More than half of the adults in the United States weigh more than is healthy.

Keeping body weight healthy requires balancing calorie intake with calorie expenditure.

The energy you obtain from food is used to keep you alive and moving and to process food.

Energy consumed in excess of needs is stored as fat; this stored fat is used when you eat fewer calories than you burn.

Genetics affect your propensity for storing excess body fat, but your food intake and activity level determine what you actually weigh.

The goal of weight management is to reduce body fat to a healthy level and maintain that level throughout life.

Weight loss requires reducing food intake and increasing activity; maintaining weight loss requires a permanent change in eating and exercise habits.

Eating disorders are psychological disorders that involve abnormal eating behaviors in response to an excessive concern with body size and weight.
Is Obesity a Disease?
Insurance, Drug Access May Hinge on Answer
By Rob Stein, Staff Writer

Monday, Nov. 10, 2003—The rising number of Americans who are seriously overweight has triggered intense debate among scientists, advocacy groups, federal agencies, insurance companies and drug makers about whether obesity should be declared a “disease,” a move that could open up insurance coverage to millions who need treatment for weight problems and could speed the approval of new diet drugs.

To read the entire article, go to www.washingtonpost.com.
to tobacco use as the leading cause of preventable death in the United States. Estimates suggest that obesity costs about $99.2 billion—more than the health-care costs incurred by daily smokers and heavy drinkers. The more people who are obese, the higher the nation’s health care expenses and the cost to society as a whole in terms of lost wages and productivity. To solve the obesity problem, we need to understand why so many of us are overweight and what we can do to change this trend.

We Are in the Midst of an Obesity Epidemic

In 1960, 13.4% of adults were obese; in 1991, 23% were obese; and now, a decade later, 31% are obese (Figure 7.1). The dramatic rise in the incidence of overweight and obesity that has occurred in the United States over the last few decades has led medical and public health officials to call the situation epidemic. Obesity-related health complications directly affect a greater proportion of the population than either the Black Death, a plague that killed about half the population of Europe in the 14th century, or the influenza epidemic of 1918, which infected a fifth of the world’s population. Sixty-four percent of American adults are overweight, and about half of these people carry enough extra fat to be considered obese. The obesity epidemic affects both men and women and spans every culture in the nation. Among African Americans, over 60% of men and 78% of women are overweight; among Mexican Americans, over 74% of men and 71% of women are overweight. The problem is not limited to adults. Ten percent of children between 2 and 5 years of age are overweight, and 15% of children and teens 6 to 19 years of age are overweight.

**FIGURE 7.1**
These maps, which show the percentage of the adult population that was obese in each state in 1991 (top map) and 2002 (bottom map), illustrate the dramatic rise in the incidence of obesity. In 1991 there were no states that had rates of obesity that exceeded 19%. By 2002 over half the states had rates of 20% or greater. (Obesity Trends Among US Adults, BRFSS, 1991–2002, Centers for Disease Control)}
Although the numbers are most striking for the United States, obesity is a growing concern worldwide. In Canada between 1978 and 1992, obesity increased from 8 to 12% among women and from 9 to 14% among men. In Europe, the incidence of obesity has increased by 10 to 40% in the last 10 years. Obesity is even becoming a problem in developing nations, where we typically think of undernutrition as the main concern. In Brazil between 1974 and 1997, obesity increased from 4.1 to 13.9%. In Western Samoa, where a strong genetic predisposition toward obesity had already made obesity rates high, it increased still further between 1978 and 1991, from 39 to 58% among men and from 60 to 77% among women.

**Excess body fat increases disease risk**

Your body weight is the sum of the weight of your fat and your lean tissue or lean body mass, which includes muscles, organs, and bones. A high body weight may be due to large muscles or to excess body fat. If the extra weight is due to excess fat, then it increases your risk of a host of chronic health problems, including high blood pressure, heart disease, high blood cholesterol, diabetes, stroke, gallbladder disease, arthritis, sleep disorders, respiratory problems, and cancers of the breast, uterus, prostate, and colon (Table 7.1). Obesity also increases the incidence and severity of infectious disease and has been linked to poor wound healing and surgical complications. It increases pregnancy risks for both the mother and child. The more overweight you are, the greater your health risks. The longer you are overweight, the greater the risks.

**TABLE 7.1**

**Excess Weight Increases Health Risks**

- **Cardiovascular disease is more likely when body weight is elevated**
  - Blood pressure increases as body weight increases
  - Triglyceride levels increase as body weight increases
  - LDL cholesterol increases as body weight increases
  - HDL cholesterol falls as body weight increases

- **Type 2 diabetes risk increases with body weight**
  - Fasting blood sugar increases with increasing body weight
  - Eighty percent of people with type 2 diabetes are obese
  - Incidence increases as much as 30-fold with a BMI >35

- **Respiratory problems are more common in overweight people**
  - Sleep apnea is more common in overweight people
  - The workload of muscles used for breathing increases
  - Asthma is worse

- **Gallbladder disease is more common in overweight people**

- **Osteoarthritis and degenerative joint disease increase with increasing weight**

- **Menstrual irregularities are increased in overweight women**

- **Cancer risk is higher in overweight people**
  - Obese women are at increased risk for cancers of the endometrium, breast, cervix, and ovaries
  - Obese men are at increased risk for colorectal and prostate cancer

- **A sedentary lifestyle further increases risk**
  - Obese individuals who are inactive have higher risks of illness and death
  - Inactivity increases the likelihood of developing diabetes and heart disease

We Are in the Midst of an Obesity Epidemic

For the first time in human history, the number of overweight people in the world rivals the number of underweight people. According to the Worldwatch Institute, a Washington, D.C.-based research organization, the number of underfed people has declined slightly since 1980 to about 1.1 billion, while the number of overweight people has surged to 1.1 billion.

**Lean body mass** Body mass attributed to nonfat body components such as bone, muscle, and internal organs. It is also called fat-free mass.
those who gain excess weight at a young age and remain overweight throughout life have the greatest health risks.

Carrying excess body fat also has psychological and social consequences. Our society puts a high value on physical appearance. Being thin is considered attractive and being fat is not. Those who do not conform to standards may pay a high psychological and social price. For example, overweight children are often teased and ostracized. This teasing about body weight is associated with low body satisfaction, low self-esteem, depression, social isolation, and thinking about and attempting suicide.\(^8,9\) If obese children grow into obese adolescents and adults, and most of them do, they may experience discrimination in college admissions and in the job market, in the workplace, and even on public transportation. Obese individuals of every age are more likely to experience depression, a negative self-image, and feelings of inadequacy.\(^10\) The physical health consequences of obesity may not manifest themselves as disease for years, but the psychological and social problems experienced by the obese are felt every day.

**A change in lifestyle can help stem the obesity epidemic**

Reversing the obesity epidemic is a monumental but not insurmountable task. Obesity is caused by consuming more calories than you burn in activity over a long period of time. Preventing obesity requires maintaining **energy balance** by matching intake with output in the short term and in the long term. On a personal level, this means paying attention to which foods you choose, how much you eat, and what you do. It involves choosing more nutrient-dense foods, consuming smaller portions than we are accustomed to, and learning to incorporate exercise into our recreation and everyday life. As a society we need to make this doable by transforming cities and communities into places where it is easy to walk or bike to the store, school, or office; by manufacturing healthier foods and packaging and serving them in more reasonable portion sizes; and by incorporating exercise into the school day and the work day. The only way to stop the obesity epidemic is to change the way we eat and the way we live, the factors that caused average American body weight to increase in the first place. The causes of obesity and solutions to the problem for individuals and the population are discussed more throughout the chapter.

**Body Fat: How Much and Where Determines the Risk**

Some body fat is essential for health; it cushions our organs, insulates us from changes in temperature and provides stored energy for times of need, but how much is too much? The answer depends on who you are. In general, women store more body fat than men, so the level that is healthy for women is somewhat higher. A healthy level of body fat for a young adult female is between 21 and 33% of total weight; for young adult males, it is between 8 and 20%.\(^11\) With aging, lean body mass decreases and body fat increases, even if body weight remains the same (Appendix B). Some of this change may be prevented by physical activity.

**There are many techniques for measuring body composition**

The proportion of body weight that is fat compared to lean, or body composition, can be measured by a variety of different techniques (Table 7.2). Some of these measurements can be made in a doctor’s office or at a health club; others require expensive, sophisticated equipment and are most often used in research settings. Currently the easiest and therefore most popular way to measure body composition is with a technique that measures current flow through the body, called **bioelectric impedance analysis**. This involves holding a meter or standing on a scale that passes a painless, low-energy electrical current through the body; the rate of current flow can be used to calculate the ratio of lean tissue to fat. Although this measurement is quick and easy
Body Fat: How Much and Where Determines the Risk

and available at many gyms and health clubs, it is not always accurate. To be accurate, measurements need to be made when your stomach and bladder are empty and you are normally hydrated. Measurements are less accurate after a meal or exercise session. Another inexpensive and non-invasive technique for estimating body composition is measuring skinfold thickness. The thickness of the skin and fat layer that lies over the muscles is measured at several locations on the arms, legs, and/or abdomen using a caliper (Figure 7.2). These measurements are accurate if they are done by someone trained in the technique. A more precise method is underwater weighing. This involves weighing someone on land and under water to calculate body density and, subsequently, the amount of body fat. Although this method is accurate, it cannot be

### Table 7.2
**Measuring Body Composition**

<table>
<thead>
<tr>
<th>Method</th>
<th>How Does It Work?</th>
<th>Pros and Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bioelectric impedance</td>
<td>Measures current flow through the body; since fat resists current flow, more fat means more resistance to flow</td>
<td>Fast, easy, and inexpensive; inaccurate if body water is not normal, such as after heavy exercise</td>
</tr>
<tr>
<td>Skinfold thickness</td>
<td>Measures subcutaneous fat at several locations, based on the assumption that subcutaneous fat is representative of total body fat</td>
<td>Fast, easy, inexpensive; can be inaccurate if not performed by a trained observer</td>
</tr>
<tr>
<td>Underwater weighing</td>
<td>Uses the difference between weight on land and weight under water to calculate body density; if you are more dense, you have less fat</td>
<td>Accurate; can’t be used for children or ill or frail adults</td>
</tr>
<tr>
<td>Air displacement (Bod Pod)</td>
<td>Measures air displacement in a closed chamber and uses this to calculate body density; if you are more dense, you have less fat</td>
<td>Accurate and easy for the subject; expensive, not readily available</td>
</tr>
<tr>
<td>Dilution</td>
<td>Measures the concentration of a detectable water-soluble substance that has been ingested or injected into the bloodstream and allowed to mix with the water throughout the body; the more it has been diluted by body water, the greater the amount of lean tissue</td>
<td>Accurate; expensive, invasive, and may involve the use of radioactive substances</td>
</tr>
<tr>
<td>Dual-energy X-ray absorptiometry (DEXA)</td>
<td>Uses low-energy X-rays for assessing body composition</td>
<td>A single investigation can accurately determine total body mass, bone mineral mass, and percent body fat; expensive and it does not distinguish between visceral and subcutaneous fat</td>
</tr>
<tr>
<td>Computerized tomography (CT)</td>
<td>Uses X-rays to visualize fat and lean tissue</td>
<td>Useful for measuring the amount of visceral fat; expensive</td>
</tr>
<tr>
<td>Magnetic resonance imaging (MRI)</td>
<td>Uses magnetic fields to create an internal body image</td>
<td>Accurately measures visceral fat; expensive</td>
</tr>
</tbody>
</table>

**Figure 7.2**

Measurements of skinfold thickness at several locations can be used to estimate total body fat. The triceps skinfold shown here is measured at the midpoint of the back of the arm. (David Young-Wolff/PhotoEdit)
used for small children or frail adults, and it is less portable than skinfold or impedance measures. Other methods for measuring the amount of fat are listed in Table 7.2; most of these are more expensive and invasive.

