus of control, and feel at least partly in control of their lives.

The term resilience refers to personality traits associated with social and academic success in groups at risk for stress, such as people from low-income families and those with mental or physical disabilities. Resilient people tend to set goals and face adversity through individual effort. There are three basic types of resilience, and each one determines how a person responds to stress:

- **Nonreactive resilience,** in which a person does not react to a stressor
- **Homeostatic resilience,** in which a person may react strongly but returns to baseline functioning quickly
- **Positive growth resilience,** in which a person learns and grows from the stress experience

Resilience is associated with emotional intelligence and violence prevention.

You probably can’t change your basic personality, but you can change your typical behaviors and patterns of thinking, and you can use positive stress-management techniques like those described later in the chapter.

Gender and Stress Your gender role—the activities, abilities, and behaviors your culture expects based on your sex—can affect your experience of stress. Some behavioral responses to stressors, such as crying or openly expressing anger, may be deemed more appropriate for one gender than another.Strict adherence to gender roles, however, can limit one’s response to stress and can itself become a source of stress. Gender roles can also affect one’s perception of a stressor. If a man derives most of his self-worth from his work, for example, retirement may be more stressful for him than for a woman whose self-image is based on several roles.

Since the American Psychological Association began its yearly “Stress in America” survey in 2007, women have reported a higher level of stress than men. In 2014, more women than men reported that in the past year their stress had increased; in the past month stress had kept them awake at night and had caused them to feel lonely or isolated. In her book *Overwhelmed,* Brigid Schulte describes a continuing unequal gendered division of labor: families are working more hours than they used to (both parents combined worked an extra 13 hours per week in 2000 than they did in 1970), but American women spend even more time with their children than they did in the 1960s. How is this possible? Mothers tend to choose jobs that are flexible rather than very high-powered, they spend...
As Table 10.1 shows, the physical, emotional, and behavioral symptoms of excess negative stress are distinct. But they are also intimately interrelated. The more intense the emotional response, the stronger the physical response. Effective behavioral responses can lessen stress; ineffective ones only worsen it. Sometimes people have such intense responses to stressors or such ineffective coping techniques that they need professional help to overcome the stress in their lives. More often, however, people can learn to handle stressors on their own.

### The Stress Experience as a Whole

As Table 10.1 shows, the physical, emotional, and behavioral symptoms of excess negative stress are distinct. But they are also intimately interrelated. The more intense the emotional response, the stronger the physical response. Effective behavioral responses can lessen stress; ineffective ones only worsen it. Sometimes people have such intense responses to stressors or such ineffective coping techniques that they need professional help to overcome the stress in their lives. More often, however, people can learn to handle stressors on their own.

### STRESS AND WELLNESS

According to the American Psychological Association, in 2014 fewer Americans reported that stress had a strong impact on them physically (25%) or mentally (28%) than in 2011 (37% and 35%). Still, 75% reported having at least one symptom of stress in the past month. The role of stress in health is complex, but evidence suggests that stress can increase vulnerability to many ailments. Several theories have been proposed to explain the relationship between stress and disease.

### The General Adaptation Syndrome

Coined by biologist Hans Selye in the 1930s, the term **general adaptation syndrome (GAS)** describes what he believed to be a universal and predictable response pattern to all stressors. Some stressors are pleasant, such as attending a party, or unpleasant, such as a bad grade. In the GAS theory, stress triggered by a pleasant stressor is called **eustress**; stress triggered by an unpleasant stressor is called **distress**. The sequence of physical responses associated with GAS (Figure 10.3) is the same for both eustress and distress and occurs in three stages:

- **Alarm.** The alarm stage includes the complex sequence of events brought on by the fight-or-flight reaction. At this stage, the body is more susceptible to disease or injury because it is geared up to deal with a crisis. Someone in this phase may experience headaches, indigestion, anxiety, and disrupted sleeping and eating patterns.
Resistance. With continued stress, the body develops a new level of homeostasis in which it is more resistant to disease and injury than normal. In this stage, a person can cope with normal life and added stress.

Exhaustion. The first two stages of GAS require a great deal of energy. If a stressor persists, or if several stressors occur in succession, general exhaustion results. This is not the sort of exhaustion you feel after a long, busy day. Rather, it’s a life-threatening type of physiological exhaustion.

Allostatic Load

Although GAS is still viewed as a key conceptual contribution to the understanding of stress, some aspects of it are considered outdated. For example, increased susceptibility to disease after repeated or prolonged stress is now thought to be due to the effects of the stress response itself rather than to a depletion of resources (the exhaustion stage). In particular, long-term over-exposure to stress hormones such as cortisol has been linked with health problems. Further, although physical stress reactions promote homeostasis (resistance stage), they also have negative effects on the body. This long-term wear and tear of the stress response is called the allostatic load. A person’s allostatic load depends on many factors, including genetics, life experiences, and emotional and behavioral responses to stressors. A high allostatic load may be due to frequent stressors, poor adaptation to common stressors, an inability to shut down the stress response, or imbalances in the stress responses of different body systems. High allostatic load is linked to heart disease, hypertension, obesity, and reduced brain and immune system functioning. In other words, when your allostatic load exceeds your ability to cope, you are more likely to get sick.

Stress and Specific Conditions

Although much remains to be learned, it is clear that people who have unresolved chronic stress in their lives or who handle stressors poorly are at risk for a wide range of health problems. In the short term, the problem might just be a cold, a stiff neck, or a stomachache. Over the long term, the problems can be more severe, such as impairment of the immune system and cardiovascular disease.

Stress and the Immune System

Study of the stress hormones cortisol and epinephrine has provided a physical link between emotions and immune function. In general, increased levels of stress hormones are linked to a decrease in the number or functioning of immune system cells. Some of the health problems linked to stress-related changes in immune function include vulnerability to colds and other infections, asthma and allergy attacks, and flare-ups of chronic diseases such as genital herpes and HIV infection.

Different types of stress may affect immunity in different ways. For example, during acute stress (typically lasting less than 100 minutes), white blood cells move into the skin, where they enhance the immune response. During a stressful sequence of events, such as a personal trauma and the events that follow, however, there are typically no overall significant immune changes. Chronic (ongoing) stressors such as unemployment have negative effects on almost all functional measures of immunity. Chronic stress may cause prolonged secretion of cortisol and may accelerate the course of diseases that involve inflammation, including multiple sclerosis, heart disease, and type 2 diabetes.

Mood, personality, behavior, and immune functioning are intertwined. For example, people who are generally pessimistic may neglect the basics of health care, become passive when ill, and fail to engage in health-promoting behaviors. People who are depressed may reduce physical activity and social interaction, which may in turn affect the immune system and the cognitive appraisal of a stressor. Optimism, successful coping, and positive problem solving, on the other hand, may positively influence immunity.

Cardiovascular Disease

The stress response profoundly affects the cardiovascular system. During the stress response, heart rate increases and blood vessels constrict, causing blood pressure to rise. Chronic high blood pressure is a major cause of atherosclerosis, a disease in which the lining of the blood vessels becomes damaged and caked with fatty deposits. These deposits can block arteries, causing heart attacks and strokes (see Chapter 11).

Certain types of emotional responses increase a person’s risk of cardiovascular disease. People who tend to react to situations with anger and hostility are more likely to have heart attacks than are people with less explosive, more trusting personalities.

Other Health Problems

Many other health problems may be caused or worsened by excessive stress, including the following:

- Digestive problems such as stomachaches, diarrhea, constipation, irritable bowel syndrome, and ulcers.

Ask Yourself

QUESTIONS FOR CRITICAL THINKING AND REFLECTION

Have you ever been so stressed that you felt ill in some way? If so, what were your symptoms? How did you handle them? Did the experience affect the way you reacted to other stressful events?
Most people can overcome insomnia by discovering the cause of poor sleep and taking steps to remedy it. Insomnia that lasts for more than six months and interferes with daytime functioning requires consultation with a physician. Sleeping pills are not recommended for chronic insomnia because they can be habit-forming; they also lose their effectiveness over time.

If you’re bothered by insomnia, try the following:

- Determine how much sleep you need to feel refreshed the next day, and don’t sleep longer than that.
- Go to bed at the same time every night, and, more important, get up at the same time every morning, seven days a week, regardless of how much sleep you got.
- Don’t nap more than 30 minutes per day.
- Exercise regularly but not too close to bedtime. Your metabolism needs at least six hours to slow down after exercise.
- Avoid tobacco and caffeine late in the day, and alcohol before bedtime (it causes disturbed, fragmented sleep).
- If you take any medications (prescription or not), ask your doctor or pharmacist if they interfere with sleep.
- Have a light snack before bedtime; you’ll sleep better if you’re not hungry.
- Use your bed only for sleep. Don’t eat, read, study, or watch television in bed.
- Establish a relaxing bedtime routine that helps you unwind and lets your brain know it’s time to go to sleep. Read, listen to music, or practice a relaxation technique. Don’t lie down in bed until you’re sleepy.
- If you don’t fall asleep in 15–20 minutes, or if you wake up and can’t fall asleep again, get out of bed, leave the room if possible, and do something monotonous until you feel sleepy. Try distracting yourself with imagery instead of counting sheep; imagine yourself on a pleasant vacation or enjoying some beautiful scenery.
- If sleep problems persist, ask your doctor for a referral to a sleep specialist in your area. You may be a candidate for a sleep study—an overnight evaluation of your sleep pattern that can uncover many sleep-related disorders.

Tension headaches and migraines
Insomnia and fatigue (see the box “Overcoming Insomnia”)
Injuries, including on-the-job injuries caused by repetitive strain
Menstrual irregularities, impotence, and pregnancy complications
Psychological problems, including depression, anxiety, panic attacks, eating disorders, and posttraumatic stress disorder (PTSD), which afflicts people who have suffered or witnessed severe trauma

COMMON SOURCES OF STRESS

Recognizing potential sources of stress is an important step in successfully managing the stress in your life.

Major Life Changes

Any major change in your life that requires adjustment and accommodation can be a source of stress. Early adulthood and the college years are associated with many significant changes, such as moving out of the family home. Even changes typically thought of as positive—such as graduation, job promotion, or marriage—can be stressful.

Clusters of life changes, particularly those that are perceived negatively, may be linked to health problems in some people. Personality and coping skills, however, are important moderating influences. People with a strong support network and a stress-resistant personality are less likely to become ill in response to life changes than people with fewer resources.

A book titled The Upside of Stress suggests that if we embrace stressful events as opportunities to learn and grow, our health will not be as negatively impacted as it is when we worry about them.

Daily Hassles

Although major life changes are undoubtedly stressful, they seldom occur regularly. Researchers have proposed that minor problems—life’s daily hassles, such as losing your keys or wallet—can be an even greater source of stress because they occur much more often.

People who perceive hassles negatively are likely to experience a moderate stress response every time they are faced with one. Over time, this can take a significant toll on health. Studies indicate that for some people, daily hassles contribute to a general decrease in overall wellness.

College Stressors

College is a time of major changes and minor hassles. For many students, college means being away from home and family for the first time. Nearly all students share stresses like the following:

- Academic stress. Exams, grades, and an endless workload await every college student but can be especially troublesome for young students just out of high school.
In America survey. Tight schedules and overtime leave less time for exercising, socializing, and other stress-proofing activities. Worries about job performance, salary, job security, and interactions with others can contribute to stress. High levels of job stress are also common for people who are left out of important decisions relating to their jobs. When workers are given the opportunity to shape their job descriptions and responsibilities, job satisfaction goes up and stress levels go down.

If job-related (or college-related) stress is severe or chronic, the result can be burnout, a state of physical, mental, and emotional exhaustion. Burnout occurs most often in highly motivated and driven individuals who come to feel that their work is not recognized or that they are not accomplishing their goals. People in the helping professions—teachers, social workers, caregivers, police officers, and so on—are also prone to burnout. For some people who suffer from burnout, a vacation or leave of absence may be appropriate. For others, a reduced work schedule, better communication with superiors, or a change in job goals may be necessary. Improving time-management skills can also help.

Relationships and Stress

Human beings need social relationships; we cannot thrive as solitary creatures. Simply put, people need people. Even so, our interpersonal relationships—even our deepest, most intimate ones—can be one of the most significant sources of stress in our life.

The first relationships we form outside the family are friendships. With members of either the same or the other sex, friendships give people the opportunity to share themselves and discover others. Friendships are often more stable and longer lasting than intimate partnerships. Friends are often more accepting and less critical than lovers, probably because their expectations are different. During times of stress, in fact, many people initially turn to their friends for comfort, rather than family members or lovers.

Intimate love relationships are among the most profound human experiences. When two people fall in love, their relationship at first is likely to be characterized by high levels of passion and rapidly increasing intimacy. In time, passion decreases as the partners become familiar with each other. The diminishing of passionate love often creates stress between partners (usually affecting one partner more than the other) and can be experienced as a crisis in the relationship. If a quieter, more lasting love fails to emerge, the relationship will likely break up, and each person will search for another who will once again ignite his or her passion.

The key to developing and maintaining any type of friendship or intimate relationship is good communication. Miscommunication creates frustration and distances us from our friends and partners. (For more information, see the section “Communication” later in this chapter.)

Other Stressors

Environmental stressors—external conditions or events that cause stress—include loud noises, unpleasant smells, industrial
accidents, violence, and natural disasters. (See Appendix A for preparation and coping strategies for large-scale disasters.) Internal stressors are found within ourselves. We put pressure on ourselves to reach personal goals and then evaluate our progress and performance. Physical and emotional states such as illness and exhaustion are also internal stressors.

**MANAGING STRESS**

What can you do about all this stress? A great deal. By pursuing a wellness lifestyle—being physically active, eating well, getting enough sleep, and so on—and by learning simple ways to identify and moderate individual stressors, you can control the stress in your life.

**Exercise**

Researchers have found that people who exercise regularly react with milder physical stress responses before, during, and after exposure to stressors and that their overall sense of well-being increases as well (see the box “Does Exercise Improve Mental Health?”). Although even light exercise can have a beneficial effect, an integrated fitness program can have a significant impact on stress.

For some people, however, exercise can become just one more stressor in an already stressful life. People who exercise compulsively risk overtraining, a condition characterized by fatigue, irritability, depression, and diminished athletic performance. An overly strenuous exercise program can even make a person sick by compromising immune function. (For information on creating a safe and effective exercise program, refer to Chapter 7.)

**Nutrition**

A healthy, balanced diet can help you cope with stress. In addition, eating wisely will enhance your feelings of self-control and self-esteem. Avoiding or limiting caffeine is also important in stress management. Caffeine, a mildly addictive stimulant, leaves some people jittery, irritable, and unable to sleep. Consuming caffeine during stressful situations can raise blood pressure and increase levels of cortisol. (For more on sound nutrition and for advice on evaluating dietary supplements, many of which are marketed for stress, see Chapter 8.)

**Sleep**

Most adults need seven–nine hours of sleep every night to stay healthy and perform their best, but many do not get that much. (See the box “Apps for Improving and Tracking Sleep.”) Getting enough sleep isn’t just good for you physically; adequate sleep also improves mood, fosters feelings of competence and self-worth, enhances mental functioning, and supports emotional functioning.

**Sleep and Stress** Stress hormone levels in the bloodstream vary throughout the day and are related to sleep patterns. Peak concentrations of these hormones occur in the early morning, followed by a slow decline during the day and evening. Concentrations return to peak levels during the final stages of sleep and in the early morning hours.

Even though stress hormones are released during sleep, it is the lack of sleep that has the greatest impact on stress. In someone who is suffering from sleep deprivation (not getting enough sleep over time), mental and physical processes deteriorate steadily. A sleep-deprived person experiences headaches, feels irritable, is unable to concentrate, and is more prone to forgetfulness. Poor-quality sleep has long been associated with stress and depression. Acute sleep deprivation slows the daytime decline in stress hormones, so evening levels are higher than normal. A decrease in total sleep time also causes an increase in the level of stress hormones. Together, these changes may cause an increase in stress hormone levels throughout the day and may contribute to physical and mental exhaustion. Extreme sleep deprivation can lead to hallucinations and other psychotic symptoms, as well as to a significant increase in heart attack risk.
The overall conclusion from many published studies is that exercise—even modest activity such as taking a daily walk—can help combat a variety of mental health problems. Overall, physically active people who exercise 2.5–7.5 hours per week are about 25–30% less likely to feel distressed than inactive people. Regardless of the number, age, or health status of the people being studied, those who were active managed stress better than their inactive counterparts. Among athletic teenagers, there is a correlation between exercise and improved social interaction, as well as between exercise and enhanced looks (e.g., better body structure), two factors that contribute to mental health. Physical activity has also been shown to improve conditions for people with anxiety, affective, eating, and substance use disorders; as well as schizophrenia and dementia. (In some studies, therapeutic contact, social support, and distraction have been found to have some of the same positive effects of low-intensity exercise.)

A simple walk can be very effective: One study found that taking a long walk can reduce anxiety and blood pressure. Another showed that a brisk walk of as little as 10 minutes’ duration can leave people feeling more relaxed and energetic for up to two hours. People who took three brisk 45-minute walks each week for three months reported that they perceived fewer daily hassles and had a greater sense of general wellness.

The findings are not surprising. The stress response mobilizes energy resources and readies the body for physical emergencies. If you experience stress and do not exert yourself physically, you are not completing the energy cycle. You may not be able to exercise while your daily stressors are occurring, but you can be active later in the day. Such activity allows you to expend the nervous energy you have built up and trains your body to return more readily to homeostasis after stressful situations. Physical activity also helps you sleep better. Sound sleep is critical to managing stress. According to the National Sleep Foundation, people who exercise vigorously are the most likely to report a good night’s sleep. Of those who do not regularly exercise, about one-half report being wakeful during the night, every night. Quality sleep and regular exercise work in a cycle, so that a decrease in one can lead to a decrease in the other. There are about 70 known sleep disorders, and disordered sleep is associated with a variety of physical and neurological problems, including health problems related to stress. Regular activity promotes better sleep and provides some protection against sleep interruptions such as insomnia and sleep apnea.

Consistent, restful sleep is now regarded as a protective factor in disorders such as depression, anxiety, obesity, and heart disease.


**Sleep Disorders**  According to the National Sleep Foundation’s 2013 Sleep in America Poll, adults sleep just under seven hours per night during the week, on average. (Compare this to the recommended seven–nine hours per night.) The 2015 Sleep in America Poll reports that those who made sleep a priority slept an average of 36 minutes more per night than those who were less motivated to get enough sleep. Many Americans cope with lack of sleep by trying to get extra sleep on the weekends, by napping, and by consuming lots of caffeine during the day. As many as 70 million Americans suffer from chronic sleep disorders—medical conditions that prevent them from sleeping well.

According to the National Sleep Foundation, more than 50% of adults suffer from at least one symptom of insomnia—trouble falling asleep or staying asleep. The most common causes of insomnia are lifestyle factors, such as high caffeine or alcohol intake before bedtime; medical problems, such as a breathing disorder; and stress. About 50% of people who suffer from chronic insomnia report some stressful life event at the onset of their sleeping problems.

Another type of chronic sleep problem, called sleep apnea, occurs when a person stops breathing while asleep (Figure 10.4).

Apnea can be caused by a number of factors, but it typically results when the soft tissue at the back of the mouth (such as the tongue or soft palate) “collapses” during sleep, blocking the airway. When breathing is interrupted, so is sleep, as the sleeper awaken repeatedly throughout the night to begin breathing.

**Figure 10.4  Sleep apnea.** Sleep apnea occurs when soft tissue surrounding the airways relax, “collapsing” the airways and restricting airflow.
Are you getting enough sleep? If you’re like the average American you get less than the recommended 7–9 hours of sleep each night. Because chronic sleep disorders affect 70 million people, the Centers for Disease Control and Prevention calls sleep deprivation a national public epidemic.

**Digital Devices and Sleep** Before we look at sleep apps, it is important to consider how use of your digital devices can negatively impact your sleep. Tablets, smartphones, and computers emit blue light, which impedes the release of melatonin, a hormone that affects sleep and wake cycles. In one study, researchers compared the sleep of people who read an eBook on a digital device with people who read a print book in the hours before bedtime. Those who read the digital book took longer to fall asleep, had reduced melatonin release, and were less alert the next morning.

Could heavy texting affect sleep? Psychologist Karla Murdock reported that texting was a direct predictor of sleep problems among first-year students in a study that examined links among interpersonal stress, text-messaging behavior, and three indicators of college students’ health: burnout, sleep problems and emotional well-being.

Murdock and other sleep experts suggest turning off your screens. Use them less during the day and also when preparing to sleep at night. If you have trouble relaxing and transitioning to sleep in the evenings, try shutting down all your devices an hour or more before you intend to sleep.

Now that you are resting in the dark, why would you consider using a sleep app or tracker on your digital device? Ironically, a smartphone may help you get to sleep—if you tuck it into the corner of your bed.

**Aids for Relaxation** There are many free and low-cost apps that provide aids for relaxation and to improve sleep. Some include music, white noise, or sounds of nature (for example, wind, rain, waves, or songbirds). Others offer specific techniques, such as guided meditation or breathing exercises, to promote relaxation in aid to falling asleep. Examples include Sleepmaker Rain, Nature Sounds Relax and Sleep, Sleep Soundly Hypnosis, Long Deep Breathing, and Relax & Sleep by Glenn Harrold.

**Sleep Trackers** More complicated technologies attempt to track and analyze sleep. Many are based on movement detectors in smartphones. These apps estimate the amount and type of sleep you get based on your movements during the night; they may generate detailed graphs of your sleep quality and then time your wake-up alarm to a specific sleep cycle. Some apps also include a sound recorder, which detects sleep talking, snoring, and other night noises, providing further information. Sleep apps include Sleepbot, Sleep Cycle, Pillow, and Smart Alarm Clock.

In addition to smartphone apps, specialized fitness wristbands such as Fitbit and Garmin include sleep trackers. Many of these are also based on movement detectors, but some incorporate heart-rate data as well; some preliminary research indicates that adding heart rate data to movement tracking may improve the accuracy of the results. Fitbit and other wearables, along with some apps, may combine sleep and fitness data into an overall picture of an individual’s activity over the course of a day.

Apps and devices may be popular, but no consumer technology yet developed can equal the capability of a sleep lab at detecting sleep stages or diagnosing specific sleep disorders. If you enjoy the features of an app or wearable tracker, go ahead and use them; but don’t rely on an app to diagnose the presence or absence of a serious sleep problem. One good effect of using a sleep tracker is simply the greater focus it places on sleep.

again. In most cases, this occurs without the sleeper even being aware of it. However, the disruption to sleep can be significant, and over time acute sleep deprivation can result from apnea. There are several treatments for apnea, including medications, special devices that help keep the airway open during sleep, and surgery.

**Social Support**

Meaningful connections with others can play a key role in stress management and overall wellness. Sharing fears, frustrations, and joys makes life richer and seems to contribute to the well-being of body and mind. One study of college students living in overcrowded apartments, for example, found that those with a strong social support system were less distressed by their cramped quarters than those who navigated life’s challenges on their own. Other studies have shown that married people live longer than single people and have lower death rates from a wide range of conditions, although some studies suggest that marriage benefits men more than women. And people infected with HIV remain symptom-free longer if they have a strong social support network. A sense of isolation can lead to chronic stress, which in turn can increase one’s susceptibility to temporary illnesses, like colds, and to chronic illnesses, such as heart disease.

Although the mechanism isn’t clear, social isolation can be as significant to mortality rates as factors like smoking, high blood pressure, and obesity. There is no single best pattern of social support that works for everyone. However, research suggests that having a variety of types of relationships may be important for wellness. Here are some tips for strengthening your social ties:

- Foster friendships. Keep in regular contact with your friends. Offer respect, trust, and acceptance, and provide help and support in times of need. Build your communication skills, and express appreciation for your friends.
- Keep your family ties strong. Stay in touch with the family members you feel close to. If your family doesn’t function well as a support system for its members, create a second “family” of people with whom you have built meaningful ties.
- Get involved with a group. Do volunteer work, take a class, attend a lecture series, or join a religious group. These types of activities can give you a sense of security, a place to talk about your feelings or concerns, and a way to build new friendships. Choose activities that are meaningful to you and that include direct involvement with other people.

**Communication**

Good communication skills can help everyone form and maintain healthy relationships. Communicating in an assertive way that respects the rights of others—as well as your own—can prevent potentially stressful situations from getting out of control. When friends or partners communicate effectively, they can reduce the stresses in their relationship and spend more time focusing on the positive aspects of being together.

Three keys to good communication in relationships are self-disclosure, listening, and feedback.

- **Self-disclosure** involves revealing personal information that we ordinarily wouldn’t reveal because of the risk involved. It usually increases feelings of closeness and moves the relationship to a deeper level of intimacy.
- **Listening** is a rare skill. Good listening skills require that we spend more time and energy trying to fully understand another person’s “story” and less time judging, evaluating, blaming, advising, analyzing, or trying to control. Empathy, warmth, respect, and genuineness are qualities of skillful listeners. Attentive listening encourages friends or partners to share more and, in turn, to be attentive listeners. To connect with other people and develop real emotional intimacy, listening is essential.
- **Feedback**, a constructive response to another’s self-disclosure, is the third key to good communication. Giving positive feedback means acknowledging that the friend’s or partner’s feelings are valid—no matter how upsetting or troubling—and offering self-disclosure in response. Self-disclosure and feedback can open the door to change, whereas other responses block communication and change.

For tips on improving your skills, see the box “Guidelines for Effective Communication.”

Some people have trouble either telling others what they need or saying no to the needs of others. They may suppress their feelings of anger, frustration, and resentment, and they may end up feeling taken advantage of or suffering in unhealthy relationships. At the other extreme are people who express anger openly and directly by being verbally or physically aggressive or indirectly by making critical, hurtful comments to others. Their abusive behavior pushes other people away, so they also have problems with relationships.
Negotiation will help dissipate the anger so the conflict can be resolved. Some basic strategies are useful in successfully negotiating with a friend, family member, colleague, or intimate partner:

1. **Clarify the issue.** Take responsibility for thinking through your feelings and discovering what’s really bothering you. Agree that one of you will speak first and have the chance to speak fully while the other listens. Then reverse the roles. Try to understand the other person’s position fully by repeating what you’ve heard and asking questions to clarify or elicit more information.

2. **Find out what each person wants.** Ask the other person to express her or his desires. Don’t assume you already know what those desires are, and don’t try to speak for your friend or partner.

3. **Determine how you both can get what you want.** Brainstorm to generate a variety of options.

4. ** Decide how to negotiate.** Work out a plan for change. For example, agree that one of you will do one task and the other...

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**TAKE CHARGE**

**Guidelines for Effective Communication**

**Getting Started**

- When you want to have a serious discussion with your partner, choose an appropriate time and place. Find a private place and a time when you will not be interrupted.

- Face your partner and maintain eye contact. Use nonverbal feedback to show that you are interested and involved in the communication process.

**Being an Effective Speaker**

- State your concern or issue as clearly as you can.

- Use “I” statements—statements about how you feel—rather than statements beginning with “You,” which tell another person how you think he or she feels. When you use “I” statements, you are taking responsibility for your feelings. “You” statements are often blaming or accusatory and will probably get a defensive or resentful response. The statement “I feel unloved,” for example, sends a clearer, less blaming message than the statement “You don’t love me.”

- Focus on a specific behavior rather than on the whole person. Be specific about the behavior you like or don’t like. Avoid generalizations beginning with “You always” or “You never.” Such statements make people feel defensive.

- Make constructive requests. Opening your request with “I would like” keeps the focus on your needs rather than on your partner’s supposed deficiencies.

- Avoid blaming, accusing, and belittling. Even if you are right, you have little to gain by putting your partner down.

- Avoid controlling your anger, you can benefit from learning anger management strategies; see the box “Dealing with Anger.”

- **Conflicts Resolution**

Conflict is natural in any relationship, and it can become a key source of stress for friends, coworkers, family members, and intimate partners. No matter how close two people become, they still remain separate individuals with their own needs, desires, past experiences, and ways of seeing the world. Conflict itself isn’t dangerous to a relationship; it may simply indicate that the relationship is growing. But if it isn’t handled in a constructive way, conflict can damage—and ultimately destroy—a relationship.

Conflict is often accompanied by anger—a universal emotion, but one that can be difficult to handle. When angry, both parties should back off until they calm down and then come back to the issue later and try to resolve it rationally. Studies have shown that when people feel criticized or attacked, they are less able to think rationally or solve problems constructively.

- **Face for action ahead of time.** Tell your partner what you would like to happen in the future; don’t wait for him or her to blow it and then express anger or disappointment.

- **Being an Effective Listener**

- Provide appropriate nonverbal feedback (nodding, smiling, and so on).

- Don’t interrupt.

- Develop the skill of reflective listening. Don’t judge, evaluate, analyze, or offer solutions (unless asked to do so). Your partner may just need to have you there in order to sort out feelings. By jumping in right away to “fix” the problem, you may be cutting off communication.

- Don’t give unsolicited advice. Giving advice implies that you know more about what a person needs to do than he or she does; therefore, it often evokes anger or resentment.

- Clarify your understanding of what your partner is saying by restating it in your own words and asking if your understanding is correct.

- Be sure you are really listening, not off somewhere in your mind rehearsing your reply. Try to tune in to your partner’s feelings as well as the words.

- Let your partner know that you value what she or he is saying and want to understand. Respect for the other person is the cornerstone of effective communication.
Anger is a universal response to something we perceive as injustice, betrayal, insult, or some other wrong—whether real or imagined. We may respond physically with faster heart and breathing rates, muscle tension, trembling, a knot in the stomach, or a red face. When anger alerts us that something is wrong, it is a useful emotion that can lead to constructive change. When anger leads to loss of control and to aggression, it causes problems.

According to current popular wisdom, it’s healthy to express your feelings, including anger. However, research has shown that people who are overtly hostile are at higher risk for heart disease and heart attacks than calmer people. In addition, expressing anger in thoughtless or out-of-control ways can damage personal and professional relationships.

People who experience rage or explosive anger are particularly at risk for negative repercussions. Some of these people may have intermittent explosive disorder, characterized by aggressiveness that is impulsive and out of proportion to the stimulus. Explosive anger renders people temporarily unable to think straight or act in their own best interests. Counseling can help very angry people learn how to manage their anger.

In dealing with anger, it is important to distinguish between a reasonable degree of self-assertiveness and a gratuitous expression of aggression. When you are assertive, you stand up for your own rights at the same time that you respect the rights of others. When you are aggressive, you violate the rights of others.

Managing Your Own Anger

What are the best ways to handle anger? If you find yourself in a situation where you are getting angry, answer these questions:

- Is the situation important enough to get angry about?
- Are you truly justified in getting angry?
- Is expressing your anger going to make a positive difference?

If the answer to all these questions is yes, then calm, assertive communication may be appropriate. Use “I” statements to express your feelings (“I would like . . .” “I feel . . .”), and listen respectfully to the other person’s point of view. Don’t attack verbally or make demands; try to negotiate a constructive, mutually satisfying solution.

If you answer no to any of the questions, try to calm yourself. First, reframe the situation by thinking about it differently. Try these strategies:

- Don’t take it personally—maybe the driver who cut you off simply didn’t see you.
- Look for mitigating factors—maybe the classmate who didn’t say hello was preoccupied with money concerns.
- Practice empathy—try to see the situation from the other person’s point of view.
- Ask questions—clarify the situation by asking what the other person meant. Avoid defensiveness.
- Focus on the present—don’t let this situation trigger thoughts of past incidents that you perceive as similar.

Second, calm your body down.

- Use the old trick of counting to 10 before you respond.
- Concentrate on your breathing, and take long, slow breaths.
- Imagine yourself in a beautiful, peaceful place.
- If needed, take a longer cooling-off period by leaving the situation until your anger has subsided.

Dealing with Other People’s Anger

If someone you are with becomes very angry, try these strategies:

- Respond asymmetrically—remain calm. Don’t get angry in response.
- Apologize if you think you are to blame. (Don’t apologize if you don’t think you are to blame.)
- Validate the other person by acknowledging that he or she has some reason to be angry. However, don’t accept verbal abuse.
- Focus on the problem and ask what can be done to alleviate the situation.
- If the person cannot be calmed, disengage from the situation, at least temporarily. After a time-out, attempts at rational problem solving may be more successful.

Warning Signs of Violence

Violence is never acceptable. The following behaviors over a period of time suggest the potential for violence:

- A history of making threats and engaging in aggressive behavior
- Drug or alcohol abuse
- Gang membership
- Access to or fascination with weapons
- Feelings of rejection or aloneness; the feeling of constantly being disrespected; victimization by bullies
- Withdrawal from usual activities and friends; poor school performance
- Failure to acknowledge the rights of others

The following are immediate warning signs of violence:

- Daily loss of temper or frequent physical fighting
- Significant vandalism or property damage
- Increased risk-taking behavior; increased drug or alcohol abuse
- Threats or detailed plans to commit acts of violence
- Pleasure in hurting animals
- The presence of weapons

Don’t spend time with someone who shows these warning signs of violence. Don’t carry a weapon or resort to violence to protect yourself. Ask someone in authority or an experienced professional for help.
other will do another task or that one of you will do a task in exchange for something she or he wants.

5. **Solidify the agreements.** Go over the plan verbally and write it down, if necessary, to ensure that you both understand and agree to it.

6. **Review and renegotiate.** Decide on a time frame for trying out the new plan and set a time to discuss how it’s working. Make adjustments as needed.

**Striving for Spiritual Wellness**

Spiritual wellness is associated with greater coping skills and higher levels of overall wellness. Researchers have linked spiritual wellness to longer life expectancy, reduced risk of disease, faster recovery, and improved emotional health. Although spirituality is difficult to define and study, and researchers aren’t sure how or why spirituality seems to improve health, several explanations have been offered. Lab 10.3 includes exercises designed to help you build spiritual wellness; choose activities that are most meaningful to you from among the ideas suggested in the lab.

**Confiding in Yourself through Writing**

Keeping a diary is like confiding in someone else, except that you are confiding in yourself. This form of coping with severe stress may be especially helpful for those who are shy or introverted and find it difficult to open up to others. Although writing about traumatic and stressful events may have a short-term negative effect on mood, over the long term, stress is reduced and positive changes in health occur. A key to promoting health and well-being through journaling is to write about your emotional responses to stressful events. Set aside a special time each day or week to write down your feelings about stressful events in your life.

**Time Management**

Learning to manage your time can be crucial to coping with everyday stressors. Over-commitment, procrastination, and even boredom are significant stressors for many people. Along with gaining control of nutrition and exercise to maintain a healthy energy balance, time management is an important element in a wellness program. Try these strategies for improving your time-management skills:

- **Set priorities.** Divide your tasks into three groups: essential, important, and trivial. Focus on the first two, and ignore the third.

- **Schedule tasks for peak efficiency.** You probably know that you’re most productive at certain times of the day (or night). Schedule as many of your tasks for those hours as you can, and stick to your schedule.

- **Set realistic goals and write them down.** Attainable goals spur you on. Impossible goals, by definition, cause frustration and failure. Fully commit yourself to achieving your goals by putting them in writing.

- **Budget enough time.** For each project you undertake, calculate how much time you will need to finish it. Then tack on another 10–15%, or even 25%, as a buffer.

- **Break up long-term goals into short-term ones.** Instead of waiting for large blocks of time, use short amounts of time to start a project or keep it moving.

- **Visualize achieving your goal.** By mentally rehearsing a task, you will be able to do it more smoothly.

- **Keep track of the tasks you put off.** Analyze the reasons you procrastinate. If the task is difficult or unpleasant, look for ways to make it easier or more fun. For example, if you find the readings for one of your classes particularly difficult, choose an especially nice setting for your reading, and then reward yourself each time you complete a section or chapter.

- **Consider doing your least favorite tasks first.** Once you have the most unpleasant task, you can work on the tasks you enjoy more.

- **Consolidate tasks when possible.** For example, try walking to the store so that you run your errands and exercise in the same block of time.

- **Identify quick transitional tasks.** Keep a list of 5- to 10-minute tasks you can do while waiting or between other tasks, such as watering your plants, doing the dishes, or checking a homework assignment.

- **Delegate responsibility.** Asking for help when you have too much to do is no cop-out; it’s good time management. Just don’t delegate the jobs you know you should do yourself.

- **Say no when necessary.** If the demands made on you don’t seem reasonable, say no—tactfully but without guilt or apology.

**Wellness Tip**  Managing the many commitments of adult life—including work, school, and parenthood—can sometimes feel overwhelming and produce a great deal of stress. Time management and problem-solving skills, including careful scheduling with a date book, smartphone, or tablet, can help you cope with busy days.
### Table 10.2 Avoiding Negative Self-Talk

<table>
<thead>
<tr>
<th>COGNITIVE DISTORTION</th>
<th>NEGATIVE SELF-TALK</th>
<th>POSITIVE SELF-TALK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Focusing on negatives</td>
<td>School is so discouraging—nothing but one hassle after another.</td>
<td>School is pretty challenging and has its difficulties, but there certainly are rewards. It’s really a mixture of good and bad.</td>
</tr>
<tr>
<td>Expecting the worst</td>
<td>Why would my boss want to meet with me this afternoon if not to fire me?</td>
<td>I wonder why my boss wants to meet with me. I guess I’ll just have to wait and see.</td>
</tr>
<tr>
<td>Overgeneralizing</td>
<td>[After getting a poor grade on a paper] Just as I thought—I’m incompetent at everything.</td>
<td>I’ll start working on the next paper earlier. That way, if I run into problems I’ll have time to talk to the TA.</td>
</tr>
<tr>
<td>Minimizing</td>
<td>I won the speech contest, but none of the other speakers was very good. I wouldn’t have done as well against stiffer competition.</td>
<td>It may not have been the best speech I’ll ever give, but it was good enough to win the contest.</td>
</tr>
<tr>
<td>Blaming others</td>
<td>I wouldn’t have eaten so much last night if my friends hadn’t insisted on going to that restaurant.</td>
<td>I overdid it last night. Next time I’ll make different choices.</td>
</tr>
<tr>
<td>Expecting perfection</td>
<td>I should have scored 100% on this test. I can’t believe I missed that one problem through a careless mistake.</td>
<td>Too bad I missed one problem through carelessness, but overall I did very well on this test. Next time I’ll be more careful.</td>
</tr>
</tbody>
</table>

- *Give yourself a break.* Allow time for play—free, unstructured time when you can ignore the clock. Don’t consider this a waste of time. Play renews you and enables you to work more efficiently.
- *Avoid your personal “time sinks.”* You can probably identify your own time sinks—activities like watching television, surfing the Internet, or talking on the phone that consistently use up more time than you anticipate and put you behind schedule. Some days, it may be best to avoid problematic activities altogether; for example, if you have a big paper due, don’t sit down for a five-minute TV break if it is likely to turn into a two-hour break. Try a five-minute walk if you need to clear your head.
- *Stop thinking or talking about what you’re going to do, and just do it!* Sometimes the best solution for procrastination is to stop waiting for the right moment and just get started. You will probably find that things are not as bad as you feared, and your momentum will keep you going.

For more help with time management, complete Activity 10 in the Behavior Change Workbook.

### Cognitive Techniques

Certain thought patterns and ways of thinking, including ideas, beliefs, and perceptions, can contribute to stress and have a negative impact on health. But other habits of mind, if practiced with patience and consistency, can help break unhealthy thought patterns. An important skill is to distinguish between types of stressors: “eustress” or “challenge stressors” create positive experiences and opportunities for growth, versus “distress” or “hindrance stressors,” which can impede growth and life satisfaction levels. Below are some suggestions for changing destructive thinking:

- Monitor your self-talk and try to minimize hostile, critical, suspicious, and self-deprecating thoughts. Substituting positive self-talk for negative self-talk can help you build and maintain self-esteem and cope better with the challenges in your life. (see Table 10.2).
- Modify your expectations. They often restrict experience and lead to disappointment. Try to accept life as it comes.
- Live in the present. Clear your mind of old debris and fears so you can enjoy life as it is now.
- Go with the flow. Accept what you can’t change, forgive others for their faults, and be flexible.

Cultivating your sense of humor is another key cognitive stress-management technique. Even a fleeting smile produces changes in your autonomic nervous system that can lift your spirits. Heart laughter triggers the release of endorphins, and after a good laugh, your muscles go slack and your pulse and blood pressure dip below normal; you are relaxed.

### Relaxation Techniques

The **relaxation response** is a physiological state characterized by a feeling of warmth and quiet mental alertness. This state is the opposite of the fight-or-flight response. When you induce the relaxation response by using a relaxation technique, your heart rate, breathing, and metabolism slow down. Blood pressure and oxygen consumption decrease. At the same time, blood flow to the brain and skin increases, and brain waves shift from an alert beta rhythm to a relaxed alpha rhythm.

The techniques described in this section are among the most popular techniques and the easiest to learn; also, see the box “Relaxing through Meditation.” All these techniques take practice, so it may be several weeks before the benefits become noticeable in everyday life.
Techniques for managing stress by inducing the relaxation response have been developed in many cultures over the centuries. Qigong, yoga, tai chi, and meditation can all complement or supplement other stress therapies.

At its most basic level, meditation, or self-reflective thought, involves quieting or emptying the mind to achieve deep relaxation. Some practitioners of meditation view it on a deeper level as a means of focusing concentration, increasing self-awareness, and bringing enlightenment to their lives. Meditation has been integrated into the practices of several religions—Buddhism, Hinduism, Confucianism, Taoism—but it is not a religion itself, nor does its practice require any special knowledge, belief, or background.

There are many styles of meditation, based on different ways of quieting the mind. Here is a simple, practical technique for eliciting the relaxation response using one style:

1. Pick a word, a phrase, or an object to focus on. You can choose a word or phrase that has a deep meaning for you, but any word or phrase will work. Some meditators prefer to focus on their breathing.
2. Sit comfortably in a quiet place. Close your eyes if you’re not focusing on an object.
3. Relax your muscles.
4. Breathe slowly and naturally. If you’re using a focus word or phrase, silently repeat it each time you exhale. If you’re using an object, focus on it as you breathe.
5. Keep your attitude passive. Disregard thoughts that drift in.
6. Continue for 10–20 minutes once or twice a day.

Progressive Relaxation In this simple relaxation technique, you tense and then relax the muscles of the body one group at a time. Also known as deep muscle relaxation, this technique addresses the muscle tension that occurs when the body is experiencing stress. Consciously relaxing tensed muscles sends a message to other body systems to reduce the stress response.

To practice progressive relaxation, begin by inhaling as you contract your right fist. Then exhale as you release your fist. Repeat. Contract and relax your right bicep. Repeat. Do the same using your left arm. Then, working from forehead to feet, contract and relax other muscles. Contract each muscle at least once, inhaling as you tense and exhaling as you relax. To speed up the process, tense and relax more muscles at one time—for example, both arms simultaneously. With practice, you’ll be able to relax quickly just by clenching and releasing only your fists.

Visualization Also known as imagery, visualization is so effective in enhancing sports performance that it has become part of the curriculum at training camps for U.S. Olympic athletes. This same technique can be used to induce relaxation; to help change habits; and to improve performance on an exam, on stage, or on a playing field.

To practice visualization, imagine yourself floating on a cloud, sitting on a mountaintop, or lying in a meadow. Try to identify all the perceptible qualities of the environment—sight, sound, temperature, smell, and so on. Your body will respond as if your imagery were real.

An alternative is to close your eyes and imagine a deep purple light filling your body. Then change the color to a soothing gold. As the color lightens, so should your distress. Imagery can also enhance performance: Visualize yourself succeeding at a task that worries you.

Deep Breathing Your breathing pattern is closely tied to your stress level. Deep, slow breathing is associated with relaxation. Rapid, shallow, often irregular breathing occurs during

Fitness Tip Activities like yoga and tai chi are well known for their relaxing, meditative aspects. But they’re great workouts, too. If you’re looking for a way to improve your flexibility and muscle tone while exercising in a quiet, pressure-free environment, check out a local yoga or tai chi class. Be sure the class is led by a qualified professional.
Controlled breathing can do more than just help you relax. It can also help control pain, anxiety, and other conditions that lead to or are related to stress. There are many methods of controlled breathing. Two of the most popular are belly breathing and tension-release breathing.

**Belly Breathing**

1. Lie on your back and relax.
2. Place one hand on your chest and the other on your abdomen. Your hands will help you gauge your breathing.
3. Take in a slow, deep breath through your nose and into your belly. Your abdomen should rise significantly (check with your hand); your chest should rise only slightly. Focus on filling your abdomen with air.
4. Exhale through your mouth, gently pushing out the air from your abdomen.

**Tension-Release Breathing**

1. Lie down or sit in a chair and get comfortable.
2. Take a slow, deep breath into your abdomen. Inhale through your nose and into your abdomen.
3. Lie on your back and relax.
4. Exhale through your mouth. Visualize tension leaving your body. Say to yourself, “Breathe out tension.”

These techniques have many variations. For example, sit in a chair and raise your arms, shoulders, and chin as you inhale; lower them as you exhale. Or slowly count to 4 as you inhale, then again as you exhale.

Many yoga experts suggest breathing rhythmically, in time with your own heartbeat. Relax and listen closely for the sensation of your heart beating, or monitor your pulse while you breathe. As you inhale, count to 4 or 8 in time with your heartbeat, then repeat the count as you exhale. Breathing in time with soothing music can work well, too.

Experts suggest inhaling through the nose and exhaling through the mouth. Breathe slowly, deeply, and gently. To focus on breathing gently, imagine a candle burning a few inches in front of you. Try to exhale softly enough to make the candle’s flame flicker, not hard enough to blow it out.

Practice is important, too. Perform your chosen breathing exercise two or more times daily, for 5–10 minutes per session.

**Counterproductive Strategies for Coping with Stress**

As we’ve seen, there are many effective coping techniques for dealing with stress. However, college students sometimes develop habits in response to stress that are ineffective and even unhealthy. Here are a few unhealthy coping techniques to avoid:

- **Alcohol.** A few drinks might make you feel at ease, and getting drunk may help you forget the stress in your life—but any relief alcohol provides is temporary. Binge drinking and excessive alcohol consumption are not effective ways to handle stress, and using alcohol to deal with stress puts you at risk for all the short- and long-term problems associated with alcohol abuse.

- **Tobacco.** The nicotine in cigarettes and other tobacco products can make you feel relaxed and may even increase your ability to concentrate. Tobacco, however, is highly addictive, and smoking causes cancer, heart disease, sexual problems, and many other health problems. Tobacco use is the leading preventable cause of death in the United States.

- **Other drugs.** Altering your body chemistry to cope with stress is a strategy with many pitfalls. Caffeine, for example, raises cortisol levels and blood pressure and can disrupt sleep. Repeated use of marijuana can elicit panic attacks.
• Binge eating. Eating can induce relaxation, which reduces stress. Eating as a means of coping with stress, however, may lead to weight gain and to binge eating, a risky behavior associated with eating disorders.

There is one other problem with these methods of fighting stress: None of them addresses the actual cause of the stress in your life. To combat stress in a healthy way, learn some of the stress-management techniques described in this chapter.

GETTING HELP

You can use the principles of behavioral self-management described in Chapter 1 to create a stress-management program tailored specifically to your needs. The starting point of a successful program is to listen to your body. When you learn to recognize the stress response and the emotions and thoughts that accompany it, you’ll be in a position to begin handling stress. Labs 10.1 and 10.2 can guide you in identifying and finding ways to cope with stress-inducing situations.

If you feel you need guidance beyond the information in this text, excellent self-help guides can be found in bookstores or the library; helpful websites are listed in “For Further Exploration” at the end of the chapter. Some people also find it helpful to express their feelings in a journal. Grappling with a painful experience in this way provides an emotional release and can help you develop more constructive ways of dealing with similar situations in the future.

Peer Counseling and Support Groups

If you still feel overwhelmed despite efforts to manage your stress, you may want to seek outside help. Peer counseling, often available through the student health center or counseling center, is usually staffed by volunteer students with special training that emphasizes maintaining confidentiality. Peer counselors can steer those seeking help to appropriate campus and community resources or just offer sympathetic listening.

Support groups are typically organized around a particular issue or problem: All group members might be entering a new school, reentering school after an interruption, struggling with single parenting, experiencing eating disorders, or coping with particular kinds of trauma. Simply voicing concerns that others share can relieve stress.

Professional Help

Psychotherapy, especially a short-term course of sessions, can also be tremendously helpful in dealing with stress-related problems. Not all therapists are right for all people, so it’s a good idea to shop around for a compatible psychotherapist with reasonable fees. (See the box “Choosing and Evaluating Mental Health Professionals.”)

Is It Stress or Something More Serious?

Most of us have periods of feeling down when we become pessimistic, anxious, less energetic, and less able to enjoy life. Such feelings and thoughts can be normal responses to the ordinary challenges of life. Symptoms that may indicate a more serious problem include the following:

• Depression, anxiety, or other emotional problems begin to interfere seriously with school or work performance or in getting along with others.
• Suicide is attempted or is seriously considered.
• Symptoms such as hallucinations, delusions, incoherent speech, or loss of memory occur.
• Alcohol or drugs are used to the extent that they impair normal functioning, finding or taking drugs occupies much of the week, or reducing the dosage leads to psychological or physical withdrawal symptoms.

Wellness Tip The most important predictor of whether or not therapy will be helpful is how much rapport you feel with your therapist at the first session. You have to like your therapist and feel that she or he will be able to help you—if you do, there’s a good chance that it will be helpful. If you seek professional help for stress-related problems, take the time to find someone who feels right for you.
Choosing and Evaluating Mental Health Professionals

College students are usually in a good position to find convenient, affordable mental health care. Larger schools typically have health services that employ psychiatrists and psychologists as well as counseling centers staffed by professionals and peer counselors. Resources in the community may include a school of medicine, a hospital, and a variety of professionals who work independently. It’s a good idea to get recommendations from physicians, friends who have been in therapy, or community agencies, rather than to pick a counselor or therapist at random.

Financial considerations are also important. Find out the cost of different services and what your health insurance will cover. If you’re not adequately covered by a health plan, don’t let that stop you from getting help; investigate low-cost alternatives on campus and in your community. The cost of treatment is linked to how many therapy sessions will be needed, which in turn depends on the type of therapy and the nature of the problem. Psychological therapies focusing on specific problems may require 8 or 10 sessions at weekly intervals. Therapies aiming for psychological awareness and personality change can last months or years.

Deciding whether a therapist is right for you requires meeting the therapist in person. Before or during your first meeting, find out about the therapist’s background and training:

- Does she or he have a degree from an appropriate professional school and a state license to practice?
- Has she or he had experience treating people with problems similar to yours?
- How much will therapy cost?

You have a right to know the answers to these questions and should not hesitate to ask them. After your initial meeting, evaluate your impressions:

- Does the therapist seem like a warm, intelligent person who would be able to help you and is interested in doing so?
- Are you comfortable with the personality, values, and beliefs of the therapist?
- Is the therapist willing to talk about the techniques he or she will use? Do these techniques make sense to you?

If you answer yes to these questions, this therapist may be satisfactory for you. If you feel uncomfortable—and if you are not in need of emergency care—it’s worthwhile to set up one-time consultations with one or two others before you make up your mind. Take the time to find someone who feels right for you.

Later in your treatment, evaluate your progress:

- Are you being helped by the treatment?
- If you are displeased, is it because you aren’t making progress or because therapy is raising difficult, painful issues you don’t want to deal with?
- Can you express dissatisfaction to your therapist? Such feedback can improve your treatment.

If you’re convinced your therapy isn’t working or is harmful, thank your therapist for her or his efforts and find another.

Depression is of particular concern because severe depression is linked to suicide, one of the leading causes of death among college students. In some cases, depression, like severe stress, is a clear-cut reaction to a specific event, such as losing a loved one or failing in school or work. In other cases, no trigger event is obvious. Symptoms of depression include the following:

- Negative self-concept
- Pervasive feelings of sadness and hopelessness
- Loss of pleasure in usual activities
- Poor appetite and weight loss
- Insomnia or disturbed sleep
- Restlessness or fatigue
- Thoughts of worthlessness and guilt
- Trouble concentrating or making decisions
- Thoughts of death or suicide

Not all of these symptoms are present in everyone who is depressed, but most experience a loss of interest or pleasure in their usual activities. Warning signs of suicide include expressing the wish to be dead, revealing contemplated suicide methods, increasing social withdrawal and isolation, and exhibiting a sudden, inexplicable lightening of mood (which can indicate the person has finally decided to commit suicide).

Ask Yourself

QUESTIONS FOR CRITICAL THINKING AND REFLECTION

What percentage of your daily stress is time related? How effective are your time-management skills? Identify one thing you can start doing right now to manage your time better, and describe how you can apply it to one aspect of your daily routine.

If you are severely depressed or know someone who is, expert help from a mental health professional is essential. Most communities and many colleges have hotlines and/or health services and counseling centers that can provide help. The National Suicide Prevention Lifeline can be reached at 1-800-273-TALK. Treatments for depression and many other psychological disorders are highly effective.
immobility are leading causes of tension headaches. There is no cure, but the pain can be relieved with over-the-counter painkillers; many people also try such therapies as massage, relaxation, hot or cold showers, and rest. Stress is also one possible trigger of migraine headaches, which are typically characterized by throbbing pain (often on one side of the head), heightened sensitivity to light and noise, visual disturbances such as flashing lights, nausea, and fatigue.

If your headaches are frequent, keep a journal with details about the events surrounding each one. Are your tension headaches associated with late nights, academic deadlines, or long periods spent sitting at a computer? Are migraines associated with certain foods, stress, fatigue, specific sounds or odors, or (in women) menstruation? If you can identify the stressors or other factors that are consistently associated with your headaches, you can begin to gain more control over the situation. If you suffer persistent tension or migraine headaches, consult your physician.

Are there any relaxation techniques I can use in response to an immediate stressor?

Yes. Try the deep breathing techniques described in the chapter, and try some of the following to see which work best for you:

- Do a full-body stretch while standing or sitting. Stretch your arms out to the sides and then reach them as far as possible over your head. Rotate your body from the waist. Bend over as far as is comfortable for you.
- Do a partial session of progressive muscle relaxation. Tense and then relax some of the muscles in your body. Focus on the muscles that are stiff or tense. Shake out your arms and legs.
- Take a short, brisk walk (three–five minutes). Breathe deeply.
- Engage in realistic self-talk about the stressor. Mentally rehearse dealing successfully with the stressor. As an alternative, focus your mind on some other activity.
- Briefly reflect on something personally meaningful. In one study of college students, researchers found that self-reflection on important personal values prior to a stressful task reduces the hormonal response to the stressor.

Can stress cause headaches?

Stress is one possible cause of the most common type of headache, the tension headache. About 90% of headaches are tension headaches, characterized by a dull, steady pain, usually on both sides of the head. It may feel as though a band of pressure is tightening around the head, and the pain may extend to the neck and shoulders. Acute tension headaches may last from hours to days, while chronic tension headaches may occur almost every day for months or even years. Stress, poor posture, and

Get out your datebook and schedule what you’ll be doing the rest of today and tomorrow. Plan a short walk and a conversation with a friend.

Take a class or workshop, such as one in assertiveness training or time management, that can help you overcome a source of stress.

Find a way to build relaxing time into every day. Just 15 minutes of meditation, stretching, or deep breathing can induce the relaxation response.
SUMMARY

- Stress is the collective physiological and emotional response to any stressor. Physiological responses to stressors are the same for everyone.
- The autonomic nervous system and the endocrine system are responsible for the body’s physical response to stressors. The sympathetic nervous system mobilizes the body and activates key hormones of the endocrine system, causing the fight-or-flight reaction. The parasympathetic system returns the body to homeostasis.
- Behavioral responses to stress are controlled by the somatic nervous system and fall under a person’s conscious control.
- The general adaptation syndrome model contributes to our understanding of the links between stress and disease. People who have many stressors in their lives or who handle stress poorly are at risk for cardiovascular disease, impairment of the immune system, and many other problems.
- Potential sources of stress include major life changes, daily hassles, college- and job-related stressors, and interpersonal and social stressors.
- Positive ways of managing stress include regular exercise, good nutrition, support from other people, clear communication, spiritual wellness, effective time management, cognitive techniques, and relaxation techniques.
- If a personal program for stress management doesn’t work, peer counseling, support groups, and psychotherapy are available.

FOR FURTHER EXPLORATION

American Headache Society. Provides information for consumers and clinicians about different types of headaches, their causes, and their treatment. http://www.americanheadachesociety.org/


Association for Applied Psychophysiology and Biofeedback. Provides information about biofeedback and referrals to certified biofeedback practitioners. http://www.aapb.org


SELECTED BIBLIOGRAPHY


National Sleep Foundation. Provides information about sleep and how to overcome sleep problems such as insomnia, apnea, and jet lag. http://www.sleepfoundation.org

LAB 10.1 Identifying Your Stress Level and Key Stressors

How Stressed Are You?

To help determine how much stress you experience on a daily basis, answer the following questions.