**Body Mass Index can determine if your weight is in the healthy range**

**Body Mass Index (BMI)** is an index of body weight in relation to height. Although BMI is not actually a measure of body fat, it is recommended as a better way to assess body fatness than measuring weight alone.\(^{12}\) BMI is calculated according to the following equation:

\[
BMI = \frac{\text{weight in kg}}{(\text{height in m})^2}
\]

or

\[
BMI = \frac{\text{weight in pounds}}{(\text{height in inches})^2 \times 703}
\]

For example, someone who is 6 feet (72 inches) tall and weighs 180 pounds has a Body Mass Index of 24.5 kg/m\(^2\) \((180/72^2 = 24.5 \text{ kg/m}^2)\).

Figure 7.3 can be used to determine BMI and see if it is in the healthy range for adults. A healthy BMI for adults is between 18.5 and 24.9 kg/m\(^2\). In general, people

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**Body Mass Index (BMI)** An index of weight in relation to height that is used to compare body size with a standard.

**FIGURE 7.3**

To determine your BMI range, locate your weight (in pounds) on the bottom scale and draw a vertical line up from this point. Locate your height (in feet and inches) on the left scale and draw a horizontal line that extends into the graph. The point where these two lines meet indicates your BMI status. (Report of the Dietary Advisory Committee on the Dietary Guidelines for Americans, 2000.)
with a BMI in this range have the lowest health risks. Those with a BMI of less than 18.5 kg/m² are considered underweight. Those whose BMI is between 25 and 29.9 kg/m² are overweight, and those with a BMI of 30 kg/m² or greater are obese. A BMI of 40 or over is classified as extreme or morbid obesity.

**Being underweight leaves no body reserves** Some people are naturally lean, and this reduces their health risks. Research has suggested that being on the low side of the body weight standard may reduce the risk of diabetes and other chronic diseases and may even increase longevity (see chapter 13). But body fat is needed for cushioning, as an insulator, and as a reserve for periods of illness. People with little energy reserves are at a disadvantage during a famine or when battling a disease such as cancer that causes wasting and malnutrition.

When leanness is due to intentional or forced food restriction rather than a lifetime of being lean, the health consequences could be severe. Substantial reductions in body weight due to starvation or eating disorders decrease the ability of the immune system to fight disease, and very low body weight is associated with an increased risk of early death. Too little body fat can cause problems at all stages of life. During adolescence it can delay sexual development. During pregnancy, too little weight gain increases the risk that the baby will have health complications, and in the elderly too little body fat increases the risk of malnutrition. Therefore, statistically a low body weight is associated with an increased risk of early death.

**A high BMI doesn’t always mean you have too much fat** Even though BMI correlates well with body fat, it is not a perfect tool for evaluating the health risks associated with obesity. This is particularly true in athletes who have highly developed muscles; their BMI may be high because they have an unusually large amount of lean body mass. In these individuals BMI is high, but body fat and hence disease risk are low (Figure 7.4). BMI is also not suitable to evaluate weight in pregnant and lactating women, because a higher body weight is normal. It is also not accurate in individuals who have lost muscle, such as many older adults. Although BMI can be a useful tool, because of these limitations, other information is also needed to determine nutritional health and fitness. Someone who is in the overweight category on the basis of BMI but consumes a healthy diet and exercises regularly may be more fit and have a lower risk of chronic disease than someone with a BMI in the healthy range who is sedentary and eats a poor diet.

**Where your body fat is located affects your health risks**

Where you store your body fat affects the health risks associated with having too much. Fat that is located under the skin, called subcutaneous fat, carries less risk than fat that is deposited around the organs in the abdomen, called visceral fat. An increase in visceral fat is associated with a higher incidence of heart disease, high blood pressure, stroke, diabetes, and breast cancer. Generally, fat in the hips and lower body is subcutaneous, whereas fat deposited around the waist in the abdominal region is primarily visceral fat. Therefore, people who carry their excess fat around and above the waist have more visceral fat. Those who carry their extra fat below the waist in the hips and thighs have more subcutaneous fat. In the popular literature, these body types have been dubbed apples and pears, respectively (Figure 7.5).

Where your extra fat is deposited is determined primarily by your genes. Visceral fat storage is more common in men than women. African American women store less visceral fat than Caucasian women, even though they have a higher overall incidence of obesity. Age and environment also influence where fat is stored. After menopause, visceral fat increases in women. Stress, tobacco use, and alcohol consumption predispose people to visceral fat deposition, whereas physical activity reduces it.

To determine if your body fat is a concern, you can measure your BMI and waist circumference. For males, a BMI of 25 to 34.9 kg/m² and a waist circumference greater than 40 inches indicates abdominal fat storage and is associated with increased risk. For

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**Underweight** A BMI of less than 18.5 kg/m².

**Extreme or morbid obesity** A condition in which BMI is greater than 40 kg/m².

**Subcutaneous fat** Body fat that lies under the skin.

**Visceral fat** Body fat that lies around internal organs.
Chapter 7 Managing Your Weight

Females in this BMI range, waist circumference of greater than 35 inches increases risks (Table 7.3). In order to monitor body weight and risk, the Dietary Guidelines for Americans, 2000, recommends that all Americans keep track of their weight and their waists and avoid increases in both.

TABLE 7.3
Does Your Body Mass Index Increase Your Disease Risk?

<table>
<thead>
<tr>
<th>Weight Class</th>
<th>BMIa</th>
<th>Disease Riskb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overweight</td>
<td>25.0–29.9</td>
<td>Increased</td>
</tr>
<tr>
<td>Obesity (class I)</td>
<td>30.0–34.9</td>
<td>High</td>
</tr>
<tr>
<td>Obesity (class II)</td>
<td>35.0–39.9</td>
<td>Very high</td>
</tr>
<tr>
<td>Extreme or morbid obesity (class III)</td>
<td>≥40</td>
<td>Extremely high</td>
</tr>
<tr>
<td>Underweight</td>
<td>&lt;18.5</td>
<td></td>
</tr>
<tr>
<td>Normal weight</td>
<td>18.5–24.9</td>
<td></td>
</tr>
</tbody>
</table>

*aBMI = Body Mass Index: body weight (kg)/height squared (m²)

*bDisease risk for type 2 diabetes, hypertension, and cardiovascular disease relative to individuals with a normal weight and normal waist circumference.

prevent significant changes in weight or fat. This is why your weight remains fairly constant even when you increase your exercise level—perhaps on a weekend hiking trip. It is also why most people gain back weight that they lose when they follow a weight-loss diet.

**Obesity genes regulate body weight and fatness**

Genes involved in regulating body fatness have been called **obesity genes** because an abnormality in one or more of these could result in obesity. More than 300 genes and regions of human chromosomes have been linked to obesity. These genes are responsible for the production of proteins that affect how much food you eat and how much energy you expend and regulate the way fat is stored in your body. The combined effects of all these genes help to determine and regulate what you weigh and how much fat you carry.

To regulate weight and fatness at a constant level, the body must be able to respond both to changes in food intake that occur over a short time frame as well as to more long-term changes in the amount of stored body fat. Signals related to food intake affect **hunger** or **satiety** over a short period of time—from meal to meal—whereas signals from the **adipose tissue** trigger the brain to adjust both food intake and energy expenditure for long-term regulation.

**How much you eat at each meal is affected by internal signals** How do you know how much to eat for breakfast or when it is time to eat lunch? The physical sensations of hunger or satiety that determine how much you eat at each meal are triggered by signals from the gastrointestinal tract, levels of circulating nutrients, and messages from the brain. Some signals are sent before we eat to tell us we are hungry, some are sent while food is in the GI tract, and some occur once nutrients are circulating in the bloodstream.

The simplest type of signal about how much food you have eaten comes from local nerves in the walls of the stomach and small intestine that sense the volume or pressure of food and send a message to your brain to either start or stop eating. Once you have eaten, nutrients in the GI tract send information directly to the brain and trigger the release of hormones that tell us to stop eating. Once nutrients have been absorbed, circulating levels of nutrients, including glucose, amino acids, ketones, and fatty acids, are monitored by the brain and may trigger signals to eat or not to eat. There are many different signals that regulate different aspects of food intake. For instance, the hormone insulin is released by the pancreas in response to the intake of carbohydrate. Insulin allows glucose to be taken up by cells, thereby reducing circulating levels of...
glucose and increasing hunger. The hormone ghrelin may be the reason you typically feel hungry around lunchtime, regardless of when and how much you had for breakfast. It is produced by the stomach and is believed to stimulate your desire to eat at usual meal times. Levels rise an hour or two before a meal and drop very low after a meal. Overproduction of ghrelin could contribute to obesity because levels have been found to increase in people who have lost weight, increasing their desire to eat more. Another hormone (peptide PYY) causes a reduction in appetite. It is released from the gastrointestinal tract after a meal and the amount released is proportional to the calories in the meal. Some food intake signals even trigger the consumption of specific nutrients. For example, when levels of the neurotransmitter serotonin are low, we have been found to crave carbohydrate, but when it is high, we prefer protein.

**Long-term regulation monitors the amount of body fat**

Sometimes we don’t pay attention to whether or not we are full and make room for dessert anyway. If this happens often enough, it can cause an increase in body weight and fatness. To return fatness to a set level, the body must be able to monitor how much fat is present. Some of this information comes from hormones, such as insulin and leptin that are secreted in proportion to the amount of body fat. Levels of insulin in the blood increase with the amount of body fat. Insulin affects food intake and body weight by sending appetite-suppressing signals to the brain and by affecting the amount of leptin produced and secreted. Leptin is a hormone produced by the adipocytes. The amount of leptin produced is proportional to the size of adipocytes, so more leptin is released as fat stores grow. Leptin travels in the blood to the hypothalamus, where it binds to proteins called leptin receptors. When leptin levels are high, mechanisms that cause an increase in energy expenditure and a decrease in food intake are stimulated, and pathways that promote food intake and, hence, weight gain are inhibited. When fat stores shrink, less leptin is released. Low leptin levels in the brain allow pathways that decrease energy expenditure and increase food intake to become active. Thus, leptin acts like a thermostat or lipostat to keep body fatness from changing (Figure 7.7).

**FIGURE 7.7**

Leptin helps maintain body fat at a preset level. When adipocytes gain fat, more leptin is released, triggering events that decrease food intake and increase energy expenditure. When fat is lost, less leptin is released, causing an increase in food intake and a decrease in energy expenditure.

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**Ghrelin** A hormone produced by the stomach that stimulates food intake.

**Leptin** A protein hormone produced by adipocytes that signals information about the amount of body fat.

**Adipocytes** Fat-storing cells.

**Hypothalamus** The region of the brain that monitors and regulates conditions and activities in the body, including food intake and energy expenditure.

**Throughout human history, starvation has threatened survival. Thus, over time the human body has developed ways to conserve body fat stores and prevent weight loss. Today more of us are concerned about eating too much than not enough. Unfortunately, preventing weight gain is not in our evolutionary repertoire. We complain about how hard it is to lose weight, but it is after all our ability to store and preserve body fat that has allowed us to survive the famines that have plagued us in the past.**
Your set point for body weight may change over time
If body weight is regulated at a particular set point, then why are so many of us getting fatter? It appears that the mechanisms that defend body weight are not absolute. Changes in physiological, psychological, and environmental circumstances do cause the level at which body weight is regulated to change, usually increasing it over time. For example, body weight increases in most adults between the ages of 30 and 60 years, and after having a baby, most women return to a weight that is 1 to 2 pounds higher than their pre-pregnancy weight. This suggests that the mechanisms that defend against weight loss are stronger than those that prevent weight gain.23

Defective obesity genes may promote excess fat storage
When a gene is defective, the protein it codes for is not made or is made incorrectly. When an obesity gene, such as the gene for leptin, is defective, the signals to decrease food intake and/or increase energy expenditure are not received, and weight gain results (Figure 7.8). A few cases of human obesity have been linked directly to defects in the genes for leptin and leptin receptors.24 But mutations in single genes such as these are not responsible for most human obesity. Rather, variations in many genes interact with one another and affect metabolic rate, food intake, fat storage, and activity level. These in turn affect overall body shape and size.