How many of the symptoms of excess stress in the list below do you experience frequently? _____

Symptoms of Excess Stress

Physical Symptoms
- Dry mouth
- Excessive perspiration
- Frequent illnesses
- Gastrointestinal problems
- Grinding of teeth
- Headaches
- High blood pressure
- Pounding heart
- Stiff neck or aching lower back

Emotional Symptoms
- Anxiety
- Depression
- Edginess
- Fatigue
- Hypervigilance
- Impulsiveness
- Inability to concentrate
- Irritability
- Trouble remembering things

Behavioral Symptoms
- Crying
- Disrupted eating habits
- Disrupted sleeping habits
- Harsh treatment of others
- Increased use of tobacco, alcohol, or other drugs
- Problems communicating
- Sexual problems
- Social isolation

Experiencing some stress-related symptoms or answering yes to a few questions is normal. However, if you experience a large number of stress symptoms or you answered yes to a majority of the questions, you may be experiencing a high level of stress. Take time out to develop effective stress-management techniques. Many coping strategies that can aid you in dealing with college stressors are described in this chapter. In addition, your school’s counseling center can provide valuable support.
LABORATORY ACTIVITIES

Weekly Stress Log

Now that you are familiar with the signals of stress, complete the weekly stress log to map patterns in your stress levels and identify sources of stress. Enter a score for each hour of each day according to the ratings listed below.

<table>
<thead>
<tr>
<th></th>
<th>A.M.</th>
<th></th>
<th>P.M.</th>
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</table>

Ratings:  
1 = No anxiety; general feeling of well-being  
2 = Mild anxiety; no interference with activity  
3 = Moderate anxiety; specific signal(s) of stress present  
4 = High anxiety; interference with activity  
5 = Very high anxiety and panic reactions; general inability to engage in activity

To identify daily or weekly patterns in your stress level, average your stress rating for each hour and each day. For example, if your scores for 6:00 a.m. are 3, 3, 4, 3, and 4, with blanks for Saturday and Sunday, your 6:00 a.m. rating would be \( \frac{17}{5} \), or 3.4 (moderate to high anxiety). Then calculate an average weekly stress score by averaging your daily average stress scores. Your weekly average will give you a sense of your overall level of stress.

Using Your Results

How did you score? How high are your daily and weekly stress scores?

Are you satisfied with your stress rating? If not, set a specific goal:

What should you do next? Enter the results of this lab in the Preprogram Assessment column in Appendix C. If you’ve set a goal for improvement, begin by using your log to look for patterns and significant time periods in order to identify key stressors in your life. Below, list any stressors that caused you a significant amount of discomfort this week; these can be people, places, events, or recurring thoughts or worries. For each, enter one strategy that would help you deal more successfully with the stressor. Examples of strategies might include practicing an oral presentation in front of a friend or engaging in positive self-talk.

Next, begin to put your strategies into action. In addition, complete Lab 10.2 to help you incorporate lifestyle stress-management techniques into your daily routine.
## LAB 10.2  Stress-Management Techniques

### Part I Lifestyle Stress Management

For each of the areas listed in the table below, describe your current lifestyle as it relates to stress management. For example, do you have enough social support? How are your exercise and nutrition habits? Is time management a problem for you? For each area, list two ways that you could change your current habits to help you manage your stress. Sample strategies might include calling a friend before a challenging class, taking a short walk before lunch, and buying and using a datebook to track your time.

<table>
<thead>
<tr>
<th></th>
<th>CURRENT LIFESTYLE</th>
<th>LIFESTYLE CHANGE #1</th>
<th>LIFESTYLE CHANGE #2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social support system</td>
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<td></td>
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<tr>
<td>Exercise habits</td>
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<td></td>
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<tr>
<td>Nutrition habits</td>
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<tr>
<td>Time-management techniques</td>
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<td>Self-talk patterns</td>
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<tr>
<td>Sleep habits</td>
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</tbody>
</table>
LABORATORY ACTIVITIES

Part II Relaxation Techniques

Choose two relaxation techniques described in this chapter (progressive relaxation, visualization, deep breathing, meditation, listening to music). If a recording is available for progressive relaxation or visualization, these techniques can be performed by your entire class as a group.

List the techniques you tried.

1. ____________________________________________________________
2. ____________________________________________________________

How did you feel before you tried these techniques?

_________________________________________________________________________________________________________________________
_________________________________________________________________________________________________________________________
_________________________________________________________________________________________________________________________

What did you think or how did you feel during each of the techniques you tried?

1. ______________________________________________________________________
   ______________________________________________________________________
   ______________________________________________________________________
   ______________________________________________________________________

2. ______________________________________________________________________
   ______________________________________________________________________
   ______________________________________________________________________
   ______________________________________________________________________

How did you feel after you tried these techniques?

_________________________________________________________________________________________________________________________
_________________________________________________________________________________________________________________________
_________________________________________________________________________________________________________________________
LAB 10.3  Developing Spiritual Wellness

To develop spiritual wellness, it is important to take time out to think about what gives meaning and purpose to your life and what actions you can take to support the spiritual dimension of your life.

Look Inward

This week, spend some quiet time alone with your thoughts and feelings. Slow the pace of your day, remove your watch, turn your phone off, and focus on your immediate experience. Try one of the following activities or develop another that is meaningful to you and that contributes to your sense of spiritual well-being.

- **Spend time in nature.** Experience continuity with the natural world by spending solitary time in a natural setting. Watch the sky (day or night), a sunrise, or a sunset; listen to waves on a shore or wind in the trees; feel the breeze on your face or raindrops on your skin; smell the grass, brush, trees, or flowers. Open all your senses to the beauty of nature.

- **Experience art, architecture, or music.** Spend time with a work of art or architecture or a piece of music. Choose one that will awaken your senses, engage your emotions, and challenge your understanding. Take a break and then repeat the experience to see how your responses change the second time.

- **Express your creativity.** Set aside time for a favorite activity, one that allows you to express your creative side. Sing, draw, paint, play a musical instrument, sculpt, build, dance, cook, garden—choose an activity in which you will be so engaged that you will lose track of time. Strive for feelings of joy and exhilaration.

- **Engage in a personal spiritual practice.** Pray, meditate, do yoga, chant. Choose a spiritual practice that is familiar to you or try one that is new. Tune out the outside world and turn your attention inward, focusing on the experience.

In the space below, describe the personal spiritual activity you tried and how it made you feel—both during the activity and after.
LABORATORY ACTIVITIES

Reach Out

Spiritual wellness can be a bond among people and can promote values such as altruism, forgiveness, and compassion. Try one of the following spiritual activities that involve reaching out to others.

- **Share writings that inspire you.** Find two writings that inspire, guide, and comfort you—passages from sacred works, poems, quotations from literature, songs. Share them with someone else by reading them aloud and explaining what they mean to you.

- **Practice kindness.** Spend a day practicing small acts of personal kindness for people you know as well as for strangers. Compliment a friend, send a card, let someone go ahead of you in line, pick up litter, do someone else’s chores, help someone with packages, say please and thank you, smile.

- **Perform community service.** Foster a sense of community by becoming a volunteer. Find a local nonprofit group and offer your time and talent. Mentor a youth, work at a food bank, support a literacy project, help build low-cost housing, visit seniors in a nursing home. You can also work on national or international issues by writing letters to your elected representatives and other officials.

In the space below, describe the spiritual activity you performed and how it made you feel—during the activity and after. Include details about the writings you chose or the acts of kindness or community service you performed.

Keep a Journal

One strategy for continuing on the path toward spiritual wellness is to keep a journal. Use a journal to record your thoughts, feelings, and experiences; to jot down quotes that engage you; to sketch pictures and write poetry about what is meaningful to you. Begin your spiritual journal today.
LOOKING AHEAD...

After reading this chapter, you should be able to

- Describe the controllable and uncontrollable risk factors associated with cardiovascular disease.
- Discuss the major forms of cardiovascular disease and how they develop.
- List the steps you can take now to lower your personal risk of developing cardiovascular disease.

TEST YOUR KNOWLEDGE

1. Women are less likely to die of cardiovascular disease than they are to die of breast cancer. True or false?

2. On average, how much earlier does heart disease develop in people who don’t exercise regularly than in people who do?
   a. 6 months
   b. 2 years
   c. 6 years

3. Which of the following foods would be a good choice for promoting heart health?
   a. whole grains
   b. salmon
   c. bananas

See answers on the next page.
Cardiovascular disease (CVD) is the leading cause of death in the United States, claiming more than 2,500 American lives every day. An estimated 85.6 million American adults have one or more types of CVD, and of these, 43.7 million are estimated to be younger than 60 years of age. Heart disease is the leading cause of death for both men and women and for European Americans African Americans, and Latinos. Among the life-threatening manifestations of CVD, heart attacks and strokes rank first and fourth on the list of the leading causes of death among Americans. High blood pressure, which is both a form of CVD and a risk factor for other types of disease, affects nearly 1 in every 3 adults, or about 80 million Americans. Another 1 in 3 American adults have blood pressure numbers that are higher than normal but not yet in the high blood pressure range.

CVD is largely due to our way of life. Millions of Americans are overweight and sedentary; they smoke, manage stress ineffectively, have uncontrolled high blood pressure or high cholesterol levels, and don’t know the signs of CVD. Not all risk factors for CVD are controllable—some people have an inherited tendency toward high cholesterol levels, for example—but many risk factors are within your control.

This chapter explains the major forms of CVD, including hypertension, atherosclerosis, and stroke, and also the factors that put people at risk for CVD. Most important, it explains the steps you can take to protect your heart and promote cardiovascular health throughout your life.

**Answers (Test Your Knowledge)**

1. **False.** Cardiovascular disease kills far more. Among American women, nearly 1 in 3 deaths is due to cardiovascular disease and about 1 in 34 is due to breast cancer.

2. **c., 6 years.** Both aerobic exercise and strength training significantly improve cardiovascular health.

3. **All three.** Whole grains (whole wheat, oatmeal, rye, barley, and brown rice), foods with omega-3 fatty acids (salmon), and foods high in potassium and low in sodium (bananas) all improve cardiovascular health.

**RISK FACTORS FOR CARDIOVASCULAR DISEASE**

Researchers have identified a variety of factors associated with an increased risk of developing CVD. They are grouped into two categories: major risk factors and contributing risk factors. Some risk factors are linked to controllable aspects of lifestyle and can therefore be changed. Others are beyond your control. (You can evaluate your personal CVD risk factors in Part I of Lab 11.1.)

**Major Risk Factors That Can Be Changed**

The American Heart Association (AHA) has identified five major risk factors for CVD that can be changed: high blood pressure, tobacco use, poor diet, physical inactivity, and diabetes. Most Americans, including young adults, have at least one major risk factor for CVD.

**Tobacco Use** Nearly 1 in 5 deaths is attributable to smoking. More than 20% of adult men and about 15% of adult women smoke. Among young adults aged 18–24, 18.7% are current smokers. Smoking remains one of the most preventable causes of CVD in the United States. People who smoke a pack of cigarettes a day have twice the risk of heart attack that non-smokers do; smoking two or more packs a day triples the risk. When smokers have heart attacks, they are two to three times more likely than nonsmokers to die from them. Cigarette smoking also doubles the risk of stroke.

Smoking harms the cardiovascular system in several ways:

- It damages the lining of arteries.
- It reduces the level of high-density lipoproteins (HDL), or “good” cholesterol.
- It raises the levels of triglycerides and low-density lipoproteins (LDL), or “bad” cholesterol.
- Nicotine increases blood pressure and heart rate.
- The carbon monoxide in cigarette smoke displaces oxygen in the blood, reducing the oxygen available to the body.
- Smoking causes platelets to stick together in the bloodstream, leading to clotting.
- Smoking speeds the development of fatty deposits in the arteries.

You don’t have to smoke to be affected. The risk of developing heart disease increases up to 30% among people exposed to environmental tobacco smoke (ETS)—also known as “secondhand smoke.” Researchers estimate that about 46,000 nonsmokers die from heart disease each year as a result of exposure to ETS.

**High Blood Pressure** In addition to being a form of CVD in itself, high blood pressure, or hypertension, is a risk factor for other forms of cardiovascular disease, including heart attacks and strokes.
Blood pressure, the force exerted by the blood on the vessel walls, is created by the pumping action of the heart. High blood pressure occurs when too much force is exerted against the walls of the arteries. Short periods of high blood pressure—such as in response to excitement or exertion—are normal, but chronic high blood pressure is a health risk.

Blood pressure is expressed as two numbers—for example, 120 over 80—and measured in millimeters of mercury (mm Hg). The first number is systolic blood pressure; the second is diastolic blood pressure (see Chapter 3). A normal blood pressure reading for a healthy adult is below 120 systolic and below 80 diastolic; CVD risk increases when blood pressure rises above this level. High blood pressure in adults is defined as equal to or greater than 140 over 90 (Table 11.1). Health care professionals measure blood pressure with a stethoscope and an instrument called a sphygmomanometer. Professional measurement is needed for a diagnosis of hypertension, but you can track your own blood pressure at a drugstore or at home with an inexpensive monitor.

High blood pressure results from an increased output of blood by the heart or from increased resistance to blood flow in the arteries. The latter condition can be caused by the constriction of smooth muscle surrounding the arteries or by atherosclerosis, a disease process that causes arteries to become clogged and narrowed. (See page T3-4 of the color transparency insert “Touring the Cardiorespiratory System” in Chapter 3.) High blood pressure also scars and hardens arteries, making them less elastic and further increasing blood pressure. When a person has high blood pressure, the heart must work harder than normal to force blood through the narrowed and stiffened arteries, straining both the heart and the arteries. Eventually, the strained heart weakens and tends to enlarge, which weakens it even more.

High blood pressure is often called a silent killer, because it usually has no symptoms. A person may have high blood pressure for years without realizing it. But during that time, it damages vital organs and increases the risk of heart attack, congestive heart failure, stroke, kidney failure, and blindness.

Recent research has shed new light on the importance of lowering blood pressure to improve cardiovascular health. The risk of death from heart attack or stroke begins to rise when blood pressure is above 115 over 75, well below the traditional 140 over 90 cutoff for hypertension. People with blood pressures in the prehypertension range (defined as systolic pressure of 120–139 and diastolic pressure of 80–89), are at increased risk of heart attack and stroke as well as at significant risk of developing full-blown hypertension.

Hypertension is common. About 31% of adults have hypertension and 30% have prehypertension. The incidence of high blood pressure rises dramatically with age, but it can occur among children and young adults. In most cases, hypertension cannot be cured, but it can be controlled. The key to avoiding complications is to have your blood pressure tested at least once every two years (more often if you have other CVD risk factors).

Lifestyle changes are recommended for everyone with prehypertension and hypertension. These changes include weight reduction, regular physical activity, a healthy diet, and moderation of alcohol use. The DASH diet (see Chapter 8), is recommended specifically for people with high blood pressure; it emphasizes fruits, vegetables, and whole grains—foods that are rich in potassium and fiber, both of which may reduce blood pressure. Sodium restriction is also helpful. According to the American Heart Association, daily sodium intake should not exceed 2,400 mg, and 1,500 mg is even better. This recommendation applies to all Americans but is particularly important for people with hypertension, African Americans, and middle-aged and older adults. Adequate potassium intake is also important. New blood pressure drug treatments are available, as well as particular combinations for the elderly and people with diabetes, chronic kidney disease, and cardiovascular diseases. People who fall into the category of prehypertension or the high normal blood pressure range may not benefit from drug therapy.

### Table 11.1 Blood Pressure Classification for Healthy Adults

<table>
<thead>
<tr>
<th>CATEGORY*</th>
<th>SYSTOLIC (mm Hg)</th>
<th>DIASTOLIC (mm Hg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal**</td>
<td>below 120</td>
<td>and below 80</td>
</tr>
<tr>
<td>Prehypertension</td>
<td>120–139</td>
<td>or 80–89</td>
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<tr>
<td>Hypertension†</td>
<td></td>
<td></td>
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<tr>
<td>Stage 1</td>
<td>140–159</td>
<td>or 90–99</td>
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<tr>
<td>Stage 2</td>
<td>160 and above</td>
<td>or 100 and above</td>
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</tbody>
</table>

*When systolic and diastolic pressure fall into different categories, the higher category should be used to classify blood pressure status.

**The risk of death from heart attack and stroke begins to rise when blood pressure is above 115/75.

†Based on the average of two or more readings taken at different physician visits. In persons over 50, systolic blood pressure greater than 140 is a much more significant CVD risk factor than diastolic blood pressure.


#### Unhealthy Cholesterol Levels

Cholesterol is a fatty, waxlike substance that circulates through the bloodstream and is an important component of cell membranes, sex hormones, vitamin D, the fluid that coats the lungs, and the protective sheaths around nerves. Adequate cholesterol is essential for the proper functioning of the body. Excess cholesterol, however, can clog arteries and increase the risk of CVD (Figure 11.1). Your liver manufactures cholesterol; you also get cholesterol from foods.

**GOOD VERSUS BAD CHOLESTEROL** Cholesterol is carried in the blood by protein-lipid packages called lipoproteins, which range in size from 10 to 1000 nanometers (nm). Low-density lipoproteins (LDLs) (26 nm) shuttle cholesterol from the
liver to the organs and tissues that require it. LDL is known as “bad” cholesterol because if there is more than the body can use, the excess is deposited in the blood vessels. LDL that accumulates and becomes trapped in artery walls may be oxidized by free radicals, speeding inflammation and damage to artery walls and increasing the likelihood that an artery will become blocked, causing a heart attack or stroke. High-density lipoproteins (HDLs), or “good” cholesterol, are the smallest of the lipoproteins (6–12.5 nm). They shuttle unused cholesterol back to the liver for recycling. By removing cholesterol from blood vessels, HDL helps protect against atherosclerosis.

**TERMS**

**high-density lipoprotein (HDL)** A lipoprotein containing relatively little cholesterol that helps transport cholesterol out of the arteries; “good” cholesterol.

**RECOMMENDED BLOOD CHOLESTEROL LEVELS** The risk for CVD increases with higher blood cholesterol levels, especially LDL. The National Cholesterol Education Program (NCEP) recommends lipoprotein testing at least once every five years for all adults, beginning at age 20. The recommended test measures total cholesterol, LDL cholesterol, HDL cholesterol, and triglycerides (another type of blood fat). In general, high LDL, total cholesterol, and triglyceride levels, combined with low HDL levels, are associated with a higher risk for CVD. You can reduce this risk by lowering LDL, total cholesterol, and triglycerides. Raising HDL is important because a high HDL level seems to offer protection from CVD even in cases where total cholesterol is high. This appears to be especially true for women.

In 2013 the American College of Cardiology (ACC) and the AHA updated their guidelines for the treatment of elevated blood cholesterol levels. The new guidelines focus on lifestyle
change as well as therapy with statins, a group of medications that lower LDL. Although the previous guidelines set specific targets for LDL and HDL, the new guidelines do not; instead, they focus on identifying the groups of people for whom medical treatment has the greatest chance of preventing heart attacks and strokes. For these at-risk groups, treatment with statin therapy at different intensity levels (dosages) is recommended (Table 11.2). Experts hope that the new recommendations will mean that more people who would benefit from statin therapy will get it, while those who would not benefit will avoid unnecessary treatment.

Individuals can review their specific risk factors and the pros and cons of therapy with their health care providers. Lifestyle choices to help improve cholesterol levels include exercising regularly, limiting saturated and trans fat intake, and choosing a healthy dietary pattern. For lowering LDL, the ACC and AHA recommend a dietary pattern that is rich in fruits, vegetables, and whole grains; includes low-fat dairy, poultry, fish, legumes, nontropical vegetable oils, and nuts; and limits sweets, sugar-sweetened beverages, and red meats.

Physical Inactivity An estimated 40–60 million Americans are so sedentary that they are at high risk for developing CVD. Exercise is thought to be the closest thing we have to a magic bullet against heart disease. It lowers CVD risk by helping to decrease blood pressure and resting heart rate, increase HDL levels, maintain desirable weight, improve the condition of the blood vessels, and prevent or control diabetes. One study found that women who accumulated at least three hours of brisk walking each week cut their risk of heart attack and stroke by more than half. (See Chapter 3 for more information on the benefits of cardiorespiratory exercise.)

Obesity The risk of death from CVD is two to three times higher in obese people (BMI ≥ 30) than it is in lean people (BMI 18.5–24.9), and for every five-unit increment of BMI, a person’s risk of death from coronary heart disease increases by 30%. Excess weight increases the strain on the heart by contributing to high blood pressure and high cholesterol. It can also lead to diabetes, another CVD risk factor (see the next section). As discussed in Chapter 6, distribution of body fat is also significant: Fat that collects in the abdomen is more dangerous than fat that collects around the hips. Obesity in general, and abdominal obesity in particular, is significantly associated with narrowing of the coronary arteries, even in young adults in their twenties.

A sensible diet and regular exercise are the best ways to achieve and maintain a healthy body weight (see Chapter 9 for an extensive discussion of weight control). For someone who is overweight, even modest weight reduction can reduce CVD risk by lowering blood pressure, improving cholesterol levels, and reducing diabetes risk.

Diabetes As described in Chapter 6, diabetes is a disorder in which the metabolism of glucose is disrupted, causing a buildup of glucose in the bloodstream. People with diabetes are at increased risk for CVD, partly because elevated blood glucose levels can damage the lining of arteries, making them more vulnerable to atherosclerosis. Diabetics also often have other risk factors, including hypertension, obesity, unhealthy cholesterol and triglyceride levels, and platelet and blood coagulation abnormalities. Even people whose diabetes is under control face an increased risk of CVD. Therefore, careful control of other risk factors is critical for people with diabetes. People with prediabetes also face a significantly increased risk of CVD.

### Contributing Risk Factors That Can Be Changed

Other CVD risk factors can be changed, including triglyceride levels, psychological and social factors, and drug use.

### Table 11.2 Groups Who Benefit from Treatment of Elevated Cholesterol

<table>
<thead>
<tr>
<th>GROUP</th>
<th>TREATMENT RECOMMENDATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. People age 75 or younger with known CVD*</td>
<td>High-intensity statin therapy unless contraindicated; no recommendation for people with heart failure or who are on dialysis for kidney disease</td>
</tr>
<tr>
<td>2. People age 21 and older with high LDL levels, 190 mg/dL or greater</td>
<td>High-intensity statin therapy unless contraindicated, or maximum tolerated intensity of therapy</td>
</tr>
<tr>
<td>3. People ages 40–75 with diabetes and an LDL level 70–189 mg/dL who do not have a history of cardiovascular disease</td>
<td>Moderate-intensity statin therapy, with high-intensity therapy considered for those with a 7.5% or greater estimated risk of developing CVD over the next 10 years**</td>
</tr>
<tr>
<td>4. People ages 40–75 without diabetes or known cardiovascular disease but with a high risk of developing CVD over the next 10 years and an LDL level 70–189 mg/dL</td>
<td>Moderate- to high-intensity therapy for those with an estimated 10-year risk of CVD of 7.5% or greater; moderate-intensity therapy considered for those with an estimated 10-year risk of CVD of 5% to less than 7.5%**</td>
</tr>
</tbody>
</table>

* Atherosclerotic cardiovascular disease types include previous heart attacks, chest pain due to partially clogged arteries, history of invasive treatment for clogged arteries, previous stroke, or previous clogged arteries in the limbs.

** 10-year CVD risk can be calculated with an online AHA/ACC tool: [http://tools.cardiosource.org/ASCVD-Risk-Estimator](http://tools.cardiosource.org/ASCVD-Risk-Estimator)

glucose levels within a normal range. Eventually even high levels of insulin may become insufficient, and blood glucose levels start to rise (hyperglycemia), resulting in type 2 diabetes.

Those who have insulin resistance tend to have several other related risk factors. This cluster of abnormalities is called metabolic syndrome or insulin resistance syndrome (Table 11.3). Metabolic syndrome significantly increases the risk of CVD—more so in women than in men. It is estimated that about 34% of the adult U.S. population has metabolic syndrome.

To reduce your risk of developing metabolic syndrome, choose a healthy dietary pattern and get plenty of aerobic exercise. Reducing calorie intake to prevent weight gain, or losing weight if needed, also reduces insulin resistance. Eating more protein, vegetables, and fiber while limiting fat, added sugars, and starches may be beneficial.

### Psychological and Social Factors
Many of the psychological and social factors that influence other areas of wellness are also important risk factors for CVD. They include chronic stress, chronic hostility and anger, lack of social support, and others. The cardiovascular system is affected by both sudden, acute episodes of mental stress and the more chronic, underlying emotions of anger, anxiety, and depression. See Chapter 10 for more information on stress, the effects of stress, and ways to combat these effects.

### Alcohol and Drugs
Drinking too much alcohol raises blood pressure and can increase the risk of stroke and heart failure. Stimulant drugs, particularly cocaine and methamphetamine—and associated stimulants, such as designer drugs including ecstasy (MDMA)—can also cause serious cardiac problems.

---

**Wellness Tip** Stress and social isolation increase the risk of cardiovascular disease, whereas social support buffers risk and may prevent or delay the onset of CVD. A strong social support network improves both heart health and overall wellness and can provide opportunities for exercise and relaxation. Take time out to develop and nurture friendships and family ties.

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### High Triglyceride Levels
Triglycerides are blood fats that are absorbed from food and manufactured by the body. High triglyceride levels are a reliable predictor of heart disease, especially if associated with other risk factors, such as low HDL levels, obesity, and diabetes. Factors contributing to elevated triglyceride levels include excess body fat, physical inactivity, cigarette smoking, type 2 diabetes, excessive alcohol intake, very-high-carbohydrate diets, and certain diseases and medications. A full lipid profile should include testing and evaluation of triglyceride levels.

For people with high triglyceride levels, lifestyle changes can bring levels down into the healthy range: losing weight, reducing intake of added sugars while increasing intake of unsaturated fats, and increasing physical activity. Limiting alcohol use is also helpful. For some people with very high triglyceride levels, drug therapy may be prescribed.

### Insulin Resistance and Metabolic Syndrome
As people gain weight and become less active, their muscles, fat, and liver become less sensitive to the effect of insulin—a condition known as insulin resistance (or prediabetes). As the body becomes increasingly insulin resistant, the pancreas must secrete more and more insulin (hyperinsulinemia) to keep the glucose levels within a normal range. Eventually even high levels of insulin may become insufficient, and blood glucose levels start to rise (hyperglycemia), resulting in type 2 diabetes.

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**Table 11.3** Characteristics of Metabolic Syndrome*

<table>
<thead>
<tr>
<th>FACTOR</th>
<th>CRITERIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large waistline</td>
<td>35 or more inches for women</td>
</tr>
<tr>
<td></td>
<td>40 or more inches for men</td>
</tr>
<tr>
<td>High triglyceride level</td>
<td>150 mg/dL or higher</td>
</tr>
<tr>
<td></td>
<td>Or taking medication to treat high triglycerides</td>
</tr>
<tr>
<td>Low HDL level</td>
<td>Less than 50 mg/dL for women</td>
</tr>
<tr>
<td></td>
<td>Less than 40 mg/dL for men</td>
</tr>
<tr>
<td></td>
<td>Or taking medication to treat low HDL</td>
</tr>
<tr>
<td>High blood pressure</td>
<td>130/85 mm Hg or higher</td>
</tr>
<tr>
<td></td>
<td>Or taking medication to treat high blood pressure</td>
</tr>
<tr>
<td>High fasting blood sugar</td>
<td>100 mg/dL or higher</td>
</tr>
<tr>
<td></td>
<td>Or taking medication to treat high blood sugar</td>
</tr>
</tbody>
</table>

*A person having three or more factors listed here is diagnosed with metabolic syndrome.

including heart attack, stroke, and sudden cardiac death. Injection drug use can cause heart infections and stroke.

**Major Risk Factors That Can’t Be Changed**
A number of major risk factors for CVD cannot be changed. They include heredity, aging, being male, and ethnicity.

**Heredity** Multiple genes contribute to the development of CVD and its risk factors. Having an unfavorable set of genes increases your risk, but risk is modifiable by lifestyle factors such as whether you smoke, exercise, or eat a healthy diet. People who inherit a tendency for CVD are not destined to develop it, but they may have to work harder than other people to prevent it.

**Aging** About 70% of all heart attack victims are age 65 or older, and about 75% who suffer fatal heart attacks are over 65. For people over 55, the incidence of stroke more than doubles in each successive decade. However, even people in their thirties and forties, especially men, can have heart attacks.

**Being Male** Although CVD is the leading killer of both men and women in the United States, men face a greater risk of heart attack than women, especially earlier in life. Until age 55, men also have a greater risk of hypertension than women. The incidence of stroke is higher for males than females until age 65. Estrogen production, which is highest during the childbearing years, may protect premenopausal women against CVD (see the box “Gender, Ethnicity, and CVD”). By age 75, the gender gap nearly disappears.

**Ethnicity** Rates of heart disease vary among ethnic groups in the United States. African Americans have much higher rates of hypertension, heart disease, and stroke than other groups do. Figure 11.2 shows how rates of CVD compare among non-Hispanic whites, blacks, and Hispanics in the United States. Puerto Rican Americans, Cuban Americans, and Hispanic Americans are more likely to suffer from high blood pressure and angina (a warning sign of heart disease) than non-Hispanic white Americans. Asian Americans historically have had far lower rates of CVD than white Americans.

**Inflammation** Inflammation plays a key role in the development of CVD. When an artery is injured by hypertension, smoking, cholesterol, or other factors, the body’s response is to produce inflammation. A substance called C-reactive protein (CRP) is released into the bloodstream during the inflammatory response, and high levels of CRP indicate a substantially elevated risk of heart attack and stroke. CRP may also be harmful to the coronary arteries themselves. Gum disease involves another type of inflammation that may moderately influence the progress of coronary heart disease.

Lifestyle changes and certain drugs can reduce CRP levels. Statin drugs, widely prescribed to lower cholesterol, also decrease inflammation; this may be one reason that statin drugs seem to lower CVD risk even in people with normal blood lipid levels.

**Possible Risk Factors Currently Being Studied**
In recent years, several other possible risk factors for cardiovascular disease have been identified.

Elevated blood levels of homocysteine, an amino acid that may damage the lining of blood vessels, are associated with an increased risk of CVD. Men generally have higher homocysteine levels than women, as do individuals with diets low in folic acid, vitamin B-12, and vitamin B-6. Most people can lower homocysteine levels easily by adopting a healthy diet rich in fruits, vegetables, and grains. Severe vitamin D deficiency has also been associated with heart dysfunction, independent of homocysteine levels.

Several infectious agents, including *Chlamydia pneumoniae*, cytomegalovirus, and *Helicobacter pylori*, have also been identified as possible risk factors for cardiovascular disease. *Chlamydia pneumoniae*, a common cause of flu-like respiratory infections, has been found in sections of clogged, damaged arterial walls, including heart attack, stroke, and sudden cardiac death. Injection drug use can cause heart infections and stroke.

**Ask Yourself**

**QUESTIONS FOR CRITICAL THINKING AND REFLECTION**
What risk factors do you have for cardiovascular disease? Which ones are factors you have control over, and which are factors you can’t change? If you have risk factors you cannot change (such as a family history of CVD), were you aware that you can make lifestyle adjustments to reduce your risk? Do you think you will make them? Why or why not?
CVD is the leading cause of death for all Americans, but significant differences exist between men and women and between white Americans and African Americans in the incidence, diagnosis, and treatment of this deadly disease.

**CVD in Women**

CVD has been thought of as a “man’s disease,” but it actually kills more women than men. Polls indicate that women vastly underestimate their risk of dying of a heart attack and overestimate their risk of dying of breast cancer; black and Hispanic women in particular have been found to be less aware of their risks for CVD. In reality, nearly 1 in 3 women dies of CVD, while 1 in 34 dies of breast cancer; although CVD typically does not develop in women younger than age 50, recent research suggests that the number of CVD deaths in women age 35–45 may be increasing.

The hormone estrogen, produced naturally by a woman’s ovaries until menopause, improves blood lipid concentrations and reduces other CVD risk factors. For several decades, many physicians encouraged menopausal women to take hormone replacement therapy (HRT), which includes estrogen, to relieve menopause symptoms and presumably to reduce their risk of CVD. However, some studies found that HRT may actually increase a woman’s risk for heart disease and other health problems, including breast cancer. Some newer studies have found that the increased risk of CVD in women who start HRT may be age dependent; women in the early stages of menopause or ages 50–59 did not appear to have excess risk. This suggests that outcomes may depend on several factors, including the timing of hormone use. The U.S. Preventive Services Task Force and the American Heart Association recommend that HRT not be used to protect against CVD.

When women have heart attacks, they are more likely than men to die within a year. One reason is that because they develop heart disease at older ages, women are more likely to have other health problems that complicate treatment. Women have smaller hearts and arteries than men do, possibly making diagnosis and treatment more difficult.

Women presenting with CVD are just as likely as men to report chest pain, but are also likely to report other symptoms, which may obscure their diagnosis. These additional symptoms include fatigue, weakness, shortness of breath, nausea, vomiting, and pain in the abdomen, neck, jaw, and back. Women are also more likely to have pain at rest, during sleep, or with mental stress. A woman who experiences these symptoms should be persistent in seeking accurate diagnosis and appropriate treatment.

Careful diagnosis of cardiac symptoms is also key in avoiding unnecessary invasive procedures in cases of stress cardiomyopathy (“broken heart syndrome”), which occurs much more commonly in women than in men. In this condition, hormones and neurotransmitters associated with a severe stress response stun the heart, producing heart attack–like symptoms and decreased pumping function of the heart, but no damage to the heart muscle. Typically, the condition reverses quickly.

Women should be aware of their CVD risk factors and consult with a physician to assess their risk and determine the best way to prevent CVD.

**CVD in African Americans**

African Americans are at substantially higher risk for death from CVD than members of other ethnic groups. The rate of hypertension among African Americans is among the highest of any group in the world. Blacks tend to develop hypertension at an earlier age than whites do, and their average blood pressure is much higher. They also have a higher risk of stroke, have strokes at younger ages, and have more significant stroke-related disabilities. Some experts recommend that blacks be treated with antihypertensive drugs at an earlier stage—when blood pressure reaches 130/80 rather than the typical 140/90 cutoff for hypertension.

Genetic and cultural factors may contribute to CVD in African Americans. For example, blacks may be more sensitive to salt and have a physiologically different response to stress, which can lead to high blood pressure and other CVD risk factors. Low income is another factor in CVD risk and is associated with reduced access to adequate health care, insurance, and information about prevention. Discrimination may also play a role, both by increasing stress and by affecting treatment by physicians and hospitals.

Although these factors are important, some evidence favors lifestyle explanations for the higher CVD rate among African Americans. For example, black New Yorkers born in the South have a much higher CVD risk than those born in the Northeast. (Researchers speculate that some lifestyle risk factors for CVD, including smoking and a high-fat diet, may be more common in the South.) People with low incomes, who are disproportionately black, tend to smoke more, use more salt, and exercise less than those with higher incomes.

The general preventive strategies recommended for all Americans may be particularly critical for African Americans. Tailoring your lifestyle to your particular ethnic risk may also be helpful in some cases. Discuss your particular risk profile with your physician to help identify lifestyle changes most appropriate for you.

High levels of a specific type of LDL called lipoprotein(a), or Lp(a), may be a risk factor for coronary heart disease (CHD), especially when associated with high LDL or low HDL levels. Lp(a) levels have a strong genetic component and are difficult to treat. About 33% of the U.S. population has elevated lipoprotein(a) levels.
arteries but not in sections of healthy arteries. This effect may be secondary to the inflammation that many infectious agents produce in the body.

Gum disease has long been suspected to be linked to CVD. Gingivitis, the beginning stages of gum disease, occurs when bacteria accumulate on the teeth, causing gums to become inflamed and to bleed easily; thus both gum disease and CVD are inflammatory processes. The exact linkages are still unknown, but studies suggest a potential relationship between oral disease and CVD, so it makes sense to practice good oral hygiene. For recommendations on good dental self-care, visit the American Dental Association’s consumer website: http://www.mouthhealthy.org.

**MAJOR FORMS OF CARDIOVASCULAR DISEASE**

Although deaths from CVD have declined drastically over the past 60 years, it remains the leading cause of death in America. According to the National Center for Health Statistics, heart disease kills about 610,000 people per year. The financial burden of CVD, including the costs of medical treatments and lost productivity, exceeds $315 billion annually. Although the main forms of CVD are interrelated and have elements in common, we treat them separately here for the sake of clarity. Hypertension, which is both a major risk factor and a form of CVD, was described earlier in the chapter.

**Atherosclerosis**

Atherosclerosis is a form of arteriosclerosis, or thickening and hardening of the arteries. In atherosclerosis, arteries become narrowed by deposits of fat, cholesterol, and other substances. The process begins when endothelial cells (the cells lining the arteries) become damaged, most likely through a combination of factors such as smoking, high blood pressure, high insulin or glucose levels, and deposits of oxidized LDL particles. The body’s response to this damage results in inflammation and changes in the artery lining. Deposits, called plaques, accumulate on artery walls; the arteries lose their elasticity and their ability to expand and contract, restricting blood flow. Once narrowed by a plaque, an artery is vulnerable to blockage by blood clots. The risk of life-threatening clots and heart attacks increases if the fibrous cap covering a plaque ruptures.

If the heart, brain, and/or other organs are deprived of blood and the oxygen it carries, the effects of atherosclerosis can be deadly. Coronary arteries, which supply the heart with blood, are particularly susceptible to plaque build-up, a condition called **coronary heart disease (CHD)**, or **coronary artery disease (CAD)**. The blockage of a coronary artery causes a heart attack. If a cerebral artery (leading to the brain) is blocked, the result is a stroke. The main risk factors for atherosclerosis are cigarette smoking, physical inactivity, high levels of blood cholesterol, high blood pressure, and diabetes.

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**Heart Disease and Heart Attacks**

The American Heart Association estimates that 635,000 Americans have a first heart attack each year, and 300,000 suffer a recurrent attack. About 155,000 people suffer a symptomless, or “silent,” heart attack each year. Although a heart attack, or myocardial infarction (MI), may come without warning, it is usually the end result of a long-term disease process. The heart requires a steady supply of oxygen-rich blood to function properly (Figure 11.3). If one of the coronary arteries that supplies blood to the heart becomes blocked, a heart attack results. A heart attack caused by a blood clot is called a **coronary thrombosis**. During a heart attack, part of the heart muscle (myocardium) may die from lack of blood flow.

Chest pain, called **angina pectoris**, is a signal that the heart isn’t getting enough oxygen to supply its needs. Although not actually a heart attack, angina—felt as an extreme tightness in
the chest and heavy pressure behind the breastbone or in the shoulder, neck, arm, hand, or back—is a warning that the heart is overloaded.

If the electrical impulses that control heartbeat are disrupted, the heart may beat too quickly, too slowly, or in an irregular fashion, a condition known as arrhythmia. The symptoms of arrhythmia range from imperceptible to severe and even fatal. Sudden cardiac death, also called cardiac arrest, is most often caused by an arrhythmia called ventricular fibrillation, a kind of “quivering” of the ventricle that makes it ineffective in pumping blood. If ventricular fibrillation continues for more than a few minutes, it is generally fatal. Cardiac defibrillation, in which an electrical shock is delivered to the heart, can jolt the heart into a more efficient rhythm. This shock can be administered with an automated external defibrillator (AED), a first-aid device that is available in many public places in case someone experiences a heart attack.

Heart attack symptoms may include pain or pressure in the chest; pain in the arm, neck, or jaw; difficulty breathing; excessive sweating; nausea and vomiting; and loss of consciousness. But not all heart attacks involve sharp chest pain. Women, in particular, are more likely to have different symptoms—shortness of breath, weakness, unusual fatigue, cold sweat, and dizziness.

If symptoms of heart trouble occur, it is critical to contact an emergency medical service or go immediately to the nearest hospital or clinic (see the box “Warning Signs of Heart Attack, Stroke, and Cardiac Arrest”). Many experts also suggest that the heart attack victim chew and swallow one adult aspirin tablet (325 mg); aspirin has an immediate anticoagulant effect. If someone having a heart attack gets to the emergency department quickly enough, a clot-dissolving agent can be injected to dissolve a clot in the coronary artery, reducing the amount of damage to the heart muscle.

Physicians have a variety of diagnostic tools and treatments for heart disease. A patient may undergo a stress or exercise test, in which he or she runs on a treadmill or pedals a stationary cycle while being monitored with an electrocardiogram (ECG or EKG). Certain characteristic changes in the heart’s electrical activity while it is under stress can reveal particular heart problems, such as restricted blood flow to the heart muscle. Tools that allow the physician to visualize a patient’s heart and arteries include magnetic resonance imaging (MRI), electron-beam computed tomography (EBCT), echocardiograms, and others.

If tests indicate a problem or if a person has already had a heart attack, several treatments are possible. Along with a low-fat diet, regular exercise, and smoking cessation, many patients are also advised to take a low-dose aspirin tablet (81 mg) daily. Aspirin has an anticoagulant effect, discouraging platelets in the blood from sticking to arterial plaques and forming clots; it also reduces inflammation. Low-dose aspirin therapy appears to help prevent first heart attacks in men, second heart attacks in men and women, and strokes in women over age 65. In addition to aspirin, prescription drugs can also help reduce the strain on the heart.

Several surgical treatments are available to treat certain forms of heart disease. Balloon angioplasty involves threading a catheter with an inflatable balloon tip through a coronary artery until it reaches the area of blockage; the balloon is then inflated, flattening the plaque and widening the arterial opening. Many surgeons permanently implant coronary stents—flexible stainless-steel tubes—to prop the artery open and prevent reclogging after angioplasty. In coronary bypass surgery, healthy blood vessels are grafted to coronary arteries to bypass blockages.

Stroke

A stroke, also called a cerebrovascular accident (CVA), occurs when the blood supply to the brain is cut off. If brain cells are deprived of blood for more than a few minutes, they die. Once brain cells begin dying, about two million cells are lost every minute that blood flow is not restored. Nerve cells control sensation and most body movements; depending on the area of the brain affected, a stroke may cause paralysis, walking disability, speech impairment, memory loss, and changes in behavior. Prompt treatment of stroke can greatly decrease the risk of permanent disability. The American Heart Association estimates that 795,000 Americans suffer a stroke each year.

There are two major types of strokes: ischemic and hemorrhagic. An ischemic stroke is caused by a blockage in a blood vessel. There are two types of ischemic strokes:

- A thrombotic stroke is caused by a blood clot that forms in a cerebral or carotid artery that has been narrowed or damaged by atherosclerosis.
- An embolic stroke is caused by an embolus, a wandering blood clot that is carried in the bloodstream and may become wedged in a cerebral artery.

Ischemic strokes are the more common type and account for 87% of all strokes.

A hemorrhagic stroke occurs when a blood vessel in the brain bursts, spilling blood into the surrounding tissue. Cells normally nourished by the vessel are deprived of blood and cannot function. In addition, accumulated blood from the burst vessel may put pressure on surrounding brain tissue, causing damage and even death. There are two types of hemorrhagic strokes:

- In an intracerebral hemorrhage, a blood vessel ruptures within the brain.
- In a subarachnoid hemorrhage, a blood vessel on the brain’s surface ruptures and bleeds into the space between the brain and the skull.

Hemorrhages can be caused by head injuries or the bursting of a malformed blood vessel, or aneurysm, which is a blood-filled pocket that bulges out from a weak spot in the artery wall.
Heart Attack Warning Signs
The most common warning symptoms of a heart attack for both men and women are the following:

- Chest pain or discomfort in the center or left side of the chest that usually lasts for more than a few minutes or goes away and comes back. It can feel like pressure, squeezing, fullness, or pain. It also can feel like heartburn or indigestion. It can be mild or severe.
- Upper body discomfort in one or both arms, the back, shoulders, neck, jaw, or upper part of the stomach (above the navel).
- Shortness of breath may be the only symptom, or it may occur before or along with chest pain or discomfort. It can occur when you are resting or doing mild physical activity.

But remember these additional facts:

- Heart attacks can start slowly and cause only mild pain or discomfort. Symptoms can be mild or more intense and sudden. Symptoms also can come and go over several hours.
- People who have high blood sugar (diabetes) may have no symptoms or very mild ones. Heart attacks without symptoms or with very mild symptoms are called silent heart attacks.
- The most common symptom, in both men and women, is chest pain or discomfort.
- Women are somewhat more likely to have shortness of breath, nausea and vomiting, unusual tiredness (sometimes for days), and pain in the back, shoulders, and jaw.
- Other possible symptoms include breaking out in a cold sweat, light-headedness or sudden dizziness, or a change in the pattern of usual symptoms.

The signs and symptoms of a heart attack can develop suddenly or slowly—within hours, days, or weeks of a heart attack. If you think you or someone you know might be having heart attack symptoms or a heart attack, don’t ignore it or feel embarrassed to call for help. Call 9-1-1 right away. Here’s why:

- An ambulance is the best and safest way to get to the hospital. Emergency medical services (EMS) personnel start lifesaving treatments right away. People who arrive by ambulance often receive faster treatment at the hospital.
- The 9-1-1 operator or EMS technician can give you advice. You might be told to crush or chew an aspirin if you’re not allergic, unless there is a medical reason for you not to take one.

Stroke Warning Signs
The symptoms of stroke are distinctive because they happen quickly:

- Sudden numbness or weakness of the face, arm, or leg (especially on one side of the body)
- Sudden confusion, trouble speaking or understanding speech
- Sudden trouble seeing in one or both eyes
- Sudden trouble walking, dizziness, loss of balance or coordination
- Sudden severe headache with no known cause

If you believe someone is having a stroke, call 9-1-1 immediately. Ischemic strokes, the most common type, can be treated with a drug called t-PA, which dissolves blood clots. The drug must be administered within three hours, but to be evaluated and treated in time, patients must get to the hospital within 60 minutes.

A transient ischemic attack (TIA) has the same signs and symptoms as a stroke. However, TIA symptoms usually last less than 1–2 hours (although they may last up to 24 hours). A TIA may occur only once in a person’s lifetime or more often and can be a warning sign for future strokes. At first, it may not be possible to tell whether someone is having a TIA or stroke. All stroke-like symptoms require medical care.

Sudden Cardiac Arrest Signs
In sudden cardiac arrest (SCA), the heart suddenly and unexpectedly stops beating. As a result, blood stops flowing to the brain and other vital organs. The patient suddenly becomes unresponsive and stops breathing, and if he or she is not treated within minutes, death occurs. Some people may have a racing heartbeat or feel dizzy or light-headed just before they faint. Within an hour before SCA, some people have chest pain, shortness of breath, nausea, or vomiting. Usually, however, the first sign of sudden cardiac arrest (SCA) is loss of consciousness (fainting). At the same time, no heartbeat (or pulse) can be felt.

If you are with someone who suddenly experiences these symptoms, begin CPR and call 9-1-1 immediately. Rapid treatment of SCA with a defibrillator can be lifesaving. A defibrillator is a device that sends an electric shock to the heart to restore its normal rhythm. Automated external defibrillators (AEDs) can be used by bystanders to save the lives of people who are having SCA. These portable devices often are found in public places, such as shopping malls, golf courses, businesses, airports, airplanes, convention centers, hotels, sports venues, and schools.

Aneurysms in the brain may remain stable and never break. But when they do, the result is a hemorrhagic stroke. Aneurysms may be caused or worsened by hypertension.

Effective treatment requires the prompt recognition of symptoms and correct diagnosis of the type of stroke that has occurred. Treatment may involve the use of clot-dissolving and antihypertensive drugs. Even if brain tissue has been damaged or destroyed, nerve cells in the brain can make new pathways, and some functions can be taken over by other parts of the brain.

Many people have strokes without knowing it, so they do not realize they may need treatment or evaluation for the risk of a full-blown stroke in the future. These silent strokes do not cause any noticeable symptoms while they are occurring. Although they may be mild, silent strokes leave their victims at a higher risk for subsequent and more serious strokes later in life. They also contribute to loss of mental and cognitive skills.

**Congestive Heart Failure**

The heart’s pumping mechanism can be damaged by a number of conditions, including high blood pressure, heart attack, atherosclerosis, viral infections, rheumatic fever, and birth defects. When the heart cannot maintain its regular pumping rate and force, fluids begin to back up. When extra fluid seeps through capillary walls, edema (swelling) results, usually in the legs and ankles, but sometimes in other parts of the body as well. Fluid can collect in the lungs and interfere with breathing, particularly when a person is lying down. This condition is called *pulmonary edema*, and the entire process is known as *congestive heart failure*. Treatment includes reducing the workload on the heart, modifying salt intake, and using drugs that help the body eliminate excess fluid.

**PROTECTING YOURSELF AGAINST CARDIOVASCULAR DISEASE**

You can take several important steps right now to lower your risk of developing CVD (Figure 11.4). Reducing CVD risk factors when you are young can pay off with many extra years of life and health.

**Eat a Heart-Healthy Diet**

For most Americans, changing to a heart-healthy diet involves cutting total fat intake, substituting unsaturated fats for saturated and trans fats, and increasing intake of whole grains and fiber. The following aspects of nutrition apply directly to heart health:

- **Fats:** The American Heart Association recommends that all Americans over age 2 adopt a dietary pattern in which fats make up 25–35% of total daily calories. Saturated fats should be limited to 7% of total daily calories, or 5–6% for adults who have elevated LDL. Trans fats should be avoided. The majority of fats in your diet should be unsaturated, from sources such as vegetable oils, fish, and nuts.
- **Fiber:** Studies have shown that a high-fiber diet is associated with a 40–50% reduction in the risk of heart attack and stroke. To get the recommended 25–38 grams of dietary fiber a day, eat whole grains, fruits, and vegetables. Good sources of fiber include oatmeal, some breakfast cereals, barley, legumes, and most fruits and vegetables.

**Do More**

- Eat a diet rich in fruits, vegetables, whole grains, and low-fat or fat-free dairy products. Eat five to nine servings of fruits and vegetables each day.
- Eat several servings of high-fiber foods each day.
- Eat two or more servings of fish per week; try a few servings of nuts and soy foods each week.
- Choose unsaturated fats rather than saturated and trans fats.
  - Be physically active; do both aerobic exercise and strength training on a regular basis.
  - Achieve and maintain a healthy weight.
  - Develop effective strategies for handling stress and anger. Nurture old friendships and family ties, and make new friends; pay attention to your spiritual side.
  - Obtain recommended screening tests and follow your physician’s recommendations.

**Do Less**

- Don’t use tobacco in any form: cigarettes, spit tobacco, cigars and pipes, bidis and clove cigarettes.
- Limit consumption of saturated fats and avoid trans fats.
- Limit consumption of salt to no more than 2,400 mg of sodium per day (1,500 mg if you have or are at high risk for hypertension).
- Avoid exposure to environmental tobacco smoke.
- Avoid excessive alcohol consumption—no more than one drink per day for women and two drinks per day for men.
- Limit consumption of red meat, added sugars, and refined carbohydrates.
- Avoid excess stress, anger, and hostility.
• Sodium and potassium. Reducing sodium intake to recommended levels, while also increasing potassium intake, can help reduce blood pressure for many people. The American Heart Association recommends that sodium intake be reduced to no more than 2,400 mg per day for all Americans. Reducing sodium intake further, to 1,500 mg/day, is associated with even greater reductions in blood pressure.

• Alcohol. Moderate alcohol use may increase HDL cholesterol; it may also reduce stroke risk, possibly by dampening the inflammatory response or by affecting blood clotting. For most people under age 45, however, the risks of alcohol use probably outweigh any health benefit. Excessive alcohol consumption increases the risk of a variety of serious health problems, including hypertension, stroke, some cancers, liver disease, alcohol dependence, and injuries.

**Exercise Regularly**

You can significantly reduce your risk of CVD with a moderate amount of physical activity (see the box “How Does Exercise Affect CVD Risk?”). A formal exercise program can provide even greater benefits. The information in Chapters 2–7 can help you create and implement a complete exercise program that meets your needs for fitness and prevention of chronic disease.

**Avoid Tobacco**

The number-one risk factor for CVD that you can control is smoking. If you smoke, quit. If you don’t smoke, don’t start. If you live or work with people who smoke, encourage them to quit—for their sake and yours. If you find yourself breathing in smoke, take steps to prevent or stop this exposure.

**Know and Manage Your Blood Pressure**

If you have no CVD risk factors, have your blood pressure measured at least once every two years; yearly tests are recommended if you have other risk factors. If your blood pressure is high, follow your physician’s advice on lowering it.

**Know and Manage Your Cholesterol Levels**

All people age 20 and over should have their cholesterol checked at least once every five years. The NCEP recommends a fasting lipoprotein profile that measures total cholesterol, HDL, LDL, and triglyceride levels. After you know your baseline numbers, you and your physician can develop a treatment and lifestyle plan.

**Develop Ways to Handle Stress and Anger**

To reduce the psychological and social risk factors for CVD, develop effective strategies for handling the stress in your life. Shore up your social support network, and try some of the techniques described in this chapter for managing stress and anger.

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**TIPS FOR TODAY AND THE FUTURE**

Because cardiovascular disease is a long-term process that can begin when you’re young, it’s important to develop heart-healthy habits early in life.

**RIGHT NOW YOU CAN**

- Make an appointment to have your blood pressure and cholesterol levels checked.
- List the key stressors in your life, and decide what to do about the ones that bother you most.
- Plan to replace one high-fat, high-sugar item in your diet with one that is high in fiber. For example, replace a doughnut with a bowl of whole-grain cereal.

**IN THE FUTURE YOU CAN**

- Track your eating habits for one week, then compare them to the DASH eating plan. Make adjustments to bring your diet closer to the DASH recommendations.
- Sign up for a class in CPR. A CPR certification equips you with valuable lifesaving skills you can use to help someone who is choking, having a heart attack, or experiencing cardiac arrest.

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**SUMMARY**

- The major controllable risk factors for CVD are smoking, hypertension, unhealthy cholesterol levels, inactivity, overweight and obesity, and diabetes.
- Contributing factors for CVD that can be changed include high triglyceride levels, inadequate stress management, a hostile personality, depression, anxiety, lack of social support, poverty, and alcohol and drug use.
- Major risk factors for CVD that can’t be changed are heredity, aging, being male, and ethnicity.
- Hypertension weakens the heart and scars and hardens arteries, causing resistance to blood flow. It is defined as blood pressure equal to or higher than 140 over 90.
- Atherosclerosis is a progressive hardening and narrowing of arteries that can lead to restricted blood flow and even complete blockage.
How Does Exercise Affect CVD Risk?

Regular exercise directly and indirectly benefits your cardiovascular health and can help you avoid having a heart attack or stroke. The evidence comes from dozens of large-scale, population-based studies conducted over the past several decades. There is so much evidence about the cardiovascular health benefits of exercise, in fact, that physicians regard physical activity as a magic bullet against heart disease.

Physical activity has an inverse relationship with cardiovascular disease, meaning that the more exercise you get, the less likely you are to develop or die from CVD. Compared to sedentary individuals, people who engage in regular, moderate physical activity lower their risk of CVD by 20% or more. People who get regular, vigorous exercise reduce their risk of CVD by 30% or more. This positive benefit applies regardless of gender, age, race, or ethnicity.

Most studies focus on various aerobic endurance exercises, such as walking, running on a treadmill, or biking. The type of exercise performed is less important than the amount of energy expended during the activity. The greater the energy expenditure, the greater the health benefits.

Exercise affects heart health via many mechanisms, all of which are being studied. For example, exercise helps people lose weight and improve body composition. Weight loss can improve heart health by reducing the amount of stress on the heart. Changing body composition to a more positive ratio of fat to fat-free mass boosts resting metabolic rate. Exercise directly strengthens the heart muscle itself, and it improves the balance of fats in the blood by boosting HDL and reducing LDL and triglyceride levels.

Exercise can also prevent metabolic syndrome and reverse many of its negative effects on the body. For example, exercise improves the health and function of the endothelial cells—the inner lining of the arteries. These cells secrete nitric oxide, which regulates blood flow, improves nerve function, strengthens the immune system, enhances reproductive health, and suppresses inflammation. Exercise training also improves the function of cell sodium-potassium pumps, which regulate fluid and electrolyte balance and cellular communication throughout the body.

One of the clearest positive effects of exercise is on hypertension. Many studies, involving thousands of people, have shown that physical activity reduces both systolic and diastolic blood pressure. These studies showed that people who engaged in regular aerobic exercise lowered their resting blood pressure by 2–4%, on average. Lowered blood pressure itself reduces the risk of other kinds of cardiovascular disease.

Fewer studies have been conducted on exercise and risk of stroke. Even with limited evidence, however, there appears to be a similar inverse relationship between physical activity and stroke. According to a handful of studies, the most physically active people reduced their risk of both ischemic and hemorrhagic strokes by up to 30%. Although this benefit appears to apply equally to men and women, there is not sufficient evidence that it applies equally across races or ethnicities.

Of course, exercise isn’t possible for everyone and may actually be dangerous for some people. People with CVD or serious risk factors for heart disease should work with their physician to determine whether or how to exercise.

Effective Means of Keeping Physically Active

Keep these guidelines in mind as you strive to reduce CVD risk factors:

- **Set goals.** Not physiological goals (for example, to improve LDL cholesterol levels) but to target a behavior (such as exercising for 30 minutes per day).
- **Monitor yourself.** Self-monitoring increases your awareness of physical cues and behaviors and helps you identify the barriers to changing a behavior.
- **Schedule follow-up exercise sessions.** Multiple sessions are more effective than single sessions.
- **Get feedback from your health care provider.** Feedback can encourage healthy choices by giving you an external measuring stick you can use to monitor your progress.
- **Keep a positive outlook on your progress.** A feeling of accomplishment is very important in motivating you to initiate new behaviors and continue your efforts once begun.

**Sources:**

• Heart attacks, strokes, and congestive heart failure are the results of a long-term disease process; hypertension and atherosclerosis are usually involved.
• Reducing heart disease risk involves eating a heart-healthy diet, exercising regularly, avoiding tobacco, managing blood pressure and cholesterol levels, and handling stress and anger.

**FOR FURTHER EXPLORATION**

**American Heart Association.** Provides information on hundreds of topics relating to the prevention and control of CVD.
http://www.heart.org (general information)

**The Human Heart: An On-Line Exploration.** An online museum exhibit containing information on the structure and function of the heart, how to monitor your heart’s health, and how to maintain a healthy heart.
http://learn.fi.edu/learn/heart/index.html

**MedlinePlus: Blood, Heart and Circulation Topics.** Provides links to reliable sources of information on cardiovascular health.

**Centers for Disease Control and Prevention.** Nutrition Basics: Cholesterol.
http://www.cdc.gov/nutrition/topics/cholesterol/

**National Heart, Lung, and Blood Institute.** Provides information on a variety of topics relating to cardiovascular health and disease, including cholesterol, smoking, obesity, hypertension, and the DASH diet.
http://www.nhlbi.nih.gov/

**National Stroke Association.** Provides information and referrals for stroke victims and their families; the website has a stroke risk assessment.
http://www.stroke.org/site/PageNavigator/HOME

See also the listings for Chapters 9 and 10.

**SELECTED BIBLIOGRAPHY**


I know what foods to avoid to prevent CVD, but are there any foods I should eat to help protect myself from CVD?

The most important dietary change for CVD prevention is a negative one: cutting back on foods high in saturated and trans fat. However, certain foods may be helpful. The positive effects of unsaturated fats, soluble fiber, and alcohol on heart health were discussed earlier in the chapter. Other potentially beneficial foods include those rich in the following:

- **Omega-3 fatty acids.** Found in fish, shellfish, and some nuts and seeds, omega-3 fatty acids reduce clotting and inflammation and may lower the risk of fatal arrhythmia.
- **Folic acid, vitamin B-6, and vitamin B-12.** These vitamins may affect CVD risk by lowering homocysteine levels; see Table 8.6 for a list of food sources.
- **Plant stanols and sterols.** Plant stanols and sterols, found in some types of trans fat–free margarines and other products, reduce the absorption of cholesterol in the body and help lower LDL levels.
- **Soy protein.** Replacing some animal protein with soy protein can lower LDL cholesterol. Soy-based foods include tofu, tempeh, and soy-based beverages.
- **Calcium.** Diets rich in calcium may help prevent hypertension and possibly stroke by reducing insulin resistance and platelet aggregation. Low-fat and fat-free dairy products are rich in calcium; refer to Chapter 8 for other sources.

How does stress contribute to cardiovascular disease?

With stress, the brain tells the adrenal glands to secrete cortisol and other hormones and neurotransmitters, which in turn activate the sympathetic nervous system—causing the fight-or-flight response. This response increases heart rate and blood pressure so that more blood is distributed to the heart and other muscles in anticipation of physical activity. Blood glucose concentrations and cholesterol also increase to provide a source of energy, and the platelets become activated so that they will be more likely to clot in case of injury. Such a response can be adaptive if you’re being chased by a hungry lion but may be more detrimental than useful if you’re sitting at a desk taking an exam or feeling frustrated by a task given to you by your boss.

If you are healthy, you can tolerate the cardiovascular responses that take place during stress, but if you already have CVD, stress can lead to adverse outcomes such as abnormal heart rhythms, heart attacks, and sudden cardiac death. It has long been known that an increase in heart rhythm problems and deaths is associated with acute mental stress. For example, the rate of potentially life-threatening arrhythmias in patients who already had underlying heart disease doubled during the month after the September 11 terrorist attacks; this increase was not limited to people in proximity to Manhattan.

Because avoiding all stress is impossible, having healthy mechanisms to cope with it is your best defense. Instead of adopting unhealthy habits such as smoking, drinking, or overeating to deal with stress, try healthier coping techniques such as exercising, getting enough sleep, and talking to family and friends.

What’s a heart murmur, and is it dangerous?

A heart murmur is an extra or altered heart sound heard during a routine medical exam. The source is often a problem with one of the heart valves that separate the chambers of the heart. Congenital defects and certain infections can cause abnormalities in the valves. The most common heart valve disorder is mitral valve prolapse (MVP), which occurs in about 4% of the population. MVP is characterized by a “billowing” of the mitral valve, which separates the left ventricle and left atrium, during ventricular contraction. In some cases, blood leaks from the ventricle into the atrium. Most people with MVP have no symptoms; they have the same ability to exercise and live as long as people without MVP.

MVP can be confirmed with echocardiography. Treatment is usually unnecessary, although surgery may be needed in the rare cases where leakage through the faulty valve is severe. Experts disagree over whether patients with MVP should take antibiotics prior to dental procedures, a precautionary step used to prevent bacteria, which may be dislodged into the bloodstream during some types of dental and surgical procedures, from infecting the defective valve. Most often, only those patients with significant blood leakage are advised to take antibiotics.

Although MVP usually requires no treatment, more severe heart valve disorders can impair blood flow through the heart. Treatment depends on the location and severity of the problem. More serious defects may be treated with surgery to repair or replace a valve.

The advice I hear from the media about protecting myself from CVD seems to be changing all the time. What should I believe?

Health-related research is now described in popular newspapers and magazines rather than just medical journals, meaning that more and more people have access to the information. Researchers do not deliberately set out to mislead or confuse people. However, news reports may oversimplify the results of research studies, leaving out some of the qualifications and questions the researchers present with their findings. In addition, news reports may not differentiate between a preliminary finding and a result that has been verified by a large number of long-term studies. And researchers themselves must strike a balance between reporting promising preliminary findings to the public, thereby allowing people to act on them, and waiting 10–20 years until long-term studies confirm (or disprove) a particular theory.

Although you cannot become an expert on all subjects, there are some strategies you can use to assess the health advice that appears in the media; see the box “Evaluating Sources of Health Information” in Chapter 1.
LAB 11.1  Cardiovascular Health

Part I  CVD Risk Assessment

Your chances of suffering a heart attack or stroke before age 55 depend on a variety of factors, many of which are under your control. To help identify your risk factors, circle the response for each risk category that best describes you.

1. Sex and Age
   0  Female age 55 or younger; male age 45 or younger
   2  Female over age 55; male over age 45

2. Heredity/Family History
   0  Neither parent suffered a heart attack or stroke before age 60.
   3  One parent suffered a heart attack or stroke before age 60.
   7  Both parents suffered a heart attack or stroke before age 60.

3. Smoking
   0  Never smoked
   3  Quit more than 2 years ago and lifetime smoking is less than five pack-years*
   6  Quit less than 2 years ago and/or lifetime smoking is greater than five pack-years*
   8  Smoke less than 1/2 pack per day
   13 Smoke more than 1/2 pack per day
   15 Smoke more than 1 pack per day

4. Environmental Tobacco Smoke
   0  Do not live or work with smokers
   2  Exposed to ETS at work
   3  Live with smoker
   4  Both live and work with smokers

5. Blood Pressure
   (If available, use the average of the last three readings.)
   0 120/80 or below
   1 121/81–130/85
   3 Don’t know blood pressure
   5 131/86–150/90
   9 151/91–170/100
   13 Above 170/100

6. Total Cholesterol
   0 Lower than 190
   1 190–210
   2 Don’t know
   3 211–240
   4 241–270
   5 271–300
   6 Over 300

7. HDL Cholesterol
   0 Over 60 mg/dl
   1 55–60
   2 Don’t know HDL
   3 45–54
   5 35–44
   7 25–34
   12 Lower than 25

8. Exercise
   0  Exercise three times a week
   1  Exercise once or twice a week
   2  Occasional exercise less than once a week
   7  Rarely exercise

9. Diabetes
   0  No personal or family history
   2  One parent with diabetes
   6  Two parents with diabetes
   9  Type 2 diabetes
   13 Type 1 diabetes

10. Body Mass Index (kg/m²)
    0  <23.0
    1 23.0–24.9
    2 25.0–28.9
    3 29.0–34.9
    5 35.0–39.9
    7  ≥40

11. Stress
    0  Relaxed most of the time
    1  Occasionally stressed and angry
    2  Frequently stressed and angry
    3  Usually stressed and angry

Scoring

Total your risk factor points. Refer to the list below to get an approximate rating of your risk of suffering an early heart attack or stroke.

<table>
<thead>
<tr>
<th>Score</th>
<th>Estimated Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 20</td>
<td>Low risk</td>
</tr>
<tr>
<td>20–29</td>
<td>Moderate risk</td>
</tr>
<tr>
<td>30–45</td>
<td>High risk</td>
</tr>
<tr>
<td>Over 45</td>
<td>Extremely high risk</td>
</tr>
</tbody>
</table>

*Pack-years can be calculated by multiplying the number of packs you smoked per day by the number of years you smoked. For example, if you smoked a pack and a half a day for 5 years, you would have smoked the equivalent of 1.5 × 5 = 75 pack-years.
LABORATORY ACTIVITIES

Part II  Hostility Assessment

Are you too hostile? To help answer that question, Duke University researcher Redford Williams, M.D., has devised a short self-test. It’s not a scientific evaluation, but it does offer a rough measure of hostility. Are the following statements true or false for you?

1. I often get annoyed at checkout cashiers or the people in front of me when I’m waiting in line.
2. I usually keep an eye on the people I work or live with to make sure they do what they should.
3. I often wonder how homeless people can have so little respect for themselves.
4. I believe that most people will take advantage of you if you let them.
5. The habits of friends or family members often annoy me.
6. When I’m stuck in traffic, I often start breathing faster and my heart pounds.
7. When I’m annoyed with people, I really want to let them know it.
8. If someone does me wrong, I want to get even.
9. I’d like to have the last word in any argument.
10. At least once a week, I have the urge to yell at or even hit someone.

According to Williams, five or more “true” statements suggest that you’re excessively hostile and should consider taking steps to mellow out.

Using Your Results

How did you score? (1) What is your CVD risk assessment score? Are you surprised by your score?

Are you satisfied with your CVD risk rating? If not, set a specific goal:

(2) What is your hostility assessment score? Are you surprised by the result?

Are you satisfied with your hostility rating? If not, set a specific goal:

What should you do next? Enter the results of this lab in the Preprogram Assessment column in Appendix C. (1) If you’ve set a goal for the overall CVD risk assessment score, identify a risk area that you can change, such as smoking, exercise, or stress. Then list three steps or strategies for changing the risk area you’ve chosen.

Risk area:
Strategies for change:

(3) If you’ve set a goal for the hostility assessment score, begin by keeping a log of your hostile responses. Review the anger management strategies in Chapter 10 and select several that you will try to use to manage your angry responses. Strategies for anger management:

Next, begin to put your strategies into action. After several weeks of a program to reduce CVD risk or hostility, do this lab again and enter the results in the Postprogram Assessment column of Appendix C. How do the results compare?

LOOKING AHEAD...

After reading this chapter, you should be able to

- Explain what cancer is and how it spreads.
- List and describe common cancers, their risk factors, signs and symptoms, treatments, and approaches to prevention.
- Discuss some of the causes of cancer and how they can be avoided or minimized.
- Describe how cancer can be detected, diagnosed, and treated.
- List specific actions you can take to lower your risk of cancer.

TEST YOUR KNOWLEDGE

1. Eating which of these foods may help prevent cancer?
   a. chili peppers
   b. broccoli
   c. oranges

2. Testicular cancer is the most common cancer in men between ages 15 and 35. True or false?

3. The use of condoms during sexual intercourse may prevent cancer in women. True or false?

See answers on the next page.
Cancer is the second leading cause of death, after heart disease. In the United States, cancer is responsible for almost one in four deaths, claiming more than 1,600 lives every day. Evidence indicates that most cancers in the United States could be prevented by simple changes in lifestyle. Tobacco use is responsible for about 29% of all cancer deaths (Figure 12.1). Diet and exercise, including their relationship with obesity, account for another 30% of cancer deaths.

**WHAT IS CANCER?**

Cancer is the abnormal, uncontrolled multiplication of cells, which can ultimately cause death if left untreated.

**Tumors**

Most cancers take the form of tumors, although not all tumors are cancerous. A tumor (or neoplasm) is a mass of tissue that serves no physiological purpose. It can be benign, like a wart, or malignant, like most lung cancers.

**Answers (Test Your Knowledge)**

1. All three. These and many other fruits and vegetables are rich in phytochemicals, naturally occurring substances that may have anti-cancer effects.
2. True. Although rare, testicular cancer is the most common cancer in men between ages 15 and 35. Regular self-exams may aid in its detection.
3. True. The primary cause of cervical cancer is infection with the human papillomavirus (HPV), a sexually transmitted pathogen. The use of condoms helps prevent HPV infection.

**Metastasis**

Metastasis, the spread of cancer cells, occurs because cancer cells do not stick to each other as strongly as normal cells do and therefore may not remain at the site of the primary tumor, the cancer’s original location. They break away and can pass through the blood and lymphatic circulation to form metastatic tumors in other parts of the body. For example, breast cancer cells may spread to the liver, lungs, or bones. Metastasis is often spread through the lymphatic system or blood vessels.
through the lining of lymph or blood vessels to invade nearby tissue. They can also drift to distant parts of the body and multiply, establishing new colonies of cancer cells. This traveling and seeding process is called metastasizing, and the new tumors are secondary tumors, or metastases.

The ability of cancer cells to metastasize makes early cancer detection critical. To control the cancer, every cancerous cell must be removed. Once cancer cells enter either the lymphatic system or the bloodstream, it is extremely difficult to stop their spread to other organs.

THE CAUSES OF CANCER

Although scientists do not know everything about what causes cancer, they have identified genetic, environmental, and lifestyle factors. Rates of cancer have declined among all U.S. ethnic groups in recent years, but significant disparities still exist. For example, genetic factors may help explain the high rate of prostate cancer among black men. Cultural factors may explain why women belonging to social groups that encourage early marriage and motherhood are likely to have a lower risk of breast cancer. People with low incomes and a lack of health insurance have higher cancer death rates.

The Role of DNA

Heredity and genetics are important factors in a person’s risk of cancer. Certain genes may predispose some people to cancer, and specific gene mutations have been associated with cancer.

DNA Basics  The nucleus of each cell in your body contains 23 pairs of chromosomes, which are made up of tightly packed coils of DNA (deoxyribonucleic acid). Each chromosome contains hundreds or thousands of genes; you have about 20,000 genes in all. Each of your genes controls the production of a particular protein. By making different proteins at different times, genes can act as switches to alter the ways a cell works. Some genes are responsible for controlling the rate of cell division, and these genes often play a critical role in the development of cancer.

DNA Mutations and Cancer  A mutation is any change in the makeup of a gene. Some mutations are inherited; others are caused by environmental agents known as mutagens. Mutagens include radiation, certain viruses, and chemical substances in the air we breathe. (When a mutagen also causes cancer, it is called a carcinogen.) Some mutations are the result of copying errors that occur when DNA replicates itself as part of cell division.

A mutated gene no longer contains the proper code for producing its protein. It usually takes several mutational changes before a normal cell takes on the properties of a cancer cell. Genes that have mutations associated with the conversion of a normal cell into a cancer cell are known as oncogenes. Many oncogenes play a role in controlling or restricting cell growth; they are called tumor suppressor genes. Mutational damage to suppressor genes releases the brake on growth and leads to rapid and uncontrolled cell division—a precondition for the development of cancer.

An example of an inherited mutated oncogene is BRCA1 (breast cancer gene 1). Women who inherit a damaged copy of this suppressor gene face a significantly increased risk of breast and ovarian cancer.

In most cases, however, mutational damage occurs after birth. For example, only about 5–10% of breast cancer cases can be traced to inherited copies of a damaged BRCA1 gene. In addition, lifestyle factors are important even for those who have inherited a damaged suppressor gene. Testing and identification of hereditary cancer risks can be helpful for some people, especially if it leads to increased attention to controllable risk factors and better medical screening.

Cancer Promoters  Substances known as cancer promoters make up another important piece of the cancer puzzle. These substances don’t directly produce DNA mutations, but they accelerate the growth of cells, which means less time for a cell to repair DNA damage caused by other factors. Estrogen, which stimulates cellular growth in the female reproductive organs, is an example of a cancer promoter.

Tobacco Use

Smoking is responsible for up to 90% of lung cancer deaths and for about 29% of all cancer deaths. Overall, tobacco use is responsible for nearly one in five American deaths—nearly 480,000 premature deaths each year. The U.S. Surgeon General has reported that tobacco use is a direct cause of several types of cancer. In addition to lung and bronchial cancer, tobacco use is linked to cancer of the larynx, mouth, pharynx, esophagus, stomach, pancreas, kidneys, bladder, and cervix. Avoiding tobacco use and exposure to environmental tobacco smoke are key lifestyle strategies for reducing cancer risk (Figure 12.2).
Dietary Factors

Diet is one of the most important factors in cancer prevention, but it is also one of the most complex and controversial. Your food choices affect your cancer risk by exposing you to potentially dangerous compounds, depriving you of potentially protective ones, or, in contrast, acting against cancer. The following dietary factors may affect cancer risk:

- **Dietary fat and meat**: Diets high in fat and meat may contribute to certain cancers, including colon, stomach, and prostate cancer. Certain types of fat may be riskier than others. Omega-6 polyunsaturated fats are associated with a higher risk of certain cancers; omega-3 fats are not. (See Chapter 8 for more information on types of fatty acids.)

- **Alcohol**: Alcohol is associated with an increased incidence of several cancers. For example, women who have 2 to 5 drinks daily have about 1.5 times the risk of women who drink no alcohol. Alcohol and tobacco interact as risk factors for oral cancer. Heavy users of both alcohol and tobacco have a risk for oral cancer many times greater than that of people who don’t drink or use tobacco.

- **Foods cooked at high temperatures**: Scientists have found high levels of the chemical acrylamide (a probable human carcinogen) in starch-based foods that have been fried or baked at high temperatures, especially French fries and certain types of snack chips and crackers. Acrylamide is also found in high concentrations in tobacco. When muscle meats (beef, pork, fish, poultry) are cooked at high temperatures, such as when grilled over an open flame or pan fried, different types of cancer-causing chemicals can form.

- **Fiber**: Various potential cancer-fighting actions have been proposed for fiber, but none has been firmly established. Further study is needed to clarify the relationship between fiber intake and cancer risk, but experts still recommend a high-fiber diet for its overall positive effect on health.

- **Fruits and vegetables**: Researchers have identified many mechanisms by which food components may act against cancer. Some may prevent carcinogens from forming in the first place or block them from reaching or acting on target cells. Others boost enzymes that detoxify carcinogens and render them harmless. Some essential nutrients act as anticarcinogens. For example, vitamin C, vitamin E, selenium, and the carotenoids (vitamin A precursors) may help block cancer by acting as antioxidants.

Many other anti-cancer agents in the diet fall under the broader heading of phytochemicals, substances in plants that help protect against chronic diseases (Table 12.1). One of the first to be identified was sulforaphane, a potent anticarcinogen found in broccoli.

**Obesity and Inactivity**

The ACS recommends maintaining a healthy weight throughout life by balancing caloric intake with physical activity, and by achieving and maintaining a healthy weight if you are currently overweight or obese. Being overweight or obese is linked with increased risk of several kinds of cancer, including endometrial, prostate, breast, and colon cancer; excess abdominal fat (apple body shape) and gaining weight...
FOODS WITH PHYTOCHEMICALS

<table>
<thead>
<tr>
<th>FOOD</th>
<th>PHYTOCHEMICAL</th>
<th>POTENTIAL ANTICANCER EFFECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chili peppers (Note: Hotter peppers contain more capsaicin.)</td>
<td>Capsaicin</td>
<td>Neutralizes effect of nitrosamines; may block carcinogens in cigarette smoke from acting on cells</td>
</tr>
<tr>
<td>Oranges, lemons, limes, onions, apples, berries, eggplant</td>
<td>Flavonoids</td>
<td>Act as antioxidants; block access of carcinogens to cells; suppress malignant changes in cells; prevent cancer cells from multiplying</td>
</tr>
<tr>
<td>Citrus fruits, cherries</td>
<td>Monoterpenes</td>
<td>Help detoxify carcinogens; inhibit spread of cancer cells</td>
</tr>
<tr>
<td>Cruciferous vegetables (broccoli, cabbage, bok choy, caulifower, kale, brussels sprouts, collards)</td>
<td>Isothiocyanates</td>
<td>Boost production of cancer-fighting enzymes; suppress growth; block effects of estrogen on cell growth</td>
</tr>
<tr>
<td>Garlic, onions, leeks, shallots, chives</td>
<td>Allyl sulfides</td>
<td>Increase levels of enzymes that break down potential carcinogens; boost activity of cancer-fighting immune cells</td>
</tr>
<tr>
<td>Grapes, red wine, peanuts</td>
<td>Resveratrol</td>
<td>Act as antioxidants; suppress tumor growth</td>
</tr>
<tr>
<td>Green, oolong, and black teas (Note: Drinking burning hot tea may increase cancer risk.)</td>
<td>Polyphenols</td>
<td>Increase antioxidant activity; prevent cancer cells from multiplying; help speed excretion of carcinogens from the body</td>
</tr>
<tr>
<td>Orange, deep yellow, red, pink, and dark green vegetables; some fruits</td>
<td>Carotenoids</td>
<td>Act as antioxidants; reduce levels of cancer-promoting enzymes; inhibit spread of cancer cells</td>
</tr>
<tr>
<td>Soy foods, whole grains, flax seeds, nuts</td>
<td>Phytoestrogens</td>
<td>Block effects of estrogen on cell growth; lower blood levels of estrogen</td>
</tr>
<tr>
<td>Whole grains, legumes</td>
<td>Phytic acid</td>
<td>Bind iron, which may prevent it from creating cell-damaging free radicals</td>
</tr>
</tbody>
</table>

**Wellness Tip**
Grilling meats at high temperatures can produce cancer-causing compounds. If you regularly eat grilled foods, cut away and avoid eating any charred parts. Reduce the formation of these cancer-causing chemicals by marinating before grilling, turning meat frequently, and reducing grilling time by precooking meat in the microwave before finishing on the grill.

Over time are also associated with elevated rates of cancer (Figure 12.3). Physical activity reduces the risk of cancer of the breast, colon, and uterus, as well as advanced prostate cancer. The ACS guidelines encourage everyone to adopt a physically active lifestyle (see the box “How Does Exercise Affect Cancer Risk?”).

**Carcinogens in the Environment**
Some carcinogens occur naturally in the environment, like viruses and the sun’s UV rays. Others are manufactured or synthetic substances that show up occasionally in the general environment but more often in the work environments of specific industries.

**TERMS**
- **carcinogen** Any substance that causes cancer.
- **carotenoid** Any of a group of yellow-to-red plant pigments that can be converted to vitamin A by the liver; many act as antioxidants or have other anti-cancer effects. The carotenoids include beta-carotene, lutein, lycopene, and zeaxanthin.
- **phytochemical** A naturally occurring substance found in plant foods that may help prevent chronic diseases such as cancer and heart disease; *phyto* means “plant.”
How Does Exercise Affect Cancer Risk?

According to statistics from the International Agency for Research on Cancer (IARC), as many as 25% of cancers are due to overweight, obesity, and physical inactivity. Increasing levels of physical activity can potentially ward off several types of cancer.

The links between exercise and cancer prevention are not entirely clear. However, experts have associated increased physical activity and a reduced risk of several specific types of cancer. Studies show, for example, that people who do moderate aerobic exercise for three to four hours per week reduce their risk of colon cancer by 30%. Women who do the same amount of exercise can reduce their risk of breast cancer by as much as 40%. (Some studies suggest that women who meet certain criteria can reduce their breast cancer risk up to 80%) Evidence also shows that, when compared with sedentary people, active people can reduce their risk of lung cancer (20%), endometrial cancer (30%), and ovarian cancer (20%). Researchers are continually trying to establish similar connections between exercise and other types of cancer.

As is the case with cardiovascular disease, physical activity appears to have an inverse relationship with the types of cancer just listed. That is, the more you exercise, the lower your risk of developing these kinds of cancer. Energy balance also seems to be a factor, at least in relation to a few types of cancer, meaning that people who burn at least as many calories as they take in may further reduce their risk of some cancers. This positive effect may be due to the fact that reducing body fat (through exercise and a healthy diet) lowers the chemical and hormonal activities of adipose (fat) tissue—activities that may encourage some cancers to develop.

In addition to reducing the biological influences of adipose tissue, physical activity is known to reduce the inflammatory response and to boost immune function. Chronic inflammation, which can have many causes, leaves body tissues more vulnerable to infection. The immune system is the body’s first line of defense against cancer, so supporting immune function through exercise may help prevent some cancers.

Emerging data also indicate that physical activity can help improve health outcomes in people who have cancer or are cancer survivors. For example, physical activity appears to restore cardiorespiratory fitness at least to some degree in patients whose heart muscles have been weakened by cancer treatments. This positive outcome was found in 13 separate studies, many of which found significant improvements in heart function among cancer survivors who performed moderate-intensity exercise for 20–40 minutes three times per week. The benefits were similar across several forms of aerobic exercise, including walking, yoga, and tai chi. Additionally, a handful of studies have found that exercise improves muscular strength and endurance and flexibility in patients whose muscles and joints have been weakened by cancer treatments.

Ingested Chemicals The food industry uses preservatives and other additives to prevent food from becoming spoiled or stale. Some of these compounds are antioxidants and may actually decrease any cancer-causing properties in the food.

Other compounds, like the nitrates and nitrites found in processed meats, are potentially more dangerous. Although nitrates and nitrites are not themselves carcinogenic, they can combine with dietary substances in the stomach and be converted to nitrosamines, which are highly potent carcinogens. Foods cured with nitrites, as well as those cured by salt or smoke, have been linked to esophageal and stomach cancer, and they should be eaten only in modest amounts.

Environmental and Industrial Pollution The best available data indicate that less than 2% of cancer deaths are caused by general environmental pollution, such as substances in our air and water. Exposure to carcinogenic materials in the workplace is a more serious problem. Occupational exposure to specific carcinogens may account for about 4% of cancer deaths. With increasing industry and government regulations, industrial sources of cancer risk should continue to diminish.

Radiation All sources of radiation are potentially carcinogenic, including medical X-rays, radioactive substances (radioisotopes), and UV rays from the sun. Most physicians and
herpesvirus 8 has been linked to Kaposi’s sarcoma and certain types of lymphoma. Hepatitis viruses B and C together cause as many as 80% of the world’s liver cancers.

COMMON CANCERS

Each year, more than 1.6 million Americans are diagnosed with cancer, and more than 580,000 die (Figure 12.4). These statistics exclude the more than 1 million cases of the curable types of skin cancer. At current U.S. rates, nearly one in two men and more than one in three women will develop cancer at some point in their lives. Nearly 14.5 million living Americans have a history of cancer.

In this section we look at some of the most common cancers and their causes, prevention, and treatment.

Lung Cancer

Lung cancer is the most common cause of cancer death in the United States; it is responsible for about 158,000 deaths each year. Since 1987, lung cancer has surpassed breast cancer as the leading cause of cancer death in women. The chief risk factor for lung cancer is tobacco smoke. When smoking is combined with exposure to other carcinogens, such as asbestos particles, the risk of cancer can be multiplied by a factor of 10 or more. Quitting substantially reduces risk, but

<table>
<thead>
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<th>Deaths</th>
<th>Male</th>
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<tr>
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<td>Brain</td>
</tr>
<tr>
<td>32,670</td>
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<td>Oral</td>
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<tr>
<td>46,610</td>
<td>9,120</td>
<td>Skin (melanoma)</td>
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<tr>
<td>115,610</td>
<td>86,380</td>
<td>Lung</td>
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<td>2,350</td>
<td>440</td>
<td>Breast</td>
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<td>6,500</td>
<td>Stomach</td>
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<td>Colon and rectum</td>
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<td>96,580</td>
<td>21,110</td>
<td>Urinary system</td>
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<td>220,800</td>
<td>27,540</td>
<td>Prostate</td>
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<td>8,430</td>
<td>380</td>
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<td>16,660</td>
<td>24,480</td>
<td>Other</td>
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<td>848,200</td>
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</table>

<table>
<thead>
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<tbody>
<tr>
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<tr>
<td>Oral</td>
<td>13,110</td>
<td>2,640</td>
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<td>Skin (melanoma)</td>
<td>33,490</td>
<td>4,220</td>
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<tr>
<td>Lung</td>
<td>105,590</td>
<td>71,660</td>
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<tr>
<td>Breast</td>
<td>231,840</td>
<td>40,290</td>
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<tr>
<td>Stomach</td>
<td>9,050</td>
<td>4,220</td>
</tr>
<tr>
<td>Liver</td>
<td>10,150</td>
<td>7,520</td>
</tr>
<tr>
<td>Pancreas</td>
<td>24,120</td>
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<tr>
<td>Colon and rectum</td>
<td>63,610</td>
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<td>42,130</td>
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<td>Prostate</td>
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<td>Uterus</td>
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<td>Cervix</td>
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<td>Myeloma</td>
<td>12,760</td>
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</tr>
<tr>
<td>Leukemia</td>
<td>23,370</td>
<td>10,240</td>
</tr>
<tr>
<td>Lymphoma</td>
<td>35,950</td>
<td>8,800</td>
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<tr>
<td>Other</td>
<td>14,850</td>
<td>19,360</td>
</tr>
<tr>
<td>Total</td>
<td>810,170</td>
<td>277,280</td>
</tr>
</tbody>
</table>

FIGURE 12.4  Cancer cases and deaths by site and sex.

Age is a key risk factor, with 90% of cases diagnosed in people age 50 and older. Many cancers arise from preexisting polyps, small growths on the wall of the colon that may gradually develop into malignancies. Many colon cancers may be due to inherited gene mutations.

Lifestyle also affects colon cancer risk. Regular physical activity reduces risk; obesity increases risk. Although the mechanisms are unclear, high intake of red meat, smoked meat and fish, refined carbohydrates, and simple sugars appears to increase risk, as do excessive alcohol consumption and smoking. Protective lifestyle factors may include a diet rich in fruits, vegetables, fish, and whole grains; adequate intake of folic acid, calcium, magnesium, and vitamin D; regular use of nonsteroidal anti-inflammatory drugs such as aspirin and ibuprofen; and, in women, use of oral contraceptives.

Young polyps and early-stage cancers can be removed before they spread. Because polyps may bleed, the standard warning signs of colon cancer are bleeding from the rectum and a change in bowel habits. The ACS recommends that regular screening be started at age 50. A yearly stool blood test can detect traces of blood in the stool long before obvious bleeding can be noticed. Another test is the colonoscopy, in which a flexible fiber-optic device is inserted through the rectum, allowing the colon to be examined and polyps to be removed (Figure 12.5). Studies show that screening could reduce the occurrence of colorectal cancer by up to 90%, but only about 60% of adults age 50 and over undergo these tests.

Surgery is the primary method of treatment for colon and rectal cancer. The five-year survival rate is 90% for colon and rectal cancers detected early and 65% overall.

Breast Cancer

Breast cancer is the most common cancer in women but causes about half as many deaths in women as lung cancer. In the United States, about 1 in 8 women will get breast cancer, and 1 in 30 women will die from the disease. Breast cancer occurs only rarely in men.

Risk Factors There is a strong genetic factor in breast cancer. A woman who has two close relatives with breast cancer is more than four times as likely to develop the disease as a woman who has no relatives with it. However, only about 5 to 10% of breast cancers occur in women with a family history of the disease.

Other risk factors include these:
- Early-onset menstruation or late-onset menopause
- Having no children or having a first child after age 30
- Current use of hormone replacement therapy
- Obesity
- Alcohol use
- Smoking cigarettes

The female hormone estrogen may be a common element for some of these risk factors. Estrogen promotes cell growth in responsive tissues, such as the breast and uterus, so any
factor that increases estrogen exposure may raise the risk of breast cancer. Fat cells produce estrogen, and estrogen levels are higher in obese women. Alcohol can increase estrogen in the blood as well.

**Prevention** Although some risk factors cannot be changed, important lifestyle risk factors can be controlled. Eating a healthy diet, exercising regularly, limiting alcohol intake, and maintaining a healthy body weight can minimize the chance of developing breast cancer, even for women at risk from family history or other factors.

A dietary pattern rich in fruits, vegetables, and whole grains and lower in refined carbohydrates and animal products is associated with reduced risk of breast cancer. Some studies have found that people with higher vitamin D intakes or higher blood levels of vitamin D have a lower risk of breast and certain other cancers; see Chapter 8 for key dietary sources of vitamin D.

**Detection** For women at average risk of breast cancer, the ACS recommends the following:

- **Mammography.** A mammogram is a low-dose breast X-ray that can spot breast abnormalities before physical symptoms arise. A newer type of mammography, called digital mammography, may provide more accurate results in some women, as may magnetic resonance imaging (MRI). The ACS recommends that women begin annual mammograms at age 45; at age 55, women should have mammograms every other year. However, the ACS also states that women between the ages of 40–44 and women over the age of 55 may choose to have annual mammograms.

- **Breast self-awareness:** While the ACS no longer recommends breast-self exams (BSE) or clinical breast exams, a woman should be familiar with her breasts and alert her health care provider to any changes right away. See the box “Breast Awareness and Self-Exam” for more information.

If a lump in the breast is detected, it can be **biopsied** or scanned by **ultrasonography** to determine whether it is cancerous. Most lumps are benign.

The U.S. Preventive Services Task Force (USPSTF) recommends against routine mammography before age 50, citing the anxiety and distress caused by false-positive results. The USPSTF also recommends against teaching BSE. The debate about screening guidelines continues.

**Treatment** If a lump is cancerous, one of several surgical treatments may be used, ranging from a lumpectomy (removal of the lump and surrounding tissue) to a mastectomy (removal of the breast). Chemotherapy or radiation treatment may also be used to eradicate as many cancerous cells as possible.

Several drugs have been developed for preventing and treating breast cancer. These include selective estrogen-receptor modulators (SERMs), which act like estrogen in some tissues but block estrogen’s effects in others. The two best-known SERMs are tamoxifen and raloxifene. Another category of drug, called trastuzumab, is a special type of antibody that binds to a specific cancer-related target in the body. Regardless of the treatments used, social support can also affect a patient’s psychological and physical wellness.

If a tumor is discovered early, before it has spread to the adjacent lymph nodes, the patient with breast cancer has about a 98% chance of surviving more than five years. The survival rate for all stages is 90% at five years.

**Prostate Cancer**

The prostate gland is situated at the base of the bladder in men; if enlarged, it can block the flow of urine. Prostate cancer is the most common cancer in men and the second leading cause of cancer death in men. Nearly 239,000 new cases of prostate cancer are diagnosed and nearly 30,000 American men die from the disease each year.

The risk factors for prostate cancer are increasing age, African ancestry, family history, and certain inherited genetic conditions. Age is the strongest predictor of the risk of prostate cancer, with about 56% of cases diagnosed in men over age 40.

**Prevention** Although some risk factors cannot be changed, important lifestyle risk factors can be controlled. Eating a healthy diet, exercising regularly, limiting alcohol intake, and maintaining a healthy body weight can minimize the chance of developing breast cancer, even for women at risk from family history or other factors.

A dietary pattern rich in fruits, vegetables, and whole grains and lower in refined carbohydrates and animal products is associated with reduced risk of breast cancer. Some studies have found that people with higher vitamin D intakes or higher blood levels of vitamin D have a lower risk of breast and certain other cancers; see Chapter 8 for key dietary sources of vitamin D.

**Detection** For women at average risk of breast cancer, the ACS recommends the following:

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- **Breast self-awareness:** While the ACS no longer recommends breast-self exams (BSE) or clinical breast exams,
Experts disagree about the role of breast self-exams (BSEs) in finding breast cancer or reducing deaths from breast cancer. BSE appears to play a relatively small role in finding cancers. Some women like to take an active role in monitoring their health with BSE, whereas others find it stressful. In some cases, BSE findings can lead to unnecessary additional tests, including biopsies. The American Cancer Society no longer recommends BSE, while some other organizations still do.

All experts agree that women should be aware of how their breasts normally look and feel and report any symptoms or changes to their health-care provider. The following are warning signs of breast cancer, but keep in mind that these can also be caused by other conditions:

- A new lump in the breast or underarm
- Thickening or swelling of part of the breast
- Irritation or dimpling of breast skin
- Redness or flaky skin in the nipple area or the breast
- Pulling in of the nipple or pain in the nipple area
- Nipple discharge other than breast milk, including blood
- Any change in the size or the shape of the breast
- Pain in any area of the breast

Remember, most breast lumps and changes are benign (not cancer).

If you decide that BSE is right for you, review the recommended technique at the U.S. National Library of Medicine website (https://www.nlm.nih.gov/medlineplus/ency/article/001993.htm) and with your physician. If you decide on a less systematic approach—such as periodically checking your breasts while getting dressed or showering—stay alert for the warning signs listed above. Breast self-exam and breast awareness do not take the place of mammography, so be sure to keep up with the screenings recommended for your age and risk factors.

to as _cervical dysplasia_—the Pap test is repeated at intervals. In about one-third of cases, the cellular changes progress toward malignancy. If this happens, the abnormal cells must be removed, either surgically or by destroying them with an ultracold (cryoscopic) probe or localized laser treatment. In more advanced cases, treatment may involve chemotherapy, radiation, or hysterectomy (surgical removal of the uterus).

Because the Pap test is highly effective, all sexually active women and women over the age of 18 should be tested. The recommended schedule for testing depends on risk factors, the type of Pap test performed, and whether the Pap test is combined with HPV testing.

Cervical cancer can be prevented by avoiding infection with HPV. Sexual abstinence, mutually monogamous sex with an uninfected partner, and regular use of condoms can reduce the risk of HPV infection (see Chapter 14 for more on HPV and other STIs).

Two HPV vaccines have been approved by the Food and Drug Administration (FDA) for the prevention of cervical cancer. Women who receive a vaccine should continue to receive routine Pap tests because the vaccines do not protect against all types of the virus.

### Uterine or Endometrial Cancer

Cancer of the lining of the uterus (the _endometrium_) most often occurs after age 55. Uterine cancer strikes almost 55,000 American women annually and kills more than 10,000 women each year. The risk factors are similar to those for breast cancer. Endometrial cancer is usually detectable by pelvic examination. It is treated surgically, as well as by radiation, hormones, and chemotherapy.

### Ovarian Cancer

Although ovarian cancer is rare compared with uterine cancer, it causes more deaths. There are no screening tests to detect it, so it is often diagnosed late in its development. The risk factors are similar to those for breast and endometrial cancer. Anything that lowers a woman’s lifetime number of ovulation cycles—pregnancy, breastfeeding, or use of oral contraceptives—reduces the risk of ovarian cancer.

Early symptoms of ovarian cancer may include bloating, pelvic or abdominal pain, difficulty eating or feeling full quickly, and urinary problems (urgency or frequency). Women who experience these symptoms almost daily for a few weeks should see their physician. Some ovarian cancers are also detected through regular pelvic exams. Ovarian cancer is treated by surgical removal of one or both ovaries, the fallopian tubes, and the uterus.

### Skin Cancer

Skin cancer is the most common cancer of all when cases of the highly curable forms are included in the count. Of the more than 2.2 million cases of skin cancer diagnosed each year, about 74,000 are of the most serious type, _melanoma_. Almost all cases of skin cancer can be traced to excessive exposure to _ultraviolet (UV)_ radiation from the sun, including longer-wavelength ultraviolet A (UVA) and shorter-wavelength ultraviolet B (UVB) radiation. UVB radiation causes sunburns and can damage the eyes and immune system. UVA is less likely to cause an immediate sunburn, but it damages connective tissue and leads to premature aging of the skin. Tanning lamps and tanning salon beds emit mostly UVA radiation. Both solar and artificial sources of UVA and UVB radiation are human carcinogens that cause skin cancer.

Both severe, acute sun reactions (sunburns) and chronic low-level sun reactions (sunspots) can lead to skin cancer. According to the American Academy of Dermatology, the risk of skin cancer doubles in people who have had five or more sunburns in their lifetime. People with fair skin have less natural protection against skin damage from the sun and a higher risk of skin cancer than people with naturally dark skin. Severe sunburns in childhood have been linked to a greatly increased risk of skin cancer in later life, so children in particular should be protected. Other risk factors include having many moles (particularly large ones), spending time at high altitudes, and having a family history of the disease.

There are three main types of skin cancer, named for the types of skin cell from which they develop. _Basal cell_ and _squamous cell carcinomas_ together account for about 95% of the skin cancers diagnosed each year. They are usually found in chronically sun-exposed areas, such as the face, neck, hands, and arms. They usually appear as pale, waxylike, pearly nodules, or red, scaly, sharply outlined patches. These cancers are often painless, although they may bleed, crust, and form an open sore.

Melanoma is by far the most dangerous skin cancer because it spreads so rapidly. It can occur anywhere on the body, but the most common sites are the back, chest, abdomen, and lower legs. A melanoma usually appears at the site of a preexisting mole. The mole may begin to enlarge, become mottled or varied in color (colors can include blue, pink, and white), or develop an irregular surface or irregular borders. Tissue invaded by melanoma may also itch, burn, or bleed easily.

To protect yourself against skin cancer, avoid overexposure to UV radiation. People of every age, including babies and children, need to be protected from the sun (see the box “Sunscreens and Sun-Protective Clothing”). You can help with early detection by examining your skin regularly. Most of the spots, freckles, moles, and blemishes on your body are normal, but if you notice an unusual growth, discoloration, or sore that does not heal, see your physician or a dermatologist immediately. The

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**Prostate-specific antigen (PSA) blood test**

A diagnostic test for prostate cancer that measures blood levels of prostate-specific antigen (PSA).

**Pap test**

A scraping of cells from the cervix for examination under a microscope to detect cancer.

**melanoma**

A malignant tumor of the skin that arises from pigmented cells, usually a mole.

**ultraviolet (UV) radiation**

Light rays of a specific wavelength, emitted by the sun; most UV rays are blocked by the ozone layer in the upper atmosphere.

**basal cell carcinoma**

Cancer of the deepest layers of the skin.

**squamous cell carcinoma**

Cancer of the surface layers of the skin.
CRITICAL CONSUMER
Sunscreens and Sun-Protective Clothing

With consistent use of the proper clothing, sunscreens, and common sense, you can lead an active outdoor life and protect your skin against most sun-induced damage.

Clothing
- Wear long-sleeved shirts and long pants. Dark-colored, tightly woven fabrics provide reasonable protection from the sun. Another good choice is clothing made from special sun-protective fabrics; these garments have an ultraviolet protection factor (UPF) rating, similar to the SPF rating for sunscreens.
- Wear a hat. A good choice is a broad-brimmed hat or a legionnaire-style cap that covers the ears and neck. Wear sunscreen on your face even if you are wearing a hat.
- Wear sunglasses. Exposure to UV rays can damage the eyes and cause cataracts.

Sunscreen
- Use a sunscreen and lip balm with a sun protection factor (SPF) of 15 or higher. An SPF rating refers to the amount of time you can stay out in the sun before you burn, compared with not using sunscreen. For example, a product with an SPF of 30 would allow you to remain in the sun without burning 30 times longer, on average, than if you didn’t apply sunscreen. If you’re fair-skinned, have a family history of skin cancer, are at high altitude, or will be outdoors for many hours, use a sunscreen with an even higher SPF.
- Choose a broad-spectrum sunscreen that protects against both UVA and UVB radiation. The SPF rating of a sunscreen currently applies only to UVB, but a number of ingredients, especially titanium dioxide and zinc oxide, are effective at blocking most UVA radiation. In 2011, the FDA announced that sunscreens would be required to pass a new broad-spectrum test to determine how effectively they protect against both UVA and UVB radiation. Starting in summer 2012, products that have passed this test have been allowed to bear the “broad spectrum” label.
- Use a water-resistant sunscreen if you swim or sweat a great deal. Under the new FDA regulations, sunscreens cannot be labeled as “waterproof” or “sweatproof” because these claims overstate the products’ actual effectiveness. Labels for “water resistance” must now specify whether they are good for 40 or 80 minutes of swimming or sweating.
- If you have acne, look for a sunscreen that is labeled “non-comedogenic,” which means that it will not cause pimples.
- Shake sunscreen before applying. Apply it 30 minutes before exposure to allow it time to bond to the skin. Reapply sunscreen frequently and generously to all sun-exposed areas (many people overlook their temples, ears, and sides and backs of their necks). Most people use less than half as much as they need to attain the full SPF rating. One ounce of sunscreen is enough to cover an average-size adult in a swimsuit. Reapply sunscreen every two hours. Also be sure to reapply sunscreen after activities, such as swimming, that could remove sunscreen.
- If you’re taking medications, ask your physician or pharmacist about possible reactions to sunlight or interactions with sunscreens. Medications for acne, allergies, and diabetes are just a few of the products that can trigger reactions. If you’re using sunscreen and an insect repellent containing DEET, use extra sunscreen (DEET may decrease sunscreen effectiveness).

Time of Day and Location
- Avoid sun exposure between 10:00 a.m. and 2:00 p.m., when the sun’s rays are most intense. Clouds allow as much as 80% of UV rays to reach your skin. Stay in the shade when you can.
- Consult the day’s UV Index, which predicts UV levels on a 0–10+ scale, to get a sense of the amount of sun protection you’ll need. Take special care on days with a rating of 5 or above. UV Index ratings are available in local newspapers, from the weather bureau, or from certain websites.
- UV rays can penetrate at least three feet below the surface of water, so swimmers should wear water-resistant sunscreens. Snow, sand, water, concrete, and white-painted surfaces are also highly reflective of UV rays.

Tanning Salons
- Stay away from tanning salons! Despite advertising claims to the contrary, the lights used in tanning parlors are damaging to your skin. Tanning beds and lamps emit mostly UVA radiation, increasing your risk of premature skin aging (such as wrinkles) and skin cancer.

characteristics that may signal that a skin lesion is a melanoma are illustrated in Figure 12.6.

If you have an unusual skin lesion, your physician will examine it and possibly perform a biopsy. If the lesion is cancerous, it is usually removed surgically, a procedure that can almost always be performed in the physician’s office using a local anesthetic. Treatment is usually simple and successful when the cancer is caught early. Even for melanoma, the outlook after
The best time to perform a testicular self-exam is after a warm shower or bath, when the scrotum is relaxed. First, stand in front of a mirror and look for any swelling of the scrotum. Then, examine each testicle with both hands. Place the index and middle fingers under the testicle and the thumbs on top. Roll each testicle gently between the fingers and thumbs. Don’t worry if one testicle seems slightly larger than the other; that’s common. Also, expect to feel the epididymis—the soft, sperm-carrying tube at the rear of each testicle.

Perform a self-exam each month. If you find a lump, swelling, or nodule, see your doctor right away. The abnormality may not be cancer, but only a physician can make a diagnosis.

Other possible signs of testicular cancer include a change in the way a testicle feels, a sudden collection of fluid in the scrotum, a dull ache in the lower abdomen or groin, a feeling of heaviness in the scrotum, or pain in a testicle or the scrotum.

**Testicular Cancer**

Testicular cancer is relatively rare, accounting for only 1% of cancers in men (about 8,400 cases per year), but it is the most common cancer in men age 20–35. Testicular cancer is much more common among white Americans than among Latinos, Asian Americans, or African Americans. Men with undescended testicles are at increased risk for testicular cancer, and for this reason the condition should be corrected in early childhood. Self-examination may help in the early detection of testicular cancer (see the box “Testicle Self-Examination”). Tumors are treated by surgical removal of the testicle and, if the tumor has spread, by chemotherapy. The five-year survival rate is about 97%.

**Other Cancers**

Several other cancers affect thousands of people each year. Some have identifiable risk factors (particularly smoking and obesity, which are controllable), but the causes of others are still under investigation.

- **Pancreatic cancer** causes almost 49,000 deaths annually in the United States. The disease is usually well advanced before symptoms become noticeable, and no effective cure is available. About 3 out of 10 cases are linked to smoking. Other risk factors include being male, African American, or over age 60; having a family history of
pancreatic cancer; having diabetes; being inactive and obese; and eating a diet high in fat and meat and low in vegetables.

- **Bladder cancer** is nearly four times as common in men as in women, and almost 2 times higher in white men than in black men. Smoking is the key risk factor. The first symptoms are likely to be blood in the urine and/or increased frequency of urination. These symptoms can also signal a urinary tract infection but should trigger a visit to a physician, who can evaluate the possibility of cancer. With early detection, 96% of bladder cancers are curable. There are about 75,000 new cases and 16,000 deaths each year.

- **Kidney cancer** usually occurs in people over 50. Smoking and obesity are mild risk factors, as is a family history of the disease. Symptoms may include fatigue, pain in the side, and blood in the urine. There are about 62,000 new cases each year and about 14,000 deaths.

- **Brain cancer** commonly develops for no apparent reason and can arise from most of the cell types that are found in the brain. One of the few established risk factors for brain cancer is ionizing radiation, such as X-rays of the head. Symptoms are often nonspecific and include headaches, fatigue, behavioral changes, and sometimes seizures. Some brain tumors are curable by surgery or by radiation and chemotherapy, but most are not. There are about 23,000 new cases and 15,000 deaths each year.

- **Leukemia**, cancer of the white blood cells, starts in the bone marrow but can then spread to the lymph nodes, spleen, liver, other organs, and central nervous system. Some possible risk factors include smoking, radiation, certain chemicals, and infections. Most symptoms occur because leukemia cells crowd out the production of normal blood cells. The result can be fatigue, anemia, weight loss, and increased risk of infection. There are about 54,000 new cases and 24,000 deaths each year.

- **Lymphoma** is a form of cancer that begins in the lymph nodes and then may spread to almost any part of the body. There are two types—Hodgkin’s disease and non-Hodgkin’s lymphoma (NHL). NHL is the more common and more deadly form of the disease. Risk factors for NHL are not well understood but may include genetic factors, radiation, and certain chemicals and infections.

### DETECTING AND TREATING CANCER

Early cancer detection often depends on our willingness to be aware of changes in our own body and to make sure we keep up with recommended screening tests. Although treatment success varies with individual cancers, cure rates have increased—sometimes dramatically—in this century, especially for cancers that are diagnosed at their early stages.

#### Detecting Cancer

Unlike those of some other diseases, early signs of cancer are usually not apparent to anyone but the person who has them. Even pain is not a reliable guide to early detection, because the initial stages of cancer may be painless. Self-monitoring is the first line of defense. By being aware of the risk factors in your own life, your immediate family’s cancer history, and your own history, you may bring a problem to the attention of a doctor long before it would be detected at a routine physical (see the box “Genetic Testing”). In addition to self-monitoring, specific screening tests for certain cancers are available. Consult the list and links in Table 12.2 for general screening guidelines from ACS, the Centers for Disease Control and Prevention (CDC), and the National Cancer Institute (NCI). Discuss your personal risk factors, such as family history or cigarette use, with your health care provider to help determine the screening tests and schedule most appropriate for you. Digital reminders can be effective in increasing the likelihood that people follow through with cancer screening; see the box “Cancer Screening Reminders” for more information.

#### Stages of Cancer

Physicians need to know the exact size and location of a tumor to treat it effectively. To confirm the type of tumor, a biopsy may be performed. Physicians can then classify the disease according to the extent of the cancer in a patient’s body, whether the cancer has invaded nearby lymph nodes, and whether metastases are present. This is usually determined through imaging techniques such as MRI, computed tomography (CT) scanning, ultrasonography, or exploratory surgery. The classifying process is called staging, and the cancer is categorized in five stages, as shown in Table 12.3. By judging the extent of each criterion—size or extent, spread, metastases—physicians can determine the cancer’s stage, establish how severe it is, and choose the most appropriate treatment based on the extent of the disease.

#### Treating Cancer

The ideal cancer therapy would kill or remove all cancerous cells while leaving normal tissue untouched. Sometimes this is almost possible, as when a surgeon removes a small superficial tumor of the skin. Typically, however, the tumor is less accessible, so some combination of surgery, radiation therapy, and chemotherapy must be used (see “Common Questions Answered” for new and emerging cancer treatments).
How far should we go to prevent potential cancers? Breast cancer genes BRCA1 and BRCA2 made the headlines in 2013 and again in 2015 when actress Angelina Jolie announced that she had a preventive double mastectomy, followed by surgery to remove her ovaries and fallopian tubes. After her mother struggled with ovarian and breast cancer for eight years until her death, Jolie learned that she harbored the same genetic minefield. Her 87% risk for breast cancer and 50% risk for ovarian cancer persuaded her to undergo surgery to remove her breasts, ovaries and fallopian tubes.

The reaction was mixed: some applauded Jolie’s encouragement for women to be aware of genetic testing and their options for preventive, informed actions; others pointed out that worried women might pursue mastectomies that were medically unnecessary. Following Jolie’s first announcement in The New York Times, cancer and genetic testing centers reported five times the number of calls they usually receive in a week related to genetic testing.

But having a mutation in the BRCA1 or BRCA2 gene is rare—only 5–10% of breast cancers and 10–15% of ovarian cancers result from this mutation among white women in the United States (data on other ethnicities are so far incomplete). Most women are advised not to opt for such extreme preventive surgery. Even if you have a mutation that suggests that you will ultimately get breast or ovarian cancer, other preventive measures are available, including several medications.

The Role of Drug and Diagnostic Companies

The so-called breast cancer genes were first discovered in the early 1990s, when Mary-Claire King, a geneticist at the University of California, Berkeley, isolated a single gene on chromosome 17. This later became known as BRCA1. King showed that as many as 5–10% of all cases of breast cancer may be hereditary. By 1994, Myriad Genetics cloned BRCA1 and filed a patent on the gene. The effect was to make screening extremely expensive. After 20 years of court battles, the U.S. Supreme Court ruled that such a patent is not permitted because genes are a product of nature. As a result, the cost of testing for mutations on the BRCA1 and BRCA2 genes should decline from its current high of $4,000. Many genetic tests used to detect other conditions cost in the $100–200 range.

Surgery For most cancers, surgery is the most useful treatment. In many cases, the organ containing the tumor is not essential for life and can be partially or completely removed. Surgery is less effective when the tumor involves cells of the immune system, which are widely distributed throughout the body, or when the cancer has already metastasized.

Chemotherapy Chemotherapy is the use of targeted drugs that destroy rapidly growing cancer cells. Many chemotherapy drugs work by interfering with DNA synthesis and replication in rapidly dividing cells. Normal cells, which usually grow slowly, are not destroyed by these drugs. However, some normal tissues such as intestinal, hair, and blood-forming cells are always growing, and damage to these tissues produces the unpleasant side effects of chemotherapy, including nausea, vomiting, diarrhea, and hair loss.