Most overweight people do not have a slower metabolism
Many overweight people contend that they eat almost nothing and yet continue to gain weight. This would imply that they expend less energy than normal-weight individuals. One possible explanation for this is that overweight people use their calories very efficiently, so they don’t need to eat as much to maintain their body weight. The results of studies comparing food intake and body weight have been mixed. Part of the problem is that overweight individuals are more likely to under-report their food intake than their lean counterparts. Studies measuring energy expenditure and body weight show that calorie use increases with increasing body weight; this suggests that overweight individuals need to eat more than their lean counterparts to maintain their higher body weight.25 Although some individuals may need fewer calories than others to maintain weight, there is little evidence that an efficient metabolism is a factor in the majority of cases of human obesity.

Overweight people may be less efficient at burning off extra calories
Your body has mechanisms that are designed to keep your weight at a specific set point. When you overeat occasionally, your metabolism speeds up to burn the extra calories and prevent weight gain.26 Conversely, when you decrease your food intake, the rate at which your body uses calories slows. These changes in the amount of energy you expend in response to changes in circumstance, such as overeating or undereating, changes in temperature, or trauma, are referred to as adaptive thermogenesis.

Several biochemical mechanisms have been proposed to explain adaptive thermogenesis. One mechanism simply wastes energy by allowing opposing biochemical reactions to occur simultaneously. For example, a molecule is formed and then broken down. The result is that calories are burned, but there is no net change in the number of molecules in the body and, therefore, no storage of energy as fat. Another mechanism that may explain adaptive thermogenesis is that excess energy is dissipated by separating or uncoupling the breakdown of energy-yielding nutrients from the production of ATP. When this occurs, energy is lost as heat. Animals have a specialized type of adipose tissue called brown adipose tissue that is particularly good at wasting energy as heat. It contains many more mitochondria (where aerobic metabolism occurs) than the more common white adipose tissue, and these mitochondria can be uncoupled to release the energy in food as heat. In rats, brown adipose tissue generates heat to prevent weight gain during overfeeding and to provide warmth when the environmental temperature is low. Brown adipose tissue is unlikely to play a major role in

Overweight people must eat more than lean individuals of the same age and height because they have more tissue to fuel and maintain. This is frustrating to dieters because, as they lose weight, the amount they can eat without weight gain decreases.
preventing weight gain in humans because, except for newborns, people have only a very small amount of brown adipose tissue. What may be significant are other tissues, including muscle, white adipose tissue, lung, spleen, white blood cells, bone marrow, and stomach, that may also be able to increase energy output to regulate body weight.27

**Overweight people may be less active** Activity burns calories; this is true whether the activity is planned exercise, daily activities like housework and walking between classes, or small, involuntary actions like fidgeting and moving to maintain your posture. How active you are is affected by your genes and your personal choices. Studies that compared body fat to activity level have found that those with the most body fat have the lowest levels of physical activity.28 This tells us that obese people are less active, but it does not mean the reduced physical activity is the cause of the obesity. Overweight people may be less active because it is more difficult to exercise or even to perform simple daily activities when carrying excess weight. However, differences in the amount of involuntary activity, such as fidgeting, may be one reason some people gain weight more easily. In a study that overfed normal-weight individuals, there was a 10-fold variation in the amount of fat they gained. Some subjects were able to increase energy expenditure to a greater extent and thus gained less fat. About two-thirds of the increase in energy expenditure that occurred with overfeeding was found to be due to an increase in involuntary exercise.29 Those who gained the least weight had the greatest levels of involuntary exercise. It is still not known what mechanisms control why some people respond to excess energy by becoming restless and fidgeting more, while others remain lethargic and gain weight.

What you weigh is a balance between your genes and your lifestyle

Obesity genes determine your propensity to carry extra fat. If one or both of your parents is obese, your risk of becoming obese is increased. Individuals with a family history of obesity are two to three times more likely to be obese, and the risk increases with the magnitude of the obesity.30 But even if you inherit genes that predispose you to being overweight, your actual weight is determined by the balance between the genes you inherit and the lifestyle choices you make. Someone with a genetic predisposition to obesity who carefully monitors their diet and exercises regularly may never be obese, but someone with no genetic tendency toward obesity who consumes a high-energy diet and gets little exercise may end up overweight. When genetically susceptible individuals find themselves in an environment where food is appealing and plentiful and physical activity is easily avoided, obesity is a likely outcome. An example of human obesity that clearly demonstrates the interaction of a genetic predisposition and an environment that is conducive to obesity is the Pima Indian population living in Arizona. More than 75% of the adults in this population are obese. Genetic analysis has identified a number of genes that may be responsible for this group’s tendency to store more body fat.31 Their current lifestyle demands little physical activity and includes lots of high-calorie foods. The outcome is the strikingly high incidence of obesity. In contrast, there is a genetically similar group of Pima Indians living in Mexico, but they are farmers who work in the fields and consume the food they grow.32 They still have higher rates of obesity than would be predicted from their diet and exercise patterns, suggesting genes that favor high body weight. However, they are significantly less obese than the Arizona Pima Indians.

**Balance What You Eat with What You Do**

How many calories do you need to maintain your weight? The answer depends on how many calories you use. This varies depending on how big you are, how old you are, whether you are male or female, and how active you are. If you eat the same amount of
energy—or number of calories—as you use, you will be in a state of energy balance and your body weight will remain the same. This doesn't necessarily mean you will be at a healthy weight; it just means that your intake is balanced with your expenditure.

The energy needed to fuel your body comes from the food you eat and the energy stored in your body. You use this energy to stay alive, process your food, move, and grow. If you consume more energy than you expend, the excess energy will be stored for later use, mostly as fat, and your weight will increase. If you expend more energy than you consume, stored energy will be used to fuel your body and you will lose weight.

**We get energy from the carbohydrate, fat, and protein in our food**

How much energy you consume depends on how much and what you eat. The calories in a specific food can be measured in a laboratory with an instrument called a bomb calorimeter (Figure 7.9). Since calories are units of heat, the heat generated by burning the food can be measured in calories. Bomb calorimeters were used to determine the amount of energy provided by carbohydrate, fat, protein, and alcohol: 4, 9, 4, and 7 Calories per gram, respectively. Vitamins, minerals, and water, though essential nutrients, do not provide energy to the body. If you know the composition of a food, you can use these numbers to calculate the calories it provides. For example, 5 grams of sugar, which is almost pure carbohydrate, contains about 20 Calories (5 g × 4 Cal/g). Five grams of corn oil, which is almost pure fat, contains about 45 Calories (5 g × 9 Cal/g). Most foods provide a combination of protein, carbohydrate, and fat. For instance, a taco with beef, cheese, sour cream, lettuce, and tomato contains about 9 grams of protein, 16 grams of carbohydrate, and 13 grams of fat (Figure 7.10). Its energy content is therefore as follows:

\[
(9 \text{ g} \times 4 \text{ Cal/g protein}) + (16 \text{ g} \times 4 \text{ Cal/g carbohydrate}) + (13 \text{ g} \times 9 \text{ Cal/g fat}) = 217 \text{ Calories}
\]

You can also find out how many calories are in the foods you eat by looking this information up in food composition tables and databases or by reading food labels. On a food label this information can be found in the Nutrition Facts, which list the total Calories in a serving of food (see Off the Label: How Many Calories in that Bowl, Box,
Off the Label: How Many Calories in that Bowl, Box, or Bar?

Are you looking for foods that will help you maintain a healthy weight? Fresh fruits and vegetables are always a good choice. But for packaged foods, you need to check the label. Be sure you know what the terms mean.

The Nutrition Facts portion of a food label lists the Calories per serving, but it is also important to check the serving size. For instance, the standard serving of cookies is usually one ounce, or about three cookies. If you eat 12 cookies, you are consuming four times the Calories listed on the label for a standard serving.

People tend to eat in units—one can of juice, one bottle of iced tea, one bag of potato chips—but food labels don’t always reflect the calorie count for that unit. For example, on a hot day a bottle of iced tea or fruit juice may be just what you need to cool off. The label says that a serving has only 100 Calories. Take a closer look. The serving size is 8 ounces and the bottle is 20 ounces. So your cool gulp of iced tea may be giving you 250 Calories, mostly as added sugars.

One of the recommendations of the FDA’s Working Group on Obesity is to label as single servings those foods for which the entire contents of the package typically are consumed at one time. For example, a 20-ounce bottle of soda would be labeled as containing 275 Calories per bottle rather than 110 Calories per 8 ounces. It has also been suggested that the label design be changed so that the number of Calories is more prominent on the food label.

In evaluating the calorie content of a food, you may also see descriptors such as “low-calorie,” “calorie-free,” “reduced-calorie,” and “light.” These terms are defined so they can be helpful in selecting foods. A food labeled “low-calorie” must have no more than 40 Calories per serving. A product labeled “calorie-free,” must contain fewer than 5 Calories in a serving. “Reduced-calorie” or “fewer calories” on the label means the product contains at least 25% fewer calories per serving than a reference food. “Light” or “lite” may be used to describe foods that contain one-third fewer calories or half the fat of a comparable product. For example, the label on “lite” microwave popcorn or “light” corn chips must state both the number of Calories per serving and the fact that this is 30% fewer than the regular product. The terms “light” and “lite” are also used to describe food properties such as texture and color. For example, a label that says “light in texture” means just that; it does not mean that the calories are reduced. The term “light” may also appear without explanation on foods like brown sugar, cream, or molasses, which have traditionally included the term as part of their name.

Watch out for low-fat and low-carbohydrate products. These are often popular choices among dieters, but they should be chosen with care. Low-fat foods may contain fewer calories than the full-fat version, but the difference may be minimal. The FDA has not yet defined “low-carb” or “low-carbohydrate,” so these terms are at the discretion of the manufacturer. The bottom line on using food labels is to read and understand the entire label before assuming that you are making the best choice.

Reference
activity. In individuals who are growing or pregnant, total energy expenditure also includes the energy used to deposit new tissues. In women who are lactating, it includes the energy used to produce milk. There is also a small amount of energy used to maintain body temperature in a cold environment.

Most of our energy is used to maintain basic body functions. About 60 to 75% of the body’s total energy expenditure is for basal metabolism. Basal metabolism includes all of the involuntary things your body does to keep you alive such as breathing, circulating blood, regulating body temperature, synthesizing tissues, removing waste products, and sending nerve signals. The rate at which energy is used for these basic functions is called basal metabolic rate (BMR) and is often expressed in Calories per hour. Basal needs include the energy necessary for essential metabolic reactions and life-sustaining functions but do not include the energy needed for physical activity or for the digestion and absorption of food. BMR is measured in the morning in a warm room before the subject rises and at least 12 hours after food intake or activity in order to minimize residual energy being used for activity or processing food. Because of the difficulty of achieving these conditions, measures are often made after about 5 to 6 hours without food or exercise. When determined under these conditions, the rate of energy expenditure is referred to as resting metabolic rate (RMR). RMR values are about 10 to 20% higher than BMR values.

Basal needs are affected by how much you weigh and how much of your weight is lean tissue. It increases with increasing body weight and thus is higher in heavier individuals. It also rises with the amount of lean body mass; BMR is generally higher in men than in women because men have greater lean body mass. BMR decreases with age, partly because of the decrease in lean body mass that usually occurs in older adults.