Radiation In cancer radiation therapy, a beam of X-rays or gamma rays is directed at the tumor, killing the tumor cells. Occasionally, when an organ is small enough, radioactive seeds are surgically placed inside the cancerous organ to destroy the tumor; they are then removed later, if necessary. Radiation destroys
# Early Detection of Cancer in Average-Risk, Asymptomatic People

<table>
<thead>
<tr>
<th>SITE/TESTS AND PROCEDURES</th>
<th>DESCRIPTION</th>
<th>LINKS FOR MORE INFORMATION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BREAST</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Mammography               | Yearly mammograms are the best way to find breast cancer early, when it is easier to treat. These imaging tests, which involve low-dose X-rays, are recommended for women starting at age 45 and especially between 50 to 74, or as long as they are in good health. | CDC: [www.cdc.gov/cancer/breast/basicInfo/screening.htm](http://www.cdc.gov/cancer/breast/basicInfo/screening.htm)  
ACS: [www.cancer.org/treatment/understandingyourdiagnosis/examsandtestdescriptions/mammogramsandotherbreastimagingprocedures/index](http://www.cancer.org/treatment/understandingyourdiagnosis/examsandtestdescriptions/mammogramsandotherbreastimagingprocedures/index) |
| Breast awareness          | Routine examination of the breasts by health care providers or by women themselves starting in their 20s has not been shown to reduce deaths from breast cancer. However, any lump or other unusual change in the breast needs to be promptly reported to a doctor. |                           |
| **CERVIX**                |             |                           |
| Pap and HPV cytology tests | Pap tests can find abnormal cells in the cervix that may turn into cancer, and they can find cervical cancer early, when the chance of a cure is high. Testing every 3 to 5 years should begin at age 21 and end at age 65, if results have been normal. Women who have been vaccinated against HPV still need HPV tests. | CDC: [www.cdc.gov/cancer/cervical/basicInfo/screening.htm](http://www.cdc.gov/cancer/cervical/basicInfo/screening.htm)  
| **COLON**                 |             |                           |
| Colonoscopy and sigmoidoscopy | A sigmoidoscopy every 5 years or a colonoscopy every 10 years between the ages of 50 and 75 can reduce the likelihood of death from colorectal cancer and can detect abnormal polyps that can be removed before they turn into cancer. The virtual colonoscopy has not been shown to reduce deaths from colorectal cancer. | CDC: [www.cdc.gov/cancer/colorectal/basicInfo/screening.htm](http://www.cdc.gov/cancer/colorectal/basicInfo/screening.htm)  
| High-sensitivity fecal occult blood test (FOBT) | This yearly multiple-stool, take-home test reduces death from colorectal cancer and is recommended for people between 50 and 75. If a positive result is found, it is followed by a colonoscopy or sigmoidoscopy. |                           |
| **LUNG**                  |             |                           |
| Low-dose computed tomography (LDCT) | This imaging test has been shown to reduce lung cancer deaths among heavy smokers (30 pack-years*) between ages 55 and 74 or 80 who still smoke or have quit within the last 15 years. | CDC: [www.cdc.gov/cancer/lung/basicInfo/screening.htm](http://www.cdc.gov/cancer/lung/basicInfo/screening.htm)  
| **OVARY AND UTERUS**      |             |                           |
| CA-125 blood test, transvaginal ultrasound | There is no evidence that any screening test reduces deaths from ovarian cancer. However, these tests can help in diagnosing ovarian cancer. Women should report any unexpected bleeding or spotting to a doctor. | CDC: [www.cdc.gov/cancer/ovarian/basicInfo/screening.htm](http://www.cdc.gov/cancer/ovarian/basicInfo/screening.htm)  
| **PROSTATE**              |             |                           |
| Prostate specific antigen (PSA) | Although this blood test, which is often done with a digital rectal exam, can detect prostate cancer at an early stage, it is more likely to lead to overtreatment than to reduce deaths from prostate cancer. Starting at age 50, men should talk to a doctor about the pros and cons of this test. African American men and men whose father or brother had prostate cancer before age 65 should talk to a doctor about this test starting at age 45. | CDC: [www.cdc.gov/cancer/prostate/basicInfo/screening.htm](http://www.cdc.gov/cancer/prostate/basicInfo/screening.htm)  

*A pack-year is calculated by multiplying the number of packs of cigarettes smoked per day by the number of years the person has smoked. For example, smoking 2 packs per day for 10 years is equal to 20 pack-years; smoking one-half pack per day for 10 years is equal to 5 pack-years.

**Sources:**  
both normal and cancerous cells, but because it can be precisely directed at the tumor, it is usually less toxic for the patient than either surgery or chemotherapy, and it can often be performed on an outpatient basis. Radiation may be used as an exclusive treatment or in combination with surgery and/or chemotherapy.

If your physician or health care clinic doesn’t offer a digital reminder service, you can sign up for one from the CDC or ACS:
- American Cancer Society: http://www.cancer.org/healthy/toolsandcalculators/reminders

To determine which screening tests are most appropriate for someone of your sex and age, use the myhealthfinder tool (http://healthfinder.gov/myhealthfinder). Discuss your individual risk factors and the risks and benefits of specific screening tests with your health care provider.

**Cervical Cancer:** the most preventable female cancer.

**Cancer Screening Reminders**

Send an e-card to help your mother, daughter, or female partner remember to get her next mammogram or Pap test. Many studies have shown that texts, emails, and e-cards are highly effective at prompting people to have regular health screenings. One study found that people who received an email reminder were significantly more likely than those who received only a verbal reminder from their physician to come to a medical office and pick up a fecal occult blood detection kit for colon cancer screening. Other studies have found that text messaging proved much more effective than telephone calls at prompting women to have mammograms.


**TIPS FOR TODAY AND THE FUTURE**

A growing body of research suggests that we can take an active role in preventing many cancers by adopting a wellness lifestyle.

**RIGHT NOW YOU CAN**
- If you are a woman, consider doing a breast self-exam; if you are a man, do a testicular self-exam.
- Buy multiple bottles of sunscreen and put them in places where you will most likely need them, such as your backpack, gym bag, or car.
- Check the cancer screening guidelines in this chapter, and make sure you are up-to-date on your screenings.

**IN THE FUTURE YOU CAN**
- Learn where to find information about daily UV radiation levels in your area, and learn how to interpret the information. Many local newspapers and television stations (and their websites) report current UV levels every day.
- Gradually add foods with abundant phytochemicals to your diet, choosing from the list shown in Table 12.1.

---

**Table 12.3 Cancer Stages**

<table>
<thead>
<tr>
<th>STAGE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Carcinoma in situ: abnormal cells are present only in the layer of cells in which they developed; not cancer but may become cancer</td>
</tr>
<tr>
<td>I, II, and III</td>
<td>Higher numbers indicate more extensive disease: Larger tumor size and/or spread of the cancer beyond the organ in which it first developed to nearby lymph nodes or to tissues or organs adjacent to the primary tumor</td>
</tr>
<tr>
<td>IV</td>
<td>Cancer that has spread to distant tissues or organs</td>
</tr>
</tbody>
</table>

**What is a biopsy?**

A biopsy is the removal and examination of a small piece of body tissue. Biopsies enable cancer specialists to carefully examine cells that are suspected of having turned cancerous. Some biopsies are fairly simple to perform, such as those on tissue from moles or skin sores. Other biopsies may require the use of a needle or probe to remove tissue from inside the body, such as in the breast or stomach.

**Are other cancer treatments available beyond surgery, chemotherapy, and radiation?**

Some experimental techniques that show promise for some particular types of cancer include the following:

- **Bone marrow transplants.** Healthy bone marrow cells from a compatible donor are transplanted following the elimination of the patient’s bone marrow by radiation or chemotherapy. Transplants of stem cells may provide a solution to the problem of donor incompatibility. These unspecialized cells can divide and produce many specialized cell types, including bone marrow cells. Stem cells can be grown outside the body and then transplanted back into the cancer patient, allowing safe repopulation of bone marrow.

  - **Vaccines and genetically modified immune cells.** These enhance the reaction of a patient’s own immune system.

  - **Anti-angiogenesis agents.** These starve tumors by blocking their blood supply.

  - **Proteasome inhibitors.** Proteasomes help control the cell cycle—the process through which cells divide. If proteasomes malfunction, as is often the case in cancer cells, then cells may begin multiplying out of control. Proteasome inhibitors block the action of proteasomes, halting cell division and killing the cells. One proteasome inhibitor is now being used against certain cancers, and other such drugs are in development.

  - **Enzyme activators/blockers.** Normal cells die after dividing a given number of times. Scientists believe that the enzyme caspase triggers the death of normally functioning cells. In cancer cells, caspase activity may be blocked. Conversely, if the enzyme telomerase becomes active in cancer cells, the life/death cycle stops and the cells duplicate indefinitely. In effect, inactive caspase or active telomerase may make cancer cells “immortal.” Researchers are studying compounds that can either activate caspase or deactivate telomerase; either type of drug might lead cancer cells to self-destruct. No such drugs are now in clinical use.

  In the future, gene sequencing techniques may allow treatments to be targeted at specific cancer subtypes, much as specific antibiotics are now used to treat specific bacterial diseases.

  - **Monoclonal antibodies.** The use of monoclonal antibodies to fight cancer mimics the way the immune system fights an infection. All cells in the body have markers on their surfaces, and the immune system develops antibodies, or special proteins, that can recognize these markers, bind to them, and trigger neutralization and destruction. Scientists carefully select cell-surface markers that are displayed on cancer cells and then administer antibodies to the patient. These monoclonal antibodies (the term monoclonal means they bind to only one particular cell-surface marker) target the cancer cells and enlist the help of the body’s own immune system to selectively kill these cells. Rituximab (Rituxan) has been one of the most successful monoclonal antibodies, used effectively for patients with lymphoma. Many other monoclonal antibodies are in use currently, and the list of potential new agents in this category is growing rapidly.
SUMMARY

- Cancer is an abnormal and uncontrolled multiplication of cells; cancer cells can metastasize (spread to other parts of the body).
- The genetic basis of some cancers appears to be mutational damage to suppressor genes, which normally limit cell division.
- Cancer-promoting dietary factors include meat, certain types of fat, and alcohol. Dietary elements that may protect against cancer include antioxidants and phytochemicals. An inactive lifestyle is associated with some cancers.
- Some carcinogens occur naturally in the environment; others are manufactured substances. Occupational exposure is a risk for some workers.
- All sources of radiation are potentially carcinogenic, including X-rays and UV rays from the sun.
- Lung cancer kills more people than any other type of cancer; tobacco smoke is the primary cause.
- Colon and rectal cancer are linked to age, heredity, obesity, and a diet rich in red meat and low in fruits and vegetables.
- Breast cancer has a genetic component, but lifestyle and hormones are also factors. Prostate cancer is chiefly a disease of aging; diet, heredity, and ethnicity are other risk factors.
- Cancers of the female reproductive tract include cervical, uterine, and ovarian cancer. Cervical cancer is linked to HPV infection; the Pap test is an effective screening test. Vaccination is recommended for girls and young women.
- Melanoma is the most serious form of skin cancer; excessive exposure to UV radiation in sunlight is the primary cause.
- Oral cancer is caused primarily by smoking, excess alcohol consumption, and use of spit tobacco.
- Testicular cancer can be detected early through self-examination.
- Self-monitoring and regular screening tests are essential to early cancer detection.
- Methods of cancer diagnosis include MRI, CT scanning, and ultrasound.
- Cancer treatment usually consists of some combination of surgery, chemotherapy, and radiation.

FOR FURTHER EXPLORATION

American Academy of Dermatology. Provides information on skin cancer prevention.
http://www.aad.org

American Cancer Society. Provides a wide range of free materials on the prevention and treatment of cancer.
http://www.cancer.org

American Institute for Cancer Research. Provides information on lifestyle and cancer prevention, especially nutrition.
http://www.aicr.org

CureSearch National Childhood Cancer Foundation. Offers information on childhood cancers and initiatives to raise awareness and funds for research.
http://www.curesearch.org

EPA/Sunwise. Provides information about the UV Index and the effects of sun exposure, with links to sites with daily UV Index ratings for U.S. and international cities.
http://www.epa.gov/sunwise/uvindex.html

LiveStrong Foundation. Provides resources on cancer and cancer support.
http://www.livestrong.org

MedlinePlus: Cancers. Provides links to reliable cancer information.

Medline Plus: Breast Cancer Health Center. Links to reliable information about genetic testing and related topics.

National Cancer Institute. Provides information on treatment options, screening, clinical trials, and newly approved drugs.
http://www.cancer.gov

Skin Cancer Foundation. Provides information on all types of skin cancers, their prevention, and treatment.
http://www.skincancer.org

Susan G. Komen for the Cure. Provides information and resources on breast cancer.
http://ww5.komen.org

Washington University School of Medicine: Your Disease Risk. Includes interactive risk assessments as well as tips for preventing common cancers.
http://www.yourdiseaserisk.wustl.edu

http://www.who.int/cancer/en

SELECTED BIBLIOGRAPHY


UC Davis Health System. Nd. Protection Against Cancer from the Grill (http://www.ucdmc.ucdavis.edu/welcome/features/20070627_grilling/index.html).


LAB 12.1 Cancer Prevention

This lab looks at two areas of cancer prevention over which you have a great deal of individual control—diet and sun exposure. For a detailed personal risk profile for many specific types of cancer, complete the assessments at the Washington University School of Medicine’s “Your Disease Risk” site (http://www.yourdiseaserisk.wustl.edu).

Part I Diet and Cancer

Track your diet for three days, recording the number of servings from each of the following groups that you consume.

<table>
<thead>
<tr>
<th>DAY 1</th>
<th>DAY 2</th>
<th>DAY 3</th>
<th>POTENTIAL CANCER FIGHTERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>_____</td>
<td>_____</td>
<td>_____</td>
<td>Orange, deep yellow, pink, and red vegetables and some fruits (for example, apricots, cantaloupe, carrots, corn, grapefruit, mangoes, nectarines, papayas, red and yellow bell peppers, sweet potatoes, pumpkin, tomatoes and tomato sauce, watermelon, winter squash such as acorn or butternut)</td>
</tr>
<tr>
<td>_____</td>
<td>_____</td>
<td>_____</td>
<td>Dark green leafy vegetables (for example, broccoli rabe, chard, kale, romaine and other dark lettuces, spinach; beet, collard, dandelion, mustard, and turnip greens)</td>
</tr>
<tr>
<td>_____</td>
<td>_____</td>
<td>_____</td>
<td>Cruciferous vegetables (bok choy, broccoli, brussels sprouts, cabbage, cauliflower, kohlrabi, turnips)</td>
</tr>
<tr>
<td>_____</td>
<td>_____</td>
<td>_____</td>
<td>Citrus fruits (for example, grapefruit, lemons, limes, oranges, tangerines)</td>
</tr>
<tr>
<td>_____</td>
<td>_____</td>
<td>_____</td>
<td>Whole grains (for example, whole-grain bread, cereal, and pasta; brown rice; oatmeal; whole-grain corn; barley; popcorn; bulgur)</td>
</tr>
<tr>
<td>_____</td>
<td>_____</td>
<td>_____</td>
<td>Legumes (peas, lentils, and beans, including fava, navy, kidney, pinto, black, and lima beans)</td>
</tr>
<tr>
<td>_____</td>
<td>_____</td>
<td>_____</td>
<td>Berries (for example, strawberries, raspberries, blackberries, blueberries)</td>
</tr>
<tr>
<td>_____</td>
<td>_____</td>
<td>_____</td>
<td>Garlic and other allium vegetables (onions, leeks, chives, scallions, shallots)</td>
</tr>
<tr>
<td>_____</td>
<td>_____</td>
<td>_____</td>
<td>Soy products (for example, tofu, tempeh, soy milk, miso, soybeans)</td>
</tr>
<tr>
<td>_____</td>
<td>_____</td>
<td>_____</td>
<td>Other cancer-fighting fruits (apples, cherries, cranberries or juice, grapes, kiwi fruit, pears, plums, prunes, raisins)</td>
</tr>
<tr>
<td>_____</td>
<td>_____</td>
<td>_____</td>
<td>Other cancer-fighting vegetables (asparagus, beets, chili peppers, eggplant, green peppers, radishes)</td>
</tr>
</tbody>
</table>

Daily totals (average for three days: _____)

The goal is to eat at least 7 (women) or 9 (men) servings of cancer-fighting fruits and vegetables each day; the more servings, the better. (Research is ongoing, and this list of cancer fighters is not comprehensive. Remember, nearly all fruits, vegetables, and grains are healthy choices.)

Part II Skin Cancer Risk Assessment

Your risk of skin cancer from the ultraviolet radiation in sunlight depends on several factors. Take the following quiz to see how sensitive you are. The higher your UV-risk score, the greater your risk of skin cancer—and the greater your need to take precautions against too much sun. Score 1 point for each true statement:

_____ 1. I have blond or red hair.
_____ 2. I have light-colored eyes (blue, gray, green).
_____ 3. I freckle easily.
_____ 4. I have many moles.
_____ 5. I had two or more blistering sunburns as a child.
_____ 6. I spent lots of time in a tropical climate as a child.
_____ 7. I have a family history of skin cancer.
_____ 8. I work outdoors.
_____ 9. I spend a lot of time in outdoor activities.
_____ 10. I like to spend as much time in the sun as I can.
_____ 11. I sometimes go to a tanning parlor or use a sunlamp.

Total score
LABORATORY ACTIVITIES

Using Your Results

How did you score?

(1) How close did you come to the goal of eating 7–9 or more servings of cancer fighters each day?

Are you satisfied with your diet in terms of cancer prevention? If not, set a specific goal for a target number of servings of cancer-fighting fruits and vegetables:

(2) What is your skin cancer risk assessment score? Does it indicate that you are at high or very high risk? Do you feel you need to take action because of your risk level?

What should you do next? Enter the results of this lab in the Preprogram Assessment column in Appendix C. (1) If you’ve set a goal for the diet and cancer portion of the lab, select a target number of additional cancer fighters from the list to try over the next few days; list the foods below, along with your plan for incorporating them into your diet (as a side dish, as a snack, on a salad, as a substitute for another food, etc.).

CANCER FIGHTER TO TRY: ______________________  PLAN FOR TRYING: ______________________

________________________________________  _______________________________________

________________________________________  _______________________________________

________________________________________  _______________________________________

(3) You cannot control all of your risk factors for skin cancer, but you can control your behavior with regard to sun exposure. Keep a journal to track your behavior on days when you are outdoors in the sun for a significant period of time. Compare your behavior with the recommendations for skin cancer prevention described in the chapter. Record information such as time of day, total duration of exposure, UV index for the day, clothing worn, type and amount of sunscreen used, frequency of sunscreen applications, and so on. From this record, identify ways to improve your behavior to lower your risk of skin cancer. Put together a behavior change plan.

Next, begin to put your strategies into action. After several weeks of a program to improve your diet or reduce your UV exposure, do this lab again and enter the results in the Postprogram Assessment column of Appendix C. How do the results compare?

LOOKING AHEAD...

After reading this chapter, you should be able to

- Define and discuss the concepts of addictive behavior, substance misuse, and substance dependence.
- List the major categories of psychoactive drugs and discuss how drug abuse can be prevented and treated.
- Describe the short-term and long-term effects of alcohol use.
- Identify strategies for drinking alcohol responsibly.
- List the health hazards associated with tobacco use and exposure to environmental tobacco smoke.
- Describe strategies that can help someone stop smoking.

TEST YOUR KNOWLEDGE

1. Which of the following is the most widely used drug among college-age students?
   a. cocaine
   b. hallucinogens
   c. marijuana
   d. heroin

2. If a man and a woman of the same weight drink the same amount of alcohol, the woman will become intoxicated more quickly than the man. True or false?

3. Every day in the United States, about 5,700 people start smoking. True or false?

See answers on the next page.
The use of drugs for both medical and social purposes is widespread in America (Table 13.1). Many people believe that every problem has or should have a chemical solution. Advertisements, social pressures, and the human desire for quick solutions to life’s difficult problems all contribute to the prevailing attitude that drugs can ease all pain. Unfortunately, using drugs can—and often does—have negative consequences.

The most serious consequences are addiction and impairment of daily activities. The drugs most often associated with addiction and impairment are psychoactive drugs—those that alter a person’s experiences or consciousness. In the short term, psychoactive drugs can cause intoxication, a state in which sometimes unpredictable physical and emotional changes occur. In the long term, recurrent drug use can have profound physical, emotional, and social effects.

This chapter examines the use of psychoactive drugs, including alcohol and tobacco, and explains their short- and long-term effects and their potential for abuse and addiction.

**Addictive Behavior**

Although addiction is most often associated with drug use, many experts now extend the concept of addiction to other areas. Addictive behaviors are habits that have gotten out of control, with resulting negative effects on a person’s health.

**What Is Addiction?**

Addiction is a chronic disease that involves disruption of the brain’s systems related to reward, motivation, and memory. Dysfunction in these systems leads to biological, psychological, and social effects associated with pathologically pursuing pleasure or relief by substance use and other behaviors. Historically, the term was applied only when the habitual use of a drug produced chemical changes in the user’s body. One such change is physical tolerance, in which the body adapts to a drug so that the initial dose no longer produces the same

---

**Table 13.1** Nonmedical Drug Use Among Americans, 2013

<table>
<thead>
<tr>
<th>PERCENTAGE REPORTING PAST MONTH USE</th>
<th>YOUNG ADULTS (AGE 18–25)</th>
<th>ALL AMERICANS (AGE 12 AND OLDER)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ILLICIT DRUGS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marijuana* and hashish</td>
<td>21.5</td>
<td>9.4</td>
</tr>
<tr>
<td>Nonmedical use of psychotherapeutics</td>
<td>4.8</td>
<td>2.5</td>
</tr>
<tr>
<td>Cocaine</td>
<td>1.1</td>
<td>0.6</td>
</tr>
<tr>
<td>Heroin</td>
<td>0.3</td>
<td>0.1</td>
</tr>
<tr>
<td>Hallucinogens</td>
<td>1.8</td>
<td>0.5</td>
</tr>
<tr>
<td>Inhalants</td>
<td>0.3</td>
<td>0.5</td>
</tr>
<tr>
<td>TOBACCO (all forms)</td>
<td>37.0</td>
<td>25.5</td>
</tr>
<tr>
<td>Cigarettes</td>
<td>30.6</td>
<td>21.3</td>
</tr>
<tr>
<td>Smokeless tobacco</td>
<td>5.8</td>
<td>3.4</td>
</tr>
<tr>
<td>Cigars</td>
<td>10.0</td>
<td>4.7</td>
</tr>
<tr>
<td>Pipe tobacco</td>
<td>2.2</td>
<td>0.9</td>
</tr>
<tr>
<td>ALCOHOL</td>
<td>69.3</td>
<td>52.5</td>
</tr>
<tr>
<td>Binge alcohol use</td>
<td>43.3</td>
<td>22.9</td>
</tr>
<tr>
<td>Heavy alcohol use</td>
<td>13.1</td>
<td>6.3</td>
</tr>
</tbody>
</table>

*Federally illegal, but some states permit the use of marijuana.

**Sources:** Substance Abuse and Mental Health Services Administration. 2014. Results from the 2013 National Survey on Drug Use and Health: Volume I. Summary of National Findings, NSDUH Series H-48, HHS Publication No. (SMA) 14-4863. Rockville, MD.

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**Answers (Test Your Knowledge)**

1. c. Marijuana ranks first, followed (in order) by hallucinogens, cocaine, and heroin. Alcohol, however, remains by far the most popular drug among college students.

2. True. Women usually have a higher percentage of body fat than men and a less active form of a stomach enzyme that breaks down alcohol. Both factors cause them to become intoxicated more quickly and to a greater degree.

3. True. Roughly 5,700 Americans start smoking each day. About half are under age 18.
emotional or psychological effects. This process, caused by chemical changes in the brain, means the user has to take larger and larger doses of the drug to achieve the same high. Now, physiological and psychological effects are both criteria in the American Psychiatric Association’s (APA) descriptions of addictive behavior.

In 2013, after 10 years of revision, the APA released the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5). The APA defines addiction as compulsive drug-seeking behavior, which falls on one end of a continuum of a “substance use disorder.” According to DSM-5, a person is neither alcoholic nor nonalcoholic, but someone with symptoms ranging from mild (an average college binge drinker) to severe (a person who is out of control). The term substance use disorder combines two categories used in the DSM’s previous editions, dependence and abuse. Dependence involves normal responses, such as tolerance and withdrawal, to prescribed medications; abuse or addiction are psychological or physical dependence on a substance or behavior. Dependence can occur without a physical component, based solely on compulsive use.

According to the APA, the following are the criteria for diagnosis of a substance use disorder:

1. Developing tolerance to the substance. When a person requires increased amounts of a substance to achieve the desired effect or notices a markedly diminished effect with continued use of the same amount, he or she has developed tolerance to the substance.

2. Experiencing withdrawal. In someone who has maintained prolonged, heavy use of a substance, a drop in its concentration within the body can result in unpleasant physical and cognitive withdrawal symptoms. Withdrawal symptoms differ for different drugs. For example, nausea, vomiting, and tremors are common withdrawal symptoms in people dependent on alcohol, opioids, or sedatives.

3. Taking the substance in larger amounts or over a longer period than was originally intended.

4. Expressing a persistent desire to cut down on or regulate substance use.

5. Spending a great deal of time getting the substance, using the substance, or recovering from its effects.

6. Giving up or reducing important social, school, work, or recreational activities because of substance use.

7. Continuing to use the substance despite the knowledge that it is contributing to a psychological or physical problem.

8. Craving or an intense desire or urge for a specific substance.

9. Use in situations that are physically hazardous.

10. Unsuccessful efforts at reducing amounts.

11. Failure to fulfill major obligations.

It is sometimes difficult to distinguish between a healthy habit and one that has become an addiction. Experts have identified some general characteristics typically associated with addictive behaviors.

• Reinforcement. The behavior produces pleasurable physical or emotional states or relieves negative ones.

• Compulsion or craving. The addict feels a compelling need to engage in the behavior.

• Loss of control. The addict loses control over the behavior and cannot block the impulse to do it.

• Escalation. More and more of the substance or activity is required to produce its desired effects.

• Negative consequences. The behavior continues despite serious negative consequences, such as problems with academic or job performance, difficulties with personal relationships, or health problems.

The Development of Addiction

An addiction often starts when a person does something to bring pleasure or avoid pain. The activity may be drinking a beer, using the Internet, or going shopping. If it works, the person is likely to repeat it. He or she becomes increasingly dependent on the behavior, and tolerance may develop; over time, the person needs more of the behavior to feel the same effect. Eventually, the behavior becomes a central focus of the person’s life, and there is a deterioration in other areas, such as school performance or relationships. The behavior no longer brings pleasure, but it is necessary to avoid the pain of going without it.

Although many common behaviors are potentially addictive, most people who engage in them don’t develop problems. Risk
alleviate stress or avoid painful emotions. There is some concern that widespread access to the Internet may expose many more people to other potentially addictive behaviors, including gambling and shopping. By some estimates, millions of Americans are compulsive Internet users—as many as one out of eight people; college students approximate one out of seven. In one study of Internet addiction, addicts averaged 38 online hours per week. Other behaviors that can become addictive include exercising, eating, gaming, watching TV, and working. Any substance or activity that becomes the focus of one’s life at the expense of other needs can be damaging to health.

PSYCHOACTIVE DRUGS

Psychoactive drugs include legal compounds such as caffeine, tobacco, alcohol, and prescription drugs, as well as illegal substances such as heroin, cocaine, and LSD. Figure 13.1 presents basic information about commonly misused drugs, which are classified according to their major effects; other drugs, especially synthetic street drugs, may not fit neatly into a single category. This section examines general issues that apply to the use of any psychoactive drug. Later sections discuss two commonly used and abused psychoactive drugs: alcohol and tobacco.

Who Uses Drugs?

Drug use and abuse occur at all income and education levels, among all ethnic groups, and across all age groups. Society is concerned with the casual or recreational use of illegal drugs because it is not really possible to know when drug use will lead to abuse or addiction. Some casual users develop substance-related problems; others do not. Some psychoactive drugs, however, are more likely than others to lead to a substance use disorder (Table 13.2).

Table 13.2

| Psychoactive Drugs and Their Potential for Substance Disorder and Addiction |
|-------------------------------|---------------------------------|
| Very high                     | Amphetamine, cocaine, nicotine, heroin, and other opioids |
| High                          | Caffeine, PCP                   |
| Moderate                      | Alcohol, marijuana, benzodiazepines |
| Low                           | Psychedelics, steroids          |
| Very low                      | Antidepressant, antiminic, and antipsychotic medications |

### PSYCHOACTIVE DRUGS

**FIGURE 13.1** Commonly misused drugs and their effects.  

<table>
<thead>
<tr>
<th>Category</th>
<th>Representative drugs</th>
<th>Street names</th>
<th>Appearance</th>
<th>Methods of use</th>
<th>Short-term effects</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Opioids</strong></td>
<td>Heroin</td>
<td>Dope, H, junk, brown sugar, smack</td>
<td>White/dark brown powder; dark tar or coal-like substance</td>
<td>Injected, smoked, snorted</td>
<td>Relief of anxiety and pain; euphoria; lethargy, apathy, drowsiness, confusion, inability to concentrate; nausea, constipation, respiratory depression</td>
</tr>
<tr>
<td></td>
<td>Opium</td>
<td>Big O, black stuff, hop</td>
<td>Dark brown or black chunks</td>
<td>Swallowed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Morphine</td>
<td>M, Miss Emma, monkey, white stuff</td>
<td>White crystals, liquid solution</td>
<td>Injected, swallowed, smoked</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Oxycodone, codeine, hydrocodone</td>
<td>Oxy, O.C., killer, Captain Cody, schoolboy, vike</td>
<td>Tablets, powder made from crushing tablets</td>
<td>Swallowed, injected, snorted</td>
<td></td>
</tr>
<tr>
<td><strong>Central nervous system depressants</strong></td>
<td>Barbiturates</td>
<td>Barbs, reds, red birds, yellows, yellow jackets</td>
<td>Colored capsules</td>
<td>Swallowed, injected</td>
<td>Reduced anxiety, mood changes, lowered inhibitions, impaired muscle coordination, reduced pulse rate, drowsiness, loss of consciousness, respiratory depression</td>
</tr>
<tr>
<td></td>
<td>Benzodiazepines (e.g., Valium, Xanax, Rohypnol)</td>
<td>Candy, downers, tranks, roofies, forget-me pill</td>
<td>Tablets</td>
<td>Swallowed, injected</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Methaqualone</td>
<td>Ludes, quad, quay</td>
<td>Tablets</td>
<td>Injected, swallowed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Gamma hydroxybutyrate (GHB)</td>
<td>G, Georgia home boy, greevous bodily harm</td>
<td>Clear liquid, white powder</td>
<td>Swallowed</td>
<td></td>
</tr>
<tr>
<td><strong>Central nervous system stimulants</strong></td>
<td>Amphetamine, methamphetamine</td>
<td>Bennies, speed, black beauties, uppers, chalk, crank, crystal, ice, meth</td>
<td>Tablets, capsules, white powder, clear crystals</td>
<td>Injected, swallowed, smoked, snorted</td>
<td>Increased and irregular heart rate, blood pressure, metabolism; increased mental alertness and energy; nervousness, insomnia, impulsive behavior; reduced appetite</td>
</tr>
<tr>
<td></td>
<td>Cocaine, crack cocaine</td>
<td>Blow, C, candy, coke, flake, rock, toot, snow</td>
<td>White powder, beige pellets or rocks</td>
<td>Injected, smoked, snorted</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ritalin</td>
<td>JIF, MPH, R-ball, Skippy</td>
<td>Tablets</td>
<td>Injected, swallowed, snorted</td>
<td></td>
</tr>
<tr>
<td><strong>Marijuana and other cannabis products</strong></td>
<td>Marijuana</td>
<td>Dope, grass, joints, Mary Jane, reefer, skunk, weed, pot</td>
<td>Dried leaves and stems</td>
<td>Smoked, swallowed</td>
<td>Euphoria, slowed thinking and reaction time, confusion, anxiety, impaired balance and coordination, increased heart rate</td>
</tr>
<tr>
<td></td>
<td>Hashish</td>
<td>Hash, hemp, boom, gangster</td>
<td>Dark, resin-like compound formed into rocks or blocks</td>
<td>Smoked, swallowed</td>
<td></td>
</tr>
<tr>
<td><strong>Hallucinogens</strong></td>
<td>LSD</td>
<td>Acid, boomers, blotter, yellow sunshines</td>
<td>Blotter paper, liquid, gelatin tabs, pills</td>
<td>Swallowed, absorbed through mouth tissues</td>
<td>Altered states of perception and feeling; nausea; increased heart rate, blood pressure; delirium; impaired motor function; numbness, weakness</td>
</tr>
<tr>
<td></td>
<td>Mescaline (peyote)</td>
<td>Buttons, cactus, mesc</td>
<td>Brown buttons, liquid</td>
<td>Swallowed, smoked</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Psilocybin</td>
<td>Shrooms, magic mushrooms</td>
<td>Dried mushrooms</td>
<td>Swallowed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ketamine</td>
<td>K, special K, cat valium, vitamin K</td>
<td>Clear liquid, white or beige powder</td>
<td>Injected, snorted, smoked</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PCP</td>
<td>Angel dust, hog, love boat, peace pill</td>
<td>White to brown powder, tablets</td>
<td>Injected, swallowed, smoked, snorted</td>
<td></td>
</tr>
<tr>
<td></td>
<td>MDMA (ecstasy)</td>
<td>X, peace, clarity, Adam, Molly</td>
<td>Tablets</td>
<td>Swallowed</td>
<td></td>
</tr>
<tr>
<td><strong>Inhalants</strong></td>
<td>Solvents, aerosols, nitrates, anesthetics</td>
<td>Laughing gas, poppers, snappers, whippets</td>
<td>Household products, sprays, glues, paint thinner, petroleum products</td>
<td>Inhaled through nose or mouth</td>
<td>Stimulation, loss of inhibition, slurred speech, loss of motor coordination, loss of consciousness</td>
</tr>
</tbody>
</table>

*PSYCHOACTIVE DRUGS* 377
Characteristics that place people at higher-than-average risk for trying illegal drugs or misusing prescription drugs include being male, young, a troubled adolescent, a thrill-seeker, in a dysfunctional family, in a peer group that accepts drug use, and poor; beginning dating at a young age is another risk factor. Drug use is less common among young people who attend school regularly, get good grades, have strong personal identities, are religious, have a good relationship with their parents, and are independent thinkers whose actions are not controlled by peer pressure. Coming from a family that has a clear policy on drug use and deals with conflicts constructively is also associated with not using drugs.

Why do some people use psychoactive drugs without becoming dependent, while others aren’t as lucky? The answer seems to be a combination of physical, psychological, and social factors. Some people may be born with a brain chemistry or metabolism that makes them more vulnerable to drug dependence. Psychological risk factors include having difficulty controlling impulses and having a strong need for excitement and immediate gratification. People may turn to drugs to numb emotional pain or to deal with difficult experiences or feelings such as rejection, hostility, or depression. Social factors that may increase the risk for dependence include exposure to drug-using family members or peers, poverty, and easy access to drugs.

Abuse of Prescription and Over-the-Counter Medications

Some medications have intoxicating effects, and for that reason, they may be abused. These include opioid painkillers, such as Vicodin, Oxycontin, and Fentanyl; stimulants used for treating attention deficit hyperactivity disorder (ADHD), such as Adderall, Concerta, and Ritalin; and central nervous system depressants used for relieving anxiety, such as Valium and Xanax. The most commonly abused over-the-counter (OTC) drugs are cough and cold remedies containing dextromethorphan, a cough suppressant with sedative properties. After marijuana, prescription and OTC medications are the most commonly abused drugs.

Abuse of a medication occurs when it is taken in a way not intended or by a person for whom it was not prescribed. This may mean taking someone else’s medication, taking a different quantity from what is prescribed, or taking a drug for a different purpose from the one intended, such as getting high. Abuse of stimulants Adderall and Ritalin is higher among college students than among other young adults; in 2013, 10.7% of college students reported nonmedical use of Adderall, and 3.6% reported nonmedical use of Ritalin.

People often assume that prescription or OTC medications are not dangerous, but taken incorrectly, many have life-threatening effects. Of particular concern is the recent rise in abuse of opioid painkillers. The number of deaths from this group of drugs more than quadrupled between 2000 and 2013 (over 16,000 in 2013; Figure 13.2). During the same time period, deaths from heroin use also rose dramatically. Researchers are still investigating possible links between the trends. Recent surveys have found that people who are addicted to opioid painkillers are 40 times more likely to also be addicted to heroin; 45% of heroin users are also addicted to prescription painkillers. Public health officials have recommended ways to change how painkillers are prescribed: In 2012, enough prescriptions were written for every American adult to have a bottle of painkillers. Strategies include greater monitoring to identify health care providers who overprescribe and patients who seek drugs from multiple doctors.

Current Illicit Drugs of Concern

Marijuana has long been the most widely used illicit drug in the United States. As of 2015, marijuana use is illegal under federal law, but four states and the District of Columbia have legalized recreational use, and 19 other states have legalized medical use of marijuana. THC (tetrahydrocannabinol) is the main active ingredient in marijuana; the concentration of THC in marijuana can vary from 1% up to 7–8%. The short-term effects of marijuana are described in Figure 13.1; of particular note is the potential impact of THC on the parts of the brain controlling balance, coordination, and reaction time. Marijuana use impairs driving performance and is even more dangerous when combined with alcohol.

Other illicit drugs tend to vary in popularity over time based on social, economic, and legal factors. The make-up of drugs also changes as their chemical structures are altered to avoid regulation and reduce the cost of manufacturing. Substitute drugs are often sold in place of street drugs, putting users at risk for taking dangerous combinations of unknown substances. Some current drugs of concern are described briefly in this section.
MDMA (Ecstasy)  Taken in pill form, MDMA (methylene-dioxymethamphetamine), or ecstasy, is a stimulant with mildly hallucinogenic and amphetamine-like effects. It can produce dangerously high body temperature and potentially fatal dehydration. Some users experience confusion, depression, anxiety, paranoia, muscle tension, involuntary teeth clenching, blurred vision, and seizures. Even low doses can affect a person’s concentration and driving ability. Use during pregnancy is linked to increased risk of birth defects. Chronic use of MDMA may produce long-lasting, perhaps permanent, damage to the neurons that release serotonin. This may explain why heavy use is associated with persistent problems with learning and verbal and visual memory. MDMA users perform worse than nonusers on complex cognitive tasks of memory, attention, and general intelligence.

LSD  A potent hallucigen, LSD (lysergic acid diethylamide) is sold in tablets or capsules, in liquid form, or on small squares of paper called blotters. LSD increases heart rate and body temperature and may cause nausea, tremors, sweating, numbness, and weakness.

Synthetic Marijuana  "Spice," "K2," and "Genie" are just a few names given to synthetic cannabinoids, which typically consist of dried, shredded plant materials with chemical additives that produce psychoactive effects. Although labels may state that the products contain natural materials, the active ingredients are synthetic compounds related to THC, the active ingredient in marijuana. The content and effects of these drugs are unpredictable because the chemicals being used change, and there are no manufacturing standards or regulation. Depending on the type and concentration of chemical additive(s) in a product, short-term effects may be similar to those from using marijuana or may be even stronger and include anxiety, agitation, nausea and vomiting, rapid heart rate, elevated blood pressure, tremors, seizures, cognitive impairment, psychosis, and suicidal and other harmful thoughts or actions. Synthetic cannabinoids may cause more frequent and severe adverse effects than marijuana.

Bath Salts  Drugs called “bath salts” contain one or more synthetic cathinones, which are chemicals related to an amphetamine-like stimulant found in the khat plant. Sold in powdered form with names like “Cloud Nine,” “Vanilla Sky,” or “Meow Meow,” bath salts are inhaled, injected, or taken orally; they may have both stimulant and hallucinatory effects. Use of the drugs has been linked to an increase in emergency room visits, with people experiencing dangerous cardiovascular symptoms (high heart rate and blood pressure, chest pains) as well as psychiatric symptoms such as panic attacks and extreme paranoia and agitation. Research is in its early stages, but frequent use may lead to tolerance, dependence and strong withdrawal symptoms.

Club Drugs (GHB, Rohypnol, Ketamine)  Club drugs are a diverse group of drugs that tend to be misused by young adults in club and party settings. GHB, Rohypnol, and Ketamine have sedative effects and can be dangerous when taken alone or, especially, with alcohol. GHB and Rohypnol can cause anterograde amnesia, meaning users cannot remember events they experienced while under the influence of the drug. Because of their effects, these drugs have been used to commit drug-assisted sexual assaults and are sometimes referred to as “date rape drugs.” Because of concern about such drugs, Congress passed the Drug-Induced Rape Prevention and Punishment Act, which increased penalties for use of any controlled substance to aid in sexual assault. (Alcohol, described in the next section of the chapter, is the drug most commonly used to facilitate sexual assault.)

Treatment for Substance Use Disorder and Addiction

Various types of programs are available to help people break their drug habits, but there is no single best method of treatment. The relapse rate is high for all types of treatment, but being treated is better than not being treated. Professional treatment programs usually take the form of drug substitution programs or treatment centers; nonprofessional self-help groups and peer counseling are also available. To be successful, a treatment program must deal with the reasons behind users’ drug abuse and help them develop behaviors, attitudes, and a social support system that will help them remain drug free. For resources related to treatment, see “For Further Exploration” at the end of the chapter.

Young people with drug problems are often unable to seek help on their own. In such cases, friends and family members may need to act on their behalf. One or more of the following signals may suggest serious drug misuse:

- Sudden withdrawal or emotional distance
- Rebellious or unusually irritable behavior
- Loss of interest in usual activities or hobbies
- Decline in school performance
- Sudden change in group of friends
- Changes in sleeping or eating habits
- Frequent borrowing of money

Preventing Substance Use Disorder

The best solution to drug misuse is prevention. Government attempts at controlling the drug problem tend to focus on stopping the production, importation, and distribution of illegal drugs.

**Terms**

- ethyl alcohol  The intoxicating ingredient in fermented liquors; a colorless, pungent liquid.
- proof value  Two times the percentage of alcohol in a beverage, measured by volume; a 100-proof beverage contains 50% alcohol.
- one drink  The amount of a beverage that typically contains about 0.6 ounce of alcohol; also called a standard drink.
Creative efforts are also being made to stop the demand for drugs. Approaches include building young people’s self-esteem, improving their academic skills, increasing their recreational opportunities, providing them with honest information about the effects of drugs, and teaching them strategies for resisting peer pressure.

The Role of Drugs in Your Life

Whatever your experience has been up to now, it is likely that you will encounter drugs at some point in your life. To make sure you’ll have the inner resources to resist peer pressure and make your own decision, cultivate a variety of activities you enjoy doing, accept that you are entitled to have your own opinion, and consider the following questions:

- **What are the risks involved?** Many drugs carry an immediate risk of injury or death or legal consequences. Most carry long-term risk of abuse and dependence.
- **Is using the drug compatible with your goals?** Consider how drug use will affect your education and career objectives, your relationships, your future happiness, and the happiness of those who love you.
- **What are your ethical beliefs about drug use?** Consider whether using a drug would cause you to go against your personal ethics, religious beliefs, social values, or family responsibilities.
- **What are the financial costs?** Many drugs are expensive, especially if you become dependent on them.
- **Are you trying to solve a deeper problem?** Drugs will not make emotional pain go away. In the long run, they will only make it worse. If you are feeling depressed or anxious, seek help from a mental health professional instead of self-medicating with drugs.

### ALCOHOL

You have probably noticed that alcohol seems to affect people in different ways. One person seems to get drunk after just a drink or two, while another is able to tolerate a great deal of alcohol without apparent effect. These differences help explain why there are so many misconceptions about alcohol use. The following sections describe how alcohol works in the body, as well as the short- and long-term effects of alcohol use and abuse.

#### Chemistry and Metabolism

**Ethyl alcohol** is the psychoactive ingredient in all alcoholic beverages. The concentration of alcohol varies with the type of beverage; it is indicated by the **proof value**, which is two times the percentage concentration. For example, if a beverage is 80 proof, it contains 40% alcohol. When alcohol consumption is discussed, **one drink** (a standard drink) refers to a 12-ounce bottle of beer, a 5-ounce glass of table wine, or a cocktail with 1.5 ounces of 80-proof liquor. Each of these drinks contains approximately 0.6 ounce of alcohol (Figure 13.3).

When consumed, alcohol is absorbed into the bloodstream from the stomach and small intestine. Once in the bloodstream, alcohol is distributed throughout the body’s tissues, affecting

**FIGURE 13.3** A standard drink contains 0.6 ounce of alcohol.

same amount of alcohol, a woman will typically have a higher BAC because of her smaller size, greater percentage of body fat, and less-active alcohol-metabolizing stomach enzymes. Drinking makes some people so uncomfortable that they are unlikely to develop alcohol addiction. Some people, primarily those of Asian descent, inherit ineffective or inactive variations of the enzyme that breaks down alcohol. Other people, including some of African and Jewish descent, have forms of this enzyme, alcohol dehydrogenase, that metabolizes alcohol very quickly. Either way, toxic acetaldehyde builds up when these people drink alcohol. They experience a reaction called flushing syndrome. Their skin feels hot, their heart and respiration rates increase, and they may get a headache, vomit, or break out in hives. Typically, the body can metabolize about half a drink in an hour. If a person drinks slightly less than that each hour, BAC remains low. People can drink large amounts of alcohol this way over a long period of time without becoming noticeably intoxicated; however, they still run the risk of significant long-term health problems. But if more alcohol is consumed than is metabolized, the BAC will increase steadily, as will the level of intoxication. For example, if you drink two beers over a four-hour period, you are unlikely to

**IMMEDIATE EFFECTS**

Central nervous system:
- Impaired reaction time and motor coordination;
- impaired judgment and sedation; coma and death at high BACs

Senses:
- Less acute vision, smell, taste, and hearing

Stomach:
- Nausea, inflammation, and bleeding

Skin:
- Flushing; sweating; heat loss and hypothermia; formation of broken capillaries

Sexual functioning:
- In men, reduced erection response

**EFFECTS OF CHRONIC USE**

Brain:
- Damaged/destroyed brain cells; impaired memory; loss of sensation in limbs; brain atrophy

Cardiovascular system:
- Weakened cardiac muscle; elevated blood pressure; irregular heartbeat; increased risk of stroke

Breast:
- Increased risk of breast cancer

Immune system:
- Lowered resistance to disease

Digestive system:
- Cirrhosis of liver; inflammation of stomach and pancreas; increased risk of cancers of the lip, mouth, larynx, esophagus, liver, rectum, stomach, and pancreas

Kidney:
- Kidney failure associated with end-stage liver disease

Nutrition:
- Nutrient deficiencies; obesity

Reproductive system:
- In women, menstrual irregularities and increased risk of having children with fetal alcohol syndrome (FAS); in men, impotence and testicular atrophy

Bone:
- Increased risk of osteoporosis; increased risk of fractures from frequent falls

**IMMEDIATE EFFECTS**

Blood alcohol concentration (BAC)—the amount of alcohol in a person’s blood—is a primary factor determining the effects of alcohol. BAC is determined by the amount of alcohol consumed and by individual factors such as heredity, body weight, and amount of body fat. Compared with a man who drinks the

**TERMS**

**blood alcohol concentration (BAC)** The amount of alcohol in the blood in terms of weight per unit volume; used as a measure of intoxication.

**cirrhosis** A disease in which the liver is severely damaged by alcohol, other toxins, or infection.

**alcohol addiction** A pathological use of alcohol, or impairment in functioning due to alcohol; characterized by tolerance and withdrawal symptoms (previously called alcoholism).
Drinking and Driving

People who drink are unable to drive safely because their judgment is impaired, their reaction time is slower, and their coordination is reduced. The National Institute on Alcohol Abuse and Alcoholism (NIAAA) estimates that each year, nearly 5 million college students drive under the influence of alcohol. In addition, 599,000 students are injured in alcohol-related accidents, including car crashes, and 1,825 die.

In addition to increasing the risk of injury and death, driving while intoxicated can have serious legal consequences. The legal limit for BAC in all states is 0.08%; however, alcohol impairs the user even at much lower BACs (Figure 13.5). States now also have zero-tolerance laws regarding alcohol use by drivers under age 21. Under these laws, a young driver who has consumed any alcohol can have his or her license suspended. There are stiff penalties for drunk driving, including fines, loss of license, confiscation of vehicle, and jail time.

If you are out drinking, find an alternative means of transportation or follow the practice of having a designated driver—someone who refrains from drinking in order to provide safe transportation home for others in the group.

It’s more difficult to protect yourself against a drunk driver. Learn to be alert to the erratic driving that signals an impaired driver. Warning signs include making wide, abrupt, and illegal turns; straddling the center line or lane marker; driving against traffic; driving on the shoulder; weaving, swerving, or nearly striking an object or another vehicle; following too closely; driving at erratic speeds; driving with headlights off at night; and driving with the window down in very cold weather.

Effects of Chronic Alcohol Misuse

The average life span of alcohol misusers is 15 years shorter than that of moderate drinkers. Potential health effects of continued alcohol use include the following:

- **Cirrhosis**: In cirrhosis, liver cells are destroyed and replaced with fibrous scar tissue; cirrhosis is a major cause of death in the United States.
- **Digestive problems**: Alcohol can inflame the pancreas, causing nausea, vomiting, abnormal digestion, and severe abdominal pain.

### Table 13.3 Effects of Alcohol

<table>
<thead>
<tr>
<th>BLOOD ALCOHOL CONCENTRATION (%)</th>
<th>COMMON BEHAVIORAL EFFECTS</th>
<th>HOURS REQUIRED TO METABOLIZE ALCOHOL</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00–0.05</td>
<td>Slight change in feelings, usually relaxation and euphoria; decreased alertness.</td>
<td>2–3</td>
</tr>
<tr>
<td>0.05–0.10</td>
<td>Emotional instability with exaggerated feelings and behavior; reduced social inhibitions; impairment of reaction time and fine motor coordination; increasing impairment while driving. Legally drunk at 0.08% in all states.</td>
<td>3–6</td>
</tr>
<tr>
<td>0.10–0.15</td>
<td>Unsteadiness in standing and walking; loss of peripheral vision. Driving is extremely dangerous.</td>
<td>6–10</td>
</tr>
<tr>
<td>0.15–0.30</td>
<td>Staggering gait; slurred speech; impairment of pain perception and other sensory perceptions.</td>
<td>10–24</td>
</tr>
<tr>
<td>More than 0.30</td>
<td>Stupor or unconsciousness; anesthesia. Death possible at 0.35% and above. Can result from rapid or binge drinking with few earlier effects.</td>
<td>More than 24</td>
</tr>
</tbody>
</table>
Being very drunk is potentially life-threatening. Helping a drunken friend could save a life.

- Be firm but calm. Don’t engage the person in an argument or discuss her drinking behavior while she is intoxicated.
- Get the person out of harm’s way. Don’t let him drive or wander outside. Don’t let him drink any more alcohol.
- If the person is unconscious, don’t assume she is just “sleeping it off.” Place her on her side with her knees up. This position helps prevent choking if she vomits.
- Stay with the person; you need to be ready to help if he vomits or stops breathing.
- Don’t try to give the person anything to eat or drink, including coffee or other drugs. Don’t give cold showers or try to make her walk around. None of these things help to sober up someone, and they can be dangerous.

Call 9-1-1 immediately in any of the following instances:

- You can’t wake up the person even by shouting or shaking.
- The person is taking fewer than eight breaths per minute, or his breathing seems shallow or irregular.
- You think the person took other drugs in addition to alcohol.
- The person has had an injury, especially a blow to the head.
- The person drank a large amount of alcohol within a short time and then became unconscious. Death from alcohol poisoning most often occurs when the blood alcohol level rises very quickly due to rapid ingestion of alcohol.

If you aren’t sure what to do, call 9-1-1. You may save a life.

FIGURE 13.5 Approximate blood alcohol concentration and body weight.

This chart shows the BAC an average person of a given weight would reach after drinking the specified number of drinks in the time shown. The legal limit for BAC is 0.08%.

For drivers under 21 years of age, many states have zero-tolerance laws that set BAC limits of 0.01% or 0.02%.

- Cardiovascular problems: Although moderate doses of alcohol (one drink or less per day for women, and one to two drinks per day for men) may slightly reduce the chances of heart attack in some people, high doses are associated with cardiovascular problems, including high blood pressure and a weakening of the heart muscle.
- Cancer: Alcohol is a known human carcinogen and is causally related to oral cancer; cancers of the esophagus, liver, stomach, and pancreas; and possibly breast cancer.
- Psychiatric problems: Excessive alcohol use can cause paranoia and memory gaps. Chronic drinking causes brain damage and impaired mental functioning in some people.
- Other health effects: Chronic alcohol misuse has also been linked to asthma, gout, diabetes, recurrent infections, nutritional deficiencies, and nervous system diseases.

Maternal drinking during pregnancy can result in miscarriage, stillbirth, or fetal alcohol syndrome (FAS). Children with this syndrome are small at birth, are likely to have heart defects, and often have abnormal features such as small, wide-set eyes. Many are mentally impaired; others exhibit more subtle problems with learning and fine motor coordination. FAS is the most common preventable cause of developmental disabilities in the Western world. Full-blown FAS occurs in up to 15 out of every 10,000 live births in the United States. Many more babies are born with alcohol-related neurodevelopmental disorder (ARND). These children appear physically normal but often have learning and behavioral problems and are more
likely as adults to develop substance abuse and legal problems. Getting drunk just one time during the final three months of pregnancy, when the fetus’s brain cells are developing rapidly, can cause fetal brain damage. The safest course of action is to abstain from alcohol during pregnancy.

**Alcohol Misuse**

Alcohol misuse or abuse is defined as recurrent alcohol use that has negative consequences, such as drinking in dangerous situations (e.g., before driving), or drinking patterns that result in academic, professional, interpersonal, or legal difficulties. Alcohol-use disorder, or what has been called alcoholism, involves more extensive problems with alcohol use, usually including physical tolerance and withdrawal. Various experts use different definitions to describe problems associated with drinking. The important point is that one does not have to be an alcoholic (term not used by the *DSM-5*) to have problems with alcohol. The person who drinks only once a month, perhaps after an exam, but then drives while intoxicated is an alcohol abuser. (Lab 13.1 includes an assessment to help you determine if alcohol is a problem in your life.)

How can you tell if you or someone you know has an alcohol use disorder? Look for the following warning signs:

- Drinking alone or secretly
- Using alcohol deliberately and repeatedly to perform or get through difficult situations
- Using alcohol as a way to “self-medicate” in order to dull strong emotions or negative feelings
- Feeling uncomfortable on certain occasions when alcohol is not available
- Escalating alcohol consumption beyond an already established drinking pattern
- Consuming alcohol heavily in risky situations, such as before driving
- Getting drunk regularly or more frequently than in the past
- Drinking in the morning or at other unusual times

**Binge Drinking**

The National Institute on Alcohol Abuse and Alcoholism (NIAAA) defines binge drinking as a pattern of alcohol use that brings a person’s BAC up to 0.08% or above (typically five drinks for men or four drinks for women), consumed within about two hours. The National Survey on Drug Use and Health defines binge drinking as having five or more drinks within about two hours at least once within 30 days. The 2013 survey estimated that nearly 23% of Americans over the age of 12 were binge drinkers. Just over 6% were heavy drinkers, defined as having five or more drinks on the same occasion on each of five or more days in the past 30 days.

According to the NIAAA, 60% of all college students drink, and 40% binge drink. Binge drinking is a common form of alcohol abuse on college campuses, and it has a profound effect on students’ lives. Frequent binge drinkers were found to be three to seven times more likely than nonbinge drinkers to engage in unplanned or unprotected sex, to drive after drinking, and to get hurt or injured. Binge drinkers were also more likely to miss classes, get behind in schoolwork, and argue with their friends. The more frequent the binges, the more problems the students encountered. Despite their experiences, fewer than 1% of the binge drinkers identify themselves as problem drinkers.

**Alcohol Use Disorder**

As described earlier, alcohol dependence is usually characterized by tolerance and withdrawal. Everyone who drinks—even nonalcoholics—develops tolerance to alcohol after repeated use. When alcoholics stop drinking or cut their intake significantly, they have withdrawal symptoms, which can range from unpleasant to serious and even life-threatening distress. Symptoms of alcohol withdrawal include trembling hands (shakes, or jitters), a rapid pulse and breathing rate, insomnia, nightmares, anxiety, and gastrointestinal upset. Less common are seizures and the severe reaction known as DTs (*delirium tremens*), characterized by confusion and vivid, usually unpleasant, hallucinations.

Some alcoholics recover without professional help, but the majority do not. Treatment is difficult. However, many different kinds of programs exist, including those that emphasize group and buddy support, those that stress lifestyle management, and those that use drugs and chemical substitutes as therapy. Although not all alcoholics can be treated successfully, considerable optimism has replaced the older view that nothing can be done.

**Drinking and Responsibility**

The responsible use of alcohol means drinking in a way that keeps your BAC low and your behavior under control. See the box “Drinking Behavior and Responsibility” for specific suggestions.

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**TERMS**

- **fetal alcohol syndrome (FAS)**: A characteristic group of birth defects caused by excessive alcohol consumption by the mother, including facial deformities, heart defects, and physical and mental impairments.
- **alcohol misuse**: The use of alcohol to a degree that causes physical damage, impairs functioning, or results in behavior harmful to others.
- **alcohol use disorder**: A chronic psychological disorder characterized by excessive and compulsive drinking, and measured as mild, moderate, or severe.
- **binge drinking**: Periodically drinking alcohol to the point of severe intoxication.
- **DTs (delirium tremens)**: A state of confusion brought on by the reduction of alcohol intake in an alcohol addicted person; other symptoms are sweating, trembling, anxiety, hallucinations, and seizures.
- **nicotine**: A poisonous, addictive substance found in tobacco and responsible for many of the effects of tobacco.
Examine Your Attitudes and Behavior

- **Consider your feelings about alcohol and drinking.** Do you care if alcohol is available at social activities? Do you consider it essential, or are you indifferent to its presence or absence? How do you feel about people who don’t drink?

- **Consider where your attitudes toward drinking and alcohol come from.** How was alcohol used in your family when you were growing up? How is it used—or how do you think it is used—on your campus? How is it portrayed in ads? In other words, what influences might be shaping your alcohol use?

- **Consider your own drinking behavior.** If you drink, what are your reasons? Is your drinking moderate and responsible? Or do you drink too much and experience negative consequences?