Basal needs can be altered by certain conditions. For instance, BMR is decreased when calorie intake is consistently below needs. This drop in BMR decreases the amount of energy needed to maintain weight. It is a beneficial adaptation in someone who is starving, but in someone who is trying to lose weight it is frustrating because it

<table>
<thead>
<tr>
<th>Exchange Groups/Lists</th>
<th>Foods</th>
<th>Serving Size</th>
<th>Energy (Cal)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Carbohydrate Group</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Starch</td>
<td>Rice, cereal, potatoes</td>
<td>1/2 cup</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>Bread</td>
<td>1 slice</td>
<td></td>
</tr>
<tr>
<td>Fruit</td>
<td>Apple, peach, pear</td>
<td>1 small</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>Banana</td>
<td>1/2 medium</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Canned fruit</td>
<td>1/2 cup</td>
<td></td>
</tr>
<tr>
<td>Milk</td>
<td>Milk or yogurt</td>
<td>1 cup</td>
<td>90–110</td>
</tr>
<tr>
<td>Reduced-fat</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whole</td>
<td></td>
<td></td>
<td>120</td>
</tr>
<tr>
<td>Vegetables</td>
<td>Cooked vegetables</td>
<td>1/2 cup</td>
<td>Varies</td>
</tr>
<tr>
<td></td>
<td>Raw vegetables</td>
<td>1 cup</td>
<td></td>
</tr>
<tr>
<td><strong>Meat Group</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Very lean</td>
<td></td>
<td></td>
<td>35</td>
</tr>
<tr>
<td>Lean</td>
<td></td>
<td></td>
<td>55</td>
</tr>
<tr>
<td>Medium fat</td>
<td></td>
<td></td>
<td>75</td>
</tr>
<tr>
<td>High fat</td>
<td></td>
<td></td>
<td>100</td>
</tr>
<tr>
<td><strong>Fat Group</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Butter, oil, margarine</td>
<td>1 tsp</td>
<td>45</td>
<td></td>
</tr>
</tbody>
</table>

**TABLE 7.4** Exchange Lists Estimate the Calories in Your Diet

On the Side

Someone whose total energy expenditure is 2500 Cal/day may use 1500 to 1800 of this for basic body functions.
makes weight loss more difficult. Abnormal levels of thyroid hormones can also affect basal needs. Individuals who overproduce these hormones require more energy, and those who underproduce them require less energy. The fact that thyroid hormones, produced by the thyroid gland, affect energy expenditure is the reason obesity was once explained as a glandular problem. It is now known that obesity due to a lack of thyroid hormones is rare. An elevation in body temperature, such as that which occurs with a fever, increases energy needs. It is estimated that for every 1 degree Fahrenheit above normal body temperature, there is a 7% increase in BMR. This extra energy use explains why people often lose weight when they have a fever.

**Energy expended in physical activity varies greatly** Physical activity is the second major component of energy expenditure. In most people it accounts for a smaller proportion of total energy expenditure than basal metabolism: about 15 to 30% of energy requirements in most cases. In some athletes and laborers it may account for a higher percentage of total energy expenditure. The energy expended for activity is the one component of our total energy needs over which we have control. It includes the energy we use for planned exercise as well as for performing the activities of daily life, such as cooking, gardening, and walking the dog. Often a person’s occupation has a great effect on their energy needs. For example, a construction worker who spends 8 hours a day doing physical labor uses a great deal more energy in his daily activities than does an office worker who spends most of his day sitting at a desk (Figure 7.11).

The amount of energy expended for various activities depends on how strenuous the activity is and the length of time it is performed. Jogging for 30 minutes uses more energy than walking for 30 minutes, but if you walk for an hour you will probably burn as many calories as you would jogging for 30 minutes. Energy expenditure is also affected by body size. Because it takes more energy to move a heavier object, the amount of energy expended for many activities increases as body weight increases. For example, a 120-pound person uses about 190 Calories walking for an hour, but a 180-pound person will expend 290 Calories for the same walk. The energy costs of specific activities are listed in Appendix J.

**A small amount of energy is needed to digest, absorb, and use the nutrients in food** Our energy comes from food, but we also need energy to digest food and to absorb, metabolize, and store the nutrients from this food. The energy used for these processes is called the **thermic effect of food (TEF)** or **diet-induced thermogenesis**. This increase in energy expenditure causes body temperature to rise slightly for several hours after eating. The energy required for TEF is estimated to be about 10% of energy intake but can vary, depending on the amounts and types of nutrients consumed. Because it takes energy to store nutrients, TEF increases with the size of the meal. The composition of meals also affects TEF. A meal that is high in fat has a lower TEF than a meal high in carbohydrate or protein because dietary fat can be efficiently stored as body fat. This difference in the energy cost of storing energy means a diet high in fat may produce more body fat than a diet high in carbohydrate.³⁵
Energy can be added to or removed from body stores

When you eat a meal, the energy contained in that meal is used to fuel your body. When you consume more than you need the extra is stored. Your body stores a small amount of energy as glycogen and a large amount as fat. Between meals or when you reduce your intake for a longer time, you still need energy, and some of it must come from glucose. To get this energy, our bodies rely on energy stores. When your energy intake exceeds your needs, body stores get bigger

People typically eat three to six times during the day. The sum of the intake for all of these meals and snacks must meet energy needs for weight to remain stable, but each time we eat we are likely to consume more energy than is needed at that moment in time. The body must therefore decide which nutrients it will use immediately and which it will store for later. This is determined on the basis of what the body needs, which nutrients can be stored, and how efficiently they can be stored. When alcohol is consumed, it is quickly broken down and used for energy. This is because it is toxic and the body cannot store it. When protein is consumed, its constituent amino acids are used to synthesize body proteins and other nitrogen-containing molecules. Then, any excess amino acids are broken down and used for energy. When carbohydrate is consumed, it is used to supply blood glucose and to build glycogen stores in the liver and in muscles. Once glycogen stores are full, the remaining carbohydrate is used for energy. When fat is consumed, it is used to meet immediate energy needs and any remaining dietary fat is stored as triglycerides, primarily in adipose tissue. These cells grow as they accumulate more fat (Figure 7.12). The greater the number of adipocytes an individual has, the greater the ability to store fat. Most adipocytes are formed between infancy and adolescence. In adulthood, only excessive weight gain can cause the production of new fat cells.

Most of the fat that is stored in the body comes from fat consumed in the diet (Figure 7.13). This is because excess dietary fat is easy to store as body fat. Dietary fat can be transported directly to the adipose tissue, where the enzyme lipoprotein lipase breaks the triglycerides into fatty acids and glycerol, which can then enter the adipocytes, where they are reassembled into triglycerides for storage. The body is capable of converting excess carbohydrate and amino acids into fat for storage. However, under normal dietary circumstances, this doesn’t occur because it involves numerous metabolic reactions and the body must expend energy in the conversion process.

When your energy intake does not meet your needs, body stores are used

When your diet doesn’t provide enough energy, you must use your body stores. Between meals, you break down liver glycogen in order to maintain a steady supply of blood glucose. But liver glycogen is limited. When you haven’t eaten in a while, you retrieve energy from these stores. A small amount of body protein is also broken down to make glucose. If you don’t eat for a long time, there are other metabolic changes that occur to ensure your energy needs are met.
don’t eat for longer periods of time, your body must find another source of glucose. This source is small amounts of body protein, primarily muscle protein, which are broken down to yield amino acids that can then be used to make glucose. The breakdown of protein to provide energy and glucose results in the loss of functional body proteins.

Energy for tissues that don’t require glucose is provided by the breakdown of stored fat (see Figure 7.13). If the supply of glucose is limited, such as during starvation, fatty acids delivered to the liver cannot be completely broken down, so ketones are produced (see Chapter 4). Ketones can be used as an energy source by many tissues. After about 3 days of starvation, even the brain adapts to meet some of its energy needs from ketones (see Chapter 5). This reduces the amount of glucose needed and therefore slows the rate of protein breakdown.

When our meals are a few hours apart, some glycogen and fat stores are used between meals and then replaced by the energy consumed in the next meal so that there is no net change in the amount of stored energy. However, if energy stores are not replenished, the amount of stored energy, mostly fat, will be reduced and weight will decrease. The amount of weight lost depends on the degree of energy deficit and the length of time over which it occurs. It is estimated that an energy deficit of about 3500 Calories results in the loss of a pound of fat.

EERs estimate the number of calories you need for energy balance

The current recommendations for energy intake in the United States are the estimated energy requirements (EERs). Equations to calculate EERs were developed by measuring energy expenditure in individuals at various levels of activity. EER equations are available for healthy people of defined age, gender, weight, height, life stage, and level of physical activity. Your EER is the estimated number of calories you need to maintain your current weight.

Energy expenditure can be measured directly or indirectly The amount of energy used by the body can be measured in a number of ways. One method measures the amount of heat released by the body. This is called direct calorimetry and is based on the fact that the amount of heat your body produces is proportional to the amount of energy used. Direct calorimetry is an accurate method for measuring energy expenditure, but it is expensive and impractical because it requires that the individual being assessed remain in an insulated chamber to measure heat release throughout the evaluation. Indirect calorimetry determines energy expenditure by measuring the amount of oxygen used and carbon dioxide produced by the body. Energy use can be calculated from these values because the burning of carbohydrate, fat, and protein in aerobic metabolism uses oxygen and produces carbon dioxide. Although the equipment needed for indirect calorimetry is much more compact than the insulated chamber needed for direct calorimetry, it is still too cumbersome for long-term use in free-living individuals (Figure 7.14). The least invasive method of determining energy expenditure is the doubly labeled water method. This method involves ingesting or injecting water labeled with isotopes of oxygen and hydrogen. Energy use is estimated by measuring the rate at which labeled oxygen and labeled hydrogen disappear from body water. The doubly labeled water technique does not require the individual to carry any equipment and can be used to measure expenditure in free-living subjects for periods up to 2 weeks. Measurements made using doubly labeled water are the basis of current EER equations.

To calculate your EER, start by estimating your level of activity In order to calculate how many calories you need using the EER equations, first you have to estimate your activity level. The DRIs have defined four physical activity levels: sedentary, low active, active, and very active. A “sedentary” person does not participate in any activity beyond that required for daily independent living, such as housework, homework, yard work, and gardening. To be in the “low active”
category, an adult weighing 70 kg would need to expend an amount of energy equivalent to walking 2.2 miles at a rate of 3 to 4 miles per hour in addition to the activities of daily living. To be "active," the same person would need to perform daily exercise equivalent to walking 7 miles at a rate of 3 to 4 miles per hour, and to be "very active," an individual would need to perform the equivalent of walking 17 miles at this rate in addition to the activities of daily living. In order to maintain a healthy weight and reduce the risk of chronic disease, physical activity at the "active" level is recommended. Not all of us have time to walk for an hour and three quarters, but if we engage in more intense activity we will expend the same number of calories in less time.

You can estimate your activity level by keeping a daily log of your activities and recording the amount of time spent in each. Activities can then be categorized as activities of daily living, moderate, or vigorous (Table 7.5). You can find your activity level by estimating the time you spend in each category of activity. As seen in Table 7.6, each physical activity level is assigned a numerical physical activity (PA) value that can then be used in the EER calculation. It is important to carefully estimate activity level because it has a significant effect on calorie needs. For example, a 22-year-old man who is 6 feet tall and weighs 185 pounds needs about 2770 Cal/day if he is at a sedentary activity level. If he increases his activity to "active," the level recommended by the DRIs, his EER increases to 3350 Cal/day.