Drink Moderately and Responsibly

- **Drink slowly and space your drinks.** Sip your drinks and alternate them with nonalcoholic choices. Don’t drink alcoholic beverages to quench your thirst. Avoid drinks made with carbonated mixers. Watch your drinks being poured or mixed so that you can be sure of what you’re drinking.

- **Eat before and while drinking.** Don’t drink on an empty stomach. Food in your stomach will slow the rate at which alcohol is absorbed and thus often lower the peak BAC.

- **Know your limits and your drinks.** Learn how different BACs affect you and how to keep your BAC under control.

- **Be aware of the setting.** In dangerous situations, such as driving, abstinence is the only appropriate choice.

- **Use designated drivers.** Arrange carpools to and from parties or events where alcohol will be served. Rotate the responsibility for acting as a designated driver.

- **Learn to enjoy activities without alcohol.** If you can’t have fun without drinking, you may have a problem with alcohol.

Encourage Responsible Drinking in Others

- **Encourage responsible attitudes.** Learn to express disapproval about someone who has drunk too much. Don’t treat the choice to abstain as strange. The majority of American adults drink moderately or not at all.

- **Be a responsible host.** Serve only enough alcohol for each guest to have a moderate number of drinks, and offer nonalcoholic choices. Always serve food along with alcohol. Stop serving alcohol an hour or more before people will leave. Insist that a guest who drank too much take a taxi, ride with someone else, or stay overnight rather than drive.

- **Hold drinkers fully responsible for their behavior.** Pardoning unacceptable behavior fosters the attitude that the behavior is due to the drug rather than the person.

- **Take community action.** Find out about prevention programs on your campus or in your community. Consider joining an action group such as Students Against Destructive Decisions (SADD) or Mothers Against Drunk Driving (MADD).

### TOBACCO

According to the U.S. Surgeon General, smoking is the leading preventable cause of illness and death in the United States. Each year, more than 480,000 Americans die prematurely from smoking-related causes; tobacco use accounts for nearly one of every five adult deaths. Millions of Americans suffer chronic illnesses (such as cancer and heart disease) as a result of smoking. Tobacco in any form—cigarettes, cigars, pipes, chewing tobacco, clove cigarettes, or snuff—is unsafe.

Despite its well-known hazards, tobacco use is still widespread in our society (Table 13.4). According to the 2012 National Health Interview Survey, approximately 1 in 5 U.S. adults smoke cigarettes, and certain population groups, such as people with less than a college education, have a higher prevalence of smoking. Among people age 18–25, 17.1% are smokers. Thousands more join their ranks every day—including an estimated 2,800 people under age 18.

### Nicotine Addiction

Regular tobacco use, and especially cigarette smoking, is not just a habit but an addiction, involving physical dependence on the psychoactive drug **nicotine**. Addicted tobacco users must
keep a steady amount of nicotine circulating in the blood and going to the brain, where the drug triggers the release of powerful chemical messengers and causes a wide range of physical and emotional changes. If that amount falls below a certain level, they experience withdrawal symptoms that can include cravings, insomnia, confusion, tremors, difficulty concentrating, fatigue, muscle pains, headache, nausea, irritability, anger, and depression. Nicotine addiction can start within a few days of smoking and after just a few cigarettes. You can get hooked on nicotine much faster than you might think—a good reason to avoid trying tobacco in the first place.

**Health Hazards of Cigarette Smoking**

Cigarette smoking has negative effects on nearly every part of the body and increases the risk of many life-threatening diseases. Some of the many damaging chemicals in tobacco are carcinogens and cocarcinogens (agents that can combine with other chemicals to promote cancer). Others irritate the tissues of the respiratory system. Carbon monoxide, the deadly gas in automobile exhaust, is present in cigarette smoke in concentrations 400 times greater than the safety threshold set in workplaces. Low-tar and low-nicotine cigarettes deliver just as dangerous a dose of these chemicals as regular cigarettes because smokers inhale more deeply and frequently.

The effects of nicotine on smokers vary, depending on the size of the dose and the smoker’s past smoking behavior. Nicotine can either excite or tranquilize the nervous system, generally resulting in stimulation that gives way to tranquility and then depression. Figure 13.6 summarizes the immediate effects of smoking.

In the short term, smoking interferes with the functions of the respiratory system and often leads rapidly to shortness of breath and the conditions known as smoker’s throat, smoker’s cough, and smoker’s bronchitis. Other common short-term complaints are loss of appetite, diarrhea, fatigue, hoarseness, weight loss, stomach pains, insomnia, and impaired visual acuity, especially at night.

Long-term effects fall into two general categories. The first is reduced life expectancy: On average, smokers lose about 14 years of life. The second category of long-term effects involves quality of life. Smokers have higher rates of acute and chronic diseases than those who have never smoked. The more people smoke, and the deeper and more often they inhale, the greater the risk of disease and other complications. Cigarette smoking increases the risk of all the following:

- Cardiovascular disease (coronary heart disease, heart attack, stroke, hypertension, high cholesterol levels), lung disease (emphysema, chronic bronchitis), osteoporosis, diabetes, and many types of cancer (lung, trachea, mouth, pharynx, esophagus, larynx, pancreas, bladder, kidney, breast, cervix, stomach, liver, colon)
- Tooth decay, gum disease, bad breath, colds, ulcers, hair loss, facial wrinkling, and discolored teeth and fingers
- Menstrual disorders, early menopause, impotence, infertility, stillbirth, and low birth weight (see the box “Gender and Tobacco Use”)
- Motor vehicle crashes (smoking causes a serious distraction) and fire-related injuries

When smokers quit, health improvements begin almost immediately. The younger people are when they stop smoking, the more pronounced are these improvements (Table 13.5).

**Other Forms of Tobacco Use**

Many smokers have switched from cigarettes to other forms of tobacco, such as cigars, pipes, clove cigarettes, and spit (smokeless) tobacco. However, these alternatives are far from safe.

**Cigars and Pipes** Cigar and pipe smokers are at increased risk for many health problems, including cardiovascular and respiratory diseases and many types of cancer. Cigars contain more tobacco than cigarettes and so contain more nicotine and produce more tar when smoked. Cigar smokers who don’t inhale have a six-times greater risk of throat cancer than non-smokers; their risk of heart and lung disease approaches that of cigarette smokers. The risks are even higher for cigar smokers who inhale.

**Clove Cigarettes and Bidis** Clove cigarettes, imported from Indonesia and Pakistan, are made of tobacco mixed with chopped cloves. Also known as kreteks, they contain almost twice as much tar, nicotine, and carbon monoxide as conventional cigarettes. Some chemical constituents of cloves can be dangerous, and there have been a number of severe respiratory injuries and deaths from smoking clove cigarettes.

Bidis, or “beadies,” are small cigarettes imported from India that contain a type of tobacco different from that used in U.S. cigarettes; they are rolled in ebony leaves and often flavored. Bidis contain up to four times more nicotine and twice as much tar as U.S. cigarettes.

**Spit (Smokeless) Tobacco** Spit tobacco comes in two main forms: snuff and chewing tobacco. Both forms have high levels of nicotine, and use can lead to nicotine addiction. Snuff is tobacco in the form of a coarse, moist powder, mixed with flavorings. The user places a pinch of tobacco between the lower lip or cheek and gum and sucks it. Long-term snuff use may increase the risk of cancer of the cheek and gums by as much as 50 times.

Chewing tobacco comes in the form of shredded leaves, pressed into bricks or cakes or twisted into ropelike strands. The user places a wad of tobacco in the mouth and chews or sucks it, spitting out or swallowing the tobacco juice. Spit tobacco causes bad breath, tooth decay, and gum disease. One of the most serious effects of chewing tobacco is the increased risk of oral cancer—cancers of the lip, tongue, cheek, throat, gums, roof and floor of the mouth, and larynx.

**Hookahs** The practice of puffing flavored tobacco through a waterpipe (hookah) has expanded in recent years, particularly among college students; in a 2013 survey, 26.1% of college students reported having smoked tobacco using a hookah in the past year. A hookah consists of a head, body, water bowl, and hose. The bowl is partially filled with water and the head is filled with moistened tobacco upon which a lit piece of charcoal is placed. The smoker inhales through the hose, drawing air over the burning charcoal, heating the tobacco, and producing smoke that travels through the body of the pipe, the water, and the hose to the user.

Many people assume that hookahs provide a safer way of using tobacco, but research has found that the smoke from these pipes contains many harmful chemicals, including 10 times more carbon monoxide than the smoke from a single cigarette. Hookah smokers take an average of about 100 puffs per session.
American men are currently more likely than women to smoke, but the rate of smoking among women is approaching that of men, as are rates of tobacco-related illness and death. Lung cancer, emphysema, and cardiovascular diseases sicken and kill both men and women who smoke, and more American women now die each year from lung cancer than from breast cancer.

Although overall risks for tobacco-related illness are similar for women and men, sex appears to make a difference in some diseases. Women, for example, are more at risk for smoking-related blood clots and strokes than are men, and the risk is even greater for women using oral contraceptives. Among men and women with the same smoking history, the odds of developing three major types of cancer, including lung cancer, are 1.2–1.7 times higher for women than men. Women may also have a greater biological vulnerability to lung cancer.

Tobacco use also is associated with sex-specific health problems. Men who smoke increase their risk of erectile dysfunction and infertility. Women who smoke have higher rates of osteoporosis (a bone-thinning disease that can lead to fractures), thyroid-related diseases, and depression.

Women who smoke also have risks associated with reproduction and the reproductive organs. Smoking is associated with greater menstrual bleeding, greater duration of painful menstrual cramps, and more variability in menstrual cycle length. Smokers have a more difficult time becoming pregnant, and they reach menopause on average a year or two earlier than nonsmokers. When women smokers become pregnant, they face increased chances of miscarriage, placental disorders, premature delivery, ectopic pregnancy, preeclampsia, and stillbirth. Smoking is a risk factor for cervical cancer, too.

Women are less successful than men in quitting. Women report more severe withdrawal symptoms when they stop smoking and are more likely than men to report cravings in response to social and behavioral cues associated with smoking. For men, relapse to smoking is often associated with work or social pressure; women are more likely to relapse when sad or depressed or concerned about weight gain. Women and men also respond differently to medications: Nicotine replacement therapy appears to work better for men, whereas the non-nicotine medication bupropion appears to work better for women.

DIVERSITY MATTERS
Gender and Tobacco Use

E-Cigarettes The latest trend in smoking is the electronic cigarette, or e-cig. The e-cig is a battery-powered device that resembles a real cigarette. Instead of containing tobacco, the device uses a changeable filter that contains one or more chemicals, such as nicotine, flavorings, and other compounds. The user “smokes” or “vapes” an e-cig by sucking the filtered end; the device’s battery heats the chemicals to create an inhalable vapor. During use, the device’s tip even glows like the burning end of a real cigarette.

Marketers of e-cigs have claimed that the devices deliver only nicotine, making them a safe cigarette that does not cause cancer and that can serve as an alternative to other nicotine replacement products such as gum and patches. According to the U.S. Food and Drug Administration (FDA), however, e-cigs have not been fully studied, so consumers currently don’t know their potential risks, how much nicotine or other potentially harmful chemicals are being inhaled during use, or whether e-cigs provide any benefits. Although they don’t produce tobacco smoke, e-cigs contain nicotine, which is highly addictive; tests of some products have found that the vapor contains formaldehyde and other toxic and carcinogenic chemicals. Studies that examined whether e-cigarettes could aid in smoking cessation have had inconsistent results. Additionally, it is not yet known whether vaping may lead young people to try other tobacco products, which are known to cause disease and lead to premature death.

Environmental Tobacco Smoke

Environmental tobacco smoke (ETS), commonly called secondhand smoke, consists of mainstream smoke, the smoke exhaled by smokers, and sidestream smoke, the smoke that enters the atmosphere from the burning end of the cigarette, cigar, or pipe. Undiluted sidestream smoke is unfiltered by a cigarette filter or a smoker’s lungs, so it contains significantly higher concentrations of toxic and carcinogenic compounds than mainstream smoke.

Nearly 85% of the smoke in a room where someone is smoking is sidestream smoke. Even though such smoke is diffuse, the concentrations can be considerable. In rooms where people are smoking, levels of carbon monoxide, for instance, can exceed those permitted by Federal Air Quality Standards for outside air. The CDC estimates that 58 million nonsmokers in the United States, including 15 million children, are exposed to ETS.

Effects of ETS ETS is a known human carcinogen. Each year in people who do not smoke, ETS causes about 7,000 lung cancer deaths and 35,000 deaths from heart disease. ETS also aggravates respiratory conditions such as allergies and asthma.
Scientists have been able to measure changes in the bloodstreams capable of contributing to lung tissue damage and potential tumor promotion of healthy young test subjects who spent three hours in a smoke-filled room. After just 30 minutes of exposure to ETS, the function in the coronary arteries of healthy nonsmokers is reduced to the same level as that of smokers. And nonsmokers can still be affected by the harmful effects of ETS hours after they have left a smoky environment. Carbon monoxide, for example, lingers in the bloodstream for five hours.

**Children and ETS** Infants and children are particularly vulnerable to the harmful effects of ETS. Because they breathe faster than adults, they inhale more air and more of the pollutants it contains. Because they weigh less than adults, children inhale proportionately more pollutants per unit of body weight.

ETS triggers bronchitis, pneumonia, and other respiratory infections in infants and toddlers up to 18 months old, resulting in as many as 15,000 hospitalizations each year. Older children suffer, too. ETS can induce asthma in children and exacerbate symptoms in children who already have asthma.

**Avoiding ETS** If you are a nonsmoker, you have the right to breathe clean air, free from tobacco smoke. Try these strategies to keep the air around you safe:

- *Speak up tactfully.* Try something like, “Would you mind putting your cigarette out or moving to another spot? The smoke is bothering me.”
- *Don’t allow smoking in your home or room.* Get rid of ashtrays and ask smokers to light up outside.
- *Open a window.* If you cannot avoid being in a room with smokers, try to provide some ventilation.
- *Fight for a smoke-free environment.* For your sake and that of others, join with others either to eliminate all smoking indoors or to confine it to certain outdoor areas.
- *Research quitting strategies.* Social pressure is a major factor in many former smokers’ decision to quit.

**Smoking and Pregnancy**

Smoking almost doubles a pregnant woman’s chance of having a miscarriage, and women who smoke also face an increased risk of ectopic pregnancy, a pregnancy in which the fertilized egg implants itself in an oviduct rather than in the uterus. Maternal smoking causes hundreds of infant deaths in the United States each year, primarily due to premature delivery and smoking-related problems with the placenta, the organ that delivers blood, oxygen, and nutrients to the fetus. Maternal smoking is a major factor in low birth weight, which puts newborns at high risk for infections and other serious problems. If a nonsmoking mother is regularly exposed to ETS, her infant is also at greater risk for low birth weight.

Babies born to mothers who smoke more than two packs a day perform poorly on developmental tests in the first hours after birth, compared to babies of nonsmoking mothers. Later in life, obesity, hyperactivity, short attention span, and lower scores on spelling and reading tests all occur more frequently in children whose mothers smoked during pregnancy than in those born to nonsmoking mothers. Prenatal tobacco exposure has also been associated with behavioral problems in children.

**Wellness Tip** Regular physical activity and social support can make it easier to stop smoking.

**Giving Up Tobacco**

Giving up tobacco is a long-term, difficult process, usually accompanied by psychological craving and physical withdrawal. Research shows that most tobacco users move through predictable stages—from being uninterested in stopping, to thinking about change, to making a concerted effort to stop, to

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**TIPS FOR TODAY AND THE FUTURE**

The best treatment for dependence is prevention—not starting in the first place—but it’s never too late to regain control of your life.

**RIGHT NOW YOU CAN**

- Carefully consider your use of drugs, alcohol, or tobacco—if any—and decide whether this is the time for you to stop. If it is, throw away the offending products.
- List five things you can do instead of giving in to the temptation to use a drug, alcohol, or tobacco.

**IN THE FUTURE YOU CAN**

- Look for local resources that can help you stop using drugs, alcohol, or tobacco. Your school may offer counseling or support services, such as a smoking cessation program. It can also be informative and inspiring to attend an Alcoholics Anonymous (AA) meeting.
- Track your progress toward quitting for good. Use a journal to record your cravings or urges and to describe the tactics you use to overcome them.
Each year, millions of Americans visit their doctors in the hope of finding a drug that will help them stop smoking. Although pharmacological options are limited, the few available drugs have proved successful.

**Chantix (Varinicline)**

The newest smoking cessation drug, marketed under the name Chantix, works in two ways: It reduces nicotine cravings, easing the withdrawal process, and it blocks the pleasant effects of nicotine. The drug acts on neurotransmitter receptors in the brain.

Unlike most smoking cessation products currently on the market, Chantix is not a nicotine replacement. For this reason, smokers may be advised to continue smoking for the first few days of treatment, to avoid withdrawal and to allow the drug to build up in their system. The approved course of treatment is 12 weeks, but the duration and recommended dosage depend on several factors, including the smoker's general health and the length and severity of his or her nicotine addiction.

Side effects reported with Chantix include nausea, headache, vomiting, sleep disruptions, and changes in taste perception. People with kidney problems or who take certain medications should not take Chantix, and it is not recommended for women who are pregnant or nursing. In 2008, the FDA issued a public health advisory warning that some Chantix users suffered adverse reactions, such as behavioral changes, agitation, depression, suicidal thoughts, and attempted suicide. Anyone taking Chantix should notify his or her doctor immediately of any sudden change in mood or behavior.

**Zyban (Bupropion)**

Bupropion is an antidepressant (prescribed as Wellbutrin) as well as a smoking cessation aid (prescribed as Zyban). As a smoking cessation aid, bupropion eases the symptoms of nicotine withdrawal and reduces the urge to smoke. Like Chantix, it acts on neurotransmitter receptors in the brain.

Because the drug is not a nicotine replacement, the user may need to continue smoking for the first few days of treatment. A nicotine replacement product, such as a patch or gum, may be recommended to further ease withdrawal symptoms after the user stops smoking.

Bupropion users have reported an array of side effects, but they are rare. Side effects may be reduced by changing the dosage, taking the medicine at a different time of day, or taking it with or without food. Bupropion is not recommended for people with specific physical conditions or who take certain drugs.

**Nicotine Replacement Products**

The most widely used smoking cessation products replace the nicotine that the user would normally get from tobacco. The user continues to get nicotine, so withdrawal symptoms and cravings are reduced. Although still harmful, nicotine replacement products provide a cleaner form of nicotine, without the poisons and tars produced by burning tobacco. Less of the product is used over time, as the need for nicotine decreases.

Nicotine replacement products come in several forms, including patches, gum, lozenges, nasal sprays, and inhalers. They are available in a variety of strengths and can be worked into many different smoking cessation strategies. Most are available without a prescription.

Finally maintaining abstinence. Most users attempt to quit several times before they finally succeed. Relapse is a normal part of the process, as with most behavior change plans. Quitting is an ongoing process, not a single event.

Quitting requires a strategy for success. Some people quit cold turkey, whereas others taper off slowly. There are over-the-counter and prescription products that help many people (see the box “Smoking Cessation Products”). Behavioral factors that have been shown to increase the chances of a smoker’s permanent smoking cessation are support from others and regular exercise (see the box “How Does Exercise Help a Smoker Quit?”). Support can come from friends and family, websites, and/or formal group programs sponsored by organizations such as the American Cancer Society and the American Lung Association or by a college health center or community hospital.

If you are trying to quit, keeping track of cravings and urges in a health journal can help you deal with them. (Lab 13.2 can help identify your smoking triggers.) When you have an urge to use tobacco, use a relaxation technique, take a brisk walk, chew gum, or substitute some other activity. Practice stress management and time management so you don’t get overwhelmed at school or work. Eat sensibly and get enough sleep. Quitting can be hard, but the benefits are lifelong.

**Action Against Tobacco**

Individuals and communities have taken action against this major health threat. An assessment made in 2010 found that nearly 80% of Americans live in municipalities that restrict or ban smoking in public buildings, workplaces, restaurants, and bars. Hundreds of colleges and universities now have totally smoke-free campuses or prohibit smoking in residential buildings. As local nonsmoking laws proliferate, evidence mounts that environmental restrictions are effective in encouraging smokers to quit.

At the state level, many tough anti-tobacco laws have been passed. As of July 2015, 28 states and the District of Columbia had met the American Lung Association’s Smokefree Air Challenge, which means they have passed laws prohibiting smoking in all public places and workplaces. California has one of the most aggressive—and successful—tobacco control programs, combining taxes on cigarettes, graphic advertisements, and bans on smoking in bars and restaurants.
Most research on smoking cessation has not found any difference in quit rates between smokers who exercise and those who don’t. However, many experts believe that health care providers should prescribe an appropriate level of physical activity to their patients who want to quit smoking. The reason for this is a growing body of evidence that exercise reduces withdrawal symptoms and cravings during smoking cessation—making it easier for people to stick to their quit plan.

In one study of young adults, combining exercise with use of a nicotine lozenge significantly and immediately reduced the craving for cigarettes. Another study showed that smokers’ withdrawal symptoms and nicotine cravings decreased significantly during a single bout of aerobic exercise and remained measurably lower for nearly an hour after exercising. The positive effects were seen whether participants exercised vigorously or at a low level of exertion. The reason for these effects may lie in brain chemistry: Researchers in one study used MRI scans to look at activity in the parts of the brain focused on reward, motivation, and attention. After only 10 minutes of moderate-intensity exercise, smokers reported lower cravings in response to smoking images, and the scans showed less activation in associated parts of the brain. This confirmed other findings and provided evidence of a shift in brain activation in response to smoking cues following exercise. Although 10 minutes of activity was enough to have a measurable effect, other studies found that the more smokers exercise, the less likely they were to resume smoking. All these studies support the idea that physical activity can aid smokers in efforts to quit.

As described in the chapter, the physical benefits of quitting smoking are tremendous. Regular physical activity enhances some of these benefits, such as improved lung function, blood pressure, and overall fitness. The jury is still out, however, on whether exercise further decreases the risk of certain diseases (including heart disease and cancer) among current and former smokers. Beyond the risk reduction achieved simply by quitting smoking, a great deal of research is being done on this question.

Many smokers worry about weight gain associated with quitting. Although most ex-smokers gain a few pounds, at least temporarily, incorporating exercise into a new, tobacco-free lifestyle lays the foundation for healthy weight management. Research findings vary on the effect of exercise on weight gain after quitting smoking, but at least one new study shows that while exercise might not reduce short-term weight gain among new ex-smokers, physical activity does produce weight loss over the long term. Regardless, the health risks of adding a few pounds are far outweighed by the risks of continued smoking. According to one estimate, an ex-smoker would have to gain 75–100 pounds to equal the health risks of smoking a pack of cigarettes a day.


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**Summary**

- Addictive behaviors are habits that have gotten out of control and have a negative impact on a person’s health. Characteristics of addictive behaviors include reinforcement, craving, loss of control, escalation, and negative consequences.
- Drug misuse is a maladaptive pattern of drug use that persists despite adverse social, psychological, or medical consequences. Substance use disorders involve taking a drug or engaging in a behavior compulsively; tolerance and withdrawal symptoms are often present.
- Factors to consider when deciding whether to try a psychoactive drug include short- and long-term risks of drug use, your future goals, ethical beliefs, the financial cost of the drug, and your reasons for drug use.
- At low doses, alcohol causes relaxation; at higher doses, it interferes with motor and mental functioning and is associated with injuries; at very high doses, alcohol poisoning, coma, and death can occur.
- Continued alcohol use has negative effects on the digestive and cardiovascular systems and increases cancer risk and overall mortality.
Women who drink while pregnant risk giving birth to children with fetal alcohol syndrome.

- Alcohol use disorder involves drinking in dangerous situations or drinking to a degree that causes academic, professional, interpersonal, or legal difficulties.
- Alcohol addiction, or alcoholism, is characterized by more severe problems with alcohol, usually involving tolerance and withdrawal.
- Binge drinking is a common form of alcohol misuse on college campuses that has negative effects on both drinking and nondrinking students.
- Nicotine is the addictive psychoactive drug in tobacco products.
- In the short term, smoking can either excite or tranquilize the nervous system; it also interferes with the functions of the respiratory system. Long-term effects of smoking include higher rates of acute and chronic diseases and reduced life expectancy.
- Other forms of tobacco use—cigars, pipes, clove cigarettes, and spit tobacco—also have serious associated health risks.
- Environmental tobacco smoke contains toxic and carcinogenic compounds in high concentrations. It causes health problems, including cancer and heart disease, in nonsmokers exposed to it; infants and children are especially at risk.
- Many approaches and products are available to aid people in quitting smoking.

### FOR FURTHER EXPLORATION

- **Action on Smoking and Health (ASH).** Provides statistics, news briefs, and other information about smoking.
  - http://www.ash.org
- **Al-Anon Family Group Headquarters.** Provides information and referrals to local Al-Anon and Alateen groups.
  - http://www.al-anon.org
- **Alcoholics Anonymous (AA) World Services.** Provides information on AA, literature on alcoholism, and information about AA meetings.
  - http://www.aa.org
- **American Cancer Society (ACS).** Sponsor of the annual Great American Smokeout; provides information on the dangers of tobacco, as well as tools for preventing and stopping the use of tobacco products.
  - http://www.cancer.org
The following hotlines provide support and referrals:

- **Smokefree.gov.** Provides step-by-step strategies for quitting as well as library, and the latest news on tobacco issues.
- **Quitnet.** Provides interactive tools and questionnaires, support groups, a library, and the latest news on tobacco issues.
- **American Psychiatric Association: College Age Students.** Covers a variety of mental health issues affecting college students, including alcohol abuse and treatment.
- **Centers for Disease Control and Prevention.** Information on current prevention and intervention programs.
- **National Clearinghouse for Alcohol and Drug Information.** Provides statistics, information, and publications on substance abuse, including resources for people who want to help friends and family members overcome substance-abuse problems.
- **National Institute on Alcohol Abuse and Alcoholism (NIAAA).** Provides booklets and other publications on a variety of alcohol-related topics, including fetal alcohol syndrome, alcoholism treatment, and alcohol use and minorities.
- **American Lung Association.** Provides information on lung diseases, tobacco control, and environmental health.
- **Health and Human Development (HHD) division of Education Development Center.** Information on current prevention and intervention programs.


# LAB 13.1 Is Alcohol a Problem in Your Life?

## Part I Do You Have a Problem with Alcohol?

For each question, choose the answer that best describes your behavior. Then total your scores.

<table>
<thead>
<tr>
<th>Questions</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>Your Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. How often do you have a drink containing alcohol?</td>
<td>Never</td>
<td>Monthly or less</td>
<td>2 to 4 times a month</td>
<td>2 to 3 times a week</td>
<td>4 or more times a week</td>
<td></td>
</tr>
<tr>
<td>2. How many drinks containing alcohol do you have on a typical day when you are drinking?</td>
<td>1 or 2</td>
<td>3 or 4</td>
<td>5 or 6</td>
<td>7 to 9</td>
<td>10 or more</td>
<td></td>
</tr>
<tr>
<td>3. How often do you have six or more drinks on one occasion?</td>
<td>Never</td>
<td>Less than monthly</td>
<td>Monthly</td>
<td>Weekly</td>
<td>Daily or almost daily</td>
<td></td>
</tr>
<tr>
<td>4. How often during the past year have you found that you were not able to stop drinking once you had started?</td>
<td>Never</td>
<td>Less than monthly</td>
<td>Monthly</td>
<td>Weekly</td>
<td>Daily or almost daily</td>
<td></td>
</tr>
<tr>
<td>5. How often during the past year have you failed to do what was normally expected from you because of drinking?</td>
<td>Never</td>
<td>Less than monthly</td>
<td>Monthly</td>
<td>Weekly</td>
<td>Daily or almost daily</td>
<td></td>
</tr>
<tr>
<td>6. How often during the past year have you needed a first drink in the morning to get yourself going after a heavy drinking session?</td>
<td>Never</td>
<td>Less than monthly</td>
<td>Monthly</td>
<td>Weekly</td>
<td>Daily or almost daily</td>
<td></td>
</tr>
<tr>
<td>7. How often during the past year have you had a feeling of guilt or remorse after drinking?</td>
<td>Never</td>
<td>Less than monthly</td>
<td>Monthly</td>
<td>Weekly</td>
<td>Daily or almost daily</td>
<td></td>
</tr>
<tr>
<td>8. How often during the past year have you been unable to remember what happened the night before because you had been drinking?</td>
<td>Never</td>
<td>Less than monthly</td>
<td>Monthly</td>
<td>Weekly</td>
<td>Daily or almost daily</td>
<td></td>
</tr>
<tr>
<td>9. Have you or has someone else been injured as a result of your drinking?</td>
<td>No</td>
<td>Yes, but not in the past year (2 points)</td>
<td>Yes, during the past year (4 points)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Has a relative or friend or a doctor or other health worker been concerned about your drinking or suggested you cut down?</td>
<td>No</td>
<td>Yes, but not in the past year (2 points)</td>
<td>Yes, during the past year (4 points)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A total score of 8 or more indicates a strong likelihood of hazardous or harmful alcohol consumption.
LABORATORY ACTIVITIES

Part II Are You Troubled by Someone’s Drinking?

Millions of people are affected by the excessive drinking of someone close to them. The following questions are designed to help you decide whether you need Al-Anon. If you answer yes to any question, put a check next to it.

_____ 1. Do you worry about how much someone else drinks?
_____ 2. Do you have money problems because of someone else’s drinking?
_____ 3. Do you tell lies to cover up for someone else’s drinking?
_____ 4. Do you feel that if the drinker cared about you, he or she would stop drinking to please you?
_____ 5. Do you blame the drinker’s behavior on his or her companions?
_____ 6. Are plans frequently upset or canceled or meals delayed because of the drinker?
_____ 7. Do you make threats, such as, “If you don’t stop drinking, I’ll leave you”?
_____ 8. Do you secretly try to smell the drinker’s breath?
_____ 9. Are you afraid to upset someone for fear it will set off a drinking bout?
_____ 10. Have you been hurt or embarrassed by a drinker’s behavior?
_____ 11. Are holidays and gatherings spoiled because of drinking?
_____ 12. Have you considered calling the police for help because of fear of abuse?
_____ 13. Do you search for hidden alcohol?
_____ 14. Do you often ride in a car with a driver who has been drinking?
_____ 15. Have you refused social invitations out of fear or anxiety?
_____ 16. Do you feel like a failure because you can’t control the drinker?
_____ 17. Do you think that if the drinker stopped drinking, your other problems would be solved?
_____ 18. Do you ever threaten to hurt yourself to scare the drinker?
_____ 19. Do you feel angry, confused, or depressed most of the time?
_____ 20. Do you feel there is no one who understands your problems?

If you answered yes to three or more of these questions, Al-Anon or Alateen may be able to help. See the “For Further Exploration” section of this chapter.

Using Your Results

How did you score? (1) What is your alcohol use assessment score from Part I? Are you surprised by your score? Does your score indicate a problem?

(2) Did the Al-Anon quiz indicate that you are affected by someone else’s excessive drinking? Are you surprised by the result?

What should you do next? If your alcohol use assessment score indicates hazardous or harmful alcohol consumption, or if you are encountering drinking-related problems with your academic performance, job, relationships, or health, or with the law, you should consider seeking help. Check for campus or community resources, including counseling, self-help groups, AA, and formal treatment programs.

If you are troubled by someone else’s drinking, you can contact Al-Anon or Alateen by looking in your local telephone directory or contacting Al-Anon’s main office (1600 Corporate Landing Parkway, Virginia Beach, VA 23454; 800-344-2666; http://www.al-anon.org).

LAB 13.2  **For Smokers Only: Why Do You Smoke?**

Although smoking cigarettes is physiologically addictive, people smoke for reasons other than nicotine craving. What kind of smoker are you? Knowing what your motivations and satisfactions are can ultimately help you quit. This test is designed to provide you with a score on each of six factors that describe many people’s smoking. Read the statements and then circle the number that represents how often you feel this way when you smoke cigarettes. Be sure to answer each question.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Always</th>
<th>Frequently</th>
<th>Occasionally</th>
<th>Seldom</th>
<th>Never</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. I smoke cigarettes to keep myself from slowing down.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>B. Handling a cigarette is part of the enjoyment of smoking it.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>C. Smoking cigarettes is pleasant and relaxing.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>D. I light up a cigarette when I feel angry about something.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>E. When I have run out of cigarettes, I find it almost unbearable until I can get them.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>F. I smoke cigarettes automatically without even being aware of it.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>G. I smoke cigarettes for stimulation, to perk myself up.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>H. Part of the enjoyment of smoking a cigarette comes from the steps I take to light up.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>I. I find cigarettes pleasurable.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>J. When I feel uncomfortable or upset about something, I light up a cigarette.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>K. I am very much aware of the fact when I am not smoking a cigarette.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>L. I light up a cigarette without realizing I still have one burning in the ashtray.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>M. I smoke cigarettes to get a “lift.”</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>N. When I smoke a cigarette, part of the enjoyment is watching the smoke as I exhale it.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>O. I want a cigarette most when I am comfortable and relaxed.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>P. When I feel “blue” or want to take my mind off cares and worries, I smoke cigarettes.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Q. I get a real gnawing hunger for a cigarette when I haven’t smoked for a while.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>R. I’ve found a cigarette in my mouth and didn’t remember putting it there.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>
LABORATORY ACTIVITIES

How to Score

Enter the numbers you have circled in the spaces provided. Total the scores on each line. Total scores can range from 3 to 15. Any score of 11 or above is high; any score of 7 or below is low.

<table>
<thead>
<tr>
<th>Totals</th>
<th>Stimulation</th>
<th>Handling</th>
<th>Pleasurable relaxation</th>
<th>Crutch: tension reduction</th>
<th>Craving: strong physiological or psychological addiction</th>
<th>Habit</th>
</tr>
</thead>
<tbody>
<tr>
<td>A + G + M =</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B + H + N =</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C + I + O =</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D + J + P =</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E + K + Q =</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F + L + R =</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Using Your Results

How did you score? For which factors did you score the highest? Are you surprised by the results of the assessment?

What should you do next? Use the information from this assessment to help plan a successful approach for quitting. The six factors measured by this test describe ways of experiencing or managing certain kinds of feelings. The higher your score on a particular factor, the more important that factor is in your smoking, and the more useful the tips below will be in your attempt to quit. Highlight or make a list of the strategies that seem most helpful to you and post the list in a prominent place.

Stimulation: If you score high on this factor, it means you are stimulated by a cigarette—you feel that it helps wake you up, organize your energies, and keep you going. If you try to give up smoking, you may want a safe substitute—a brisk walk or moderate exercise, for example—whenever you feel the urge to smoke.

Handling: Handling things can be satisfying, but there are many ways to keep your hands busy without lighting up or playing with a cigarette. Try doodling or toying with a pen, pencil, or other small object.

Pleasurable relaxation: Those who do get real pleasure from smoking often find that an honest consideration of the harmful effects of their habit is enough to help them quit. They substitute social or physical activities and find they do not seriously miss their cigarettes.

Crutch: Many smokers use cigarettes as a kind of crutch in moments of stress or discomfort, and occasionally it may work; but heavy smokers are apt to discover that cigarettes do not help them deal with their problems effectively. When it comes to quitting, this kind of smoker may find it easy to stop when everything is going well but may be tempted to start again in a time of crisis. Physical exertion or social activity may serve as a useful substitute for cigarettes.

Craving: Quitting smoking is difficult for people who score high on this factor. It may be helpful for them to smoke more than usual for a day or two, so that the taste for cigarettes is spoiled, and then isolate themselves completely from cigarettes until the craving is gone.

Habit: These smokers light up frequently without even realizing it; they no longer get much satisfaction. They may find it easy to quit and stay off if they can break the habit patterns they have built up. The key to success is becoming aware of each cigarette when it’s smoked. Ask, “Do I really want this cigarette?”

LOOKING AHEAD...
After reading this chapter, you should be able to
- Explain how HIV infection affects the body and how it is transmitted, diagnosed, and treated.
- Discuss the symptoms, risks, and treatments of other major STIs.
- List strategies for protecting yourself from STIs.

TEST YOUR KNOWLEDGE
1. Worldwide, which of the following is the primary means of spreading HIV infection?
   a. injection drug use
   b. sex between men
   c. mother-to-child transmission
   d. heterosexual sex
2. A man with an STI is more likely to transmit the infection to a female partner than vice versa. True or false?
3. After you have had an STI once, you become immune to that disease and cannot get it again. True or false?

See answers on the next page.
onsidering the intimate nature of sexual activity, it is not surprising that many diseases can be transmitted from one person to another through sexual contact. Of course, colds, influenza, and many other infections can spread from one sexual partner to another, but sexual contact is not the primary means of transmission for these illnesses. **Sexually transmitted infections (STIs)**—also still called **sexually transmitted diseases (STDs)**—spread from person to person mainly through sexual activity. STIs are a particularly insidious group of illnesses because a person can be infected and able to transmit a disease, yet not look or feel sick; this is why the term **sexually transmitted infection** has come into common use.

STIs can be prevented. Many STIs can also be cured if treated early and properly. This chapter introduces the major forms of STIs. It also provides information about healthy, safer sexual behavior to help you understand how to reduce the further spread of these diseases.

### THE MAJOR STIs

The following seven STIs pose major health threats:

- **HIV/AIDS**
- **Chlamydia**
- **Gonorrhea**
- **Human papillomavirus (HPV)**
- **Herpes**
- **Hepatitis**
- **Syphilis**

These diseases are considered major threats because they are serious in themselves, cause serious complications if left untreated, and pose risks to a fetus or newborn. STIs often result in long-term consequences, including chronic pain, infertility, stillbirths, genital cancers, and death.

All these diseases have a relatively high incidence among Americans (Table 14.1). In fact, the United States has the highest or near highest rate of STIs of any industrialized nation; young people ages 15–24 account for half of STI cases in the United States. The Centers for Disease Control and Prevention (CDC) reports that several of the most common STIs are on the rise in the United States. The CDC estimates that nearly 20 million Americans become newly infected with an STI each year and 110 million have an STI. Some STIs are treatable or resolve on their own, but others persist, increasing the number of people with STIs.

### STIs and Sexual Anatomy

Both men and women are affected by STIs, but the symptoms and outcomes can vary between the sexes. For example, **Chlamydia** may cause inflammation of the oviducts in women and the epididymis in men. Figures 14.1 and 14.2 provide basic information about male and female sexual anatomy as a point of reference throughout the discussion of STIs. As will be described later in the chapter, women in the United States and around the world tend to be harder hit by STIs, for both biological and social reasons.

### HIV Infection and AIDS

The **human immunodeficiency virus (HIV)** causes **acquired immunodeficiency syndrome (AIDS)**, a disease that without treatment ultimately kills most of its victims. On average,
THE MAJOR STIs

infections in 2013. Despite a slowing of the epidemic, however, AIDS remains a primary cause of death in Africa and continues to be a major cause of mortality around the world.

In the United States, more than 1.2 million people are living with HIV infection; about 50,000 new HIV infections are reported each year. Nearly 1 in 8 Americans infected with HIV are unaware of their infection. More than 658,000 Americans have died from AIDS since the start of the epidemic.

What Is HIV Infection? HIV infection is a chronic disease that progressively damages the body’s immune system, making an otherwise healthy person less able to resist a variety of infections and disorders. Normally, when a virus or other pathogen enters the body, it is targeted and destroyed by the with the best treatment currently available, someone with HIV infection will live 20 to 30 years or more after diagnosis. For most people infected with HIV worldwide, however, adequate treatment is not available, and most infected persons die within 10 years.

An estimated total of 65 million people have been infected since the epidemic began in 1981—nearly 1% of the world’s population—and 39 million of those people have died. Currently, about 35 million people are infected with HIV/AIDS worldwide.

Worldwide, the number of people living with HIV infection has leveled off. Many experts believe that the global HIV epidemic peaked in the late 1990s, at about 3.5 million new infections per year, compared with an estimated 2.1 million new infections in 2013. Despite a slowing of the epidemic, however, AIDS remains a primary cause of death in Africa and continues to be a major cause of mortality around the world.

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What Is HIV Infection? HIV infection is a chronic disease that progressively damages the body’s immune system, making an otherwise healthy person less able to resist a variety of infections and disorders. Normally, when a virus or other pathogen enters the body, it is targeted and destroyed by the
THE EVIDENCE FOR EXERCISE

Does Exercise Help or Harm the Immune System?

Like any infectious illness, STIs attract the attention of the body’s immune system—an information network operating through billions of specialized white blood cells to protect the body from disease. When an infection is detected inside the body, these cellular defenders—including lymphocytes, macrophages (“big eaters”), and “natural killer” cells, among others—spring into action. They attack invading pathogens, destroy body cells that are already infected, and prime the immune system in case of future infections by the same agent. This is even the case in HIV infection. Although HIV targets specific types of immune system cells—primarily CD4 T cells and other kinds of T cells—other immune cells pick up the fight and attempt to rid the body of the virus.

A strong immune system can help defend your body against infections, including STIs, if only by keeping the infection at bay and minimizing damage until medical therapy (such as antibiotics) can be started. Many lifestyle factors, including nutrition, sleep, and stress management, are known to support immune function. The effects of physical activity and exercise on the immune system are more complex. It appears that effects vary depending on the intensity of the activity. Research has demonstrated that moderate-intensity exercise tends to improve immune function, whereas vigorous-intensity exercise tends to impair immunity temporarily.

A 2013 study found that patients with HIV/AIDS could exercise at low to moderate intensity and not increase their risk for developing other infections. Aerobic exercise and resistance training improved muscle and cardiovascular endurance and also prevented muscle wasting due to HIV. Resistance training has also been shown to improve strength in frail older adults with HIV. It is possible that strength training increases CD4 cell counts. Other studies have examined the effects of exercise on specific components of the immune system (such as natural killer cells, neutrophils, and dendritic cells) and found that the overall immune system response to physical activity is positive.

Intensive training for long periods has mixed short- and long-term effects. On one hand, studies have found that people who exercise vigorously, for prolonged periods, or without proper nutrition experience temporary declines in immune system function; full function is then typically recovered in a matter of hours or days. But longitudinal studies (those conducted repeatedly over longer periods of time, such as months or years) also show that vigorous exercise offers important anti-inflammatory benefits. For most of us, the evidence strongly indicates that regular moderate-intensity exercise promotes immune system function in many ways.


Immune system. But HIV attacks the immune system itself, taking over immune system cells and forcing them to produce new copies of HIV. It also makes them incapable of performing their immune functions (see the box “Does Exercise Help or Harm the Immune System?”).

The destruction of the immune system is signaled by the loss of CD4 T cells. As the number of CD4 T cells declines, an infected person may begin to experience mild to moderately severe symptoms. A person is diagnosed with AIDS when he or she develops one of the conditions defined as a marker for AIDS or when the number of CD4 T cells in the blood drops below a certain level (200/µL). People with AIDS are vulnerable to a number of serious—often fatal—secondary, or opportunistic, infections.

The asymptomatic or incubation period of HIV—the time between the initial viral infection and the onset of disease symptoms—may range from 2 to 20 years, with an average of 11 years in untreated adults. Most, but not all, infected people experience flulike symptoms shortly after the initial infection, but most remain generally healthy for years. During this time, however, the virus is progressively infecting and destroying the cells of the immune system. People infected with HIV can pass the virus to others—even if they have no symptoms and especially if they do not know they have been infected.

Transmitting the Virus HIV lives only within cells and body fluids, not outside the body. It is transmitted by blood and blood products, semen, vaginal and cervical secretions, and breast milk. It cannot live in air, water, or saliva, or on objects or surfaces such as toilet seats, eating utensils, or telephones. A person is not at risk of getting HIV infection by
being in the same classroom, dining room, or even household with someone who is infected.

There are three main routes of HIV transmission:

- Specific kinds of sexual contact
- Direct exposure to infected blood
- Contact between an HIV-infected woman and her child during pregnancy, childbirth, or breastfeeding

These means of transmission are discussed in the following sections.

**SEXUAL CONTACT** HIV is more likely to be transmitted through unprotected vaginal or anal intercourse than by other sexual activities. During vaginal intercourse, male-to-female transmission is more likely to occur than female-to-male transmission. HIV has been found in preejaculatory fluid, so transmission can occur before ejaculation. Any trauma or irritation of tissues, such as those that can occur through rough or unwanted intercourse or through the overuse of spermicides, increases the risk of HIV transmission. The presence of lesions or blisters from other STIs also makes it easier for the virus to be passed.

Oral-genital contact carries some risk of transmission, although less than vaginal or anal intercourse. The risk of HIV transmission during oral sex increases if a participant has oral sores, even if from poor oral hygiene practice (which can include bleeding gums from vigorous flossing or brushing just before or after oral sex). Some evidence suggests that drinking alcohol before oral sex may make the cells that line the mouth more susceptible to infection with HIV.

Among Americans with HIV infection, the most common means of HIV exposure is sexual activity between men (MSM); heterosexual contact and injection drug use (IDU) are the next most common (Figure 14.1). Direct contact with infected blood is another major route of HIV transmission.

**CONTACT WITH INFECTED BLOOD** Needles used to inject drugs (including heroin, cocaine, and anabolic steroids) are usually contaminated with the user’s blood. If needles are shared, small amounts of one person’s blood are injected into another person’s bloodstream. HIV can be transmitted through subcutaneous and intramuscular injection as well, from needles or blades used in acupuncture, tattooing, ritual scarring, and piercing of any body part. About 8% of all new U.S. cases of HIV are caused, directly or indirectly, through the sharing of drug injection equipment contaminated with HIV.

**CONTACT BETWEEN MOTHER AND CHILD** The final major route of HIV transmission is mother to child, also called **vertical, or perinatal, transmission**, which can occur during pregnancy, childbirth, or breastfeeding. The number of new cases of HIV/AIDS among American infants has declined more than 90% since 1992 because of testing and treatment of infected women with anti-HIV drugs. Treatment is expensive, however, and vertical transmission continues to be a major threat worldwide (see the box “HIV Infection Around the World”). Cesarean delivery further reduces the risk of HIV transmission in women with high blood levels of HIV.

**Symptoms** Within a few days or weeks of infection with HIV, some victims develop symptoms of **primary HIV infection**. These can include fever, fatigue, rashes, headache, swollen lymph nodes, body aches, night sweats, sore throat, nausea, and...
HIV is a worldwide scourge, with 36.9 million people living with AIDS and 1.2 million deaths due to AIDS-related causes in 2014. Approximately 2 million individuals became newly infected with HIV in 2014, including more than 220,000 children.

The vast majority of cases—95%—have occurred in poorer countries; heterosexual contact is the primary means of transmission, responsible for 85% of all adult infections. In the industrialized world, HIV is increasingly becoming a disease that disproportionately affects the poor and ethnic minorities. Worldwide, women are the fastest-growing group of newly infected people; half of adults living with HIV in 2014 were women. Some 2.6 million children now live with HIV infection, and about 15 million children are AIDS orphans.

The HIV epidemic seems to have stabilized in many parts of the world. Rates of new infections peaked around 1997 and since then have dropped in most regions. Sub-Saharan Africa remains the hardest-hit area of the world, but even there the number of new infections dropped from 2.4 million in 2001 to 1.4 million in 2014, a 40 percent decline. Despite gradual improvement, Sub-Saharan Africa still accounts for 70 percent of all new HIV infections and 66 percent of AIDS-related deaths. However, treatment rates rose by a factor of thirty worldwide between 2003 and 2014—from fewer than 1 million people receiving treatment to over 15 million.

After sub-Saharan Africa, the regions most heavily affected by AIDS are the Caribbean, eastern Europe, and Central Asia. In sub-Saharan Africa and the Caribbean, infection rates have gone down and treatment rates have gone up in recent years. The story is different in eastern Europe and parts of Asia, where the incidence of HIV infection began increasing in the late 2000s after having remained relatively stable for several years.

Efforts to combat AIDS are complicated by political, economic, and cultural barriers. Education and prevention programs are often hampered by resistance from social and religious institutions and by the taboo on openly discussing sexual issues. Condoms are not commonly used in many countries, and women in many societies do not have sufficient control over their sexual situations to demand that men use condoms. Successful prevention approaches include STI treatment and education, public education campaigns about safer sex, and syringe exchange programs for injection drug users.

In countries where there is a substantial imbalance in the social power of men and women, empowering women is a crucial priority in reducing the spread of HIV. In particular, reducing sexual violence against women, allowing women property and inheritance rights, and increasing women’s access to education and employment are essential.

Approximate number of people living with HIV/AIDS in 2013.

DIVERSITY MATTERS
HIV Infection Around the World

International efforts are under way to make condoms more available by lowering their price and to develop effective antiviral creams that women can use without the knowledge of their partners. Other potential strategies for fighting the spread of HIV include the widespread use of drugs to suppress genital herpes simplex, an extremely common STI that can dramatically increase transmission of HIV.

Studies in poorer nations with high rates of HIV infection have found that circumcised males have a lower risk of HIV infection than uncircumcised males. Circumcision is uncommon in most parts of the world, but these findings are heightening interest in the practice. In the United States, where circumcision is common and HIV infection rates are much lower, circumcision does not appear to offer any significant protection against HIV.

In industrialized nations such as the United States, new drugs are easing AIDS symptoms and lowering viral levels dramatically for some patients. In the past few years, a small but growing number of people in poor countries have gained access to antiviral drugs because of the introduction of inexpensive generic drugs and increasing international funding for HIV treatment. Still, the majority of people with HIV remain untreated.

ulcers in the mouth. Because the symptoms of primary HIV infection are similar to those of many common viral illnesses, the condition often goes undiagnosed.

Because the immune system is weakened, people with HIV infection are highly susceptible to other infections, both common and uncommon. The infection most often seen among people with HIV is Pneumocystis pneumonia, a fungal infection. Kaposi’s sarcoma, a once-rare form of cancer, is common in HIV-infected men. Women with HIV infection often have frequent and difficult-to-treat vaginal yeast infections. Cases of tuberculosis are also increasingly being reported in people with HIV.

Diagnosis The most commonly used screening blood test for HIV is the HIV antibody test. This procedure consists of an initial screening called an ELISA test and a more specific confirmation test called the Western blot. These tests determine whether a person has antibodies to HIV circulating in the bloodstream, a sign that the virus is present in the body (see the box “Getting an HIV Test”).

If a person is diagnosed as HIV positive, the next step is to determine the current severity of the disease in order to plan appropriate treatment. The infection can be monitored by tracking the amount of virus in the body (the viral load) through a test that measures the amount of HIV RNA in a blood sample.

A new diagnostic test that may help guide treatment decisions is called HIV Replication Capacity. This test shows how fast HIV from a patient’s blood sample can reproduce itself. It is a measure of viral fitness and may be helpful when used in conjunction with CD4 and viral load tests in predicting how quickly a given person may progress to more serious disease.

Being tested once is not enough. Periodic routine testing is the best way for anyone to find out if he or she has HIV. The frequency of testing depends on multiple factors. For example, the CDC recommends that men who have sex with men should be tested at least once a year. People who engage in high-risk behavior (such as unprotected anal sex) should be tested more often. Rather than testing only at-risk individuals, the CDC also recommends universal HIV testing as part of routine medical care for everyone age 13–64. The CDC hopes that routine HIV testing will increase the odds that people with HIV are diagnosed earlier.

Treatment Although there is no known cure for HIV infection, medications can significantly alter the course of the disease and extend life. The drop in the number of U.S. AIDS deaths that has occurred since 1996 is in large part due to the increasing use of combinations of new drugs.

The main types of antiviral drugs used against HIV/AIDS are reverse transcriptase inhibitors, protease inhibitors, integrase inhibitors, and entry inhibitors. These drugs either block HIV from replicating itself or prevent it from infecting other cells. More than 30 drugs are now available to treat HIV, including two once-a-day tablets (containing three combined HIV medications). In addition to antiviral drugs, most patients with low CD4 T cell counts take a variety of antibiotics to help prevent opportunistic infections such as pneumonia, tuberculosis, and other bacterial and fungal infections.

The cost of treatment for HIV continues to be an area of major concern. Pharmaceutical companies, the World Bank, and the international community are working to lower drug costs and provide aid for developing regions. HIV treatment is also challenging because taking the combination drugs is complicated, and the drugs have short-term side effects that may cause people to stop taking them. The drugs can also have long-term side effects, including serious health problems. The National Institutes of Health has issued guidelines
Getting an HIV Test

You should strongly consider being tested for HIV if any of the following apply to you or to any past or current sexual partner:

- You have had unprotected sex (vaginal, anal, or oral) with more than one partner or with a partner who was not in a mutually monogamous relationship with you.
- You have used or shared needles, syringes, or other paraphernalia for injecting drugs (including steroids).
- You received a transfusion of blood or blood products between 1978 and 1985.
- You have been diagnosed with an STI.

If you decide to get an HIV test, you can either visit a physician or health clinic or take a home test.

Physician or Clinic Testing

Your physician, student health clinic, Planned Parenthood, public health department, or local AIDS association can arrange your HIV test. Testing usually costs $50–$100, but public clinics often charge little or nothing. The standard test involves drawing a sample of blood that is sent to a lab, which checks for antibodies. If the first stage of testing is positive, a confirmatory test is done. This standard test takes 1–2 weeks, and you’ll be asked to phone or come in personally to obtain your results, which should also include appropriate counseling.

Alternative tests are available at some clinics. The Orasure test uses oral fluid, which is collected by placing a treated cotton pad in the mouth; urine tests are also available. New rapid tests are also available at some locations. These tests involve the use of blood or oral fluid and can provide results in as little as 20 minutes. If a rapid test is positive for HIV infection, a confirmatory test will be performed.

Before getting tested, be sure you understand what will be done with the results. Results from confidential tests may still become part of your medical record and/or be reported to state and federal public health agencies. If you decide you want to be tested anonymously, ask your physician or counselor about an anonymous test, or use a home test.

Home Testing

Home HIV test kits are available and cost about $40–$70. Avoid tests sold on the Internet that are not FDA approved. As of this writing, there were two HIV home testing kits approved by the FDA: Home Access and OraQuick. Positive results with either test kit need to be confirmed with follow-up testing. To use the Home Access test, you prick a finger with a supplied lancet, blot a few drops of blood onto blotting paper, and mail it to the company’s laboratory. In about a week (or within three business days for more expensive “express” tests), you call a toll-free number to find out your results. Anyone testing positive is routed to a trained counselor, who can provide emotional and medical support. Similar to the Orasure clinic test, the OraQuick test uses a sample taken from the mouth and returns results in 20 minutes. Anyone testing positive should call their health care professional or the OraQuick Consumer Support Center so that they can be counseled and routed to care. The results of home test kits are completely anonymous.

Understanding the Results

A negative test result means that no antibodies were found in your sample. However, it usually takes at least a month (and possibly as long as six months in some people) after exposure to HIV for antibodies to appear. Therefore, an infected person may get a false-negative result. If you think you’ve been exposed to HIV, get a test immediately; if it’s negative but your risk of infection is high, ask for an HIV RNA assay, which allows very early diagnosis.

A positive result means that you are infected. It is important to seek medical care and counseling immediately. Rapid progress is being made in treating HIV, and treatments are potentially much more successful when begun early. For more information on testing, visit the National HIV and STI Testing Resources website (http://hivtest.cdc.gov/Default.aspx).
for HIV treatment that help patients and their doctors with decisions about treatment.

The best hope for stopping the spread of HIV worldwide rests with the development of a safe, effective, and inexpensive vaccine. The U.S. Food and Drug Administration has approved a drug—tenofovir disoproxil fumarate plus emtricitabine (TDF/FTC)—to be taken by people who do not have HIV but are at high risk for it. It is called a pre-exposure prophylaxis, meaning that it is a prevention method, intended to be used with other methods for reducing HIV risk. This approval comes after a study was conducted of adults who inject drugs in Bangkok. They took a daily dose of the TDF/FTC pill and were found to reduce their risk of acquiring HIV by about 49%.

Many different approaches to the development of an AIDS vaccine are currently under investigation, and human trials have begun on several vaccines. However, no vaccine is likely to be ready for widespread use within the next decade. Researchers are making more rapid progress in producing a microbicide that could be used to prevent HIV and other STIs. A microbicide in the form of a cream, gel, sponge, or suppository could function as a kind of chemical condom.

**Prevention** Although AIDS is currently incurable, it is preventable. You can protect yourself by avoiding behaviors that may bring you into contact with HIV. This means making careful choices about sexual activity (Figure 14.4) and not sharing needles if you inject drugs.

Anal and vaginal intercourse are the sexual activities associated with the highest risk of HIV infection. If you have intercourse, always use a condom (see the box “Using Male Condoms”). The use of a lubricated condom reduces the risk of transmitting HIV during all forms of intercourse. Condoms are not perfect, and they do not provide risk-free sex. When used properly, however, a condom provides a high level of protection against HIV and other STIs. Experts also suggest the use of latex squares and dental dams, devices that can be used as barriers during oral-genital or oral-anal sexual contact. Also, avoid using lubricants and lubricated condoms that contain the spermicide nonoxynol-9 (N-9). This spermicide has been shown to cause tissue irritation, which can make STI transmission more likely.