Your gender, age, size, and life stage affect your calorie needs. Your calorie needs are affected by your age, gender, height, weight, and life stage (Table 7.7 or inside cover). To determine your EER, enter your age in years, height in meters, weight in kilograms, and PA value into the equation that is appropriate for your age and gender. The EER values for infants, children, and adolescents include the energy used to deposit tissues associated with growth. Beginning at age 3 years, there are separate EER equations for boys and girls because of differences in growth and physical activity. The EER for pregnancy is determined as the sum of the

| TABLE 7.5  
How Active Are You? |
<table>
<thead>
<tr>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Activities of Daily Living</strong></td>
</tr>
<tr>
<td>Gardening (no lifting)</td>
</tr>
<tr>
<td>Watering plants</td>
</tr>
<tr>
<td>Raking leaves</td>
</tr>
<tr>
<td>Mowing the lawn</td>
</tr>
<tr>
<td>Household tasks</td>
</tr>
<tr>
<td>Mopping</td>
</tr>
<tr>
<td>Vacuuming</td>
</tr>
<tr>
<td>Walking from the house to car or bus</td>
</tr>
<tr>
<td>Loading/unloading the car</td>
</tr>
<tr>
<td>Walking the dog</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
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<tr>
<td></td>
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<tr>
<td></td>
</tr>
</tbody>
</table>

*It is assumed that we spend about 2.5 hours per day in these types of activities.

†Activities that expend about 250 to 350 Cal/hour for a 150-lb individual.

‡Activities that expend more than 350 Cal/hour for a 150-lb individual.
### Table 7.6
Find Your Physical Activity (PA) Value

<table>
<thead>
<tr>
<th>Physical Activity Level</th>
<th>PA Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>3–18 Years Old</strong></td>
<td></td>
</tr>
<tr>
<td>Boys</td>
<td>1.00</td>
</tr>
<tr>
<td>Girls</td>
<td>1.00</td>
</tr>
<tr>
<td><strong>19 Years Old</strong></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>1.00</td>
</tr>
<tr>
<td>Women</td>
<td>1.00</td>
</tr>
</tbody>
</table>

**Moderate or vigorous activities**

### Table 7.7
How Many Calories Do You Need?

To determine estimated energy requirement (EER):

- Find your weight in kilograms (kg) and your height in meters (m)

  \[
  \text{Weight in kilograms} = \text{weight in pounds} \div 2.2 \text{ lbs/kg} \\
  \text{Height in meters} = \text{height in inches} \times 0.0254 \text{ inches/m} \\
  \text{For example:} \ 160 \text{ pounds} \div 2.2 \text{ lbs/kg} = 72.7 \text{ kg} \\
  5 \text{ feet 9 inches} = 69 \text{ inches} \times 0.0254 \text{ in/m} = 1.75 \text{ m}
  \]

- Estimate the amount of physical activity you get per day and use Table 7.6 to find the PA value for someone of your age, gender, and activity level. For example, if you are a 19-year-old male who performs 40 minutes of vigorous activity a day, you are in the active category and have a PA of 1.25.

- Choose the appropriate EER prediction equation below and calculate your EER. For example, if you are an active 19-year-old male:

  \[
  \text{EER} = 662 - (9.53 \times \text{age in yr}) + \text{PA} [(15.91 \times \text{weight in kg}) + (539.6 \times \text{height in m})] \\
  \text{Where age} = 19 \text{ yr}, \text{weight} = 72.7 \text{ kg}, \text{height} = 1.75 \text{ m}, \text{active PA} = 1.25 \\
  \text{EER} = 662 - (9.53 \times 19) + 1.25 [(15.91 \times 72.7) + (539.6 \times 1.75)] = 3107 \text{ Cal/day}
  \]

<table>
<thead>
<tr>
<th>Gender Age (yr)</th>
<th>EER Prediction Equation*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boys, 9–18</td>
<td>\text{EER} = 88.5 - (61.9 \times \text{age in yr}) + \text{PA} [(26.7 \times \text{weight in kg}) + (903 \times \text{height in m})] + 25</td>
</tr>
<tr>
<td>Girls, 9–18</td>
<td>\text{EER} = 135.3 - (30.8 \times \text{age in yr}) + \text{PA} [(10.0 \times \text{weight in kg}) + (934 \times \text{height in m})] + 25</td>
</tr>
<tr>
<td>Men, ≥19</td>
<td>\text{EER} = 662 - (9.53 \times \text{age in yr}) + \text{PA} [(15.91 \times \text{weight in kg}) + (539.6 \times \text{height in m})]</td>
</tr>
<tr>
<td>Women, ≥19</td>
<td>\text{EER} = 354 - (6.91 \times \text{age in yr}) + \text{PA} [(9.36 \times \text{weight in kg}) + (726 \times \text{height in m})]</td>
</tr>
</tbody>
</table>

*These equations are appropriate for determining EERs for normal-weight individuals. Equations that predict the amount of energy needed for weight maintenance in overweight and obese individuals are also available (Appendix G).
Balancing Intake and Expenditure

April is unhappy about the 10 pounds she gained during her freshman year at college. Her parents are both obese, and she is worried that she too will become obese. She is 5 feet 4 inches tall, is 23 years old, and weighs 140 pounds. She would like to weigh 130 pounds.

In analyzing why she gained weight, April realizes that, with her busy college schedule, she gets less exercise than she used to and often eats candy bars from the vending machine while studying late at night. By recording and analyzing her food intake for 3 days, she determines that she eats about 2450 Calories per day. To see how this compares to her recommended intake, she calculates her EER. She estimates that she is in the “low active” activity category.

**What is her EER?**

*Your answer (Hint: Use the EER equation in Table 7.7 and the low-active PA value in Table 7.6 for a 23-year-old woman):*

**How does her EER compare to her intake?**

*Your answer:*

April realizes she needs to either increase her output or decrease her intake in order to lose weight. She decides to start by increasing her activity level. She loves to play tennis and therefore plans to add 2 hours of tennis a day. Tennis is a vigorous activity, so playing 2 hours per day would move her into the “very active” category.

**What would her EER be with the added 2 hours of tennis per day?**

*Your answer:*

**Is this a reasonable plan?**

Although April loves tennis and this level of activity would allow her to lose weight, she probably won’t play for 2 hours each day. A more reasonable approach might be to plan on playing tennis 3 days a week while also adding some moderate activity such as riding her bike to and from class, using the stairs instead of the elevator, and going dancing some evenings with friends. She is more likely to keep up this schedule, and this amount of activity will put her in the “active” category, which is the level recommended to maintain health.

April also wants to change her diet. She decides to start by replacing her high-calorie candy bars with lower-calorie choices such as fruits.

**If April loses 10 pounds but keeps her activity in the active category, how will it affect her EER?**

*Your answer:*

**Americans Are Eating More and Moving Less**

Although genes are an important determinant of what we weigh, they are not the reason more Americans are obese today than 30 years ago. The genetic mix in the population cannot have changed that fast. What has changed is the environmental influences on what we eat, how much we eat, and how much exercise we get. Simply
put, more Americans are overweight than ever before because we are eating more and burning fewer calories than we did 30 years ago. Food is plentiful and continuously available, and little activity is required in our daily lives.37

**We eat more today than we used to**

Part of the reason Americans weigh more than they did 30 years ago is that they are eating more.38 Palatable, affordable food is readily available to the majority of the population 24 hours a day in supermarkets, fast-food restaurants, and convenience marts. Looking at the food supply, both the numbers of foods and the portions served have increased since the 1970s. Does having more food available make you eat more? To answer this, think about why you stop for an ice cream cone. Is it because you are hungry or because the ice cream looks good? How do you know when to stop eating? Is it when your plate is empty or when your stomach is full? Your appetite may be triggered or inhibited by the sight, taste, and smell of food, as well as the time of day, your emotions, and social conventions. It is usually appetite and not hunger that makes us stop for that ice cream cone on the way home, so having more tempting choices available does make you eat more.

In addition to having more enticing choices available, we consume more calories today because our food portions have increased. Did your mother tell you to clean your plate? Studies of how much people eat have shown that the more that is put in front of us, the more we eat.39 Therefore, bigger portions mean more calories are consumed. We tend to eat in units, such as one cookie, one sandwich, or one bag of chips, regardless of the size of the unit. So, if we are presented with larger units, we still eat the whole thing. One of the best examples of the effect of portion size on actual intake is the servings at fast-food restaurants; the meal of a hamburger and french fries served today is two to five times bigger than it was when fast food first appeared (Figure 7.15). You probably wouldn't order an extra hamburger, but you will finish the one you order even if it is twice as big.

Lifestyle changes that have occurred over the last few decades have also affected how many calories Americans eat. The increasing number of single-parent households and households with two working parents means that the time families have to prepare meals at home is limited. As a result prepackaged, convenience, and fast food have become mainstays. These foods are typically higher in fat and energy than what you would have prepared at home.

**We move less than we used to**

Not only are we eating more, but we are also exercising less. Along with the increase in energy intake, there has been a decrease in the amount of energy used in the activities of daily life, whether working or playing. Fewer American adults today work in jobs that require physical labor. People drive to work in automobiles, rather than walking or bik-
ing; they take elevators instead of the stairs; they use vacuum cleaners rather than brooms; and they cut the lawn with riding rather than push mowers. All of these simple changes reduce the amount of energy expended to perform the tasks of daily living. A typical office worker today walks only about 3000 to 5000 steps in their daily activities. In contrast, in the Amish community—where driving automobiles and using electrical appliances and other modern conveniences are not allowed—a typical adult takes 14,000 to 18,000 steps a day. The overall incidence of obesity in the group is only 4%.40

In addition to less active jobs, busy schedules and long days at work and commuting make people feel they have no time for active recreation. Instead, at the end of the day, Americans sit in front of televisions, electronic games, and computers—all sedentary ways to spend leisure time.

The reduction in physical activity is not restricted to adults. American children are also less active. Many schools have reduced or even eliminated physical education programs in trying to find more time for academics. Social conditions that have increased crime have forced children to stay inside after school. In the 1960’s kids spent their after-school hours outdoors with bikes, balls, and friends. Today they are more likely to spend it indoors with video games and computers. The end result is that they burn fewer calories and have more opportunities to consume more, and consequently they gain weight.

According to the U.S. Surgeon General’s Call to Action to Prevent and Decrease Overweight and Obesity, to improve our health we need to eat less and/or move more.1 This report recommends a number of strategies aimed at improving food choices and increasing physical activity. It suggests that the public and food manufacturers work together to offer smaller portion sizes so that we eat less. It suggests that communities work to provide recreational facilities for people of all ages and employers offer more opportunities for physical activity at the workplace. It also emphasizes that these changes be implemented among America’s youth by improving the diets and increasing the activity of children and young adults. The changes recommended are not large but need to be consistent in order to arrest the increase in obesity in the population. It has been estimated that a population-wide shift in energy balance of only 100 Calories a day, the equivalent of walking a mile or cutting out a scoop of ice cream, would prevent further weight gain in 90% of the population.41

Managing Your Weight Means Keeping It Healthy

Are you one of the 64% of Americans who are overweight? Do you want to avoid becoming one? Managing your weight is a lifestyle choice. It involves maintaining a balance of intake and exercise that will bring your weight in the healthy range and keep it there. For some people weight management may mean avoiding weight gain as they age by making healthy food choices, controlling portion size, and maintaining an active lifestyle. For others, it may mean developing a meal and exercise plan that will allow their weight to decrease (or increase). The goal is getting to a healthy weight and staying there (Figure 7.16).