**Chlamydia**

*Chlamydia trachomatis* causes *chlamydia*, the most prevalent bacterial STI in the United States. According to the CDC, almost 2.9 million new chlamydia infections occur each year, 63% of them among individuals age 15 to 24. African American women experience chlamydia infections at nearly eight times the rate of white women.

Both men and women are susceptible to chlamydia, but women bear the greater burden because of possible complications and consequences of the disease. If left untreated, chlamydia can lead to *pelvic inflammatory disease (PID)*, a serious infection that can cause infertility. PID is discussed later in this chapter.

Chlamydia can also lead to infertility in men, although not as often as in women. In men under age 35, chlamydia is the most common cause of *epididymitis*—inflammation...
of the sperm-carrying ducts. In men, up to half of all cases of urethritis—inflammation of the urethra—are caused by chlamydia.

Symptoms Most people experience few or no symptoms from chlamydia infection, increasing the likelihood that they will inadvertently spread the infection to their partners. In men, symptoms can include painful urination, a slight watery discharge from the penis and sometimes pain around the testicles.

Women may notice increased vaginal discharge, burning with urination, pain or bleeding with intercourse, and lower abdominal pain. Because infection rates are high and most women are asymptomatic, annual screening is recommended for sexually active young women.

Diagnosis and Treatment Chlamydia is diagnosed through a urine test or laboratory examination of fluid from the urethra or cervix. After chlamydia has been diagnosed, the
Gonorrhea

Gonorrhea is caused by the bacterium *Neisseria gonorrhoeae*, which flourishes in mucous membranes. The CDC estimates that there are more than 820,000 new gonorrhea infections each year in the United States. The highest incidence is among 15- to 24-year-olds. Like chlamydia, untreated gonorrhea can cause PID in women and urethritis and epididymitis in men. It can also cause arthritis and rashes, and it occasionally involves internal organs. An infant passing through the birth canal of an infected mother may contract *gonococcal conjunctivitis*, an infection in the eyes that can cause blindness if not treated.

### Symptoms

In males, the incubation period for gonorrhea is brief, generally two to seven days. The first symptoms are due to urethritis, which causes urinary discomfort and a thick, yellowish-white or yellowish-green discharge from the penis. The lips of the urethral opening may become inflamed and swollen. In some cases, the lymph glands in the groin become enlarged and swollen. Many males have very minor symptoms or none at all.

Most females with gonorrhea are asymptomatic. Those who have symptoms often experience urinary pain, increased vaginal discharge, and severe menstrual cramps. Women may also develop painful abscesses in the Bartholin’s glands, a pair of glands located on either side of the opening of the vagina. Up to 40% of women with untreated gonorrhea develop PID.

Gonorrhea can also infect the throat of people who engage in oral sex or rectum of people who engage in anal sex. Gonorrhea symptoms in the throat may be a sore throat or pus on the tonsils, and those in the rectum may be pus or blood in the feces or rectal pain and itching.

### Diagnosis and Treatment

Several tests—gram stain, detection of bacterial genes or DNA, or culture—are available to detect gonorrhea. The physician may also collect samples of urine or cervical, urethral, throat, or rectal fluids.

Antibiotics can cure gonorrhea, but increasing drug resistance is a major concern. Today only one class of antibiotics, the cephalosporins, remains consistently effective against gonorrhea. People with gonorrhea often also have chlamydia, requiring additional antibiotics to treat chlamydia.

### Pelvic Inflammatory Disease

Pelvic inflammatory disease (PID) is a major complication in 10–40% of women who have been infected with either chlamydia or gonorrhea and have not received treatment. PID occurs when the initial infection travels upward, often along with other bacteria, beyond the cervix into the uterus, oviducts, ovaries, and pelvic cavity. PID is often serious enough to require hospitalization and sometimes surgery. Even if the disease is treated successfully, about 25% of affected women will have long-term problems such as a continuing susceptibility to infection, ectopic pregnancy, infertility, and chronic pelvic pain. PID is the leading cause of infertility in young women.
Symptoms Symptoms of PID vary greatly. Some women, especially those with PID from chlamydia, may be asymptomatic; others may feel very ill with abdominal pain, fever, chills, nausea, and vomiting. Early symptoms are essentially the same as those described for chlamydia and gonorrhea. Symptoms often begin or worsen during or soon after a woman’s menstrual period. Many women have abnormal vaginal bleeding—either bleeding between periods or heavy and painful menstrual bleeding.

Diagnosis and Treatment Diagnosis of PID is made on the basis of symptoms, physical examination, ultrasound, and laboratory tests. Laparoscopy may be used to confirm the diagnosis and obtain material for cultures.

Treatment should begin as quickly as possible to minimize damage to the reproductive organs. Antibiotics are usually started immediately; in severe cases, the woman may be hospitalized and antibiotics given intravenously. It is especially important that an infected woman’s partners be treated. As many as 60% of the male contacts of women with PID are infected but asymptomatic.

Human Papillomavirus (HPV)

Human papillomavirus (HPV) infection causes several human diseases, including common warts, genital warts, and genital cancers. HPV also causes virtually all cervical cancer, as well as penile cancer and some forms of anal and oropharyngeal cancer. Genital HPV is usually spread through sexual activity, including oral sex.

HPV is the most common STI in the United States; more than 50% of sexually active people will have been infected with HPV by age 50. HPV is especially common in young people, with some of the highest infection rates among college students.

Three HPV vaccines have been approved by the FDA—Gardasil, Gardasil 9, and Cervarix. They protect against different numbers and types of HPV strains, but all target the strains that cause the majority of cervical and other HPV-linked cancers. Routine vaccination is recommended at 11–12 years of age; younger children respond better to the vaccine, and it is important for individuals to be vaccinated before their first sexual encounter for the most protection against HPV. Vaccination is recommended for women up to 26 years of age and men up to 21 who did not receive it when they were younger. All the HPV vaccines were approved relatively recently, and the recommendations for their use may be updated in the future; check the CDC website (http://www.cdc.gov/vaccines) for the most up-to-date information. Initial findings suggest that vaccination is having a significant impact on HPV infection rates.

Symptoms HPV-infected tissue often appears normal; it may also look like anything from a small bump on the skin to a large warty growth. Untreated warts can grow together to form a cauliflower-like mass. In males, they appear on the penis and often involve the urethra, appearing first at the opening and then spreading inside. The growths may cause irritation and bleeding, leading to painful urination and a urethral discharge. Warts may also appear around the anus or within the rectum.

In women, warts may appear on the labia or vulva and may spread to the perineum, the area between the vagina and the anus. If warts occur only on the cervix, the woman will generally have no symptoms or awareness that she has HPV.

The incubation period ranges from 1 month to 2 years from the time of contact. People can be infected with the virus and be capable of transmitting it to their sex partners without having any symptoms at all. The vast majority of people with HPV infection have no visible warts or symptoms of any kind.

Diagnosis and Treatment Genital warts are usually diagnosed based on the appearance of the lesions. Frequently, HPV infection of the cervix is detected on routine Pap tests.

Treatment of genital warts focuses on reducing the number and size of warts. The currently available treatments do not eradicate HPV infection. Warts may be removed by cryosurgery (freezing), electrocautery (burning), or laser surgery. Direct applications of a cytotoxic acid may be used, and there are treatments that patients can use at home.

Even after treatment and the disappearance of visible warts, the individual may continue to carry HPV in healthy-looking tissue and can probably still infect others. Anyone who has ever had HPV should inform all partners. Condoms should be used, even though they do not provide total protection. As with HIV, circumcision may provide some protection against HPV.

Genital Herpes

Genital herpes affects about one in five adults in the United States. Two types of herpes simplex viruses, HSV 1 and HSV 2, cause genital herpes and oral-labial herpes (cold sores). Many people wrongly assume that they are unlikely to pick up an STI if they limit their sexual activity to oral sex, but this is not true, particularly in the case of genital herpes. HSV can also cause rectal lesions, usually transmitted through anal sex. Infection with HSV is generally lifelong; after infection, the virus lies dormant in nerve cells and can reactivate at any time.

HSV 1 infection is so common that 50–80% of adults have antibodies to HSV 1 (indicating previous exposure to the virus). Most people are exposed to HSV 1 during childhood. HSV 2 infection usually occurs during adolescence and early adulthood, most commonly between ages 18 and 25. About 16% of adults have antibodies to HSV 2.

HSV 2 is almost always sexually transmitted, including during oral sex. The infection spreads readily whether people...
have active sores or are completely asymptomatic. If you have ever had an outbreak of genital herpes (that is, the appearance of genital sores), you should consider yourself always contagious and inform your partners. Avoid intimate contact when any sores are present, and use condoms during all sexual contact, including times when you have no symptoms. One study showed that using condoms for every act of intercourse results in a 30% decrease in the transmission of herpes compared with no condom use. Condoms are more effective in preventing the transmission of other STIs than for herpes, but this study shows that they can make a significant difference in preventing the spread of genital herpes.

Newborns can occasionally be infected with HSV, usually during passage through the birth canal of an infected mother. Without treatment, 65% of newborns with HSV will die, and most who survive will have some degree of brain damage. Pregnant women who have ever been exposed to genital herpes should inform their physician so that appropriate precautions can be taken to protect the baby from infection.

**Symptoms** Most people who are infected with HSV have no symptoms. Those who develop symptoms often first notice them within 2–20 days of having sex with an infected partner. The first episode of genital herpes frequently causes flu-like symptoms in addition to genital lesions. The lesions usually heal within three weeks, but the virus remains alive in an inactive state within nerve cells. A new outbreak of herpes can occur at any time. On average, newly diagnosed people will experience five to eight outbreaks a year, with a decrease in the frequency of outbreaks over time. Outbreaks can be triggered by stress, illness, fatigue, sun exposure, sexual intercourse, and menstruation.

**Diagnosis and Treatment** Genital herpes can be diagnosed on the basis of symptoms; a sample of fluid from the lesions may also be sent to a laboratory for evaluation. Several blood tests can detect the presence of HSV antibodies in the blood and may alert many asymptomatic people to the fact that they are infected.

There is no cure for herpes. Once infected, a person carries the virus for life. Antiviral drugs such as acyclovir can be taken at the beginning of an outbreak to shorten the severity and duration of symptoms. Support groups are available to help people learn to cope with herpes. There is no vaccine to prevent herpes infection, but research is ongoing.

**Hepatitis B**

**Hepatitis** (inflammation of the liver) can cause serious and sometimes permanent damage to the liver, which can result in death in severe cases. One of the many types of hepatitis is caused by hepatitis B virus (HBV). Hepatitis B virus is somewhat similar to HIV, but it is much more contagious than HIV, and it can also be spread through nonsexual close contact.

HBV is found in all body fluids, including blood and blood products, semen, saliva, urine, and vaginal secretions. It is easily transmitted through any sexual activity that involves the exchange of body fluids, the use of contaminated needles, and any blood-to-blood contact, including the use of contaminated razor blades, toothbrushes, and eating utensils. The primary risk factors for acquiring hepatitis B are sexual exposure and injection drug use; having multiple partners greatly increases risk.

**Symptoms** Many people infected with HBV never develop symptoms; they have what is known as a silent infection. The normal incubation period is 30–180 days. Mild cases of hepatitis cause flu-like symptoms. As the illness progresses, there may be nausea, vomiting, dark-colored urine, abdominal pain, and jaundice.

People with hepatitis B sometimes recover completely, but they can also become chronic carriers of the virus, capable of infecting others for the rest of their lives. Some chronic carriers remain asymptomatic, while others develop chronic liver disease. Chronic hepatitis can cause cirrhosis, liver failure, and a deadly form of liver cancer. Hepatitis kills some 1,800 Americans each year; worldwide, the annual death toll is approximately 1 million.

**Diagnosis and Treatment** Blood tests can diagnose hepatitis by analyzing liver function and detecting the infecting organism. There is no cure for HBV and no specific treatment for acute infections; antiviral drugs and immune system modulators may be used for chronic HBV infection to help delay or reverse liver damage. For people exposed to HBV, treatment with hepatitis B immunoglobulin can provide protection against the virus.

The vaccine for hepatitis B is safe and effective. Immunization is recommended for everyone under age 19 and for all adults at increased risk, including people who have more than one sex partner in six months, men who have sex with other men, those who inject illegal drugs, and health care workers who are exposed to blood and body fluids.

**Syphilis**

**Syphilis**, a disease that once caused death and disability for millions, can now be treated effectively with antibiotics. In 2013, there were 56,471 new cases of syphilis in the United States.

Syphilis is caused by a corkscrew-shaped bacterium called *Treponema pallidum*. It requires warmth and moisture to survive and dies very quickly outside the human body. The bacterium passes through any break or opening in the skin or mucous membranes and can be transmitted by kissing, vaginal or anal intercourse, or oral-genital contact.

**Hepatitis** Inflammation of the liver, which can be caused by infection, drugs, or toxins; some forms of infectious hepatitis can be transmitted sexually.

**Syphilis** A sexually transmitted infection caused by the bacterium *Treponema pallidum*.

**Chancre** The sore produced by syphilis in its earliest stage.
TAKE CHARGE
Protecting Yourself from STIs

- **Abstinence.** The only truly foolproof way to protect yourself from STIs is abstinence—abstaining from sexual relations with other people. Remember that it is okay to say no to sex.
- **Monogamy.** Next to abstinence, the most effective way to protect yourself is monogamy—having sex exclusively with one partner, who engages in sex with no one else but you, and who does not have an STI.
- **Communication.** If you choose to be sexually active, protect yourself by practicing open and honest communication and insisting on the same from your partner. Be truthful about your past, and ask your partner to do the same. Remember that you are indirectly exposing yourself to all of your partner’s prior sexual contacts.
- **Safer sexual activities.** Know what sexual activities are risky (see Figure 14.4). Safer alternatives to intercourse include fantasy, hugging, massage, rubbing clothed bodies together, mutual masturbation, and closed-mouth kissing.
- **Condoms.** Always use latex condoms during every act of vaginal intercourse, anal intercourse, and oral sex. Multiple studies show that regular condom use can reduce the risk of several diseases, including HIV, chlamydia, and genital herpes.
- **Activities to avoid.** Don’t drink or use drugs in sexual situations. Mood-altering drugs can affect your judgment and make you more likely to engage in risky behaviors. Limit the number of sexual partners; having multiple partners is associated with increased risk of STIs. Avoid sexual contact with partners who have an STI or have had unprotected sex in the past. Avoid sexual contact that could cause tears or cuts in the skin or tissue. Don’t inject drugs; don’t share needles, syringes, or anything that might have blood on it. Decontaminate needles and syringes with household bleach and water. If you are at risk for HIV infection, don’t donate blood, sperm, or organs.
- **Other preventive measures.** Get tested for HIV during your next routine medical examination. Have periodic screenings for STIs if you are at risk. Make sure all your vaccinations are up-to-date. Girls and women ages 11–26 and boys and men ages 11–21 should be vaccinated against HPV, unless there are medical reasons to avoid the vaccination. (The HPV vaccine is also recommended for any man who has sex with men, or any man with a compromised immune system, through age 26.) Ask your physician if it is appropriate for you to be vaccinated against hepatitis B.

**Symptoms** Syphilis progresses through several stages. *Primary syphilis* is characterized by an ulcer called a chancre that appears within about 10–90 days after exposure. The chancre is usually found at the site where the organism entered the body, such as the genital area, but it may also appear in other sites such as the mouth, breasts, or fingers. Chancres contain large numbers of bacteria and make the disease highly contagious when present; they are often painless and typically heal on their own within a few weeks. If the disease is not treated during the primary stage, about a third of infected individuals progress to chronic stages of infection.

*Secondary syphilis* is usually marked by mild, flulike symptoms and a skin rash that appears three to six weeks after the chancre. The rash may cover the entire body or only a few areas, but the palms of the hands and soles of the feet are usually involved. Areas of skin affected by the rash are highly contagious but usually heal within several weeks or months. If the disease remains untreated, the symptoms of secondary syphilis may recur over a period of several years. Affected individuals may then lapse into an asymptomatic latent stage in which they experience no further consequences of infection. In about a third of cases of untreated secondary syphilis, however, the individual develops *late*, or *tertiary*, syphilis. Late syphilis can damage many organs of the body, possibly causing severe dementia, cardiovascular damage, blindness, and death.

In infected pregnant women, the syphilis bacterium can cross the placenta. If the mother is not treated, the probable result is stillbirth, prematurity, or congenital deformity. In some cases, the infant is born infected (*congenital syphilis*) and requires treatment.

**Diagnosis and Treatment** Syphilis is diagnosed by examination of infected tissues and with blood tests. All stages can be treated with antibiotics, but damage from late syphilis can be permanent.

**Other STIs**

A few other infections are transmitted sexually, but they can be avoided by observing responsible sexual behavior.

**Trichomoniasis**, often called *trich*, is a common STI. The single-celled organism that causes trich, *Trichomonas vaginalis*, thrives in warm, moist conditions, making women particularly susceptible to these infections in the vagina. Women who become symptomatic with trich develop a greenish, foul-smelling vaginal discharge and severe itching and pain in the vagina. Prompt treatment with metronidazole (Flagyl) is important because studies suggest that trich may increase the risk of HIV transmission and, in pregnant women, premature delivery. Although trich is treatable, reinfection is common.

**Bacterial vaginosis** (BV) is the most common cause of abnormal vaginal discharge in women of reproductive age. BV occurs when healthy bacteria that normally inhabit the vagina
TRICHOMONIASIS A protozoal infection caused by Trichomonas vaginalis, transmitted sexually and externally.

BACTERIAL VAGINOSIS (BV) A condition caused by an overgrowth of certain bacteria inhabiting the vagina.

PUBLIC LICE Parasites that infest the hair of the pubic region; commonly called crabs.

SCABIES A contagious skin disease caused by burrowing parasitic mites.
TIPS FOR TODAY AND THE FUTURE

Because STIs can have serious, long-term effects, it is important to be vigilant about exposure, treatment, and prevention.

RIGHT NOW YOU CAN
- Make an appointment with your health care provider if you are worried about possible STI infection.
- Resolve to discuss condom use with your partner if you are sexually active and are not already using condoms.

IN THE FUTURE YOU CAN
- Learn how to communicate effectively with a partner who resists safer sex practices or is reluctant to discuss his or her sexual history. Support groups and classes can help.
- Make sure all your vaccinations are up-to-date; ask your doctor if you should be vaccinated against any STIs. Follow instructions for treatment carefully and complete all the medication as prescribed.

SUMMARY

- HIV damages the immune system and causes AIDS. People with AIDS are vulnerable to often-fatal opportunistic infections.
- HIV is carried in blood and blood products, semen, vaginal and cervical secretions, and breast milk; it is transmitted through the exchange of these fluids.
- Drugs have been developed to slow the course of HIV infection and to prevent or treat certain secondary infections, but there is no cure.
- Chlamydia is a bacterial infection that causes epididymitis and urethritis in men and can lead to PID in women.
- Untreated, gonorrhea can cause PID in women and epididymitis in men, leading to infertility. In infants, untreated gonorrhea can cause blindness.
- Pelvic inflammatory disease (PID), a complication of untreated chlamydia or gonorrhea, is an infection of the uterus and oviducts that may extend to the ovaries and pelvic cavity. It can lead to infertility, ectopic pregnancy, and chronic pelvic pain.
- Genital warts, caused by the human papillomavirus (HPV), are associated with cervical cancer. Treatment does not eradicate the virus, but vaccines are available.
- Genital herpes is a common incurable viral infection characterized by outbreaks of lesions and periods of latency.
- Hepatitis B is a viral infection of the liver transmitted through sexual and nonsexual contact. Some people become chronic carriers of the virus and may develop serious, potentially fatal, complications.
- Syphilis is a highly contagious bacterial infection that can be treated with antibiotics. If left untreated, it can lead to deterioration of the central nervous system and death.
- Other common STIs include trichomoniasis, bacterial vaginosis, lymphogranuloma venereum, and pubic lice and scabies.
- Successful diagnosis and treatment of STIs involves being alert for symptoms, getting tested, informing partners, and following treatment instructions.
- All STIs are preventable; the key is practicing responsible sexual behaviors.

FOR FURTHER Exploration

American College Health Association. Offers free brochures on STIs, alcohol use, acquaintance rape, and other health issues.
http://www.acha.org/Topics/sexualhith.htm

American Sexual Health Association (ASHA). Provides information and referrals on STIs; sponsors support groups for people with herpes and HPV.
http://www.ashsexualhealth.org/

The Body: The Complete HIV/AIDS Resource. Provides information about prevention, testing, and treatment, and includes an online risk assessment.
http://www.thebody.com

CDC National Prevention Information Network. Provides extensive information and links on AIDS and other STIs.
http://www.cdcnpin.org

CDC National STI and AIDS Hotlines. Callers can obtain information, counseling, and referrals for testing and treatment. The hotlines offer information on more than 20 STIs and include Spanish and TTY service.
800-344-AIDS or 800-227-8922; 800-344-SIDA (Spanish)
800-243-7889 (TTY, deaf access)

HIV InSite: Gateway to AIDS Knowledge. Provides information about prevention, education, treatment, statistics, clinical trials, and new developments.
http://hivinsite.ucsf.edu

http://www.unaids.org

MedlinePlus: Sexually Transmitted Diseases. Maintained by the CDC; a clearinghouse of links and information on STIs and other sexual health topics.

Planned Parenthood Federation of America. Provides information on STIs, family planning, and contraception.
http://www.plannedparenthood.org

Smarter Sex. Designed for college students; provides tips and information on safer sex practices, relationships, STIs, and more.
http://smartersex.org/index.asp

SELECTED BIBLIOGRAPHY

Q Why do young people, including college students, have high rates of STIs?

A Half of all STI cases in the United States are accounted for by young people. Contributing factors may include the following:

- **College students underestimate their risk of STIs and HIV.** Although students may know about STIs, they often believe the risks do not apply to them. One study of students with a history of STIs showed that more than half had unprotected sex while they were infected, and 25% of them continued to have sex without ever informing their partner(s).

- **Risky sexual behavior is common.** One study of college students found that fewer than half used condoms consistently and one-third had had 10 or more sex partners. Another study found that 19% of male students and 33% of female students had consented to sexual intercourse simply because they felt awkward refusing. Nearly half of young adults are sexually active by age 18 (more than 95% by age 25), but they are not yet in long-term monogamous relationships; they are more likely to have more than one partner over time and to have a partner with an STI.

- **Alcohol and drug use play an important role.** Between one-third and one-half of college students report participating in sexual activity as a direct result of being intoxicated. Students who binge drink are more likely to have multiple partners, use condoms inconsistently, and delay seeking treatment for STIs than students who drink little or no alcohol. Sexual assaults occur more frequently when either the perpetrator or the victim has been drinking. A 2013 study corroborated that both frequent drinking and binge drinking were associated with risky sexual behavior among individuals with HIV, especially women and gay or bisexual men.

Q Does the success of the new AIDS drugs mean that I don’t need to worry about HIV infection anymore?

A No. The new combination drug therapy has had dramatic effects for some people infected with HIV. In the United States, the number of HIV-infected people who progress to AIDS each year is declining, as is the death rate from AIDS. But the new drugs are expensive, can have serious side effects, and are not effective for everyone. Scientists do not yet know how long the drugs will keep HIV at bay, and no treatment has yet been shown to permanently eradicate HIV from the body. AIDS is still an incurable, fatal disease.

Q Why are women hit harder by STIs than men?

A Sexually transmitted infections cause suffering for all who are infected, but in many ways, women and girls are the hardest hit, for both biological and social reasons:

- **Male-to-female transmission of many infections is more likely to occur than female-to-male transmission.** This is particularly true of HIV.

- **Young women are even more vulnerable to STIs than older women because the less-mature cervix is more susceptible to injury and infection.** As a woman ages, the cells at the opening of the cervix gradually change so that the tissue becomes more resistant to infection. Young women are also more vulnerable for social and emotional reasons: Lack of control in relationships, fear of discussing condom use, and having an older sex partner are all linked to increased STI risk.

- **Once infected, women tend to suffer more consequences of STIs than men.** For example, gonorrhea and chlamydia can cause PID and permanent damage to the oviducts in women, while these infections tend to have less serious effects in men. HPV infection causes nearly all cases of cervical cancer. HPV infection is also associated with penile cancer in men, but penile cancer is much less common than cervical cancer. Women also have the added concern of the potential effects of STIs during pregnancy.

- **Women with HIV infection often face greater challenges when they are ill.** Women may become sicker at lower viral loads compared to men. Women and men with HIV do about as well if they have similar access to treatment, but in many cases women are diagnosed later in the course of HIV infection, receive less treatment, and die sooner. In addition, they may be caring for family members who are also infected and ill. The proportion of new AIDS cases in women is increasing both in the United States and globally.

- **Worldwide, social and economic factors play a large role in the transmission and consequences of AIDS and other STIs for women.** Practices such as very early marriage for women, often to much older men who have had many sexual partners, place women at risk for infection. Cultural gender norms that promote premartial and extramarital relationships for men, combined with women’s lack of power to negotiate safe sex, make infection a risk even for women who are married and monogamous. In some parts of the world, the stigma of AIDS hits women harder. In addition, lack of education and limited economic opportunities can force women into commercial sex work, placing them at high risk for all STIs. Solutions to the STI crisis in women include greater access to health care as well as empowerment in the social sphere.
LAB 14.1 Behaviors and Attitudes Related to STIs

Part I Risk Assessment

To identify your risk factors for STIs, read the following list of statements and mark whether they’re true or false for you. Note: The statements in this assessment are worded in a way that assumes current sexual activity. If you have never been sexually active, you are not now at risk for STIs. Respond to the statements in the quiz based on how you realistically believe you would act. If you are currently in a mutually monogamous relationship with an uninfected partner or are not currently sexually active (but have been in the past), you are at low risk for STIs at this time. Respond to the statements in the quiz according to your attitudes and past behaviors. (For more on your risk factors for STIs, take the online assessment available at www.thebody.com.)

<table>
<thead>
<tr>
<th>True</th>
<th>False</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1. I have only one sex partner.</td>
</tr>
<tr>
<td></td>
<td>2. I always use a latex condom for each act of intercourse, even if I am fairly certain my partner has no infections.</td>
</tr>
<tr>
<td></td>
<td>3. I do not use oil-based lubricants with condoms.</td>
</tr>
<tr>
<td></td>
<td>4. I discuss STIs and prevention with new partners before having sex.</td>
</tr>
<tr>
<td></td>
<td>5. I do not use alcohol or another mood-altering drug in sexual situations.</td>
</tr>
<tr>
<td></td>
<td>6. I would tell my partner if I thought I had been exposed to an STI.</td>
</tr>
<tr>
<td></td>
<td>7. I am familiar with the signs and symptoms of STIs.</td>
</tr>
<tr>
<td></td>
<td>8. I regularly perform genital self-examination to check for signs and symptoms of STIs.</td>
</tr>
<tr>
<td></td>
<td>9. When I notice any sign or symptom of any STI, I consult my physician immediately.</td>
</tr>
<tr>
<td></td>
<td>10. I have been tested for HIV or plan to be tested at my next routine medical exam.</td>
</tr>
<tr>
<td></td>
<td>11. I obtain screenings for STIs regularly. In addition (if female), I obtain recommended pelvic exams and Pap tests.</td>
</tr>
<tr>
<td></td>
<td>12. I have been vaccinated for hepatitis B and, if recommended for my age, for HPV.</td>
</tr>
<tr>
<td></td>
<td>13. When diagnosed with an STI, I inform all recent partners.</td>
</tr>
<tr>
<td></td>
<td>14. When I have a sign or symptom of an STI that goes away on its own, I still consult my physician.</td>
</tr>
<tr>
<td></td>
<td>15. I do not use drugs prescribed for friends or partners or left over from other illnesses to treat STIs.</td>
</tr>
<tr>
<td></td>
<td>16. I do not share syringes or needles to inject drugs.</td>
</tr>
</tbody>
</table>

Using Your Results

How did you score? False responses indicate attitudes and behaviors that may put you at risk for contracting STIs or for suffering serious medical consequences from them. How many false responses did you give? Are you satisfied that you’re doing everything you can to protect yourself from STIs?

What should you do next? Any false response indicates a factor that you could change to reduce your risk for STIs. Choose one as the focus of a behavior change program.
LABORATORY ACTIVITIES

Part II Communication

Good communication with sex partners or potential sex partners is a critical component of STI prevention. Regardless of your responses to the risk assessment, complete this communication exercise to help build your communication skills.

1. List three ways to bring up the subject of STIs with a new partner. How would you ask whether he or she has been exposed to any STIs or engaged in any risky behaviors? (Remember that because many STIs can be asymptomatic it is important to know about past behaviors even if no STI was diagnosed.)
   
   a. __________________________________________

   b. __________________________________________

   c. __________________________________________

2. List three ways to bring up the subject of condom use with your partner. How might you convince someone who does not want to use a condom?
   
   a. __________________________________________

   b. __________________________________________

   c. __________________________________________

3. If you have had an STI in the past that you might possibly still pass on (e.g., herpes, genital warts), how would you tell your partner(s)?

   __________________________________________

   __________________________________________

4. If you were diagnosed with an STI that you believe was given to you by your current partner, how would you begin a discussion of STIs with her or him?

   __________________________________________

   __________________________________________
LOOKING AHEAD...

After reading this chapter, you should be able to

- Explain how population growth affects the earth’s environment and contributes to pollution and climate change.
- Discuss the causes and effects of air and water pollution, and describe strategies that people can take to protect these resources.
- Discuss the issue of solid waste disposal and the impact it has on the environment and human health.
- Identify some key sources of chemical and radiation pollution, and discuss methods for preventing such pollution.
- Explain how energy use affects the environment, and describe steps everyone can take to use energy more efficiently.

TEST YOUR KNOWLEDGE

1. The world’s current population is approximately
   a. 7.3 billion
   b. 73 billion
   c. 730 billion
   
2. Air pollution can be naturally occurring, as well as human made. True or false?

3. Light-emitting diode (LED) bulbs can last 40 times longer than standard incandescent lightbulbs. True or false?

See answers on the next page.
We are constantly reminded of our intimate relationship with everything that surrounds us—our **environment**. Although the planet provides us with food, water, air, and everything else that sustains life, it also provides us with natural occurrences—earthquakes, tsunamis, hurricanes, drought, climate changes—that destroy life and disrupt society. Humans have always had to struggle against the environment to survive. Today, in addition to dealing with natural disasters, we also have to find ways to protect the environment from the by-products of our way of life.

This chapter introduces the concept of environmental health and explains how the environment affects us. The chapter also discusses the ways humans affect the planet and its resources, and it describes steps you can take to improve your personal environmental health while reducing your impact on the earth.

**ENVIRONMENTAL HEALTH DEFINED**

The field of **environmental health** grew out of efforts to control communicable diseases. When certain insects and rodents were found to carry microorganisms that cause disease in humans, campaigns were undertaken to eradicate or control these animal vectors. It was also recognized that pathogens (i.e., microorganisms that can produce diseases) could be transmitted in sewage, drinking water, and food. These discoveries led to systematic garbage collection, sewage treatment, filtration and chlorination of drinking water, food inspection, and the establishment of public health enforcement agencies.

These efforts to control and prevent communicable diseases changed the health profile of the industrialized world. Americans rarely contract cholera, typhoid fever, plague, diphtheria, or other diseases that once killed large numbers of people, but these diseases have not been eradicated worldwide.

In the United States, a huge, complex public health system is constantly at work behind the scenes attending to the details of these critical health concerns. Every time the system is disrupted, danger recurs. After any disaster that damages a community’s public health system—whether a natural disaster such as a hurricane or a human-made disaster such as a terrorist attack—prompt restoration of basic health services becomes crucial to human survival. Every time we venture beyond the boundaries of our everyday world, whether traveling to a poorer country or camping in a wilderness area, we are reminded of the importance of these basics: clean water, sanitary waste disposal, safe food, and insect and rodent control.

**Wellness Tip**

Natural disasters—such as the 2015 earthquake in Nepal—can directly kill thousands of people while wiping out essential services, polluting water, and facilitating the spread of disease. Visit [www.ready.gov](http://www.ready.gov) to find out more about how to prepare for an emergency in your area, including putting together a kit of basic disaster supplies.

Over the past few decades, the focus of environmental health has expanded and become more complex, for several reasons. We now recognize that environmental pollutants contribute not only to infectious diseases and immediate symptoms but to many chronic diseases as well. In addition, technological advances have increased our ability to affect and damage the environment. Further, rapid population growth (more than doubling in the past 50 years), which has resulted partly from past environmental improvements, means that ever more people are consuming and competing for resources, increasing human environmental impact.

**Answers (Test Your Knowledge)**

1. **b.** The world’s current population is about 7.3 billion, and it is expected to reach 9.6 billion by 2050.
2. **True.** There are many types of naturally occurring air pollution, such as smoke from forest fires and dust from dust storms.
3. **True.** LED bulbs use 10% as much energy as and last up to 42 times longer than regular lightbulbs.

**TERMS**

**environment** The natural and human-made surroundings in which we spend our lives.

**environmental health** The collective interactions of humans with the environment and the short-term and long-term health consequences of those interactions.
The world’s population, currently about 7.3 billion, is increasing at a rate of about 75 million per year—approximately 150 people every minute. The United Nations projects that world population will reach 9.6 billion by 2050.

The average number of children per woman fell from 5 in 1950 to half that (2.6) in 2010. This decline in fertility began in Western countries decades ago and is now also happening in poor countries. In Sub-Saharan Africa, Asia, and Latin America, women with more education have fewer children; these regions nevertheless contribute the most to population growth. Changes are also projected for the world’s age distribution: For the first time in history, there are more older people than young children. During the second half of the 21st century, the number of older persons (aged 60 years or more) will increase to almost 3 billion, while the number of children will decrease to 1.94 billion.

This rapid expansion of population, particularly in the past 50 years, is generally believed to be responsible for most of the stress humans put on the environment. A large and rapidly growing population makes it more difficult to provide the basic components of environmental health discussed earlier, including clean and disease-free food and water. It is also a driving force behind many of the relatively more recent environmental health concerns, including chemical pollution, global warming, and the thinning of the atmosphere’s ozone layer.

How Many People Can the World Hold?

No one knows how many people the world can support, but most scientists agree that there is a limit. A 2011 report from the United Nations’ Convention on Biological Diversity states that the population’s demand for resources already exceeds the...
CHECKING YOUR ENVIRONMENTAL "FOOTPRINT"

Environmental health may seem like a global challenge, but each person has a unique impact on our planet’s health. In fact, there are ways to measure the environmental impact of your individual lifestyle.


Go online and take one or all of these quizzes, and compare your results with the results of your classmates. Then identify ways you can reduce the size of your ecological and carbon footprints, both as an individual and as a class.

earth’s capacity by 20%. The primary factors that may eventually put a cap on human population are the following:

- **Food:** Enough food is currently produced to feed the world’s entire population, but economic and sociopolitical factors have led to food shortages and famine. Food production can be expanded in the future, but better distribution of food will be needed to prevent even more widespread famine as the world’s population keeps growing. For all people to receive adequate nutrition, the makeup of the world’s diet may also need to change. A current controversy is the use of “golden rice,” a crop genetically modified to contain vitamin A and provide extra nutrition to economically emerging countries. Although many oppose the use of genetically modified organisms (GMOs), others believe that GMOs can help solve the food crisis.

- **Available land and water:** Rural populations rely on local trees, soil, and water for their direct sustenance, and a growing population puts a strain on these resources. Forests are cut for wood, soil is depleted, and water is withdrawn at ever-increasing rates. These trends contribute to local hardships and to many global environmental problems, including habitat destruction and species extinction.

- **Energy:** Currently, most of the world’s energy comes from nonrenewable sources: oil, coal, natural gas, and nuclear power. As these sources are depleted, the world will have to shift to renewable (sustainable) energy sources, such as hydropower and solar, geothermal, wind, biomass, and ocean power. Supporting a growing population, maintaining economic productivity, and stemming environmental degradation will require both greater energy efficiency and an increased use of renewable energy sources.

- **Minimum acceptable standard of living:** The mass media have exposed the entire world to the American lifestyle and raised people’s expectations of living at a comparable level. But such a lifestyle is supported by levels of energy consumption that the earth cannot support indefinitely. The United States has about 5% of the world’s population but uses 18% of the world’s energy. In contrast, India has 18% of the population but uses only 5% of the energy. China’s energy consumption is rapidly increasing, and that nation accounts for 19% of the world’s population. If all people are to enjoy a minimally acceptable standard of living, the population must be limited to a number that available resources can support.

**Factors That Contribute to Population Growth**

Although it is apparent that population growth must be controlled, population trends are difficult to influence and manage. A variety of interconnecting factors fuel the current population explosion:

- **High birth rates:** The combination of poverty, high child mortality rates, and a lack of social provisions of every type is associated with high birth rates in the developing world. Families have many children to ensure that enough survive childhood to work for the household and to care for parents in old age. Most countries, whether economically emerging or stable, have experienced significant reductions in birth rates as contraceptive use has increased. However, the majority of economically emerging countries still have fertility levels that ensure substantial population growth. In a small number of countries, most of which are classified as poorest, birth rate continues to be very high.

- **Lack of family planning resources:** Half the world’s couples don’t use any form of family planning or contraceptives.

- **Lower death rates:** Although death rates remain relatively high in the developing world, they have decreased in recent years because of public health measures and improved medical care.
Changes in any of these factors can affect population growth, but the issues are complex. Increasing death rates through disease, famine, or war might slow population growth, but few people would argue in favor of these as methods of population control. Although the increased availability of family planning services is a crucial part of population management, cultural, political, and religious factors also need to be considered. To be successful, population management policies must change the condition of people’s lives, especially poverty, to remove the pressures to have large families. Research indicates that the combination of improved health, better education, and increased literacy and employment opportunities for women works together with family planning to decrease fertility rates.

**AIR QUALITY AND POLLUTION**

Air pollution is not a human invention or even a new problem. The air is polluted naturally with every forest fire, pollen bloom, and dust storm, as well as with countless other natural pollutants. To these natural sources, humans have always contributed the by-products of our activities.

Air pollution is linked to a wide range of health problems, and the very young and the elderly are among the most susceptible to air pollution’s effects. For people with chronic ailments such as diabetes or heart failure, even relatively brief exposure to particulate air pollution increases the risk of death by nearly 40%. Recent studies have linked exposure to air pollution to reduced birth weight, reduced lung capacity in teens, and atherosclerosis (thickening of the arteries) in adults.

**Air Quality and Smog**

The U.S. Environmental Protection Agency (EPA) uses a measure called the **Air Quality Index (AQI)** to indicate whether air pollution levels pose a health concern. The AQI is used for five major air pollutants:

- **Carbon monoxide (CO)**: An odorless, colorless gas, CO forms when the carbon in fossil fuels does not completely burn. The primary sources of CO are vehicle exhaust and fuel combustion in industrial processes. CO binds to blood cells in place of oxygen, depriving the body of oxygen, causing headaches, fatigue, and impaired vision and judgment. It also aggravates cardiovascular diseases.

- **Sulfur dioxide (SO₂)**: SO₂ is produced by the burning of sulfur-containing fuels such as coal and oil, during metal smelting, and by other industrial processes; power plants are a major source. In humans, SO₂ narrows the airways, which may cause wheezing, chest tightness, and shortness of breath, particularly in people with asthma. SO₂ may also aggravate symptoms of CVD.

- **Nitrogen dioxide (NO₂)**: NO₂ is a reddish-brown, highly reactive gas formed when nitric oxide combines with oxygen in the atmosphere; major sources include motor vehicles and power plants. In people with respiratory diseases such as asthma, NO₂ affects lung function and causes symptoms such as wheezing and shortness of breath. NO₂ exposure may also increase the risk of respiratory infections.

- **Particulate matter (PM)**: Particles of different sizes are released into the atmosphere from a variety of sources, including combustion of fossil fuels, crushing or grinding operations, industrial processes, and dust from roadways. PM can accumulate in the respiratory system, aggravate cardiovascular and lung diseases, and increase the risk of respiratory infections.

- **Ground-level ozone**: At ground level, ozone is a harmful pollutant. Where it occurs naturally in the upper atmosphere, it shields the earth from the sun’s harmful ultraviolet rays. (The health hazards from the thinning of this protective ozone layer are discussed later in the chapter.) Ground-level ozone is formed when pollutants emitted by cars, power plants, industrial plants, and other sources react chemically in the presence of sunlight (photochemical reactions). Ozone can irritate the respiratory system, reduce lung function, aggravate asthma, increase susceptibility to respiratory infections, and damage the lining of the lungs. Short-term elevations of ozone levels have also been linked to increased death rates.

AQI values run from 0 to 500; the higher the AQI, the greater the level of pollution and associated health danger. When the AQI exceeds 100, air quality is considered unhealthy, at first for certain sensitive groups of people and then for everyone as AQI values get higher. For local areas, AQI values are calculated for each of the five pollutants listed above, and the highest value becomes the AQI rating for that day. Depending on the AQI value, local officials may issue precautionary health advice. Local AQI information is often available in newspapers, on television and radio, from state and local telephone hotlines, and from airnow.gov.

The term **smog** was first used in the early 1900s in London to describe the combination of smoke and fog. What we typically call smog today is a mixture of pollutants, with ground-level ozone being the key ingredient. Major smog occurrences are linked to the combination of several factors: Heavy motor vehicle traffic, high temperatures, and sunny weather can increase the production of ozone. Pollutants are also more likely to build up in areas with little wind and/or where a topographic feature such as a mountain range or valley prevents the wind from pushing out stagnant air.

**The Greenhouse Effect and Global Warming**

The temperature of the earth’s atmosphere depends on the balance between the amount of energy the planet absorbs from the sun (mainly as high-energy ultraviolet radiation) and the amount of energy radiated back into space as lower-energy infrared radiation. Key components of temperature regulation...
are carbon dioxide, water vapor, methane, and other greenhouse gases—so named because, like the glass panes in a greenhouse, they let through visible light from the sun but trap some of the resulting infrared radiation and reradiate it back to the earth’s surface. This reradiation causes a buildup of heat that raises the temperature of the lower atmosphere, a natural process known as the greenhouse effect. Without it, the atmosphere would be far cooler and much more hostile to life.

There is scientific consensus that human activity is causing global warming, or climate change. The concentration of greenhouse gases is increasing because of human activity, especially the combustion of fossil fuels and emissions from agricultural production (Table 15.1). Carbon dioxide levels in the atmosphere have increased rapidly in recent decades. The use of fossil fuels pumps more than 20 billion tons of carbon dioxide into the atmosphere every year. Experts believe carbon dioxide may account for about 60% of the greenhouse effect. Analysis of ice core samples shows that carbon dioxide levels are now about 25% higher than at any other time in the past 650,000 years. The United States is responsible for one-third of the world’s total emissions of carbon dioxide. Deforestation, often by burning, also sends carbon dioxide into the atmosphere and reduces the number of trees available to convert carbon dioxide into oxygen.

To date, 2014 was the warmest year on record since record keeping began in 1880. The global temperature has risen more than 1.4 degrees Fahrenheit in the past century. There is agreement among scientists that temperatures will continue to rise, although estimates vary as to how much they will change. If global warming persists, experts say the impact may be devastating (Figure 15.2). Possible consequences include the following:

- Increased rainfall and flooding in some regions, increased drought in others. Coastal zones, where half the world’s people live, would be severely affected.
- Increased mortality from heat stress, urban air pollution, and tropical diseases. Deaths from weather events such as hurricanes, tornadoes, droughts, and floods might also increase.

<table>
<thead>
<tr>
<th>Table 15.1</th>
<th>Sources of Greenhouse Gases</th>
</tr>
</thead>
<tbody>
<tr>
<td>GREENHOUSE GAS</td>
<td>SOURCES</td>
</tr>
<tr>
<td>Carbon dioxide</td>
<td>Fossil fuel and word burning, factory emissions, car exhaust, deforestation</td>
</tr>
<tr>
<td>Chlorofluorocarbons (CFCs)</td>
<td>Refrigeration and air conditioning, aerosols, foam products, solvents</td>
</tr>
<tr>
<td>Methane</td>
<td>Cattle, wetlands, rice paddies, landfills, gas leaks, coal and gas industries</td>
</tr>
<tr>
<td>Nitrous oxide</td>
<td>Fertilizers, soil cultivation, deforestation, animal feedlots and wastes</td>
</tr>
<tr>
<td>Ozone and other trace gases</td>
<td>Photochemical reactions, car exhaust, power plant emissions, solvents</td>
</tr>
</tbody>
</table>

Fitness Tip Smog tends to form over cities because of geographical features and because of the tremendous amount of motor vehicle exhaust in the air. Exercising in polluted outdoor air can actually reduce lung function, at least temporarily. When the air quality outside is bad, exercise indoors.
A poleward shift of about 50–350 miles (150–550 km) in the location of vegetation zones, affecting crop yields, irrigation demands, and forest productivity.

Alterations of ecosystems, resulting in possible species extinction.

Increasingly rapid and drastic melting of the earth’s polar ice caps. Arctic ice melts to some extent during the summer each year, but melting has increased by 20 percent since 1979. Extensive melting could mean increased flooding in the Northern Hemisphere, further changes in weather patterns, and the elimination of habitat for species that live in the Arctic.

According to estimates from the Environmental Protection Agency (EPA), the earth’s average surface temperature is likely to increase 4.0–8.0°F (7.2–14.4°C) by the end of the twenty-first century. Warming will not be evenly distributed around the globe. Land areas will warm more than oceans in part due to water’s ability to store heat. High latitudes will warm more than low ones in part due to the effects of melting ice. Most of North America, all of Africa, Europe, Northern and Central Asia, and most of Central and South America are likely to warm more than the global average.

At the September 2014 United Nations Climate Summit, some groups endorsed the current scientific consensus that keeping the increase in global temperature below 2 degrees Celsius is necessary to stave off the worst effects of climate change. Although this conference did not end with a binding agreement among the world’s nations, the parties did pledge to reduce greenhouse gas emissions.

Increasing research on climate change has revealed that significant amounts of greenhouse gases come from sources other than manufacturing industries. The United Nations has reported, for example, that raising cattle produces more greenhouse gases than driving cars.

**Thinning of the Ozone Layer**

Another air pollution problem is the thinning of the ozone layer of the atmosphere, a fragile, invisible layer about 10–30 miles above the earth’s surface that shields the planet from the sun’s hazardous ultraviolet (UV) rays. Since the mid-1980s, scientists have observed the seasonal appearance and growth of a hole in the ozone layer over Antarctica. More recently, thinning over other areas has been noted.

The ozone layer is being destroyed primarily by chlorofluorocarbons (CFCs), industrial chemicals used as coolants in refrigerators and air conditioners, as foaming agents in some rigid foam products, as propellants in some kinds of aerosol sprays (most of which were banned in 1978), and as solvents. When CFCs rise into the atmosphere, winds carry them toward the polar regions. During winter, circular winds form a vortex that keeps the air over Antarctica from mixing with air from elsewhere. CFCs react with airborne ice crystals, releasing chlorine atoms, which destroy ozone. When the polar vortex weakens in the summer, winds richer in ozone from the north replenish the lost Antarctic ozone.

The largest and deepest ozone hole on record, measured at 11.5 million square miles (29.9 million square kilometers),...
occurred on September 6, 2000. In 2014, the maximum size of the ozone hole was 9.3 million square miles (24.1 million square kilometers), or the area of the United States, Canada, and Mexico combined. The Antarctic ozone layer likely will not return to its early 1980s state until about 2040, because of the long lifetimes of ozone-depleting substances in the atmosphere. Because of an international agreement that regulates the production of ozone-depleting chemicals, overall atmospheric ozone is no longer decreasing. The gradual recovery is masked by annual variations caused by weather fluctuations over Antarctica.

Without the ozone layer to absorb the sun’s UV radiation, life on Earth would be impossible. (UV radiation levels under the Antarctic hole were high enough to cause sunburn within 7 minutes.) The potential effects of increased long-term exposure to UV light for humans include skin cancer, wrinkling and aging of the skin, cataracts and blindness, and reduced immune response. The United Nations Environment Programme predicts that a drop of 10% in overall ozone levels would cause a 26% rise in the incidence of nonmelanoma skin cancers. Some scientists blame ozone loss for many cases of melanoma.

UV light may interfere with photosynthesis and cause lower crop yields; it may also kill phytoplankton and krill, the basis of the ocean food chain. And because heat generated by the absorption of UV rays in the ozone layer helps create stratospheric winds, the driving force behind weather patterns, a drop in the concentration of ozone could potentially alter the earth’s climate systems.

**Energy Use and Air Pollution**

In 2009, China passed the United States as the top energy user in the world. However, Americans are much greater users of energy on a per-capita basis, with the average American using five times more energy than the average Chinese citizen. We use energy to create electricity, transport us, power our industries, and run our homes. About 83% of the energy we use comes from fossil fuels—oil, coal, and natural gas. The remainder comes from nuclear power and renewable energy sources such as hydroelectric, wind, and solar power.

Energy consumption is at the root of many environmental problems, especially those relating to air pollution. Automobile exhaust and the burning of oil and coal by industry and by electric power plants are primary causes of smog, acid precipitation, and the greenhouse effect. The mining of coal and the extraction and transportation of oil cause pollution on land and in the water; the 2010 oil spill in the Gulf of Mexico was the worst environmental disaster in American history and one of the largest oil spills ever to occur. Nuclear power generation creates hazardous wastes and carries the risk of dangerous releases of radiation.

Two key strategies for controlling energy use are conservation and the development of nonpolluting, renewable sources of energy. Although the use of renewable energy sources has increased in recent years, renewables still supply only a small proportion of our energy, in part because of their cost. Some countries have chosen to promote energy efficiency by removing subsidies or adding taxes on the use of fossil fuels. This strategy is reflected in the varying prices drivers pay for gasoline. For example, drivers in France, Germany, and England pay more than twice per gallon than drivers in the United States, where more than 70% of commuters drive alone to work, and low fuel-economy sport utility vehicles (SUVs) remain popular. The largest SUVs increase greenhouse gas emissions by six or more tons per year more than an average car.

**Alternative Fuels** The U.S. Department of Energy (DOE) is encouraging researchers and automobile manufacturers to produce vehicles that can handle alternative fuels such as ethanol. Ethanol, a form of alcohol, is a renewable fuel produced from fermenting plant sugars in corn, sugarcane, and other starchy agricultural products. Ethanol use reduces the amount of imported oil required to produce gasoline, reduces overall greenhouse gas emissions from automobiles, and supports the U.S. agricultural industry.

Another type of alternative fuel is E85, which is a mixture of 85% ethanol and 15% gasoline. E85 is becoming more popular in the Midwest region (the “corn belt”) of the United States. E85 provides lower mileage than gasoline, though it typically costs the same as regular gasoline. Ethanol has been mixed with gasoline for years in the United States, but several other countries (such as Brazil) use ethanol much more extensively.

Ethanol, however, has its critics, who say the alternative fuel may do more harm than good. For one thing, some reports show that corn-based ethanol requires more energy to produce than it yields when burned as fuel. Other reports dispute this point, and improvements in manufacturing processes may reduce the amount of energy required to make the fuel. Regardless, ethanol made from sugarcane and other plant matter may be far more energy-efficient, say some experts.

One huge potential drawback of ethanol is the diversion of corn crops from the food supply to produce the fuel. Food-related concerns prompted the United Nations to call for a moratorium on food-based ethanol production until nonfood sources of alternative fuels could be developed.

**Wellness Tip** Your transportation choices can help reduce air pollution. Bike, walk, or use public transportation whenever possible; public transit may provide a choice of vehicles, including hybrid and electric options. When selecting your own vehicle, research your choices at fueleconomy.gov.
Another alternative fuel is biodiesel, a fuel made primarily from vegetable oils, fats, or greases. It is the fastest-growing alternative fuel in the United States, is biodegradable, and produces lower levels of air pollutants than petroleum-based products. Biodiesel, like ethanol, can be problematic depending on its material source. If it is produced from waste animal fat and grease or as a by-product of other agricultural processes, it can be carbon-neutral. But in some parts of the world, natural vegetation and forests have been cleared and burned to grow soybeans and palm oil trees to make biodiesel, and these negative environmental and social effects can outweigh any benefit.

**Hybrid and Electric Vehicles** Hybrid vehicles use two or more distinct power sources to propel the vehicle, such as an on-board energy storage system (batteries, for example) and an internal combustion engine and electric motor. The hybrid vehicle typically realizes greater fuel economy than a conventional car does and produces fewer pollutants. Hybrids also tend to run with less noise than conventional vehicles. Several hybrid models are currently available in the United States, but they typically cost several thousand dollars more than their conventional gas-powered counterparts. Still, hybrids are gaining popularity with consumers and are being more commonly used in both corporate and government vehicle fleets.

Researchers hope that hybrid technology can be extended to all classes of vehicles and that Americans can be convinced to use more fuel-efficient vehicles and to travel more frequently on public transportation, in carpools, or on foot.

Another type of alternative vehicle is all-electric. In these vehicles, electricity is stored in battery packs and then converted into mechanical power that runs the vehicle. After a given number of miles, the batteries must be recharged. These vehicles do not produce tailpipe emissions, but generators that produce the electricity do emit pollutants. All-electric vehicles are gaining credibility and popularity. A new generation of all-electric vehicles has recently been introduced to consumer markets, taking advantage of better battery storage performance, “quick-charging station” infrastructure, and changing consumer perceptions of trip use and distance. Researchers hope that hybrid and battery technologies can be extended to all classes of vehicles.

**Indoor Air Pollution**

Although most people associate air pollution with the outdoors, your home may also harbor potentially dangerous pollutants. Some of these compounds trigger allergic responses, and others have been linked to cancer. Common indoor pollutants include the following:

- **Environmental tobacco smoke (ETS)**, a human carcinogen that also increases the risk of asthma, bronchitis, and cardiovascular disease. Many states and cities have passed legislation known as Clean Indoor Air Acts, which state that any enclosed, indoor areas used by the public shall be smoke-free except for certain designated areas.

- **Carbon monoxide and other combustion by-products**, which can cause chronic bronchitis, headaches, dizziness, nausea, fatigue, and even death. Common sources in the home are woodstoves, fireplaces, kerosene heaters and lamps, and gas ranges. In poverty-stricken areas, especially in Asia and Africa, people commonly burn solid fuels like coal for cooking and heating their homes. The World Health Organization (WHO) says the smoke and by-products from these indoor fires kill about 1.5 million people annually—mostly children. Solid fuels are the primary heating source for about 6.5 million Americans.

- **Formaldehyde gas**, which can cause eye, nose, and throat irritation; shortness of breath; headaches; nausea; lethargy; and, over the long term, cancer. This gas can seep from certain construction materials, paints, floor finishes, permanent press clothing, and nail polish.

- **Biological pollutants**, including bacteria, dust mites, mold, and animal dander, which can cause allergic reactions and other health problems. These allergens are typically found in bathrooms, damp or flooded basements, humidifiers, air conditioners, and even some carpets and furniture.

- **Indoor mold**, the fuzzy black substance growing on shower tiles and damp basement walls, is an indoor pollutant not to be taken lightly. More than 100 common indoor molds have been classified as potentially hazardous to people, but only a few are serious threats to human health. One of the most common of these is *Stachybotrys* mold, commonly known as “toxic black mold.” It is greenish black in color and appears slimy when wet. Toxic mold spores permeate the air and can cause health problems when inhaled, especially for people with asthma and other respiratory conditions.

**Preventing Air Pollution**

You can do a great deal to reduce air pollution. Here are a few ideas:

- **Cut back on driving.** Ride your bike, walk, use public transportation, or carpool in a fuel-efficient vehicle. When carbon monoxide, nitrogen dioxide, and particulate matter pollution were reduced in Los Angeles County, the number of hospitalizations for asthma decreased.

- **Keep your car tuned and well maintained.** Keep your tires inflated at recommended pressures. To save energy when driving, avoid quick starts, stay within the speed limit, limit the use of air conditioning, and don’t let your car idle unless absolutely necessary. Have your car’s air conditioner checked and serviced by a station that uses environmentally friendly refrigerants; the most commonly used refrigerant is a potent greenhouse gas, but more climate-friendly compounds have recently become available. Turn off the engine when you are parked or when you run into a store for a quick errand.
Water Contamination and Treatment

Many cities rely at least in part on wells that tap local groundwater, but often it is necessary to tap lakes and rivers to supplement wells. Because such surface water is more likely to be contaminated with both organic matter and pathogenic microorganisms, it is purified in water treatment plants before being piped into the community. At treatment facilities, the water is subjected to various physical and chemical processes, including screening, filtration, and disinfection (often with chlorine), before it is introduced into the water supply system. Fluoridation, a water-treatment process that reduces tooth decay by 15–40%, has been used successfully in the United States for more than 60 years.