Assessing your health risks determines if you should lose weight

Do you need to lose weight? Answering this question starts with an evaluation of your current weight and weight history along with a review of your medical history. Start by determining your BMI. In general, a BMI above the healthy range means that weight loss would improve long-term health, but this is not always the case. Some people with high BMIs, such as weight lifters, may have a greater muscle mass but not more body fat than is recommended. If, in addition to a high BMI, body fat is elevated or waist circumference is increased, weight loss is usually recommended. Age is
also important because extra weight may be less of a health risk at certain times in life. For example, in a teen who is still growing, an increase in body weight may be followed by a growth spurt that puts BMI back in the healthy range. In older adults a few extra pounds may provide a reserve that is beneficial in the event of a long-term illness.

A key factor in whether or not weight loss is recommended is the presence of diseases and abnormalities associated with excess body fat (see Table 7.1). For example, blood pressure, blood sugar, and blood cholesterol levels all increase with body weight, and with them the risk of heart disease and diabetes. A person whose BMI is above the healthy range and has two or more of these conditions will probably benefit from weight loss. A family history of these conditions is also a consideration in determining whether or not weight loss is recommended. On the basis of these criteria, not everyone who is a few pounds over ideal body weight needs to lose the extra weight. People who have a BMI in the overweight range (25–29.9 kg/m²) but have none of the health conditions associated with excess body fat and have a healthy lifestyle may not benefit from weight loss. For example, a person with a BMI of 28 kg/m² whose blood pressure and cholesterol are normal and who exercises regularly would not reduce his or her health risks by losing weight. For persons such as this, weight management may mean simply preventing further weight gain. For others, this risk assessment may indicate that body weight is a health risk and that a weight loss plan should be developed. For example, weight loss would be recommended for a person with a BMI of 28 kg/m² who has high blood pressure and high blood cholesterol levels.

**Even losing a small amount of weight can decrease disease risk** The medical goal for weight loss in an overweight person is to reduce the health risks associated with being overweight. For most people, a loss of 5 to 15% of body weight will significantly reduce disease risk. The initial goal of weight loss should therefore be to reduce body weight by about 10% over a period of about 6 months. After this initial weight loss, risks can be reassessed to determine if additional weight loss would be beneficial. A slow loss of 10% of body weight is considered achievable for most people and is easier to maintain than larger weight losses. Most people who lose large amounts of weight or lose weight rapidly eventually regain all that they have lost. Repeated cycles of weight loss and regain, referred to as weight cycling or yo-yo dieting, increase the proportion of body fat with each successive weight regain and cause a decrease in BMR, making subsequent weight loss more difficult (Figure 7.17). Even if an individual has lost and regained weight in the past, weight loss is recommended if they are still obese or overweight and have two or more conditions that increase the health risks associated with obesity.

---

**Figure 7.17**

Weight cycling, commonly known as yo-yo dieting, is the repeated loss and subsequent regain of body weight.
Weight loss is not recommended at all life stages. Obesity is a growing problem among children (Figure 7.18). However, strict weight-loss diets are generally not recommended for children or adolescents, because a severe reduction in intake can interfere with growth. A better approach is to encourage physical activity, along with a moderate energy-intake restriction, allowing the child to grow in height with little additional weight gain (see Chapter 13).

Weight-loss diets are also not recommended during pregnancy. Even women who are overweight at the start of pregnancy should gain at a slow, steady rate to accumulate about 15 to 25 pounds over the course of pregnancy. A weight-loss program can be initiated after the baby is born and the mother has recovered (see Chapter 12). Slow weight loss is appropriate during lactation, but rapid weight loss can decrease milk production.

For older adults, the risks associated with excess body fat are lower than they are for younger adults. However, the decision to treat obesity should not be based on age alone. Weight loss can enhance day-to-day functioning and improve cardiovascular disease risk factors at all ages. Older people tend to lose muscle and replace it with fat; therefore, weight-training activities are an important part of a weight-loss program for the elderly (see Chapter 13).

Weight loss involves reducing intake, increasing activity, and changing behavior.

Losing weight requires tipping the energy balance scale: eating less or exercising more (Figure 7.19). A pound of body fat provides about 3500 Calories. Therefore, to lose a pound of fat, you need to decrease your intake or increase your expenditure by this amount. To lose a pound in a week, you would need to tip your energy balance by...
A 1500-Calorie diet will promote weight loss in most people, but how much food can you eat for 1500 Calories? The answer depends on which foods you choose. Your choices can mean the difference between feeling hungry all day and feeling satisfied so you can stick with the low-calorie diet and lose the weight. In terms of weight loss, it doesn't matter if the calories are from a few high-calorie foods or many low-calorie choices. If your energy intake is less than your output, you will lose weight. But if you choose nutrient-dense foods, you will have more to choose from. For example, a breakfast of two eggs fried in butter and two breakfast sausages provides about 350 Calories. If instead you choose a bowl of oatmeal with raisins and a glass of skim milk, you would be eating 100 fewer Calories. This translates into a banana, some yogurt, or another 100-calorie snack that can be eaten later in the day. The two diets shown below each provide 1500 Calories, but one has a lot more food and nutrients than the other. Which diet would you rather eat?

<table>
<thead>
<tr>
<th>Meal</th>
<th>More Nutrient Dense</th>
<th>Less Nutrient Dense</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breakfast</td>
<td>Cheerios</td>
<td>Fried eggs</td>
</tr>
<tr>
<td></td>
<td>Skim milk</td>
<td>Sausage</td>
</tr>
<tr>
<td></td>
<td>Banana</td>
<td>Toast with butter</td>
</tr>
<tr>
<td></td>
<td>Orange Juice</td>
<td>Coffee</td>
</tr>
<tr>
<td></td>
<td>Coffee</td>
<td>Hamburger on bun with lettuce, tomato, ketchup, mustard, and mayonnaise</td>
</tr>
<tr>
<td>Lunch</td>
<td>Turkey sandwich with lettuce, tomato, and mustard</td>
<td>Apple</td>
</tr>
<tr>
<td></td>
<td>Skim milk</td>
<td>Skim milk</td>
</tr>
<tr>
<td>Dinner</td>
<td>Baked chicken breast</td>
<td>Fried chicken breast</td>
</tr>
<tr>
<td></td>
<td>Baked potato with butter</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Green salad with dressing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Brownie</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Skim milk</td>
<td></td>
</tr>
</tbody>
</table>

Decrease energy intake by choosing low-calorie, nutrient-dense foods. In order to lose weight without compromising nutrient intake, your diet must be low in energy but provide for all the body’s nutrient needs. Nutrient density becomes more important as energy intake is reduced; choosing foods that are low in fat and added sugars will increase nutrient density. Even when choosing nutrient dense foods, it is difficult to meet nutrient needs with intakes of less than 1200 Calories per day; therefore, dieters consuming less than this should take a multivitamin and mineral supplement. Medical supervision is recommended if intake is 800 Calories per day or less.

Trying to lose weight? Drink your milk. We all know it is a good source of calcium, which keeps your bones healthy, but studies now indicate that it may also make it easier to lose weight.

About 500 Calories per day. This could mean adding 500 Calories of exercise, subtracting 500 Calories from your food intake, or some combination of the two. Weight loss should be kept at between 1/2 and 2 pounds per week to ensure that most of what you lose is fat and not lean tissue. If weight is lost more rapidly, the loss is less likely to be maintained, and the additional loss will be from fluid, glycogen, and muscle protein.

Although the arithmetic is simple, achieving and maintaining weight loss is not easy. There are regulatory mechanisms at work to keep body weight stable. There are environmental and emotional motivators to increase food intake and reduce the inclination to exercise. Nonetheless, reductions in intake, increases in activity, and changes in behavior can promote weight loss and long-term weight management.

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Increase physical activity to increase energy expenditure and reduce stress. Physical activity is an important component of any weight-management program. Exercise promotes fat loss and weight maintenance. It increases energy expenditure, so if intake remains the same, energy stored as fat is used for fuel. An increase in activity of 200 Calories five times a week will result in the loss of a pound in about 3 1/2 weeks. In addition to increasing energy expenditure, exercise also promotes muscle development. This is important for promoting weight loss because muscle is metabolically active tissue. Increasing muscle mass helps to prevent the drop in calorie needs that occurs as body weight decreases. Weight loss is better maintained when physical activity is included. In addition, physical activity improves overall fitness and relieves boredom and stress. The benefits of exercise are discussed in Chapter 11.

Change behavior to promote weight loss and maintenance. People tend to think of weight loss as something they can accomplish by going on a diet. When the weight is lost, they go off the diet. The problem is that when their eating patterns return to what they were previously, they regain the weight. This “on a diet, off a diet” pattern may allow you to look good for the prom, but it isn’t what is needed for long-term weight management. To manage your weight at a healthy level, you need to establish a pattern of food intake and exercise that allows you to enjoy foods and activities you like without your weight climbing. It should be a pattern that you can comfortably adapt for life.

Changing food consumption and exercise patterns requires identifying the old patterns that led to weight gain and replacing them with new ones to promote and maintain weight loss. This can be accomplished through a process called behavior modification, which is based on the theory that behaviors involve (1) antecedents or cues that lead to the behavior, (2) the behavior itself, and (3) consequences of the behavior. These are referred to as the ABCs of behavior modification.

The first step in a behavior modification program is to identify cues that lead to eating. You can do this by keeping a log of everything you eat or drink, where you were when you ate, what else you were doing at the time, and what motivated you to eat at that time. Then by analyzing this log, you can see what prompted you to eat excessive amounts of high-calorie foods. For instance, sitting in front of the television and mindlessly demolishing a bag of potato chips may cause you to overeat and then feel bad because you consumed the extra calories. In this case, the antecedent is watching TV, the behavior is mindlessly eating the chips, and the consequence is feeling remorse and gaining weight. The key to modifying this behavior is to recognize the antecedent, change the behavior, and replace the negative consequence with a positive one. In this example, not taking food with you to the television, or taking only the portion of food you want to consume, eliminates the antecedent and the behavior. The consequence is that you have consumed only the food you planned, you do not gain weight, and you feel a sense of accomplishment. Applying behavior modification techniques to change eating behaviors has been shown to improve long-term weight maintenance.

Weight gain can be achieved by increasing intake and weight training. As difficult as weight loss is for some people, weight gain can be equally elusive for underweight individuals. The first step toward weight gain is a medical evaluation to rule out medical reasons for low body weight. This is particularly important when weight loss occurs unexpectedly. If the low body weight is due to low intake or high expenditure, gradually increasing consumption of energy-dense foods is suggested. More frequent meals and high-calorie snacks such as nuts, peanut butter, or milkshakes between meals can help increase energy intake. Replacing low-calorie fluids like water and diet beverages with fruit juices and milk may also help. To encourage a gain in muscle rather than fat, strength-training exercise should be a component of any weight gain program. This approach requires extra calories to fuel the activity needed.
to build muscles. These recommendations apply to individuals who are naturally thin and have trouble gaining weight on the recommended energy intake. This dietary approach may not promote weight gain for those who limit intake because of an eating disorder.

There Are Many Diets; All Depend on Reducing Intake

Want to lose 10 pounds in just 5 days? What dieter wouldn't? People desperate to lose weight are prey to all sorts of diets that promise quick fixes. They willingly eat a single food for days at a time, select foods on the basis of special fat-burning qualities, and consume odd combinations at specific times of the day. Most diets, no matter how outlandish, will promote weight loss because they reduce energy intake. Even diets that focus on modifying fat or carbohydrate intake or promise to allow unlimited amounts of certain foods work because intake is reduced. The effectiveness of a weight-loss diet becomes evident when you evaluate long-term success.

When selecting a weight-management program, look for one that is based on sound nutrition and exercise principles, suits your individual food preferences, promotes long-term lifestyle changes, and meets your needs in terms of cost, conve-

So, What Should I Eat?

Watch your serving size
- Pour your chips into a one-serving bowl rather than eating right from the big bag
- Fill your plate once; skip the seconds
- Check labels to see if your serving matches the label
- Don't supersize—choose a small drink and a small order of fries
- Have a plain old burger, not one with a special sauce or extra-large patty
- When you eat out, share an entrée with a friend or take some home for lunch the next day

Cut down on high-calorie foods
- Have 1 scoop of ice cream rather than 2
- Skip dessert
- Bring your own lunch instead of having hot lunch at school
- Have an apple with lunch instead of a candy bar
- Have water instead of soda
- Switch to low-fat milk

Don't get too hungry
- Eat breakfast—you'll eat less later in the day
- Increase your vegetable servings
- Plan your snacks; you will probably choose more nutrient-dense food
- Keep cut-up veggies and fruit available for snacks

If you want to eat more, exercise more
- Go for a bike ride
- Try bowling instead of watching TV on Friday nights
- Take a walk during your lunch break or after dinner
- Play tennis; you don't have to be good to get plenty of exercise
- Shoot some hoops
- Get off the bus one stop early
An ideal diet is one that is part of a weight-management program that allows weight loss and then maintenance of that loss over the long term. To be successful it needs to promote changes in the lifestyle patterns that led to weight gain. While quick fixes are tempting, if the program’s approach is not one that can be followed for a lifetime, it is unlikely to promote successful weight management.

The following sections discuss some of the more common methods for reducing calorie intake. The advantages and disadvantages of a number of popular diets and commercial weight-management programs are given in Table 7.9.

### Some weight-loss programs use exchanges and points to help you choose foods

For breakfast, choose one food from group A, one from group B, and two from group C. The foods in these groups or exchanges are similar in their energy and nutrient content, so they can be exchanged for one another. Diets that are based on such exchanges recommend certain numbers of servings from specific food groups in order to limit calorie intake but provide an adequate balance of nutrients. Some diet plans use the Exchange Lists established by the American Diabetes and American Dietetic Associations (see Table 7.4 and Appendix I). Others, such as Weight Watchers, have developed their own point system from which to choose foods. These programs offer variety from meal to meal and from day to day and are likely to meet nutrient needs. In addition, they teach meal-planning skills that are easy to apply away from home and can be used over the long term.

### TABLE 7.8
Rate Your Weight-Loss Program Before You Start

<table>
<thead>
<tr>
<th>Does it promote a healthy dietary pattern that can be followed for life?</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Does it meet your nutrient needs?</td>
<td></td>
</tr>
<tr>
<td>• Does it include enough variety to not become boring over time?</td>
<td></td>
</tr>
<tr>
<td>• Does it fit your health needs? For example, would it be healthy for someone who has high blood cholesterol?</td>
<td></td>
</tr>
<tr>
<td>• Does it suit your food preferences?</td>
<td></td>
</tr>
<tr>
<td>• Is the diet plan flexible enough to follow when eating away from home?</td>
<td></td>
</tr>
<tr>
<td>• Does it include foods that you can easily obtain?</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Does it promote a reasonable rate of weight loss?</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Does it provide a reasonable number of calories (not less than 1200)?</td>
<td></td>
</tr>
<tr>
<td>• Does it recommend realistic weight-loss goals (1/2 to 2 pounds per week)?</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Does it promote physical activity?</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Does it include an increase in activity?</td>
<td></td>
</tr>
<tr>
<td>• Is the activity plan one you can follow?</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Does it promote a change in behavior?</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Does it provide the social support you need?</td>
<td></td>
</tr>
<tr>
<td>• Does it promote changes in behavior that you can maintain over the long term?</td>
<td></td>
</tr>
<tr>
<td>• Does it help you learn healthy eating habits?</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Is it scientifically sound?</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Is the program based on sound scientific principles?</td>
<td></td>
</tr>
<tr>
<td>• Are the personnel monitoring the weight-management program health professionals?</td>
<td></td>
</tr>
</tbody>
</table>

Adapted from the American Heart Association’s Web site at www.amhrt.org/Health/Risk_Factors/Overweight/Fad_Diets/fadguide.html.
**Table 7.9**

<table>
<thead>
<tr>
<th>Diet</th>
<th>Approach</th>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight Watchers</td>
<td>Low energy, social support</td>
<td>Safe, inexpensive, flexible</td>
<td>Requires group participation</td>
</tr>
<tr>
<td>Jenny Craig</td>
<td>Low energy</td>
<td>Safe, convenient</td>
<td>Expensive; relies on purchase of special foods</td>
</tr>
<tr>
<td>SlimFast</td>
<td>Low energy</td>
<td>Safe</td>
<td>Does not promote long-term behavior change</td>
</tr>
<tr>
<td>The New Beverly Hills Diet</td>
<td>Specific timing and combinations of foods</td>
<td>Inexpensive</td>
<td>Based on unsound principles; does not promote long-term behavior change; nutritionally unsound</td>
</tr>
<tr>
<td>Optifast</td>
<td>Very-low-calorie formula</td>
<td>Rapid weight loss</td>
<td>Expensive; dangerous if does not include medical supervision</td>
</tr>
<tr>
<td>Fit or Fat</td>
<td>Increased exercise</td>
<td>Safe, inexpensive</td>
<td>No social support</td>
</tr>
<tr>
<td>The Zone (and Mastering the Zone) Diet</td>
<td>Low carbohydrate (40% of energy)</td>
<td>Inexpensive, flexible</td>
<td>Based on questionable principles; no social support</td>
</tr>
<tr>
<td>Eating Thin for Life</td>
<td>Moderation—written as weight-loss success stories, recipes, and menu ideas</td>
<td>Inexpensive</td>
<td>No social support</td>
</tr>
<tr>
<td>Dieting with the Duchess</td>
<td>Simple nutrition and exercise tips</td>
<td>Inexpensive, flexible</td>
<td>No social support</td>
</tr>
<tr>
<td>Cabbage soup diet</td>
<td>Unlimited amounts of cabbage soup, fruit, coffee, and tea</td>
<td>Rapid weight loss</td>
<td>No social support; does not promote long-term behavior change; lacks variety</td>
</tr>
<tr>
<td>Grapefruit diet</td>
<td>Some foods have special qualities that burn fat</td>
<td>Inexpensive</td>
<td>Based on unsound principles</td>
</tr>
<tr>
<td>Sugar Busters</td>
<td>Eliminates sugar; low calorie—1200 Cal a day</td>
<td>Inexpensive</td>
<td>No social support; based on unsound principles; insufficient carbohydrate</td>
</tr>
<tr>
<td>Volumetrics Weight Control Plan</td>
<td>Emphasizes foods high in water, fiber, and air to promote fullness with few calories</td>
<td>Safe, inexpensive</td>
<td>No social support or exercise component</td>
</tr>
<tr>
<td>Atkins' Diet</td>
<td>Very low carbohydrate</td>
<td>Inexpensive, rapid initial weight loss</td>
<td>Difficult to follow in the long term; no social support</td>
</tr>
<tr>
<td>South Beach Diet</td>
<td>Initially very low carbohydrate, then more healthy carbohydrates are allowed</td>
<td>Safe, inexpensive, heart-healthy</td>
<td>Initial weight loss is mostly water; no social support</td>
</tr>
</tbody>
</table>

Some programs use packaged meals and drinks to limit portions and eliminate decisions.

Whether you have a personal chef or buy frozen meals, it is easier to eat less when someone else decides what you’re having and puts that food in front of you. This is the idea behind diet plans that sell prepackaged meals designed to replace some or all...
of your usual meals. These diets are easy to follow as long as you are not traveling or eating out, but they can be expensive and are not practical in the long term. Because all meals are provided, they do not teach the food selection skills needed to make a long-term lifestyle change.

**Over-the-counter diet drinks can help reduce calorie intake** Rather than pre-packaged meals, many diet plans replace some or all of your meals with special beverages (Figure 7.20). They can make reducing intake easy because they eliminate the problem of choosing low-calorie foods. Many of the liquid weight-loss diets that are available over-the-counter recommend a combination of food and formula to provide about 800 to 1200 Calories per day. These formula plans promote weight loss as long as the foods eaten with them are low in calories. They are easy to use and relatively inexpensive, but they do little to change eating habits for life. Most diet programs that rely exclusively on liquid formulas have high dropout rates and poor long-term weight-maintenance results. These are not recommended without medical supervision.

**Very-low-calorie diets cause rapid weight loss but can increase risks** A very-low-calorie diet is defined as one with fewer than 800 Calories per day. These diets are generally a variation of the protein-sparing modified fast, which is a diet providing a high proportion of protein but little energy. The concept behind this is that the protein in the diet will be used to meet the body’s protein needs and therefore will prevent excessive loss of body protein. Frequently, very-low-calorie diets are offered as a liquid formula. These formulas provide from 300 to 800 Calories and 50 to 100 g of protein per day and meet all other nutrient needs.

These diets will cause you to lose fast; initial weight loss is 3 to 5 pounds per week. This can provide a psychological boost and motivate the dieter to continue losing weight; however, in most cases, almost 75% of this initial weight loss is from water loss. Once the initial water loss ends, weight loss slows. The dieter’s basal metabolism slows to conserve energy, and physical activity decreases because the dieter often does not have the energy to continue his or her typical level of activity.

Very-low-calorie diets are no more effective than other methods in the long term and carry more risks. At these low-energy intakes, body protein is broken down and potassium is excreted. Depletion of potassium can result in an irregular heartbeat and is potentially deadly. Other side effects include gallstones, fatigue, nausea, cold-intolerance, light-headedness, nervousness, constipation or diarrhea, anemia, hair loss, dry skin, and menstrual irregularities. These diets are not recommended for people who are less than 30 to 40% above their healthy body weight, for pregnant or breast-feeding women, or for children, adolescents, or those with severe medical problems. Since 1984, the FDA has required that all very-low-calorie diet formulas carry a warning that they can cause serious illness and should be used only under medical supervision.

**Low-fat diets are not necessarily low in calories** If a food is low in fat, is it low in calories? The answer is sometimes yes, but not always. Because fat is high in calories, consuming a low-fat diet typically reduces energy intake. Low-fat diets provide more food for the same amount of energy than high-fat diets and may satisfy hunger after less energy is consumed. Differences in the way dietary fat and dietary carbohydrate are used by the body also explain why low-fat diets are effective for weight loss. Excess calories from dietary fat are stored more efficiently than excess calories from carbohydrate, so consuming excess energy from fat leads to a greater accumulation of body fat than consuming excess energy as carbohydrate.

Problems with low-fat diets occur when people think they can eat low-fat foods in unlimited quantities. This is not too much of a problem if the low-fat food is broccoli, but problems emerged in the 1990’s when the food industry flooded the market with low-fat cookies and cakes. These foods were low in fat but not in energy. When consumed in large amounts they cause weight gain. Even a diet low in fat will result in
weight gain if energy intake exceeds energy output. This is illustrated by the fact that the percent of calories as fat in the typical American diet has decreased, while the number of people who are overweight continues to increase. 

**Low-carbohydrate diets vary in the amount of carbohydrate allowed**

If you cut out the pasta and potatoes you will lose weight, right? The Atkin’s diet, South Beach diet, Sugar-busters, Calories Don’t Count, the Scarsdale diet, and the Zone are just a few of the low-carbohydrate weight-loss diets that have been promoted over the last 30 years. In addition to promising weight loss, these diets claim to improve athletic performance and promote overall health. They are all based on the premise that a high carbohydrate intake causes an increase in insulin levels, which promotes the storage of body fat. Restricting carbohydrate intake is hypothesized to reduce insulin, thereby reducing fat storage and promoting fat loss. Unfortunately, the relationship between carbohydrate intake, insulin levels, and body fat is not that simple. Some of these diets severely restrict carbohydrate intake, while others are less restrictive and are more concerned with the type of carbohydrate.