In most areas of the United States, water systems have adequate, dependable supplies, are able to control waterborne disease, and provide water without unacceptable color, odor, or taste. However, problems do occur. In 1993, more than 400,000 people became ill and 100 died when Milwaukee’s drinking water was contaminated with the bacterium Cryptosporidium. The Centers for Disease Control and Prevention (CDC) estimate that 1 million Americans become ill and 900–1,000 die each year from microbial illnesses from drinking water. Pollution by hazardous chemicals from manufacturing, agriculture, and household wastes is another concern. (Chemical pollution is discussed later in the chapter.) Worldwide, 1.6 million people, mostly children, die from water-related diseases each year.

Water Shortages

Water shortages are a growing concern in many regions of the world. Some parts of the United States are experiencing a combination of severe drought and rapid population growth that outstrips the ability of local systems to provide adequate water to all. Many proposals are being discussed to relieve these shortages, including long-distance transfers; conservation; the recycling of some water, such as the water in office-building air conditioners; and the sale of water by regions with large supplies to areas with less available water.

According to the World Health Organization (WHO), as of 2015, 663 million people do not have safe drinking water and 2.4 billion do not have access to basic sanitation. Less than 1% of the world’s fresh water—about 0.007% of all the water on Earth—is readily accessible for direct human use.

Groundwater pumping and the diversion of water from lakes and rivers for irrigation are further reducing the amount of water available to local communities. In some areas, groundwater is being removed at twice the rate at which it is replaced. Due to agricultural diversions, the Yellow River ran dry for the first time in China’s 3,000-year history in 1972, failing to reach the sea for 15 days that year; now, the dry period extends for more than half of each year. In the United States, the Colorado River is now diverted to the extent that it no longer flows into the ocean.

Sewage

Prior to the mid-nineteenth century, many people contracted diseases such as typhoid, cholera, and hepatitis A by direct contact with human feces, which were disposed of at random. After the links between sewage and disease were discovered, practices began to change. People learned how to build sanitary outhouses and how to locate them so they would not contaminate water sources.

WATER QUALITY AND POLLUTION

Few parts of the world have enough safe, clean drinking water, and yet few things are as important to human health.

- Buy energy-efficient appliances and use them only when necessary. Run the washing machine, dryer, and dishwasher only when you have full loads, and do laundry in warm or cold water instead of hot; don’t overdry your clothes. Clean refrigerator coils and clothes dryer lint screens frequently. Towel or air-dry your hair rather than using an electric dryer.
- Replace incandescent bulbs with light-emitting diode (LED) and compact fluorescent bulbs (not fluorescent tubes). For more information, see the box “Energy Efficient Lighting.”
- Make sure your home is well insulated with ozone-safe agents; use insulating shades and curtains to keep heat in during winter and out during summer.
- Plant and care for trees in your yard and neighborhood. They recycle carbon dioxide, so trees work against global warming. They also provide shade and cool the air, so less air conditioning is needed.
- Before discarding a refrigerator, air conditioner, or dehumidifier, check with the waste hauler or your local government to ensure that ozone-depleting refrigerants will be removed prior to disposal.
- Keep your house adequately ventilated and buy some houseplants; they have a natural ability to rid the air of harmful pollutants.
- Keep paints, cleaning agents, and other chemical products tightly sealed in their original containers.
- Don’t smoke, and don’t allow others to smoke in your room, apartment, or home. If these rules are too strict for your situation, limit smoking to a single, well-ventilated room.
- Clean and inspect chimneys, furnaces, and other appliances regularly. Install carbon monoxide detectors.

fluence The addition of fluoride to the water supply to reduce tooth decay.

septic system A self-contained sewage disposal system, often used in rural areas, in which waste material is decomposed by bacteria.
Differences between incandescent bulbs and high-efficiency bulbs. First, high-efficiency bulbs use much less energy by requiring less electricity to produce light. For example, a 17W LED bulb produces as much light as a 75W incandescent lightbulb. Second, they last longer: CFLs also last up to 10 times longer than conventional lightbulbs, and some LED bulbs have useful lives of more than 22 years.

To aid consumers in selecting bulbs, the Federal Trade Commission mandated Lighting Facts labels on all bulbs. Using these labels, you can compare different types of bulbs and select the most appropriate bulb for your planned use. The brightness comparison is based on lumens rather than watts, because energy-efficient bulbs produce a brighter light with less energy—more lumens per watt than a traditional incandescent bulb.


As plumbing moved indoors, sewage disposal became more complicated. In rural areas, the septic system, a self-contained sewage disposal system, worked quite well. Today, many rural homes still rely on septic systems; however, many old tanks are leaking contaminants into the environment. Different approaches became necessary as urban areas developed. Most cities have sewage-treatment systems that separate fecal matter from water in huge tanks and ponds and stabilize it so that it cannot transmit infectious diseases. After the water is treated and is biologically safe, it is released back
into the environment. The sludge that remains behind is often contaminated with heavy metals and is handled as hazardous waste; if not contaminated, sludge may be used as fertilizer, although this practice is being discouraged by scientists and some government agencies and is not permitted in organic agriculture. If incorporated into the food chain, heavy metals, such as lead, cadmium, copper, and tin, can cause illness or death; therefore, these chemicals must not be released into the environment when sludge is burned or buried.

In addition to regulating industrial discharge, many cities have expanded sewage-treatment measures to remove heavy metals and other hazardous chemicals. This action has resulted from many studies linking exposure to chemicals such as mercury, lead, and polychlorinated biphenyls (PCBs) with long-term health consequences, including cancer and damage to the central nervous system. The technology to effectively remove heavy metals and chemicals from sewage is still developing, and the costs involved are immense.

Protecting the Water Supply

By reducing your own water use, you help preserve your community’s valuable supply and lower your monthly water bill. By taking steps to keep the water supply clean, you reduce pollution overall and help protect the land, wildlife, and other people from illness. Here are some simple steps you can take to protect your water supply:

- Take showers, not baths, to minimize your water consumption. Don’t let water run when you’re not actively using it while brushing your teeth, shaving, or hand-washing clothes. Don’t run a dishwasher or washing machine until you have a full load.
- Install sink faucet aerators and water-efficient showerheads, which use two to five times less water with no noticeable decrease in performance.
- Purchase a water-saver toilet, or put a displacement device in your toilet tank to reduce the amount of water used with each flush.
- Fix any leaky faucets in your home. Leaks can waste thousands of gallons of water per year.
- Don’t pour toxic materials such as cleaning solvents, bleach, or motor oil down the drain. Store them until you can take them to a hazardous waste collection center.
- Don’t pour old medicines down the drain or flush them down the toilet. Some pharmacies will take back unused or expired medications for disposal, and many communities have drop-off days for these drugs.

SOLID WASTE POLLUTION

Humans generate huge amounts of waste, which must be handled appropriately if the environment is to be kept safe.

Solid Waste

The bulk of the organic food garbage produced in American kitchens is now dumped in the sewage system by way of the mechanical garbage disposal. The garbage that remains is not very hazardous from the standpoint of infectious disease because there is very little food waste in it, but it does represent an enormous disposal and contamination problem.

What’s in Our Garbage? In 2013, Americans generated about 254 million tons of trash and recycled and composted about 87 million tons of materials. The biggest single component of household trash by weight is paper products, including junk mail, glossy mail-order catalogs, and computer printouts (Figure 15.3). Yard waste, plastic, metals, and glass are other significant components. About 1% of the solid waste is toxic; a major source of toxic waste is the disposal of computer components in both household and commercial waste. Burning, as opposed to burial, reduces the bulk of solid waste, but it can release hazardous material into the air, depending on what is being burned. Solid waste is not limited to household products. Manufacturing, mining, and other industries all produce large amounts of potentially dangerous materials that cannot simply be dumped.

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**FIGURE 15.3** Components of municipal solid waste, by weight, before recycling.


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**TERMS**

- **heavy metal** A metal with a high specific gravity, such as lead, copper, or tin.
- **polychlorinated biphenyl (PCB)** An industrial chemical used as an insulator in electrical transformers and linked to certain human cancers; banned worldwide since 1977 but persistent in the environment.
- **sanitary landfill** A disposal site where solid wastes are buried.
- **biodegradable** The ability of some materials to break down naturally and disappear back into the environment.
- **recycling** The use of waste materials as raw materials in the production of new products.
Disposing of Solid Waste Since the 1960s, billions of tons of solid waste have been buried in sanitary landfill disposal sites. Careful site selection and daily management are an essential part of this approach to disposal. The site is thoroughly studied to ensure that it is not near groundwater, streams, or any other source of water that could be contaminated by leakage from the landfill. Sometimes protective liners are used around the site, and nearby monitoring wells are now required in most states. Layers of solid waste are regularly covered with thin layers of dirt until the site is filled. Some communities then plant grass and trees and convert the site into a park. Landfill is relatively stable; almost no decomposition occurs in the solidly packed waste.

Burying solid waste in landfills has several disadvantages. Much of this waste contains chemicals, ranging from leftover pesticides to paints and oils, which should not be released into the environment. Despite precautions, buried contaminants sometimes leak into the surrounding soil and groundwater. Burial is also expensive and requires huge amounts of space.

Biodegradability Biodegradation is the process by which organic substances are broken down naturally by living organisms. Organic materials can be degraded either aerobically (with oxygen) or anaerobically (without oxygen). These organic materials—including plant and animal matter, substances originating from living organisms, or artificial materials similar in nature to plants and animals—are put to use by microorganisms. The term biodegradable means that certain products can break down naturally, safely, and quickly into the raw materials of nature, then disappear back into the environment. Table 15.2 shows the amount of time required for different types of material to biodegrade.

Recycling Because of the expense and potential chemical hazards of any form of solid waste disposal, many communities encourage individuals and businesses to recycle their trash. In recycling, many kinds of waste materials are collected and used as raw materials in the production of new products. For example, waste paper can be recycled into new paper products, or an old bicycle frame can be melted down and used in the production of appliances. The number of recycling opportunities is almost limitless. Recycling is a good idea for two reasons. First, it puts unwanted objects back to good use. Second, it reduces the amount of solid waste sitting in landfills, some of which takes decades to decay naturally. Some cities offer curbside pickup of recyclables; others have recycling centers where people can bring their waste. These materials are not limited to paper, glass, and cans but also include things such as discarded tires and used oils.

Even as recycling grows in popularity, however, the total amount of garbage Americans generate will probably continue to rise as the population increases. Researchers estimate that 80% of the nation’s landfills will be closed within 20 years.

Discarded Technology: eWaste A newer solid waste disposal problem involves the discarding of old computers, televisions, cell phones, MP3 players, and other electronic devices. Americans scrap about 400 million consumer electronic devices each year. This “e-waste” is the fastest-growing portion of our waste stream. Junked electronic devices are toxic because they contain varying amounts of lead, mercury, and other heavy metals. Many components of electronic devices are valuable, however, and can be recycled and reused.

Reducing Solid Waste

By recycling more and throwing away less, you can conserve landfill space and put more reusable items back into service. Here are some ideas to help you reduce solid waste:

- Buy products with the least amount of packaging you can, or buy products in bulk (see the box “How to Be a Green Consumer”). For example, buy large jars of juice, not individually packaged juice drinks; buy a water filter, not individual bottles of drinking water. Buy products packaged in recyclable containers.

<table>
<thead>
<tr>
<th>Table 15.2 Biodegrading Times of Different Objects</th>
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<tbody>
<tr>
<td>ITEM</td>
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<tr>
<td>----------------------------------</td>
</tr>
<tr>
<td>Banana peel</td>
</tr>
<tr>
<td>Paper</td>
</tr>
<tr>
<td>Rope</td>
</tr>
<tr>
<td>Orange peel</td>
</tr>
<tr>
<td>Wool sock</td>
</tr>
<tr>
<td>Cigarette butt</td>
</tr>
<tr>
<td>Plastic-coated milk carton</td>
</tr>
<tr>
<td>Aluminum can</td>
</tr>
<tr>
<td>Plastic six-pack holder ring</td>
</tr>
<tr>
<td>Glass bottle</td>
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<tr>
<td>Plastic bottle</td>
</tr>
</tbody>
</table>

Wellness Tip Each year, millions of pounds of electronic waste are discarded; about 40% is recycled, but much more could be. If you have a cell phone, computer, or other electronic device to dispose of, look for an e-waste recycling program in your area. Look for a “green” program or one that is certified by e-stewards, an organization that advocates for responsible e-waste recycling (www.e-stewards.org).
CRITICAL CONSUMER  
How to Be a Green Consumer

It may seem like a hassle to consider the environmental impact of the things you buy, but a few simple choices can make a big difference without compromising your lifestyle.

- **Remember the four Rs of green consumerism:**
  - **Reduce** the amount of trash and pollution you generate by consuming and throwing away less.
  - **Reuse** as many products as possible—either yourself or by selling them or donating them to charity.
  - **Recycle** all appropriate materials and buy recycled products whenever possible.
  - **Respond** by educating others about reducing waste and recycling, by finding creative ways to reduce waste and toxicity, and by making your preferences known.

- Choose products packaged in refillable, recycled, reusable containers or in readily recyclable materials, such as paper, cardboard, aluminum, or glass. Don’t buy products that are excessively packaged or wrapped.
- Look for products made with the highest possible content of recycled paper, metal, glass, plastic, and other materials.
- Choose simple products containing the lowest amounts of bleaches, dyes, and fragrances. Look for organically grown foods and clothes made from organically grown cotton, from Fox Fibre, or another naturally colored type of cotton.
- **Buy** high-quality appliances that have an Energy Star seal from the EPA or some other type of certification indicating that they are energy- and water-efficient.
- **Get** a reusable cloth shopping bag. Don’t bag items that don’t need to be bagged.
- **Don’t buy** what you don’t need—borrow, rent, or share. Take good care of the things you own, repair items when they break, and replace them with used rather than new items whenever possible.
- Look beyond the products to the companies that make them. Support those with good environmental records. If some of your favorite products are overpackaged or contain harmful ingredients, contact the manufacturer.
- **Keep in mind** that doing something is better than doing nothing. Even if you can’t be a perfectly green consumer, doing your best on any purchase will make a difference.


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**CHEMICAL POLLUTION AND HAZARDOUS WASTE**

Chemical pollution is by no means a new problem. The ancient Romans were plagued by lead poisoning; industrial chemicals have claimed countless lives over the past few centuries.

Today, new chemical substances are constantly being introduced into the environment—as pesticides, herbicides, solvents, and hundreds of other products. More people and wildlife are exposed and potentially exposed to them than ever before. See the box “Endocrine Disruption” for more information on one new type of chemical hazard.

The problem of chemical pollution and hazardous waste became so prominent in the 1970s that the EPA established the Superfund program to clean up the nation’s uncontrolled hazardous waste sites. A national priorities list determines which locations get cleaned up. To date, the EPA has completed cleanups at hundreds of hazardous waste sites. As the Superfund program matures, so does the size, complexity, and cost of cleanup work. The EPA also pushes industrial polluters to pay the costs of cleanups.

**Asbestos**

A mineral-based compound, asbestos was widely used for fire protection and insulation in buildings until the late 1960s. Microscopic asbestos fibers can be released into the air when...
In the 1970s and 1980s, scientists began to document strange occurrences in wildlife: disrupted reproduction, birth defects, tumors, and behavioral changes in birds, fish, and reptiles. It was also becoming apparent that a drug given to pregnant women in the 1950s (a potent synthetic estrogen, DES) was causing infertility and rare reproductive cancers in their adult daughters. These effects were all stemming from types of synthetic chemicals known as endocrine disrupting chemicals (EDCs). In the mid-1990s the term "endocrine disruption" was coined.

Most systems in the body rely on hormones, which are chemical signals that initiate a variety of effects in the immune, metabolic, nervous, and other body systems. Low levels of EDCs can disrupt these systems by mimicking or blocking natural hormones. EDC exposure before and after birth may cause lifelong effects, including fertility problems, cancers, cardiovascular diseases, obesity, and mental disorders. These effects have been proven in laboratory animals and supported by observational (epidemiological) studies in humans.

Various synthetic chemicals, some in everyday products such as plastic, cosmetics, food packaging, flame-retardants, pesticides, and others, are proven EDCs. Bisphenol A (BPA) is a chemical present in #7 plastic—in water bottles, the lining of canned foods, dental fillings, and cash register receipts. In the United States, BPA has been removed by manufacturers from many infant products, but some scientists believe it should be more stringently regulated.

Traditional methods of determining chemical toxicity usually test "gross" effects: death, deformities, and tumors. These methods typically do not test low (environmental) doses of chemicals; rather, they test at high doses and extrapolate down to find "safe" exposure levels. Often, EDCs have detrimental effects at low doses but not higher ones. As our scientific knowledge of these chemicals and their effects at different doses evolves, new tests and policies are needed for the continued protection of human health

What can you do?

- Educate yourself about the personal-care and household products you use.
- Eat organic foods. Eat lower on the food chain.
- Avoid plastic, especially in contact with food and drinks. Do not microwave plastic containers.
- Dust, vacuum, and wipe down surfaces often.
- Avoid nonstick cookware and products.
- Avoid flame-retardant clothes and furniture.
- Avoid handling cash-register receipts. If you must, use gloves.
- Be especially aware of potential exposure to pregnant women, infants, and children.
- Support legislation that will provide adequate testing and regulation of potential EDCs.

For more information and a list of EDCs visit www.endocrinedisruption.org and www.niehs.nih.gov.

Lead

Thanks to better preventive efforts, lead poisoning is not as serious a problem today as it was in the past. Still, the CDC estimates that about 500,000 children under age 6 may have unsafe lead levels in their blood; the actual number could be much higher. Many of these children live in poor, inner-city areas (see the box “Poverty and Environmental Health”). When lead is ingested or inhaled, it can damage the central nervous system, cause mental impairment, hinder oxygen transport in the blood, and create digestive problems. Severe lead poisoning may cause coma or even death. Neurological damage can be permanent.

Long-term exposure to low levels of lead may cause kidney disease; it can also cause lead to build up in bones, where it may be released into the bloodstream during pregnancy or when bone mass is lost from osteoporosis.

Lead-based paints are the chief culprit in lead poisoning of children. They were banned from residential use in 1978, but as many as 57 million American homes still contain lead paint. New guidelines requiring contractors to take special lead containment measures when doing renovations, repairs, or painting in certain buildings were implemented in April 2010. The use of lead in plumbing is now also banned, but some old pipes and faucets contain lead.
Residentsofpoorandminoritycommunitiesareoftenexposedtomoreenvironmentaltoxinsthanresidentsofwealthiercommunities,andyetheymorelikelytosufferfromhealthproblemscausedoraggravatedbypollutants.

Poorneighborhoodsareoftenlocatednearhighwaysandindustrialareasthathavehighlevels ofairandnoisepollution;theyarealsocommon sitesforhazardouswaste production and disposal. Residentsofsubstandard housingaremorelikelytocometocontactwithlead,asbestos,carbone
monoxide,pesticides,andotherr
hazardouspollutantsassociatedwithpeeling paint,oldplumbing,andpoorlymain
tainedinsulationandheatingequipment.

Poorpeoplearemorelikelytohave jobs that expose them to asbestos,silica dust,andpesticides,andothertendemorelikelyto catchandconsumefish contaminatedwithPCBs,mercury,and other toxins.

Themostthoroughlyresearchedand documentedlinkamongpoverty, the environment,and healthislead poisoninginchildren. Onestudy showed thatwhetherthey livedinarural or urban environment,blacks and Latinos were morelikelyexposedtosoil lead concentrationsthan nonmi
norities. This was trueforchildren age 6 andunder, whichisimpor
tantbecausechildrenare especiallyvul
nerabletolead exposure.

TheCDCandtheAmericanAcademy of Pediatricsrecommendannual test
ing of blood lead levelsfor allchildren under age 6, withmorefrequenttesting for children at special risk.

Asthma is another health threat that ap
pears to be linked with both environ
mentalandsocioeconomicfactors. ThenumberofAmericanswithasthmahasgrowndramaticallyinthepast20years;

mostoftheincreasehasoccurredin children,withAfricanAmericansandthe poorhardesthit. Researchersarenosurewhataccountsforthisincrease,buttendstoincludehouseholdpollutants, pesticides,airpollution,cigarettesmoke, andallergenslikecockroaches.Theserisk factorsarelikelytoclusterinpoor urban areaswhereinadequatehealth caremayworsenasthma’seffects.

Pesticides

Pesticidesareusedprimarilyfortwopurposes:topreventthespreadofinsectborne diseasesandtomaximizefoodproduc
tionbykillinginsectsateatscrops.Bothuseshar
risksaswellasbenefits. Forexample,DDTwasextremely effectiveincontrollinginsectborne diseasesintropicalcountriesandin increasingcrop yields throughouttheworld, butitwastounderto
ruptidelifecyclesofbirds,fish,ande
ptilesandwasbannedintheUnitedStatesin1972/DDTalsobuildsinthe food chain,increasinginc
centrationaslargeranimals eatsmaller ones, aprocessknownasbiomagnification.

Mercury

A naturallyoccurringmetal,mercuryisatoxinthataffects thenervoussystemandmaydamage thebrain,kidneys,and gastrointestintractandincreasebloodpressure,heart rate, andheartattackrisk. Mercury slowsfetalandchild de
velopmentandcausesirreversibledeficitsinbrainfunction. Coal
firedpowerplantsarethelargestproducersofmercury;oth
ersourcesinclude miningandsmelting operations andthe dis
posalofconsumerproductscontainingmercury.

Mercurypersistsintheenvironment,andliked pesticides,itis bioaccumulative. Inparticular,large,longlivedfishmancaryhighlevelsofmercury.

Other Chemical Pollutants

Thelistorealandpotentialchemicalpollutionproblemsmaywell beaslongasthelistofknownchemicals. Asmentioned earlier,hazardouswastesarecommonlyfoundinthomeandshould be handledanddisposedofproperly. They includeautomotive supplies (motor oil, antifreeze,transmissionfluid),painsupplies (turpentine,paintthinner,mineralspirits),arto
hobby
supplies (oilbasedpaint,solvents,acidsandalkalis,aerosol sprays),insecticides,batteries,computerande
ctroniccomponents,and householdcleanerscontaining sodiumhydroxide(lye)orammon
ia.Thesechemicalsaredangerouswheninhaledoringested,whentheycontacttheskinortheeyes,orwhentheyareburnedor dumped.Manycitiesprovidelineguidelinesaboutapproveddisposal methodsandhavehazardouswaste collectiondays.

Preventing Chemical Pollution

You can take steps toreduce thechemicalpollutionin yourcommunity.Justasimportant,byreducingandeliminatingthe
Radiation comes in different forms, such as ultraviolet rays, microwaves, or X-rays, and from different sources, such as the sun, uranium, and nuclear weapons (Figure 15.4). These forms of electromagnetic radiation differ in wavelength and energy, with shorter waves having the highest energy levels.

Of most concern to health are gamma rays produced by radioactive sources such as nuclear weapons, nuclear energy plants, and radon gas. These high-energy waves are powerful enough to penetrate objects and break molecular bonds. Although gamma radiation cannot be seen or felt, its effects at high doses can include radiation sickness and death. At lower doses, chromosome damage, sterility, tissue damage, cataracts, and cancer can occur. Other types of radiation can also affect health. For example, exposure to UV radiation from the sun or from tanning salons can increase the risk of skin cancer. The effects of some sources of radiation, such as cell phones, remain controversial.

Wellness Tip Hazardous chemicals accumulate in many homes, as well as in business and industrial sites. Dispose of your household hazardous wastes properly. If you don’t know how to dispose of an item, contact your local environmental health office or health department for information.

- When buying products, read the labels, and try to buy the least toxic ones available. Choose nontoxic, nonpetrochemical cleansers, disinfectants, polishes, and other personal and household products.
- Buy organic produce or produce that has been grown locally.
- If you must use pesticides or toxic household products, store them in a locked place where children and pets can’t get to them. Don’t measure chemicals with food-preparation utensils, and wear gloves whenever handling them.
- If you have your house fumigated for pest control, be sure to hire a licensed exterminator. Keep everyone, including pets, out of the house while the crew works and, if possible, for a few days after.

Nuclear Weapons and Nuclear Energy

Nuclear weapons pose a health risk of the most serious kind to all species. Public health associations have stated that in the event of an intentional or unintentional discharge of these weapons, the casualties would run into the hundreds of thousands or millions. Reducing the stockpiles of nuclear weapons is a challenge and a goal for the twenty-first century.

TERMS

| radiation | Energy transmitted in the form of rays, waves, or particles. |
| radiation sickness | An illness caused by excess radiation exposure, marked by low white blood cell counts and nausea; possibly fatal. |
| nuclear power | The use of controlled nuclear reactions to produce steam, which in turn drives turbines to produce electricity. |

Figure 15.4 Electromagnetic radiation. Electromagnetic radiation takes the form of waves that travel through space. The length of the wave determines the type of radiation. The shortest waves are high-energy gamma rays; the longest are radio waves and extremely low-frequency waves used for communication between aircraft, ships, and submarines. Different types of electromagnetic radiation have different effects on health.
Power-generating plants that use nuclear fuel also pose health problems. When nuclear power was first developed as an alternative to oil and coal, it was promoted as clean, efficient, inexpensive, and safe. In general, this has proven to be the case. Power systems in several parts of the world rely on nuclear power plants. However, despite all the built-in safeguards and regulating agencies, accidents in nuclear power plants do happen, many due to human error (as at Three Mile Island in the United States and Tokaimura in Japan), and the consequences of such accidents are far more serious than those of similar accidents in other types of power-generating plants. The 1986 fire and explosion at the Chernobyl nuclear power station in Ukraine caused hundreds of deaths and increased rates of genetic mutation and cancer; the long-term effects are not yet clear. The zone around Chernobyl could be unsafe for the next 24,000 years. In 2011, a 9.0 magnitude earthquake 15 miles below Japan’s Honshu Island, followed by a powerful tsunami, severely damaged the Fukushima Daiichi nuclear power plant complex. It took nine months to stabilize and completely shut down the reactors.

An additional, enormous problem is disposing of the radioactive wastes these plants generate. They cannot be dumped in a sanitary landfill because the amount and type of soil used to cap a sanitary landfill are not sufficient to prevent radiation from escaping. Deposit sites have to be developed that will be secure not just for a few years but for tens of thousands of years—longer than the total recorded history of human beings on this planet. To date, no storage method has been devised that can provide infallible, indefinitely durable shielding for nuclear waste. Despite these problems, nuclear power is gaining favor again as an alternative to fossil fuels.

**Medical Uses of Radiation**

Another area of concern is the use of radiation in medicine, primarily the X-ray. The development of machines that could produce images of internal bone structures was a major advance in medicine, and applications abounded. Chest X-rays were routinely used to screen for tuberculosis, and children’s feet were even X-rayed in shoe stores to make sure their new shoes fit properly. But, as is often the case, this new technology had disadvantages. As time passed, studies revealed that X-ray exposure is cumulative and that no level of exposure is absolutely safe.

Early X-ray machines are no longer used because of the high amounts of radiation they give off. Each new generation of X-ray machines has used less radiation more effectively. From a personal health point of view, no one should ever have a “routine” X-ray examination; each such exam should have a definite purpose, and its benefits and risks should be carefully weighed.

**Radiation in the Home and Workplace**

Recently, there has been concern about electromagnetic radiation associated with common modern devices such as microwave ovens, computer monitors, and even high-voltage power lines. These forms of radiation do have effects on health, but research results are inconclusive.

Another controversial issue today is the effect of radiation from cell phones on health. Cell phones use electromagnetic waves (radio frequency radiation) to send and receive signals. This radiation is not directional, meaning that it travels in all directions equally, including toward the user. Factors such as the type of digital signal coding in the network, the antenna and handset design, and the position of the phone relative to the head all determine how much radiation is absorbed by a user.

Specific absorption rate (SAR) is a way of measuring the quantity of radio frequency energy that is absorbed by the body. If you’re concerned about limiting your exposure to possible radiation from your cell phone, look for a phone with a low SAR (some municipalities require phone manufacturers to provide this information on packaging). You can also text instead of calling, use a wired headset or speakerphone whenever possible, and carry your phone at least one inch from your body.

**Avoiding Radiation**

The following steps can help you avoid unneeded exposure to radiation:

- If your physician orders an X-ray, ask why it is necessary. Only get X-rays that you need, and keep a record of the date and location of every X-ray exam. Don’t have a full-body CT scan for routine screening; the radiation dose of one full-body CT scan is nearly 100 times that of a typical mammogram.
- Follow government recommendations for radon testing.
- Find out if there are radioactive sites in your area. If you live or work near such a site, form or join a community action group to get the site cleaned up.

**NOISE POLLUTION**

We are increasingly aware of the health effects of loud or persistent noise in the environment. Concerns focus on two areas: hearing loss and stress. Prolonged exposure to sounds above 80–85 decibels (a measure of the intensity of a sound wave) can cause permanent hearing loss (Figure 15.5). Hearing damage can occur after eight hours of exposure to sounds louder than 80 decibels. Regular exposure for longer than one minute to more than 100 decibels can cause permanent hearing loss. Children may suffer damage to their hearing at lower noise levels than those at which adults suffer damage.

Two common sources of excessive noise are the workplace and large gatherings of people at sporting events, rock concerts, and movie theaters. The Occupational Safety and Health Administration (OSHA) sets legal standards for noise in the workplace, but no laws exist regulating noise levels at concerts, which can be much louder than most workplaces.

Here are some ways to avoid exposing yourself to excessive noise:

- Wear ear protectors when working around noisy machinery.
not push your earbuds in too far. Keep the volume quite a bit lower than you think you need because the sound is far louder than you realize.

- Avoid toys for children that make loud noise.
- Avoid loud music. Don’t sit or stand near speakers or amplifiers at a concert, and don’t play a car radio or stereo so loud that you can’t hear the traffic.
- Avoid exposure to painfully loud sounds, and avoid repeated exposure to any sounds above 80 decibels.

**TIPS FOR TODAY AND THE FUTURE**

Environmental health involves protecting ourselves from environmental dangers and protecting the environment from the dangers created by humans.

**RIGHT NOW YOU CAN**

- Turn off the lights, televisions, and stereos in any unoccupied rooms.
- Turn off power strips when not in use.
- Turn down the heat a few degrees and put on a sweater, or turn off the air conditioner and change into cooler clothes.
- Check your trash for recyclable items and take them out for recycling. If your town does not provide curbside pickup for recyclable items, find out where the nearest community recycling center is.

**IN THE FUTURE YOU CAN**

- As your existing lightbulbs burn out, replace them with high-efficiency lightbulbs.
- Have your car checked to make sure it runs as well as it can and puts out the lowest amount of polluting emissions possible.
- Go online and find one of the many calculators available that can help you estimate your environmental footprint. After calculating your footprint, figure out ways to reduce it.

**SUMMARY**

- Environmental health encompasses all the interactions of humans with their environment and the health consequences of those interactions.
- The world’s population is increasing rapidly, especially in the developing world. Factors that may eventually limit human population are food, availability of land and water, energy, and minimum acceptable standard of living.
- Increased amounts of air pollutants are especially dangerous for children, older adults, and people with chronic health problems.
- Factors contributing to the development of smog include heavy motor vehicle traffic, hot weather, and stagnant air.
• Carbon dioxide and other natural gases act as a greenhouse around the earth, increasing the temperature of the atmosphere. Levels of these gases are rising through human activity; as a result, the world’s climate could change.

• The ozone layer that shields the earth’s surface from the sun’s UV rays has thinned and developed holes in certain regions.

• Environmental damage from energy use can be limited through energy conservation and the development of nonpolluting, renewable sources of energy.

• Indoor pollutants can trigger allergies and illness in the short term and cancer in the long term.

• Concerns with water quality focus on pathogenic organisms and hazardous chemicals from industry and households, as well as on water shortages.

• Sewage treatment prevents pathogens from contaminating drinking water; it often must also deal with heavy metals and hazardous chemicals.

• The amount of garbage is growing all the time; paper is the biggest component. Recycling can help reduce solid waste disposal problems.

• Potentially hazardous chemical pollutants include asbestos, lead, pesticides, mercury, and many household products. Proper handling and disposal are critical.

• Radiation can cause radiation sickness, chromosome damage, and cancer, among other health problems.

FOR FURTHER EXPLORATION

CDC National Center for Environmental Health. Provides brochures and fact sheets on a variety of environmental issues.
http://www.cdc.gov/nceh/default.htm

Earth Times. An international online newspaper devoted to global environmental issues.
http://www.earthtimes.org

Ecological Footprint. Calculates your personal ecological footprint based on your diet, transportation patterns, and living arrangements.
http://www.myfootprint.org

Fuel Economy. Provides information on the fuel economy of cars made since 1985 and tips on improving gas mileage.
http://www.fueleconomy.gov

Indoor Air Quality Information Hotline. Answers questions, provides publications, and makes referrals.
800-438-4318

National Lead Information Center. Provides information packets and specialist advice.
http://www2.epa.gov/lead

National Oceanic and Atmospheric Administration (NOAA): Climate. Provides information on a variety of issues related to climate, including global warming, drought, and El Niño and La Niña.
http://www.noaa.gov/climate.html

National Safety Council. Provides information on lead, radon, indoor air quality, hazardous chemicals, and other environmental issues.
http://www.nsc.org/pages/home.aspx

No Impact Man. A blog by Colin Beavan about what each of us can do in our daily lives to leave less of a footprint on our environments. Also features his book No Impact Man (Farrar, Straus, and Giroux, 2009) and film (No Impact Man, 2009).
http://colindeavan.com/

Student Environmental Action Coalition (SEAC). A coalition of student and youth environmental groups; the website has contact information for local groups.
http://www.seac.org

United Nations. Several U.N. programs are devoted to environmental problems on a global scale; the websites provide information on current and projected trends and on international treaties developed to deal with environmental issues.
http://www.unep.org (Environment Programme)
http://www.epa.gov (U.S. Environmental Protection Agency)

http://www.eere.energy.gov

U.S. Environmental Protection Agency (EPA). Provides information about EPA activities and many consumer-oriented materials. The website includes special sites devoted to global warming, ozone loss, pesticides, and other areas of concern.
http://www.epa.gov

Worldwatch Institute. A public policy research organization focusing on emerging global environmental problems and the links between the world economy and the environment.
http://www.worldwatch.org

There are many national and international organizations working on environmental health problems. A few of the largest and best known are listed below:

Greenpeace: 800-326-0959; http://www.greenpeace.org
National Audubon Society: 212-979-3000; http://www.audubon.org
Nature Conservancy: 800-628-6860; http://www.nature.org
Sierra Club: 415-977-5500; http://www.sierraclub.org

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Are newer sources of fossil fuel, such as oil extraction from tar sands, safe for the environment?

That is a difficult question to answer because there are many unknowns, but all fossil fuel extraction processes have potential environmental costs. As supplies of easily accessible oil dwindle, some energy companies have turned to what are often called unconventional or “extreme” energy sources. This term describes fossil fuels that are relatively difficult to access and extract from the environment. Examples include deepwater oil rigs, tar sands oil extraction, and drilling and hydrofracking of natural gas. Accessing these energy sources requires new technologies and practices. Critics worry that these technologies have been insufficiently studied and regulated and may pose significant new environmental risks.

The Deepwater Horizon oil rig that exploded in April 2011 in the Gulf of Mexico was a deepwater rig. It took three months to plug the leak, after nearly 5 million barrels of oil were released into the Gulf. The combination of the oil and the chemicals used to clean it up killed thousands of birds and marine mammals, and the long-term health effects to the remaining wildlife are not known. The Gulf’s ecosystems may need generations to recover fully, and some parts of it may never recover. Researchers have discovered trace amounts of oil in some fish and shellfish, leading to concerns that oil could reach the human food chain.

Tar sands (or oil sands) are sand deposits that are saturated with a dense form of petroleum called bitumen. The largest deposits are found in Canada, Kazakhstan, and Russia. Making liquid fuel from the oil in tar sands is a very energy-intensive process. When used as fuel, the resulting molasses-like product produces two to four times the amount of greenhouse gases per barrel compared to other conventional oils.

What is renewable energy, and what are its advantages?

With fossil fuels becoming increasingly problematic politically, economically, and environmentally, interest and investment in renewable energy sources have grown in recent years. Renewable energy sources are those sources that are naturally replenished and essentially inexhaustible, such as wind and water. Together with technologies that improve energy efficiency, renewable energy sources contribute to sustainability—the capacity of natural or human systems to endure and maintain well-being over time. A common definition of sustainable development is development that meets society’s present needs without compromising the ability of future generations to meet their needs.

Renewable energy sources include wind power, solar power, water and wave power, geothermal power, and biomass and biofuels from renewable sources, among others.

- Wind power uses the energy of the wind to turn blades that run a turbine, which spins a generator, which produces electricity.
- Solar power uses the heat and light of the sun to produce energy via a variety of technologies. One solar technology is the concentrating solar power (CSP) system, which use mirrors, dishes, or towers to reflect and collect solar heat to generate steam, which runs a turbine to produce electricity. Another solar technology is the photovoltaic (solar cell) system, which converts sunlight directly into electricity by means of semiconducting materials.
- Geothermal power taps the heat in the earth’s core. It may be in the form of hot water or steam, which can be used to run a turbine to produce electricity. In some geologically unstable parts of the planet, including Yellowstone Park and parts of northern California, geothermal energy is close to the surface.
- Biomass is plant material, including trees. When biomass is burned, it produces energy. If the plants are produced and harvested sustainably, they are a renewable source of energy.
- Biofuels are fuels based on natural materials. Bioethanol is made primarily from sugar and starch crops like corn, although trees and grasses may be used in the future. Ethanol can be used as a fuel for vehicles or added to gasoline. Biodiesel is made from vegetable oils or animal fats and can be used either in a pure form to power vehicles or added to diesel to reduce carbon emissions.

World renewable energy production increased by 27% from 2008 to 2012. Within this period, solar electricity generation grew by 74%, wind power grew by 136%, and biomass production grew by 46%.
LAB 15.1  Environmental Health Checklist

The following list of statements relates to your effect on the environment. Check the statements that are true for you.

____  I ride my bike, walk, carpool, or use public transportation whenever possible.
____  I keep my car tuned up and well maintained.
____  My residence is well insulated.
____  Where possible, I use compact fluorescent bulbs instead of incandescent bulbs.
____  I turn off lights and appliances when they are not in use.
____  I avoid turning on heat or air conditioning whenever possible.
____  I run the washing machine, dryer, and dishwasher only when they have full loads.
____  I run the clothes dryer only as long as it takes my clothes to dry.
____  I dry my hair with a towel rather than a hair dryer.
____  I keep my car’s air conditioner in good working order and have it serviced by a service station that recycles CFCs.
____  When shopping, I choose products with the least amount of packaging.
____  I choose recycled and recyclable products.
____  I avoid products packaged in plastic and unrecycled aluminum.
____  I store food in glass jars and waxed paper rather than plastic wrap.
____  I take my own bag along when I go shopping.
____  I recycle newspapers, glass, cans, and other recyclables.
____  When shopping, I read labels and try to buy the least toxic products available.
____  I dispose of household hazardous wastes properly.
____  I take showers instead of baths.
____  I take short showers and switch off the water when I’m not actively using it.
____  I do not run the water while brushing my teeth, shaving, or hand-washing clothes.
____  My faucets have aerators installed in them.
____  My shower has a low-flow showerhead.
____  I have a water-saver toilet or a water displacement device in my toilet.
____  I snip or rip plastic six-pack rings before I throw them out.
____  When hiking or camping, I never leave anything behind.

Statements you have not checked can help you identify behaviors you can change to improve environmental health.
NUTRITIONAL CONTENT OF COMMON FOODS

If you are developing a behavior change plan to improve your diet, or if you simply want to choose healthier foods, you may want to know more about the nutritional content of common food items. You can track your daily food intake, calculate your nutrient intake from foods, and compare your intake with the U.S. Department of Agriculture’s recommendations for your age, sex, height, and weight at the MyPlate website (www.choosemyplate.gov).

You can also look up the nutrient content of the foods you eat in the USDA Agricultural Research Service National Nutrient Database, which lists foods both by description and by nutrient content (www.ars.usda.gov/Services/docs.htm?docid=17477). For example, under “protein,” you can find out how much protein there is in a chicken pot pie or what foods have the most protein per serving. Although cumbersome, the database is comprehensive.

Nutritional Content of Popular Items from Fast-Food Restaurants

Although most foods served at fast-food restaurants are high in calories, fat, saturated fat, cholesterol, sodium, and sugar, some items are healthier than others. If you eat at fast-food restaurants, knowing the nutritional content of various items can help you make better choices. Fast-food restaurants provide nutritional information both online and in print brochures available at most restaurant locations. To learn more about the items you order, visit the restaurants’ websites:

- Arby’s: http://arbys.com
- Burger King: http://www.bk.com
- Chipotle: http://www.chipotle.com
- Domino’s Pizza: www.dominos.com
- Hardees: www.hardees.com
- KFC: www.kfc.com
- McDonald’s: www.mcdonalds.com
- Papa John’s Pizza: http://www.papajohns.com/index.html
- Pizza Hut: http://www.pizzahut.com
- Starbucks: http://www.starbucks.com
- Taco Bell: www.tacobell.com
- Wendy’s: www.wendys.com
- White Castle: www.whitecastle.com
Unintentional injuries are the leading cause of death in the United States for people under age 45. The greatest number of disabling injuries occur in the home; falls are the leading cause of nonfatal, unintentional injuries that are treated in hospital emergency departments. In all these arenas, the action you take can mean the difference between injury or death and no injury at all.

Injuries are generally classified into four categories, based on where they occur: motor vehicle injuries, home injuries, leisure injuries, and work injuries.

**MOTOR VEHICLE INJURIES**

According to the National Safety Council (NSC), nearly 35,000 Americans were killed and nearly 3.7 million were injured in motor vehicle crashes in 2011. Those most affected by motor vehicle crashes are people 15–24 years of age. It is more likely that your death will be caused by a motor vehicle crash than by any other type of unintentional or intentional injury. Motor vehicle injuries also result in the majority of cases of paralysis due to spinal injuries, and they are the leading cause of severe brain injury in the United States.

**Factors in Motor Vehicle Injuries**

**Driving Habits** Nearly two-thirds of motor vehicle injuries are caused by bad driving, especially speeding. As speed increases, momentum and force of impact increase and the time available for the driver to react decreases. Speed limits are posted to establish the safest maximum speed limit for a given area under ideal conditions. Aggressive driving—characterized by speeding, frequent and abrupt lane changes, tailgating, and passing on the shoulder—also increases the risk of crashes.

Distracted driving contributes to 25 to 50% of all crashes. Anything that distracts a driver—sleepiness, bad mood, children or pets in the car, use of a cell phone—can increase the risk of a crash. Sleepiness reduces reaction time, coordination, and speed of information processing and can be as dangerous as drug and alcohol use. Even mild sleep deprivation causes a deterioration in driving ability comparable to that caused by a 0.05% blood alcohol concentration.

Cell phone users respond to hazards about 20% slower than undistracted drivers and are about twice as likely to rear-end a braking car in front of them. According to 2011 statistics from the AAA Foundation for Traffic Safety, drivers who use cell phones are nearly four times as likely to be involved in a crash as drivers who don’t. Hands-free devices do not help significantly; the mental distraction of talking is the factor in crashes rather than holding a phone. Newer research shows that text-messaging (texting) on a cell phone while driving is even more dangerous than talking. Estimates provided by the NSC attribute 1.3 million traffic crashes (about 24% of all crashes) to the use of cell phones and text messaging. Many cities and states have outlawed the use of cell phones while driving.

**Safety Belts and Air Bags** A person who doesn’t wear a safety belt is twice as likely to be injured in a crash as a person who does wear one. Safety belts not only prevent occupants from being thrown from the car at the time of the crash but also provide protection from the “second collision,” which occurs when the occupant of the car hits something inside the car, such as the steering column or windshield. The safety belt also spreads the stopping force of a collision over the body.

Since 1998, all new cars have been equipped with dual air bags—one for the driver and one for the front passenger seat. Air bags provide supplemental protection in a collision but are most useful in head-on collisions. (Many newer vehicles feature side air bags to offer protection in a side-impact crash.) They also deflate immediately after inflating and so do not provide protection in collisions involving multiple impacts. To ensure that air bags work as intended, follow these guidelines:

- Place infants in rear-facing infant seats in the backseat.
- Transport children age 12 and under in the backseat.
- Always use safety belts or appropriate safety seats.
- Keep at least 10 inches between the air bag cover and the breastbone of the driver or passenger.

If you cannot comply with these guidelines, you can apply to the National Highway Traffic Safety Administration for permission to install an on-off switch that temporarily disables the air bag.

**Alcohol and Other Drugs** Alcohol is involved in about 3 out of 10 fatal crashes. Alcohol-impaired driving, defined by blood alcohol concentration (BAC), is illegal. The legal BAC limit is 0.08% in all states, but driving ability is impaired at much lower BACs. All psychoactive drugs have the potential to impair driving ability.

**Preventing Motor Vehicle Injuries**

About 75% of all motor vehicle collisions occur within 25 miles of home and at speeds lower than 40 mph. These crashes often occur because the driver believes safety measures are not necessary for short trips. Clearly, the statistics prove otherwise.

To prevent motor vehicle injuries:

- Obey the speed limit. If you have to speed to get to your destination on time, you’re not allowing enough time.
- Always wear a safety belt and ask passengers to do the same.
- Strap infants and toddlers into government-approved car seats in the back seat. Children who have outgrown child safety seats but who are still too small for adult safety belts alone (usually age 4–8) should be secured using booster seats. All children under 12 should ride in the backseat.
- Never drive under the influence of alcohol or other drugs or with a driver who is.
- Do not drive when you are sleepy or have been awake for 18 or more hours.
- Avoid using your cell phone while driving—your primary obligation is to pay attention to the road. If you do make calls, follow laws set by your city or state. Place calls when you are at a stop, and keep them short. Pull over if the conversation is stressful or emotional.
- Never text while driving.
- Keep your car in good working order. Regularly inspect tires, oil and fluid levels, windshield wipers, spare tire, and so on.
- Always allow enough following distance. Follow the “3-second rule”: When the vehicle ahead passes a reference point, count out 3 seconds. If you pass the reference point before you finish counting, drop back and allow more following distance.
- Always increase following distance and slow down if weather or road conditions are poor.
- Choose major highways rather than rural roads. Highways are much safer because of better visibility, wider lanes, fewer surprises, and other factors.
- Always signal before turning or changing lanes.
- Stop completely at stop signs. Follow all traffic laws.
- Take special care at intersections. Always look left, right, and then left again. Make sure you have plenty of time to complete your maneuver in the intersection.
- Don’t pass on two-lane roads unless you are in a designated passing area and have a clear view ahead.

Motorcycles and Scooters
About 1 out of every 7 traffic fatalities among people age 15–34 involves someone riding a motorcycle. Injuries from motorcycle collisions are generally more severe than those involving automobiles because motorcycles provide little, if any, protection. Scooter riders face additional challenges. Motorized scooters usually have a maximum speed of 30–35 mph and have less power for maneuverability.

To prevent motorcycle and scooter injuries:
- Make yourself easier to see by wearing light-colored, reflective clothing.
- Face traffic when walking or jogging along a roadway, and follow traffic laws.
- Avoid using your cell phone while driving—your primary obligation is to pay attention to the road. If you do make calls, follow laws set by your city or state. Place calls when you are at a stop, and keep them short. Pull over if the conversation is stressful or emotional.
- Never text while driving.
- Keep your car in good working order. Regularly inspect tires, oil and fluid levels, windshield wipers, spare tire, and so on.
- Always allow enough following distance. Follow the “3-second rule”: When the vehicle ahead passes a reference point, count out 3 seconds. If you pass the reference point before you finish counting, drop back and allow more following distance.
- Always increase following distance and slow down if weather or road conditions are poor.
- Choose major highways rather than rural roads. Highways are much safer because of better visibility, wider lanes, fewer surprises, and other factors.
- Always signal before turning or changing lanes.
- Stop completely at stop signs. Follow all traffic laws.
- Take special care at intersections. Always look left, right, and then left again. Make sure you have plenty of time to complete your maneuver in the intersection.
- Don’t pass on two-lane roads unless you are in a designated passing area and have a clear view ahead.

Pedestrians and Bicycles
Injuries to pedestrians and bicyclists are considered motor vehicle-related because they usually involve motor vehicles. About 1 in 7 motor vehicle deaths involves pedestrians, and more than 160,000 pedestrians are injured each year.

To prevent injuries when walking or jogging:
- Walk or jog in daylight.
- Make yourself easier to see by wearing light-colored, reflective clothing.
- Face traffic when walking or jogging along a roadway, and follow traffic laws.
- Avoid using your cell phone while driving—your primary obligation is to pay attention to the road. If you do make calls, follow laws set by your city or state. Place calls when you are at a stop, and keep them short. Pull over if the conversation is stressful or emotional.
- Never text while driving.
- Keep your car in good working order. Regularly inspect tires, oil and fluid levels, windshield wipers, spare tire, and so on.
- Always allow enough following distance. Follow the “3-second rule”: When the vehicle ahead passes a reference point, count out 3 seconds. If you pass the reference point before you finish counting, drop back and allow more following distance.
- Always increase following distance and slow down if weather or road conditions are poor.
- Choose major highways rather than rural roads. Highways are much safer because of better visibility, wider lanes, fewer surprises, and other factors.
- Always signal before turning or changing lanes.
- Stop completely at stop signs. Follow all traffic laws.
- Take special care at intersections. Always look left, right, and then left again. Make sure you have plenty of time to complete your maneuver in the intersection.
- Don’t pass on two-lane roads unless you are in a designated passing area and have a clear view ahead.

Aggressive Driving
Aggressive driving, known as road rage, has increased more than 50% since 1990. Aggressive drivers increase the risk of crashes for themselves and others. They further increase the risk of injuries if they stop their vehicles and confront each other. Even if you are successful at controlling your own aggressive driving impulses, you may still encounter an aggressive driver.

To avoid being the victim of an aggressive driver:
- Always keep distance between your car and others. If you are behind a very slow driver and can’t pass, slow down to increase distance in case that driver does something unexpected. If you are being tailgated, do not increase your speed; instead, let the other driver pass you. If you are in the left lane when being tailgated, signal and pull over to let the other driver go by, even if you are traveling at the speed limit. When you are merging, make sure you have plenty of room. If you are cut off by a merging driver, slow down to make room.
- Be courteous, even if the other driver is not. Use your horn rarely, if ever. Avoid making gestures of irritation, even shaking
your head. When parking, let the other driver have the space that both of you found.

- Refuse to join in a fight. Avoid eye contact with an angry driver. If someone makes a rude gesture, ignore it. If you think another car is following you and you have a cell phone, call the police. Otherwise, drive to a public place and honk your horn to get someone’s attention.
- If you make a mistake while driving, apologize. Raise or wave your hand or touch or knock your head with the palm of your hand to indicate “What was I thinking?” You can also mouth the words “I’m sorry.”

HOME INJURIES

Contrary to popular belief, home is one of the most dangerous places to be. The most common fatal home injuries are caused by falls, poisoning, fires, suffocation and choking, and incidents involving firearms.

Falls

About 90% of fatal falls involve people age 45 and older, but falls are a significant cause of unintentional death for people under age 25. Most deaths occurring from falls involve falling on stairs or steps or from one level to another. Falls also occur on the same level, from tripping, slipping, or stumbling. Alcohol is a contributing factor in many falls.

To prevent injuries from falls:
- Install handrails and nonslip surfaces in the shower and bathtub. Place skidproof backing on rugs and carpets.
- Keep floors, stairs, and outside areas clear of objects or conditions that could cause slipping or tripping, such as heavy wax coating, electrical cords, and toys.
- Put a light switch by the door of every room so no one has to walk across a room to turn on a light. Use night lights in bedrooms, halls, stairways, and bathrooms.
- Outside the house, clear dangerous surfaces created by ice, snow, fallen leaves, or rough ground.
- Install handrails on stairs. Keep stairs well lit and clear of objects.
- When climbing a ladder, use both hands. Never stand higher than the third step from the top. When using a stepladder, make sure the spreaderbrace is in the locked position. With straight ladders, set the base out 1 foot for every 4 feet of height. Don’t stand on chairs to reach things.
- If there are small children in the home, place gates at the top and bottom of stairs. Never leave a baby unattended.

Poisoning

More than 2.5 million poisonings and more than 35,000 poison-related deaths occur every year in the United States.

To prevent poisoning:
- Store all medicines out of the reach of children. Use medicines only as directed on the label or by a physician.
- Use cleaners, pesticides, and other dangerous substances only in areas with proper ventilation. Store them out of the reach of children.
- Never operate a vehicle in an enclosed space. Have your furnace inspected yearly. Use caution with any substance that produces potentially toxic fumes, such as kerosene. If appropriate, install carbon monoxide detectors.
- Keep poisonous plants out of the reach of children. These include azalea, oleander, rhododendron, wild mushrooms, daffodil and hyacinth bulbs, mistletoe berries, apple seeds, morning glory seeds, wisteria seeds, and the leaves and stems of potato, rhubarb, and tomato plants.

To be prepared in case of poisoning:
- Keep the number of the nearest Poison Control Center (or emergency room) in an accessible location. A call to the national poison control hotline (800-222-1222) will be routed to a local center.

Emergency first aid for poisonings:
1. Remove the poison from contact with eyes, skin, or mouth, or remove the victim from contact with poisonous fumes or gases.
2. Call the Poison Control Center immediately for instructions. Have the container with you.
3. Do not follow emergency instructions on labels. Some may be out-of-date and carry incorrect treatment information.
4. If you are instructed to go to an emergency room, take the poisonous substance or its container with you.

Guidelines for specific types of poisons:
- **Swallowed poisons.** Call the Poison Control Center or a physician for advice. Do not induce vomiting.
- **Poisons on the skin.** Remove any affected clothing. Flood affected parts of the skin with warm water, wash with soap and water, and rinse. Then call for advice.
- **Poisons in the eye.** For children, flood the eye with lukewarm water poured from a pitcher held 3–4 inches above the eye for 15 minutes; alternatively, irrigate the eye under a faucet. For adults, get in the shower and flood the eye with a gentle stream of lukewarm water for 15 minutes. Then call for advice.
- **Inhaled poisons.** Immediately carry or drag the person to fresh air and, if necessary, give rescue breaths (Figure A.1). If the victim is not breathing easily, call 9-1-1 for help. Ventilate the area. Then call the Poison Control Center for advice.

Fires

Each year, about 85% of fire deaths and 65% of fire injuries occur in the home. Careless smoking is the leading cause of home fire deaths. Cooking is the leading cause of home fire injuries.

To prevent fires:
- Dispose of all cigarettes in ashtrays. Never smoke in bed.
- Do not overload electrical outlets. Do not place extension cords under rugs or where people walk. Replace worn or frayed extension cords.
- Place a wire screen in front of fireplaces and woodstoves. Remove ashes carefully and store them in airtight metal containers, not paper bags.
- Properly maintain electrical appliances, kerosene heaters, and furnaces. Clean flues and chimneys annually.
**EMERGENCY CARE FOR CHOKING**

- If the victim is coughing, encourage the coughing to clear the object from the airway.
- If the victim is not coughing, follow the steps in “Choking Care for Responsive Adult or Child.”

**Choking Care for Responsive Adult or Child**

1. Stand behind an adult victim with one leg forward between the victim’s legs. (With a child, kneel behind the victim.) Keep your head slightly to one side. Reach around the abdomen with both arms. Make a fist with one hand and place the thumb side of the fist against the abdomen just above the navel.

2. Grasp your fist with your other hand and thrust inward and upward into the victim’s abdomen with quick jerks. Continue abdominal thrusts until the victim expels the object or becomes unresponsive. If the victim becomes unresponsive while you are administering abdominal thrusts, lower the victim to the floor onto his or her back, and follow the steps in “Choking Care for Unresponsive Adult or Child.”

**Choking Care for Unresponsive Adult or Child: CPR**

1. Call 911 and begin CPR.

2. Open the airway to see if the victim is breathing. Use the “head tilt–chin lift” maneuver to open the airway: Push down on the forehead and lift the chin.

3. If the victim is not breathing, give two rescue breaths, each lasting 1 second. Pinch the victim’s nose shut and blow a normal breath into the victim’s mouth. If the first breath does not go in (the chest does not rise), reposition the head to open the airway and try again. Each time you give a rescue breath, look for an object in the victim’s mouth and remove it if present.

4. If the obstruction remains, begin chest compressions. Place the heel of one hand in the center of the chest between the nipples and the other hand on top of the first. Position your shoulders over your hands and lock your elbows. Give 30 chest compressions at a rate of 100 per minute. The chest should go down by 1 1/2 to 2 inches. Then give two breaths, looking in the mouth for an expelled object. Continue chest compressions until help arrives. Remember: Push hard and push fast at a rate of 100 compressions per minute.

**EMERGENCY CARE FOR CARDIAC ARREST**

For cardiac arrest, the American Heart Association’s revised (2005) Emergency Cardiac Care guidelines are as follows:

1. Call 911.

2. Start CPR (100 compressions per minute, stopping every 30 to 60 seconds to give two rescue breaths).

3. If an automated external defibrillator (AED) is available, or when one arrives, give one shock to restart the victim’s heart.

4. Go back to CPR immediately after the shock.

**Hands-Only CPR**

In 2008, the American Heart Association reported that hands-only (compression-only) CPR can be as effective as conventional CPR. There are only two steps:

1. Call 911.

2. Push hard and fast in the center of the chest.

Don’t wait for an emergency to learn how to use an AED or perform CPR. To find a course in your area, contact the American Heart Association (800 242-8721) or the American Red Cross (202 303-4498).

**Figure A.1** Emergency care for choking and for cardiac arrest.

To be prepared for a fire:
- Plan at least two escape routes out of each room. Designate a location outside the home as a meeting place. Stage a home fire drill.
- Install a smoke detection device on every level of your home. Clean the detectors and test batteries once a month, and replace the batteries at least once a year.
- Keep a fire extinguisher in your home and know how to use it.

To prevent injuries from fire:
- Get out as quickly as possible and go to the designated meeting place. Don’t stop for a keepsake or a pet. Never hide in a closet or under a bed. Once outside, count heads to see if everyone is out. If you think someone is still inside the burning building, tell the firefighters. Never go back inside a burning building.
- If you’re trapped in a room, feel the door. If it is hot or if smoke is coming in through the cracks, don’t open it; use the alternative escape route. If you can’t get out of a room, go to the window and shout or wave for help.
- Avoid inhaling smoke. Smoke inhalation is the largest cause of death and injury in fires. To avoid inhaling smoke, crawl along the floor away from the heat and smoke. Cover your mouth and nose, ideally with a wet cloth, and take short, shallow breaths.
- If your clothes catch fire, don’t run. Drop to the ground, cover your face, and roll back and forth to smother the flames. Remember: Stop-drop-roll.

Suffocation and Choking
Suffocation and choking account for over 6,000 deaths annually in the United States. Children can suffocate if they put small items in their mouths, get tangled in their crib bedding, or get trapped in airtight appliances like old refrigerators. Keep small objects out of reach of children under age 3, and don’t give them raw carrots, hot dogs, popcorn, peanuts, or hard candy. Examine toys carefully for small parts that could come loose; don’t give plastic bags or balloons to small children.

Adults can also become choking victims, especially if they fail to chew food properly, eat hurriedly, or try to talk and eat at the same time. Many choking victims can be saved with abdominal thrusts, also called the Heimlich maneuver (see Figure A.1). Infants who are choking can be saved with blows to the upper back, followed by chest thrusts if necessary.

Incidents Involving Firearms
Firearms pose a significant threat of unintentional injury, especially to people between ages 5 and 29.

To prevent firearm injuries:
- Always treat a gun as though it were loaded, even if you know it isn’t.
- Never point a gun—loaded or unloaded—at something you do not intend to shoot.
- Always unload a firearm before storing it. Store unloaded firearms under lock and key, away from ammunition.

LEISURE INJURIES
Leisure injuries take place in public places but do not involve motor vehicles. Many injuries in this category involve such recreational activities as boating and swimming, playground activities, in-line skating, and sports.

Drowning and Boating Injuries
Although most drownings are reported in lakes, ponds, rivers, and oceans, more than half the drownings of young children take place in residential pools. Among adolescents and adults, alcohol plays a significant role in many boating injuries and drownings.

To prevent drowning and boating injuries:
- Develop adequate swimming skill and make sure children learn to swim.
- Make sure residential pools are fenced and that children are never allowed to swim without supervision.
- Don’t swim alone or in unsupervised places.
- Use caution when swimming in unfamiliar surroundings or for an unusual length of time. To avoid being chilled, don’t swim in water colder than 70°F.
- Don’t swim or boat under the influence of alcohol or other drugs. Don’t chew gum or eat while in the water.
- Check the depth of water before diving.
- When on a boat, use a life jacket (personal flotation device).

In-Line Skating and Scooter Injuries
Most in-line skating injuries occur because users are not familiar with the equipment and do not wear appropriate safety gear. Injuries to the wrist and head are the most common. To prevent injuries while skating, wear a helmet, elbow and knee pads, wrist guards, a long-sleeved shirt, and long pants.

Wearing a helmet and knee and elbow pads is also important for preventing scooter injuries. The rise in popularity of lightweight scooters has seen a corresponding increase in associated injuries. Scooters should not be viewed as toys, and young children should be closely supervised. Be sure that handlebars, steering column, and all nuts and bolts are securely fastened. Ride on smooth, paved surfaces away from motor vehicle traffic. Avoid streets and surfaces with water, sand, gravel, or dirt.

Sports Injuries
Since more people have begun exercising to improve their health, there has been an increase in sports-related injuries.

To prevent sports injuries:
- Develop the skills required for the activity. Recognize and guard against the hazards associated with it.
- Always warm up and cool down.
- Make sure facilities are safe.
- Follow the rules and practice good sportsmanship.
• Use proper safety equipment, including, where appropriate, helmets, eye protection, knee and elbow pads, and wrist guards. Wear correct footwear.
• When it is excessively hot and humid, avoid heat stress by following the guidelines given in Chapter 3.

**WORK INJURIES**

Many aspects of workplace safety are monitored by the Occupational Safety and Health Administration (OSHA), a federal agency. The Bureau of Labor Statistics estimates that more than 3 million Americans suffered injuries on the job in 2012. The highest rate of work-related injuries occurs among laborers, whose jobs usually involve extensive manual labor and lifting—two areas not addressed by OSHA safety standards. Back injuries are the most common work injury.

**To protect your back when lifting:**
- Don’t try to lift beyond your strength. If you need it, get help.
- Get a firm footing, with your feet shoulder-width apart. Get a firm grip on the object.
- Keep your torso in a relatively upright position and crouch down, bending at the knees and hips. Avoid bending at the waist. To lift, stand up or push up with your leg muscles. Lift gradually, keeping your arms straight. Keep the object close to your body.
- Don’t twist. If you have to turn with an object, change the position of your feet.
- Put the object down gently, reversing the rules for lifting.

Another type of work-related injury is damage to the musculoskeletal system from repeated strain on the hand, arm, wrist, or other part of the body. Such repetitive-strain injuries are proliferating due to increased use of computers. One type, carpal tunnel syndrome, is characterized by pain and swelling in the tendons of the wrists and sometimes numbness and weakness.

**To prevent carpal tunnel syndrome:**
- Maintain good posture at the computer. Use a chair that provides back support and place the feet flat on the floor or on a footrest.
- Position the screen at eye level and the keyboard so the hands and wrists are straight.
- Take breaks periodically to stretch and flex your wrists and hands to lessen the cumulative effects of stress.

**VIOLENCE AND INTENTIONAL INJURIES**

According to the Federal Bureau of Investigation (FBI), more than 1.2 million violent crimes occurred in the United States in 2012. Violence includes assault, sexual assault, homicide, domestic violence, suicide, and child abuse. Compared with rates of violence in other industrialized countries, U.S. rates are unusually high in two areas: homicide and firearm-related deaths.

**Assault**

Assault is the use of physical force to inflict injury or death on another person. Most assaults occur during arguments or in connection with another crime, such as robbery. Poverty, urban settings, and the use of alcohol and drugs are associated with higher rates of assault. Homicide victims are most likely to be male, between ages 19 and 24, and members of minority groups. Most homicides are committed with a firearm; the murderer and the victim usually know each other.

**To protect yourself at home:**
- Secure your home with good lighting and effective locks, preferably deadbolts. Make sure that all doors and windows are securely locked.
- Get a dog, or post “Beware of Dog” signs.
- Don’t hide keys in obvious places, and don’t give anyone the chance to duplicate your keys.
- Install a peephole in your front door. Don’t open your door to people you don’t know.
- If you or a family member owns a weapon, store it securely. Store guns and ammunition separately.
- If you are a woman living alone, use your initials rather than your full name on your door or buzzer. Don’t use a greeting on your answering machine that implies you live alone or are not home.
- Teach everyone in the household how to get emergency assistance.
- Know your neighbors. Work out a system for alerting each other in case of an emergency.
- Establish a neighborhood watch program.

**To protect yourself on the street:**
- Avoid walking alone, especially at night. Stay where people can see and hear you.
- Walk on the outside of the sidewalk, facing traffic. Walk purposefully. Act alert and confident. If possible, keep at least two arm lengths between yourself and a stranger.
- Know where you are going. Appearing to be lost increases your vulnerability.
- Carry valuables in a fanny pack, pants pocket, or shoulder bag strapped diagonally across the chest.
- Always have your keys ready as you approach your vehicle or home.
- Carry a whistle to blow if you are attacked or harassed. If you feel threatened, run and/or yell. Go into a store or knock on the door of a home. If someone grabs you, yell for help.

**To protect yourself in your car:**
- Keep your car in good working condition, carry emergency supplies, and keep the gas tank at least half full.
- When driving, keep doors locked and windows rolled up at least three-quarters of the way.
- Park your car in well-lit areas or parking garages, preferably those with an attendant or a security guard.
- Lock your car when you leave it, and check the interior before opening the door when you return.
- Don’t pick up strangers. Don’t stop for vehicles in distress; drive on and call for help.
- Note the location of emergency call boxes along highways and in public facilities. Carry a cell phone.
• If your car breaks down, raise the hood and tie a white cloth to the antenna or door handle. Wait in the car with the doors locked and windows rolled up. If someone approaches to offer help, open a window only a crack and ask the person to call the police or a towing service.
• When you stop at a light or stop sign, leave enough room to maneuver if you need an escape route.
• If you are involved in a minor automobile crash and you think you have been bumped intentionally, don’t leave your car. Motion to the other driver to follow you to the nearest police station.
• If confronted by a person with a weapon, give up your car.

To protect yourself on public transportation:
• While waiting, stand in a populated, well-lighted area.
• Make sure that the bus, subway, or train is bound for your destination before you board it. Sit near the driver or conductor in a single seat or an outside seat.
• If you flag down a taxi, make sure it’s from a legitimate service. When you reach your destination, ask the driver to wait until you are safely inside the building.

To protect yourself on campus:
• Make sure that door and window locks are secure and that halls and stairwells have adequate lighting.
• Don’t give dorm or residence keys to anybody.
• Don’t leave your door unlocked or allow strangers into your room.
• Avoid solitary late-night trips to the library or laundry room. Take advantage of on-campus escort services.
• Don’t exercise outside alone at night. Don’t take shortcuts across campus that are unfamiliar or seem unsafe.
• If security guards patrol the campus, know the areas they cover and stay where they can see or hear you.

Sexual Assault—Rape and Date Rape
The use of force and coercion in sexual relationships is one of the most serious problems in human interactions. The most extreme manifestation of sexual coercion—forcing a person to submit to another’s sexual desires—is rape. Taking advantage of circumstances that render a person incapable of giving consent (such as when drunk) is also considered sexual assault or rape. Coerced sexual activity in which the victim knows or is dating the rapist is often referred to as date rape.

An estimated 700,000 females are raped annually in the United States, and some males—perhaps 10,000 annually—are raped each year by other males. Research shows that 1 in 5 women and 1 in 71 men have experienced an attempted or completed rape. A study of college students also found that between 1 in 4 and 1 in 5 women experience a completed or attempted rape during their college years. Rape victims suffer both physical and psychological injury. The psychological pain can be substantial and long-lasting.

To protect yourself against rape:
• Follow the guidelines listed earlier for protecting yourself against assault.
• Trust your gut feeling. If you feel you are in danger, don’t hesitate to run and scream.
• Think out in advance what you would do if you were threatened with rape. However, no one knows what he or she will do when scared to death. Trust that you will make the best decision at the time—whether to scream, run, fight, or give in to avoid being injured or killed.

To protect yourself against date rape:
• Believe in your right to control what you do. Set limits and communicate them clearly, firmly, and early. Be assertive; men often interpret passivity as permission.
• If you are unsure of a new acquaintance, go on a group date or double date. If possible, provide your own transportation.
• Remember that some men think flirtatious behavior or sexy clothing indicates an interest in having sex.
• Remember that alcohol and drugs interfere with judgment, perception, and communication about sex. In a bar or at a party, don’t leave your drink unattended, and don’t accept opened beverages; watch your drinks being poured. At a party or club, check on friends and ask them to check on you.
• Use the statement that has proved most effective in stopping date rape: “This is rape and I’m calling the cops!”

If you are raped:
• Go to a safe place.
• Call the police. Tell them you were raped and give your location.
• Call someone you trust who can be with you and give support.
• Try to remember everything you can about your attacker and write it down.
• Don’t wash or douche before the medical exam. Don’t change your clothes, but bring a new set with you if you can.
• Be aware that at the hospital you will have a complete exam. Show the physician any bruises or scratches.
• Tell the police exactly what happened. Be honest and stick to your story.
• If you do not want to report the rape to the police, see a physician as soon as possible. Be sure you are checked for pregnancy and STDs.
• Contact an organization with skilled counselors so you can talk about the experience. Look in the telephone directory under “Rape” or “Rape Crisis Center” for a hotline number.

Guidelines for men (pursuing women, but the same guidelines apply to men pursuing men):
• Be aware of social pressure. It’s OK not to score.
• Understand that “No” means “No.” Stop making advances when your date says to stop. Remember that she has the right to refuse sex.
• Don’t assume that flirtatious behavior or sexy clothing means a woman is interested in having sex, that previous permission for sex applies to the current situation, or that your date’s relationships with other men constitute sexual permission for you.
• Remember that alcohol and drugs interfere with judgment, perception, and communication about sex.

Stalking and Cyberstalking
Stalking is characterized by harassing behaviors such as following or spying on a person and making verbal, written, or implied threats.
To protect yourself online:

- Never use your real name as an e-mail user name or chat room nickname. Select an age- and gender-neutral identity.
- Avoid filling out profiles for accounts related to e-mail use or chat room activities with information that could be used to identify you.
- Do not share personal information in public spaces anywhere online or give it to strangers.
- Learn how to filter unwanted e-mail messages.
- If you experience harassment online, do not respond to the harasser. Log off or surf elsewhere. Save all communications for evidence. If harassment continues, report it to the harasser’s Internet service provider, your Internet service provider, and the local police.
- Don’t agree to meet someone you’ve met online face-to-face unless you feel completely comfortable about it. Schedule a series of phone conversations first. Meet initially in a very public place and bring along a friend to increase your safety.

Coping After Terrorism, Mass Violence, or Natural Disasters

Trauma from natural disasters—for example, hurricanes, tornadoes, floods, and earthquakes—can be similar to trauma experienced from violent attacks. Whether episodes of mass violence such as occurred in New York 2001 and Boston 2013 or the multiple shootings that happen around the country each year, some people suffer direct physical harm and loss of loved ones. Many others experience emotional distress and are robbed of their sense of security.

Each person reacts differently to traumatic disaster, and it is normal to experience a variety of responses. Reactions may include disbelief and shock, fear, anger and resentment, anxiety about the future, difficulty concentrating or making decisions, mood swings, irritability, sadness and depression, panic, guilt, apathy, feelings of isolation or powerlessness, and many of the behavioral signs such as headaches or insomnia that are associated with excess stress (see Chapter 10). Reactions may occur immediately or may be delayed until weeks or months after the event.

Taking positive steps can help you cope with powerful emotions. Consider the following strategies:

- Share your experiences and emotions with friends and family members. Be a supportive listener. Reassure children and encourage them to talk about what they are feeling.
- Take care of your mind and body. Choose a healthy diet, exercise regularly, get plenty of sleep, and practice relaxation techniques.

Don’t turn to unhealthy coping techniques such as using alcohol or other drugs.

- Take a break from media reports and images, and try not to develop nightmare scenarios for possible future events.
- Reestablish your routines at home, school, and work.
- Find ways to help others. Donating money, blood, food, clothes, or time can ease difficult emotions and give you a greater sense of control.

Everyone copes with tragedy in a different way and recovers at a different pace. If you feel overwhelmed by your emotions, seek professional help. Additional information about coping with terrorism and violence is available from the Federal Emergency Management Agency (www.fema.gov), the U.S. Department of Justice (www.usdoj.gov), and the National Mental Health Association (www.nmha.org).

Emergency Preparedness

Most prevention and coping activities related to terrorism, mass violence, and natural disasters occur at the federal, state, and community levels. However, one step you can take is to put together an emergency plan and kit for your family or household that can serve for any type of emergency or disaster.

Emergency Supplies

Your kit of emergency supplies should include everything you’ll need to make it on your own for at least 3 days. You’ll need nonperishable food, water, first-aid and sanitation supplies, a battery-powered radio, clothing, a flashlight, cash, keys, copies of important documents, and supplies for sleeping outdoors in any weather. Remember special-needs items for infants, seniors, and pets. Supplies for a basic emergency kit are listed in Figure A.2; add to your kit based on your family situation and the type of problems most likely to occur in your area.

You may want to create several kinds of emergency kits. The primary one would contain supplies for home use. Put together a smaller, lightweight version that you can take with you if you are forced to evacuate your residence. Smaller kits for your car and your workplace are also recommended.

A Family or Household Plan

You and your family or household members should have a plan about where to meet and how to communicate. Choose at least two potential meeting places—one in your neighborhood and one or more in other areas. Your community may also have set locations for community shelters. Where you go may depend on the circumstances of the emergency situation. Use your common sense, and listen to the radio or television for instructions from emergency officials about whether to evacuate or stay in place. In addition, know all the transportation options in the vicinity of your home, school, and workplace; roadways and public transit may be affected, so a sturdy pair of walking shoes is a good item to keep in your emergency kit.

Everyone in the family or household should also have the same emergency contact person to call, preferably someone who lives outside the immediate area and won’t be affected by the same local disaster. Local phone service may be significantly disrupted, so long-distance
### Basic emergency supplies

<table>
<thead>
<tr>
<th>Category</th>
<th>Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food and related supplies</td>
<td>Manual (nonelectric) can opener, utility knife, paper towels</td>
</tr>
<tr>
<td>Water</td>
<td>Three-day-supply, at least 1 gallon of water per person per day, stored in plastic containers: ( \text{Number of people: } \frac{\text{people}}{1 \text{gal}} \times 1 \text{ gal} \times 3 \text{ days} = \text{total minimum gallons of water} )</td>
</tr>
<tr>
<td>Sanitation</td>
<td>Plastic garbage bags (and ties), toilet paper, moist towelettes or hand soap, washcloth and towel</td>
</tr>
<tr>
<td>Insect repellent</td>
<td>Insect repellent, antibiotic ointment, burn ointment, petroleum jelly or another lubricant, sterile adhesive bandages, several sizes, sterile rolled bandages and triangular bandages, cotton balls, eyewash solution, chemical heat and cold packs, aspirin or nonaspirin pain reliever</td>
</tr>
<tr>
<td>Food</td>
<td>Ready-to-eat canned meats, fruits, soups, and vegetables, protein or fruit bars, dry cereal or granola, peanut butter, sugar, salt, pepper, dried fruit, nuts, crackers, canned, powdered, or boxed juices, nonperishable pasteurized milk or powdered milk, coffee, tea, sodas, high-energy foods, comfort/stress foods, MREs (military rations), infant formula and baby foods, pet foods</td>
</tr>
<tr>
<td>Water purification tablets</td>
<td>Small cooking stove and cooking fuel (if food must be cooked), water purification tablets</td>
</tr>
<tr>
<td>First aid kit</td>
<td>Insect repellent, antibiotic ointment, burn ointment, petroleum jelly or another lubricant, sterile adhesive bandages, several sizes, sterile rolled bandages and triangular bandages, cotton balls, eyewash solution, chemical heat and cold packs, aspirin or nonaspirin pain reliever, anti-diarrhea medication, laxative, antacid, activated charcoal (use if advised by Poison Control Center), potassium iodide (use following radiation exposure if advised by local health authorities), prescription medications and prescribed medical supplies, list of medications, dosages, and any allergies, medicine dropper</td>
</tr>
<tr>
<td>Special needs items</td>
<td>Feminine hygiene supplies, denture needs, hearing aid or wheelchair batteries, other special equipment, pet care supplies, including leash, pet carrier, copy of vaccination history, and tie-out stakes, other list</td>
</tr>
<tr>
<td>Infant care needs</td>
<td>Infant care needs (formula, bottles, diapers, powdered milk, diaper rash ointment), books or toys, extra eyeglasses, contact lenses and supplies, extra eyeglasses, contact lenses and supplies, extra eyeglasses, contact lenses and supplies</td>
</tr>
<tr>
<td>Medication</td>
<td>Prescription medications and prescribed medical supplies, list of medications, dosages, and any allergies, medicine dropper</td>
</tr>
<tr>
<td>For a clean air supply</td>
<td>Face masks or several layers of dense-weave cotton material (handkerchiefs, T-shirts, towels) that fit snugly over your nose and mouth, shelter-in-place supplies, to be used in an interior room to create a barrier between you and potentially contaminated air outside: Heavyweight plastic garbage bags or plastic sheeting, duct tape, scissors, and if possible, a portable air purifier with a HEPA filter</td>
</tr>
</tbody>
</table>

### Family emergency plan

Plan places where your family will meet; choose one location near your home and one outside your neighborhood.

- **Local**
- **Outside neighborhood**

Have one local and one out-of-state contact person for family members to call if separated during a disaster. (It may be easier to make long-distance calls than local calls.)

- **Local**
- **Out-of-state**

**FIGURE A.2** Sample emergency preparedness kit and plan.
When You Have to Provide Emergency Care

Remain calm and act sensibly. The basic pattern for providing emergency care is check-call-care:

1. Check the situation. Make sure the scene is safe for both you and the injured person. Don’t put yourself in danger; if you get hurt, too, you will be of little help to the injured person.

2. Check the victim. Conduct a quick head-to-toe examination. Assess the victim’s signs and symptoms, such as level of responsiveness, pulse, and breathing rate. Look for bleeding and any indications of broken bones or paralysis.

3. Call for help. Call 9-1-1 or a local emergency number. Identify yourself and give as much information as you can about the condition of the victim and what happened.

4. Care for the victim. If the situation requires immediate action (no pulse, shock, etc.), provide first aid if you are trained to do so (refer back to Figure A.1).

Selected Bibliography


As explained in Chapters 2–7, regular, appropriate exercise is safe and beneficial for many people with chronic conditions or other special health concerns. In fact, for many people with special health concerns, the risks associated with not exercising are far greater than those associated with a moderate program of regular exercise.

The fitness recommendations made throughout this book are intended for the general population and can serve as basic guidelines for any exercise program. If you have a chronic health condition, however, you may need to modify your exercise program to accommodate your situation. This appendix presents precautions and specialized recommendations for people with a variety of special health concerns.

These recommendations, however, are not intended to replace a physician’s advice. If you have a special health concern, talk to your physician before starting any exercise program.

**ARTHRITIS**
- Begin an exercise program as early as possible in the course of the disease.
- Warm up thoroughly before each workout to loosen stiff muscles and lower the risk of injury.
- For cardiorespiratory endurance exercise, avoid high-impact activities that may damage arthritic joints. Consider swimming, water walking, or another type of exercise that can be done in a warm pool.
- Strength train the whole body. Pay special attention to muscles that support and protect affected joints. For example, build the quadriceps, hamstrings, and calf muscles to support and protect arthritic knees. Start with small amounts of weight and gradually increase the intensity of your workouts.
- Perform flexibility exercises daily to maintain joint mobility.

**ASTHMA**
- Exercise regularly. Acute attacks are more likely to occur if you exercise only occasionally.
- Carry medication during workouts and avoid exercising alone. Use your inhaler as recommended by your physician.
- Warm up and cool down slowly to reduce the risk of acute attacks.
- When starting an exercise program, choose self-paced endurance activities, especially those involving interval training (short bouts of exercise followed by a rest period). Gradually increase the intensity of your cardiorespiratory endurance workouts.
- Educate yourself about situations that can trigger an asthma attack and act accordingly when exercising. For example, cold, dry air can trigger or worsen an attack. Pollen, dust, and polluted air can also trigger an attack. To avoid attacks in dry air, drink water before, during, and after a workout to moisten your airways. In cold weather, cover your mouth with a mask or scarf to warm and humidify the air you breathe. Also, avoid outdoor activities during pollen season or when the air is polluted or dusty.

**DIABETES**
- Don’t begin an exercise program unless your diabetes is under control and you have discussed exercise safety with your physician. Because people with diabetes have an increased risk for heart disease, an exercise stress test may be recommended.
- Don’t exercise alone. Wear a bracelet that identifies you as someone with diabetes.
- If you take insulin or another medication, adjust the timing and amount of each dose as needed. Work with your physician and check your blood sugar level regularly so you can learn to balance your energy intake and output and your medication dosage.
- To prevent abnormally rapid absorption of injected insulin, inject it over a muscle that will not be exercised, and wait at least an hour before exercising.
- Check your blood sugar before, during, and after exercise. Adjust your diet and insulin dosage as needed. Keep high-carbohydrate foods on hand during a workout. Avoid exercise if your blood sugar level is above 250 mg/dl; if your blood sugar level is below 100 mg/dl, eat some carbohydrate-rich food before exercising.
- If you have poor circulation or numbness in your extremities, check your skin regularly for blisters and abrasions, especially on your feet. Avoid high-impact activities and wear comfortable shoes.
- For maximum benefit and minimum risk, choose moderate-intensity activities.

**HEART DISEASE AND HYPERTENSION**
- Check with your physician about exercise safety before increasing your activity level. Your doctor may recommend that you take an exercise stress test before starting your program.
- Exercise at moderate intensity rather than high intensity. Keep your heart rate below the level at which abnormalities appear on an exercise stress test.
- Warm up and cool down gradually. Every warm-up and cool-down session should last at least 10 minutes.
• Monitor your heart rate during exercise, and stop if you experience dizziness or chest pain.
• If your physician prescribes nitroglycerin, carry it with you during exercise. If you take a beta-blocker to manage hypertension, use RPE rather than heart rate to monitor your exercise intensity (beta-blockers reduce heart rate). Exercise at an RPE level of “fairly light” to “somewhat hard.” Your breathing should be unlabored, and you should be able to talk during exercise.
• Don’t hold your breath when exercising. Doing so can cause sudden, steep increases in blood pressure. Take special care during weight training and do not lift heavy loads. Exhale during the exertion phase of each lift.
• Increase exercise frequency, intensity, and time very gradually.

**OBESITY**

• For maximum benefit and minimum risk, begin by choosing low-to moderate-intensity activities. Increase intensity slowly as your fitness improves. Studies of overweight people show that exercising at moderate to high intensities causes more fat loss than training at low intensities.
• People who want to lose weight or maintain weight loss should exercise moderately for 60 minutes or more every day. To get the benefit of 60 minutes of exercise, you can exercise all at once or divide your total activity time into sessions of 10, 20, or 30 minutes.
• Choose non- or low-weight-bearing activities such as swimming, water exercises, cycling, or walking. Low-impact activities are less likely to cause joint problems or injuries.
• Stay alert for symptoms of heat-related problems during exercise (as described in Chapter 3). Obese people are vulnerable to heat intolerance.
• Ease into your exercise program and increase overload gradually. Increase time and frequency of exercise before increasing intensity.
• Include strength training in your fitness program to build or maintain muscle mass.
• Try to include as much lifestyle physical activity in your daily routine as possible.

**OSTEOPOROSIS**

• For cardiorespiratory endurance activities, exercise at the maximum intensity that causes no significant discomfort. If possible, choose low-impact, weight-bearing exercises to help safely maintain bone density. (See Chapter 8 for strategies for building and maintaining bone density.)
• To prevent fractures, avoid any activity or movement that stresses the back or carries a risk of falling.
• Include weight training in your exercise program to improve strength and balance and to reduce the risk of falls and fractures. Always use proper exercise technique and avoid lifting heavy loads.
• Include muscle-strengthening exercises three days per week.
• Include bone-strengthening exercises, such as jumping, at least three days per week, if they are safe for you. If you already have bone loss, avoid high-impact activities.
As you completed the labs listed below, you entered the results in the Preprogram Assessment column of this appendix. Now that you have been involved in a fitness and wellness program for some time, do the labs again and enter your new results in the Postprogram Assessment column. You will probably notice improvement in several areas. Congratulations! If you are not satisfied with your progress thus far, refer to the tips for successful behavior change in Chapter 1 and throughout this book. Remember fitness and wellness are forever. The time you invest now in developing a comprehensive, individualized program will pay off in a richer, more vital life in the years to come.

<table>
<thead>
<tr>
<th>LAB 2.3 Pedometer</th>
<th>Preprogram Assessment</th>
<th>Postprogram Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily steps: _____</td>
<td>Daily steps: _____</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LAB 3.1 Cardiorespiratory Endurance</th>
<th>Preprogram Assessment</th>
<th>Postprogram Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-mile walk test</td>
<td>( \dot{VO}_2 ): _____ Rating: _____</td>
<td>( \dot{VO}_2 ): _____ Rating: _____</td>
</tr>
<tr>
<td>3-minute step test</td>
<td>( \dot{VO}_2 ): _____ Rating: _____</td>
<td>( \dot{VO}_2 ): _____ Rating: _____</td>
</tr>
<tr>
<td>1.5-mile run-walk test</td>
<td>( \dot{VO}_2 ): _____ Rating: _____</td>
<td>( \dot{VO}_2 ): _____ Rating: _____</td>
</tr>
<tr>
<td>Beep test</td>
<td>( \dot{VO}_2 ): _____ Rating: _____</td>
<td>( \dot{VO}_2 ): _____ Rating: _____</td>
</tr>
<tr>
<td>12-minute swim test</td>
<td>Rating: _____</td>
<td>Rating: _____</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LAB 4.1 Muscular Strength</th>
<th>Preprogram Assessment</th>
<th>Postprogram Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum bench press test</td>
<td>Weight: _____ lb Rating: _____</td>
<td>Weight: _____ lb Rating: _____</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LAB 4.2 Muscular Endurance</th>
<th>Preprogram Assessment</th>
<th>Postprogram Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Curl-up test</td>
<td>Number: _____ Rating: _____</td>
<td>Number: _____ Rating: _____</td>
</tr>
<tr>
<td>Push-up test</td>
<td>Number: _____ Rating: _____</td>
<td>Number: _____ Rating: _____</td>
</tr>
<tr>
<td>Squat endurance test</td>
<td>Number: _____ Rating: _____</td>
<td>Number: _____ Rating: _____</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LAB 5.1 Flexibility</th>
<th>Preprogram Assessment</th>
<th>Postprogram Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sit-and-reach test</td>
<td>Score: _____ cm Rating: _____</td>
<td>Score: _____ cm Rating: _____</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LAB 5.3 Low-Back Muscular Endurance</th>
<th>Preprogram Assessment</th>
<th>Postprogram Assessment</th>
</tr>
</thead>
</table>
### APPENDIX C  MONITORING YOUR PROGRESS

#### LAB 6.1 Body Composition

<table>
<thead>
<tr>
<th>Preprogram Assessment</th>
<th>Postprogram Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Body Composition</strong></td>
<td></td>
</tr>
<tr>
<td>Body mass index</td>
<td>BMI: _____ kg/m² Rating: _____</td>
</tr>
<tr>
<td>Skinfold measurements (or other methods for determining percent body fat)</td>
<td>Sum of 3 skinfolds: _____ mm % body fat: _____% Rating: _____</td>
</tr>
<tr>
<td>Waist circumference</td>
<td>Circumf.: _____ Rating: _____</td>
</tr>
<tr>
<td>Waist-to-hip ratio</td>
<td>Ratio: _____ Rating: _____</td>
</tr>
</tbody>
</table>

#### LAB 8.1 Daily Diet

<table>
<thead>
<tr>
<th>Preprogram Assessment</th>
<th>Postprogram Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Daily Diet</strong></td>
<td></td>
</tr>
<tr>
<td>Number of oz-eq</td>
<td>Grains: _____</td>
</tr>
<tr>
<td>Number of cups</td>
<td>Vegetables: _____</td>
</tr>
<tr>
<td>Number of cups</td>
<td>Fruits: _____</td>
</tr>
<tr>
<td>Number of cups</td>
<td>Milk: _____</td>
</tr>
<tr>
<td>Number of oz-eq</td>
<td>Meat or beans: _____</td>
</tr>
<tr>
<td>Number of tsp</td>
<td>Oils: _____</td>
</tr>
<tr>
<td>Number of g</td>
<td>Solid fats: _____</td>
</tr>
<tr>
<td>Number of g or tsp</td>
<td>Added sugars: _____</td>
</tr>
</tbody>
</table>

#### LAB 8.2 Dietary Analysis

<table>
<thead>
<tr>
<th>Preprogram Assessment</th>
<th>Postprogram Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dietary Analysis</strong></td>
<td></td>
</tr>
<tr>
<td>Percentage of calories</td>
<td>From protein: _____ %</td>
</tr>
<tr>
<td>Percentage of calories</td>
<td>From fat: _____ %</td>
</tr>
<tr>
<td>Percentage of calories</td>
<td>From saturated fat: _____ %</td>
</tr>
<tr>
<td>Percentage of calories</td>
<td>From carbohydrate: _____ %</td>
</tr>
</tbody>
</table>

#### LAB 9.1 Daily Energy Needs

<table>
<thead>
<tr>
<th>Preprogram Assessment</th>
<th>Postprogram Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Daily Energy Needs</strong></td>
<td>Daily energy needs: _____ cal/day</td>
</tr>
</tbody>
</table>

#### LAB 10.1 Identifying Stressors

<table>
<thead>
<tr>
<th>Preprogram Assessment</th>
<th>Postprogram Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Identifying Stressors</strong></td>
<td>Average weekly stress score: _____</td>
</tr>
</tbody>
</table>

#### LAB 11.1 Cardiovascular Health

<table>
<thead>
<tr>
<th>Preprogram Assessment</th>
<th>Postprogram Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cardiovascular Health</strong></td>
<td>Score: _____ Estimated risk: _____</td>
</tr>
<tr>
<td>CVD risk assessment</td>
<td>Score: _____ Rating: _____</td>
</tr>
<tr>
<td>Hostility assessment</td>
<td>Score: _____ Rating: _____</td>
</tr>
</tbody>
</table>

#### LAB 12.1 Cancer Prevention

<table>
<thead>
<tr>
<th>Preprogram Assessment</th>
<th>Postprogram Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cancer Prevention</strong></td>
<td></td>
</tr>
<tr>
<td>Diet: Number of servings</td>
<td>Fruits/vegetables: _____</td>
</tr>
<tr>
<td>Skin cancer</td>
<td>Score: _____ Risk: _____</td>
</tr>
</tbody>
</table>
This workbook is designed to take you step by step through a behavior change program. The first eight activities in the workbook will help you develop a successful plan—beginning with choosing a target behavior, moving through the planning steps described in Chapter 1, and completing and signing a behavior change contract. The final seven activities will help you work through common obstacles to behavior change and maximize your program’s chances of success.

**Part 1  Developing a Plan for Behavior Change and Completing a Contract**

1. Choosing a Target Behavior
2. Gathering Information About Your Target Behavior
3. Monitoring Your Current Patterns of Behavior
4. Setting Goals
5. Examining Your Attitudes About Your Target Behavior
6. Choosing Rewards
7. Breaking Behavior Chains
8. Completing a Contract for Behavior Change

**Part 2  Overcoming Obstacles to Behavior Change**

9. Building Motivation and Commitment
10. Managing Your Time Successfully
11. Developing Realistic Self-Talk
12. Involving the People Around You
13. Dealing with Feelings
14. Overcoming Peer Pressure: Communicating Assertively
15. Maintaining Your Program over Time

**ACTIVITY 1  CHOOSING A TARGET BEHAVIOR**

Use your knowledge of yourself and the results of Lab 1.2 (Lifestyle Evaluation) to identify five behaviors that you could change to improve your level of wellness. Examples of target behaviors include smoking cigarettes, not exercising regularly, eating candy bars every night, not getting enough sleep, getting drunk frequently on weekends, and not wearing a safety belt when driving or riding in a car. List your five behaviors below.

1. __________________________
2. __________________________
3. __________________________
4. __________________________
5. __________________________

For successful behavior change, it’s best to focus on one behavior at a time. Review your list of behaviors and select one to start with. Choose a behavior that is important to you and that you are strongly motivated to change. If this will be your first attempt at behavior change, start with a simple change, such as wearing your bicycle helmet regularly, before tackling a more difficult change, such as quitting smoking. Circle the behavior on your list that you’ve chosen to start with; this will be your target behavior throughout this workbook.

**ACTIVITY 2  GATHERING INFORMATION ABOUT YOUR TARGET BEHAVIOR**

Take a close look at what your target behavior means to your health, now and in the future. How is it affecting your level of wellness? What diseases or conditions does this behavior place you at risk for? What will changing this behavior mean to you? To evaluate your behavior, use information from this text, from the resources listed in the For Further Exploration section at the end of each chapter, and from other reliable sources.
Health behaviors have short-term and long-term benefits and costs associated with them. For example, in the short term, an inactive lifestyle allows for more time to watch TV and hang out with friends but leaves a person less able to participate in recreational activities. In the long term, it increases the risk of cardiovascular disease, cancer, and premature death. Fill in the blanks below with the benefits and costs of continuing your current behavior and of changing to a new, healthier behavior. Pay close attention to the short-term benefits of the new behavior—these are an important motivating force behind successful behavior change programs.

**Target (current) behavior**

<table>
<thead>
<tr>
<th>Benefits</th>
<th>Short-Term</th>
<th>Long-Term</th>
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<tbody>
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<table>
<thead>
<tr>
<th>Costs</th>
<th>Short-Term</th>
<th>Long-Term</th>
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<tr>
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</table>

**New behavior**

<table>
<thead>
<tr>
<th>Benefits</th>
<th>Short-Term</th>
<th>Long-Term</th>
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<tbody>
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<th>Long-Term</th>
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**Activity 3: Monitoring Your Current Patterns of Behavior**

To develop a successful behavior change program, you need detailed information about your current behavior patterns. You can obtain this information by developing a system of record keeping geared toward your target behavior. Depending on your target behavior, you may want to monitor a single behavior, such as your diet, or you may want to keep daily activity records to determine how you could make time for exercise or another new behavior. Consider tracking factors such as the following:

- What the behavior was
- When and for how long it occurred
- Where it occurred
- What else you were doing at the time
- What other people you were with and how they influenced you
- What your thoughts and feelings were
- How strong your urge for the behavior was (for example, how hungry you were or how much you wanted to watch TV)

Figure 1.7 shows a sample log for tracking daily diet. Create a format for a sample daily log for monitoring the behavior patterns relating to your target behavior. Then use the log to monitor your behavior for a day. Evaluate your log as you use it. Ask yourself if you are tracking all the key factors that influence your behavior; make any necessary adjustments to the format of your log. Once you’ve developed an appropriate format, use a separate notebook (your health journal) to keep records of your behavior for a week or two. These records will provide solid information about your
behavior that will help you develop a successful behavior change program. Later activities in this workbook will ask you to analyze your records.

**ACTIVITY 4  SETTING GOALS**

For your behavior change program to succeed, you must set meaningful, realistic goals. In addition to an ultimate goal, set some intermediate goals—milestones that you can strive for on the way to your final objective. For example, if your overall goal is to run a 5K road race, an intermediate goal might be to successfully complete 2 weeks of your fitness program. If you set a final goal of eating 7 servings of fruits and vegetables every day, an intermediate goal would be to increase your daily intake from 3 to 4 servings. List your intermediate and final goals below. Don’t strive for immediate perfection. Allow an adequate amount of time to reach each of your goals.

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<th>Intermediate Goals</th>
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<tr>
<th>Final Goals</th>
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**ACTIVITY 5  EXAMINING YOUR ATTITUDES ABOUT YOUR TARGET BEHAVIOR**

Your attitudes toward your target behavior can determine whether your behavior change program will be successful. Consider your attitudes carefully by completing the following statements about how you think and feel about your current behavior and your goal.

1. I like ______________________ because ______________________ (current behavior)

2. I don’t like ______________________ because ______________________ (current behavior)

3. I like ______________________ because ______________________ (behavior goal)

4. I don’t like ______________________ because ______________________ (behavior goal)

5. I don’t ______________________, now because ______________________ (behavior goal)

6. I would be more likely to ______________________ if ______________________ (behavior goal)
If your statements indicate that you have major reservations about changing your behavior, work to build your motivation and commitment before you begin your program. Look carefully at your objections to changing your behavior. How valid and important are they? What can you do to overcome them? Can you adopt any of the strategies you listed under statement 6? Review the facts about your current behavior and your goals.

**ACTIVITY 6  CHOOSING REWARDS**

Make a list of objects, activities, and events you can use as rewards for achieving the goals of your behavior change program. Rewards should be special, relatively inexpensive, and preferably unrelated to food or alcohol—for example, tickets to a ball game, a new piece of clothing, or a walk with a friend—whatever is meaningful for you. Write down a variety of rewards you can use when you reach milestones in your program and your final goal.


Many people also find it helpful to give themselves small rewards daily or weekly for sticking with their behavior change program. These could be things like a study break, a movie, or a Saturday morning bike ride. Make a list of rewards for maintaining your program in the short term.


And don’t forget to congratulate yourself regularly during your behavior change program. Notice how much better you feel. Savor how far you’ve come and how you’ve gained control of your behavior.

**ACTIVITY 7  BREAKING BEHAVIOR CHAINS**

Use the records you collected about your target behavior in Activity 3 and in your health journal to identify what leads up to your target behavior and what follows it. By tracing these chains of events, you’ll be able to identify points in the chain where you can make a change that will lead to your new behavior. The sample behavior chain on the next page shows a sequence of events for a person who wants to add exercise to her daily routine—but who winds up snacking and watching TV instead. By examining the chain carefully, you can identify ways to break it at every step. After you review the sample, go through the same process for a typical chain of events involving your target behavior. Use the blank behavior chain on the following page.

Some general strategies for breaking behavior chains include the following:

- **Control or eliminate environmental cues that provoke the behavior.** Stay out of the room where your television is located. Go out for an ice cream cone instead of keeping a half gallon of ice cream in your freezer.

- **Change behaviors or habits that are linked to your target behavior.** If you always smoke in your car when you drive to school, try taking public transportation instead.

- **Add new cues to your environment to trigger your new behavior.** Prepare easy-to-grab healthy snacks and carry them with you to class or work. Keep your exercise clothes and equipment in a visible location.

See also the suggestions in Chapter 1.
Chain of Events

Come home from class
Feel tired, not like exercising
Look for walking shoes; can’t find them
Feel annoyed
Go to kitchen, see food
Feel hungry
Grab a soda and bag of chips
Turn on TV and sit down
Eat chips, watch TV
Feel guilty

Strategies for Breaking the Chain

You had planned an afternoon walk as part of your exercise program.
Tell yourself you’ll feel better and more alert after working out.
Put shoes and clothes for exercise in an obvious place the night before.
Remind yourself of your program goals, and tell yourself that you can stick with your program.
Stay out of the kitchen unless you will be fixing or eating a planned meal or snack.
Look at the picture of a healthy exercise that you’ve put on the refrigerator to remind you of your goals.
Have a glass of water or a pre-prepared healthy snack.
Turn on the radio instead; listen to news or music while you get ready to exercise.
If you really like to watch TV in the afternoon, plan to work out in the morning or exercise on a stationary bike or treadmill in front of the TV.
Even if you do have occasional lapses, don’t beat yourself up. Think positively about how you’ll resume your program the next day.
ACTIVITY 8  COMPLETING A CONTRACT FOR BEHAVIOR CHANGE

Your next step in creating a successful behavior change program is to complete and sign a behavior change contract. Your contract should include details of your program and indicate your commitment to changing your behavior. Use the information from previous activities in this workbook to complete the following contract. (If your target behavior relates to exercise, you may want to use the program plan and contract for a fitness program in Lab 7.1.)

1. I, ____________________________________________, agree to ____________________________________________.  
   (name)  (specify behavior you want to change)

2. I will begin on ___________________________ and plan to reach my goal of ___________________________ by _________________.  
   (start date)  (specify final goal)

3. To reach my final goal, I have devised the following schedule of mini-goals. For each step in my program, I will give myself the reward listed.

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<thead>
<tr>
<th>Mini-goal 1</th>
<th>Target Date</th>
<th>Reward</th>
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<th>Mini-goal 2</th>
<th>Target Date</th>
<th>Reward</th>
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<tr>
<th>Mini-goal 3</th>
<th>Target Date</th>
<th>Reward</th>
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<th>Mini-goal 4</th>
<th>Target Date</th>
<th>Reward</th>
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<tr>
<th>Mini-goal 5</th>
<th>Target Date</th>
<th>Reward</th>
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My overall reward for reaching my final goal will be ___________________________________________.

4. I have gathered and analyzed data on my target behavior and have identified the following strategies for changing my behavior:

   ___________________________________________.

   ___________________________________________.

   ___________________________________________.

5. I will use the following tools to monitor my progress toward reaching my final goal:

   (list any charts, graphs, or journals you plan to use)

   ___________________________________________.

I sign this contract as an indication of my personal commitment to reach my goal.

   (your signature)  (date)

I have recruited a helper who will witness my contract and ___________________________________________.

   (list any way in which your helper will participate in your program)

   (helper’s signature)  (date)
Describe in detail any special strategies you will use to help change your behavior (refer to Activity 7).

Create a plan for any charts, graphs, or journals you will use to monitor your progress. The log format you developed in Activity 3 may be appropriate, or you may need to develop a more detailed or specific record-keeping system. Examples of journal formats are included in Labs 3.2, 4.3, 5.2, 8.1, and 10.1. You might also want to develop a graph to show your progress; posting such a graph in a prominent location can help keep your motivation strong and your program on track. Depending on your target behavior, you could graph the number of push-ups you can do, the number of servings of vegetables you eat each day, or your average daily stress level.

**ACTIVITY 9  BUILDING MOTIVATION AND COMMITMENT**

Complete the following checklist to determine whether you are motivated and committed to changing your behavior. Check the statements that are true for you.

- [ ] I feel responsible for my own behavior and capable of managing it.
- [ ] I am not easily discouraged.
- [ ] I enjoy setting goals and then working to achieve them.
- [ ] I am good at keeping promises to myself.
- [ ] I like having a structure and schedule for my activities.
- [ ] I view my new behavior as a necessity, not an optional activity.
- [ ] Compared with previous attempts to change my behavior, I am more motivated now.
- [ ] My goals are realistic.
- [ ] I have a positive mental picture of the new behavior.
- [ ] Considering the stresses in my life, I feel confident that I can stick to my program.
- [ ] I feel prepared for lapses and ups-and-downs in my behavior change program.
- [ ] I feel that my plan for behavior change is enjoyable.
- [ ] I feel comfortable telling other people about the change I am making in my behavior.

Did you check most of these statements? If not, you need to boost your motivation and commitment. Consider these strategies:

- Review the potential benefits of changing your behavior and the costs of not changing it (see Activity 2). Pay special attention to the short-term benefits of changing your behavior, including feelings of accomplishment and self-confidence. Post a list of these benefits in a prominent location.

- Visualize yourself achieving your goal and enjoying its benefits. For example, if you want to manage time more effectively, picture yourself as a confident, organized person who systematically tackles important tasks and sets aside time each day for relaxation, exercise, and friends. Practice this type of visualization regularly.

- Put aside obstacles and objections to change. Counter thoughts such as “I’ll never have time to exercise” with thoughts like “Lots of other people do it, and so can I.”

- Bombard yourself with propaganda. Take a class dealing with the change you want to make. Read books and watch television shows on the subject. Post motivational phrases or pictures on your refrigerator or over your desk. Talk to people who have already made the change.

- Build up your confidence. Remind yourself of other goals you’ve achieved. At the end of each day, mentally review your good decisions and actions. See yourself as a capable person, as being in charge of your behavior.

List two strategies for boosting your motivation and commitment; choose from the list above, or develop your own. Try each strategy, and then describe how well it worked for you.
Strategy 1: ________________________________________________________________
How well it worked: ________________________________________________________

Strategy 2: ________________________________________________________________
How well it worked: ________________________________________________________

**ACTIVITY 10  MANAGING YOUR TIME SUCCESSFULLY**

“Too little time” is a common excuse for not exercising or engaging in other healthy behaviors. Learning to manage your time successfully is crucial if you are to maintain a wellness lifestyle. The first step is to examine how you are currently spending your time; use the following grid to track your activities.

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
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<tbody>
<tr>
<td>6:00 A.M.</td>
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<td>7:00 A.M.</td>
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<td>10:00 A.M.</td>
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<td>3:00 P.M.</td>
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<td>4:00 P.M.</td>
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<td>5:00 P.M.</td>
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<th>Time</th>
<th>Activity</th>
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<td>4:00 A.M.</td>
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<td>5:00 A.M.</td>
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Next, list each type of activity and the total time you engaged in it on a given day in the chart below (for example, sleeping, 7 hours; eating, 1.5 hours; studying, 3 hours; working, 3 hours; and so on). Take a close look at your list of activities. Successful time management is based on prioritization. Assign a priority to each of your activities according to how important it is to you: essential (A), somewhat important (B), or not important (C). Based on these priority rankings, make changes in your schedule by adding and subtracting hours from different categories of activities; enter a duration goal for each activity. Add your new activities to the list and assign a priority and duration goal to each.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Current Total Duration</th>
<th>Priority (A, B, or C)</th>
<th>Goal Total Duration</th>
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Prioritizing in this manner will involve trade-offs. For example, you may choose to reduce the amount of time you spend watching television, listening to music, and chatting on the telephone while you increase the amount of time spent sleeping, studying, and exercising. Don’t feel that you have to miss out on anything you enjoy. You can get more from less time by focusing on what you are doing. Strategies for managing time more productively and creatively are described in Chapter 10.

**ACTIVITY 11 DEVELOPING REALISTIC SELF-TALK**

Self-talk is the ongoing internal dialogue you have with yourself throughout much of the day. Your thoughts can be accurate, positive, and supportive, or they can be exaggerated and negative. Self-talk is closely related to self-esteem and self-concept. Realistic self-talk can help maintain positive self-esteem, the belief that you are a good and competent person, worthy of friendship and love. A negative internal dialogue can reinforce negative self-esteem and can make behavior change difficult. Substituting realistic self-talk for negative self-talk can help you build and maintain self-esteem and cope better with the challenges in your life.

First, take a closer look at your current pattern of self-talk. Use your health journal to track self-talk, especially as it relates to your target behavior. Does any of your self-talk fall into the common patterns of distorted, negative self-talk shown in Chapter 10? If so, use the examples of realistic self-talk from Chapter 10 to develop more accurate and rational responses. Write your current negative thoughts in the left-hand column, and then record more realistic thoughts in the right-hand column.

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<thead>
<tr>
<th>Current Self-Talk About Target Behavior</th>
<th>More Realistic Self-Talk</th>
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ACTIVITY 12 INVOLVING THE PEOPLE AROUND YOU

Your behavior change program will be more successful if the people around you are supportive and involved—or at least are not sabotaging your efforts. Use your health journal to track how other people influence your target behavior and your efforts to change it. For example, do you always skip exercising when you’re with certain people? Do you always drink or eat too much when you socialize with certain friends? Are friends and family members offering you enthusiastic support for your efforts to change your behavior, or do they make jokes about your program? Have they even noticed your efforts? Summarize the reactions of those around you in the chart below.

<table>
<thead>
<tr>
<th>Target behavior</th>
<th>Person</th>
<th>Typical Effect on Target Behavior</th>
<th>Involvement in/Reaction to Program</th>
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It may be difficult to change the actions and reactions of the people who are close to you. For them to be involved in your program, you may need to develop new ways of interacting with them (for example, taking a walk rather than going out to dinner as a means of socializing). Most of your friends and family members will want to help you—if they know how. Ask for exactly the type of help or involvement you want. Do you want feedback, praise, or just cooperation? Would you like someone to witness your contract or to be involved more directly in your program? Do you want someone to stop sabotaging your efforts by inviting you to watch TV, eat rich desserts, and so on? Look for ways that the people who are close to you can share in your behavior change program. They can help to motivate you and to maintain your commitment to your program. Develop a way that each individual you listed above can become involved in your program in a positive way.

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<thead>
<tr>
<th>Person</th>
<th>Target Involvement in Behavior Change Program</th>
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Choose one person on your list to tackle first. Talk to that person about her or his current behavior and how you would like her or him to be involved in your behavior change program. Below, describe this person’s reaction to your talk and her or his subsequent behavior. Did this individual become a positive participant in your behavior change program?

|                                               |
|                                               |
|                                               |
|                                               |
|                                               |
ACTIVITY 13  DEALING WITH FEELINGS

Long-standing habits are difficult to change in part because many of them represent ways people have developed to cope with certain feelings. For example, people may overeat when bored, skip their exercise sessions when frustrated, or drink alcoholic beverages when anxious. Developing new ways to deal with feelings can help improve the chance that a behavior change program will succeed.

Review the records on your target behavior that you kept in your health journal. Identify the feelings that are interfering with the success of your program, and develop new strategies for coping with them. Some common problematic feelings are listed below, along with one possible coping strategy for each. Put a check mark next to those that are influencing your target behavior, and fill in additional strategies. Add the other feelings that are significant roadblocks in your program to the bottom of the chart, along with coping strategies for each.

<table>
<thead>
<tr>
<th>Feeling</th>
<th>Coping Strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stressed out</td>
<td>Go for a 10-minute walk.</td>
</tr>
<tr>
<td>Anxious</td>
<td>Do one of the relaxation exercises described in Chapter 10.</td>
</tr>
<tr>
<td>Bored</td>
<td>Call a friend for a chat.</td>
</tr>
<tr>
<td>Tired</td>
<td>Take a 20-minute nap.</td>
</tr>
<tr>
<td>Frustrated</td>
<td>Identify the source of the feeling and deal with it constructively.</td>
</tr>
</tbody>
</table>

Add the other feelings that are significant roadblocks in your program to the bottom of the chart, along with coping strategies for each.
Consider the following situations:

- Julia is trying to give up smoking; her friend Marie continues to offer her cigarettes whenever they are together.
- Emilio is planning to exercise in the morning; his roommates tell him he’s being antisocial by not having breakfast with them.
- Tracy’s boyfriend told her that in high school he once experimented with drugs and shared needles; she wants him to have an HIV test, but he says he’s sure the people he shared needles with were not infected.

Peer pressure is the common ingredient in these situations. To successfully maintain your behavior change program, you must develop effective strategies for resisting peer pressure. Assertive communication is one such strategy. By communicating assertively—firmly, but not aggressively—you can stick with your program even in the face of pressure from others.

Review your health journal to determine how other people affect your target behavior. If you find that you often give in to peer pressure, try the following strategies for communicating more assertively:

- Collect your thoughts, and plan in advance what you will say. You might try out your response on a friend to get some feedback.
- State your case—how you feel and what you want—as clearly as you can.
- Use “I” messages—statements about how you feel—rather than “you” statements.
- Focus on the behavior rather than the person. Suggest a solution, such as asking the other person to change his or her behavior toward you. Avoid generalizations. Be specific about what you want.
- Make clear, constructive requests. Focus on your needs (“I would like . . .”) rather than the mistakes of others (“You always . . .”).
- Avoid blaming, accusing, and belittling. Treat others with the same respect you’d like to receive yourself.
- Ask for action ahead of time. Tell others what you would like to have happen; don’t wait for them to do the wrong thing and then get angry at them.
- Ask for a response to what you have proposed. Wait for an answer and listen carefully to it. Try to understand other people’s points of view, just as you would hope that others would understand yours.

With these strategies in mind, review your health journal and identify three instances in which peer pressure interfered with your behavior change program. For each instance, write out what you might have said to deal with the situation more assertively. (If you can’t think of three situations from your experiences, choose one or more of the three scenarios described at the beginning of this activity.)

1. 

2. 

3. 

Assertive communication can help you achieve your behavior change goals in a direct way by helping you keep your program on track. It can also provide a boost for your self-image and increase your confidence in your ability to successfully manage your behavior.

ACTIVITY 15 MAINTAINING YOUR PROGRAM OVER TIME

If you maintain your new behavior for at least 6 months, you’ve reached the maintenance stage, and your chances of lifetime success are greatly increased. However, you may find yourself sliding back into old habits at some point. If this happens, there are some things you can do to help maintain your new behavior.
- Remind yourself of the goals of your program (list them here).

- Pay attention to how your new pattern of behavior has improved your wellness status. List the major benefits of changing your behavior, both now and in the future.

- Consider the things you enjoy most about your new pattern of behavior. List your favorite aspects.

- Think of yourself as a problem solver. If something begins to interfere with your program, devise strategies for dealing with it. Take time out now to list things that have the potential to derail your program and develop possible coping mechanisms.

<table>
<thead>
<tr>
<th>Problem</th>
<th>Solution</th>
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- Remember the basics of behavior change. If your program runs into trouble, go back to keeping records of your behavior to pinpoint problem areas. Make adjustments in your program to deal with new disruptions. Don’t feel defeated if you lapse. The best thing you can do is renew your commitment and continue with your program.
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