**Very-low-carbohydrate diets cause ketosis and weight loss** Very restrictive low-carbohydrate diets prohibit foods such as breads, grains, and fruits, and limit vegetable intake while allowing unlimited quantities of meat and high-fat foods that are low in carbohydrate. These diets cause a rapid initial weight loss, most of which is water. This occurs because when carbohydrate intake is very low, glycogen stores, along with the water they hold, are lost quickly. Ketones are produced because fat is not completely broken down in the absence of carbohydrate. Excretion of these ketones causes further water loss. In addition, there is evidence that ketones in the blood suppress appetite, making it easier to reduce food intake. The appetite-suppressing effect of ketones is not unique to low-carbohydrate diets. Ketone levels increase on any low-calorie diet and suppress appetite.

Although these diets do promote weight loss, more research is needed to determine the health consequences of long-term consumption of very-low-carbohydrate diets. These diets are higher in fat and protein than recommended. High intakes of saturated fat and cholesterol increase the risk of high blood cholesterol and gallbladder disease. They are also lower in fruits, vegetables, whole grains, and milk than is recommended. Low intakes of these will reduce intakes of essential nutrients, phytochemicals, and fiber.

**The type of carbohydrate is more important than the amount** Not all low-carbohydrate diets severely restrict the amount of carbohydrate, and most allow an increase in some types of carbohydrate over time. The carbohydrates that are allowed are those from unrefined sources such as vegetables and whole grains. These foods are high in fiber and do not increase insulin nearly as much as refined carbohydrates such as white flour and sugar. Including whole grains and vegetables increases the intake of fiber, phytochemicals, and micronutrients and has only a modest effect on insulin levels.

**Low-carbohydrate diets reduce energy intake** Weight loss occurs on low-carbohydrate diets because total energy intake is reduced. After all, if you remove the bun from your burger and take the baked potato away from your steak dinner, you have cut the calories in the overall meal. But if you replace the bun with some low-carbohydrate bread and substitute some low-carbohydrate pasta for the potato, you may have more trouble losing pounds. As with special low-fat products, low-carbohydrate foods are not necessarily low in calories and cannot be eaten liberally without affecting energy balance (Figure 7.21).
Choosing a Weight Loss Plan that Works for You

Mark is 40 pounds overweight. He has high blood pressure and high blood cholesterol levels. Given his BMI of 28 kg/m² and his other risk factors, his doctor advises him to lose weight. He researches a number of weight-loss programs and finally narrows his choices down to three. He lists these below with the reasons he is considering them.

• Low-carbohydrate plan—Many of his friends have used this to shed pounds and say they were never hungry
• Liquid formula that replaces two meals a day—Easy because he doesn’t need to do much meal planning and he can still eat dinner with his family
• Exchange plan run through his community center—Lots of social support and includes a walking group that meets 5 days a week

To decide which is best for him, he considers the advantages and disadvantages of each plan in terms of the nutritional soundness of the diet, variety, ease, expense, and how it will affect his exercise level.

Are the diets nutritionally sound?

• Low-carbohydrate plan—The diet is too low in carbohydrate to prevent ketosis, low in fiber, and low in calcium because milk is restricted
• Liquid formula—Seems alright as long as the meal is nutritionally sound
• Exchange plan—This is nutritionally sound because it includes choices from all food groups

How would you rate these diets in terms of variety?

Your answer:

How easy are these diets to follow?

At first the liquid diet seems easiest because he needs to worry about only one meal a day. But then he realizes he still has to cook for his family. The only diet that will allow him to prepare a meal that will fit into his diet and work for the whole family is the exchange plan.

How do these plans compare in cost?

All three are equal in cost. The extra cost of the more expensive meats included in the high-carbohydrate diet is similar to the extra cost of the liquid formula. The exchange plan involved a monthly fee to the community center.

How do they rate in terms of exercise?

Your answer:

Which plan do you think would work best for Mark over the long term? Why?

Your answer:

Drugs and surgery can help promote weight loss but these drastic measures are not for everyone. They can be acceptable weight-management tools however for obese individuals when diet and exercise alone are not enough.
An ideal weight-loss drug would promote long-term weight loss without side effects

Some of the drugs available to promote weight loss are well studied and offer legitimate aids to weight loss; others offer little more than water loss. An ideal drug for the treatment of obesity would permit an individual to lose weight and maintain the loss, be safe when used for long periods of time, have no side effects, and not be addictive. Many attempts have been made to develop such a drug, but weight-loss drugs still carry risks. In 1997, a prescription drug combination called fen-phen (fenfluramine and phentermine) that was being used to reduce food intake was linked to serious heart valve damage. As a result, fenfluramine and the related drug dexfenfluramine were withdrawn from the market.50

There are only a few drugs that promote weight loss

Prescription drugs available for the treatment of obesity include those that reduce appetite by affecting the activity of brain neurotransmitters (sibutramine, brand name Meridia) and those that decrease the absorption of fat in the intestine (orlistat, brand name Xenical). Prescription drugs such as these are recommended only for those whose health is seriously compromised by their body weight: those with a BMI greater than 30 kg/m^2 and those with a BMI greater than or equal to 27 kg/m^2 who have risk factors or diseases.43 One of the major disadvantages of drug treatment is that even if the drug promotes weight loss in the short term, the weight is regained when the drugs are discontinued.

There are also some nonprescription medications sold over-the-counter to promote weight loss. Most contain either caffeine, which promotes water loss, or fiber, which increases satiety. These are regulated by the FDA and must adhere to strict guidelines regarding the dose per pill and the effectiveness of the ingredients. Some may be moderately effective, but, as with prescription medications, the weight is usually regained when the product is no longer taken.

Weight-loss supplements are not regulated by the FDA

Weight-loss supplements often include herbal sources of compounds contained in prescription medications. Some of these are powerful drugs with dangerous side effects. The FDA does not regulate dietary supplements for weight loss unless they claim to be a substitute for a drug or claim to perform a drug action or therapy (see Chapter 10). Because they are not strictly regulated, their safety and effectiveness may not have been carefully tested, and doses may vary from tablet to tablet and brand to brand. It cannot be assumed that a product is safe simply because it is labeled “herbal” or “all natural.” Common ingredients in weight-loss dietary supplements include the amino acids arginine and ornithine, chromium, and a variety of herbs. Arginine and ornithine are hypothesized to burn fat during sleep because they stimulate the release of growth hormone. Although growth hormone promotes fat loss and muscle growth, research has not found any relationship between body weight and the levels of growth hormone. The mineral chromium is usually included as chromium picolinate. Advertisements claim that chromium picolinate will decrease body fat and increase the proportion of lean tissue, but human trials have not consistently demonstrated an effect on body composition or body weight.

Herbal products marketed for weight loss also include teas and supplements that contain plant-derived laxatives such as senna, aloe, buckthorn, rhubarb root, cascara, and castor oil. Cascara, senna, and castor oil are approved by the FDA and regulated as drugs for use in nonprescription laxatives. These cause weight loss by inducing diarrhea, which causes water loss. They don’t lead to fat loss, however, because they do not significantly reduce nutrient absorption. This is because they act in the colon, not in the small intestine, where most absorption occurs. Overuse of herbal laxatives can cause serious side effects, including nausea, diarrhea, vomiting, stomach cramps, chronic constipation, fainting, and severe electrolyte imbalances leading to cardiac arrhythmia and death.51
Weight-loss surgery reduces the amount of food that can be eaten and absorbed

There are a number of surgical procedures that reduce body weight by altering the GI tract to reduce food intake and absorption. These surgical approaches are recommended only in cases where the risk of dying from obesity and its complications is great. It is appropriate only for individuals with a BMI greater than or equal to 40 kg/m² (extreme obesity) and in those with a BMI between 35 and 40 kg/m² who have other life-threatening conditions that could be remedied by weight loss. Each case must be evaluated individually to assess the potential risks and benefits of the surgery.

Currently, the most popular surgical approach to treat obesity is gastric bypass. Gastric bypass involves bypassing part of the stomach by connecting the intestine to the upper portion of the stomach. Food intake is reduced because the now-smaller stomach becomes full with less food and absorption is reduced because the small intestine is shortened. Significant weight loss is usually achieved 18 to 24 months after surgery (Figure 7.22). Some weight regain is common after 2 to 5 years. Another surgery, gastroplasty, involves stapling off a section of the top of the stomach to limit the amount of food that can be consumed at any given time. The success rate is lower with gastroplasty because the staples can be broken by consumption of large meals. Both of these procedures have short-term surgical risks and a long-term risk of nutrient deficiencies, particularly of vitamin B₁₂, folate, and iron.⁵² Even after surgery, it is necessary to limit the types and amounts of food consumed in order to allow weight loss and maintenance.

Fat can be removed from specific locations on the body by liposuction. This procedure involves inserting a large hollow needle under the skin into a localized fat deposit and literally vacuuming out the fat. Liposuction does not significantly reduce overall body weight.

Some people go to great extremes to limit their food intake. One procedure wires the jaw shut so intake is restricted to liquids that can be taken through a straw. Jaw wiring is not effective for maintaining weight loss in the long term because it does not help change the eating habits that led to weight gain.

On some days, you may eat twice as much as other days. One day you may stuff yourself at lunch and indulge in a rich dessert at dinner and on the next skip lunch altogether. Some days you may survive on snack foods while on others you eat three balanced meals. Is this normal? Yes, normal eating patterns are flexible; sometimes people overeat, and sometimes they undereat. Normal eating may involve limiting what you eat in order to manage your weight and meet recommendations for a healthy diet. It can also mean eating more than you need at a party or other special occasion. What and how much people eat vary in response to social occasions, personal...
emotions, time limitations, hunger, and the availability of food, but generally people eat when they are hungry, choose foods they enjoy, and stop eating when they are satisfied.

Abnormal eating occurs when someone becomes overly concerned with food, eating, and body size and shape. If the emotional aspects of food and eating overpower the role of food as nourishment, an eating disorder may develop. The term “eating disorder” is somewhat of a misnomer because it implies that the problem is a nutritional one. In fact, eating disorders are primarily psychological disorders that involve nutrition-related behaviors; they have nutritional and physiological complications.

According to mental health guidelines, there are three categories of eating disorders: anorexia nervosa, bulimia nervosa, and a third category called “eating disorders not otherwise specified” (EDNOS) that includes abnormal eating behaviors that don’t fit the other two categories. Binge-eating disorder is included in the EDNOS category (Table 7.10).53

Anorexia nervosa is characterized by self-starvation, a distorted body image, and low body weight. Anorexia nervosa was first recognized by physicians in the second half of the 19th century, but the characteristics they described are still true of the syndrome today: severe weight loss, amenorrhea, constipation, and restlessness. Anorexia nervosa affects 1% of female adolescents in the United States. The average age of onset is 17 years.
There is a 5% death rate in the first 2 years, and this can reach 20% in untreated individuals. Anorexia is a psychological disorder that has a behavioral component and physical and nutritional consequences that can be life-threatening.

**The fear of being fat dominates anorexia** The psychological component of anorexia nervosa revolves around an overwhelming fear of gaining weight, even in those who are already underweight. It is not uncommon for individuals with anorexia to feel that they would rather be dead than fat. Anorexia is also characterized by disturbances in body image or perception of body size that prevent those affected from seeing themselves as underweight even when they are dangerously thin. Those with this disorder may use body weight and shape as a means of self-evaluation: “If I weren’t so fat then everyone would like and respect me and I wouldn’t have other problems.” However, no matter how much weight they lose they do not gain self-respect, inner assurance, or the happiness they seek. Therefore, they continue to restrict their intake, overexercise, or use purging behaviors in order to lose weight.

**People with anorexia restrict food intake** The most obvious behavioral component of anorexia nervosa is a restriction in food intake. Food and eating become an obsession. In addition to restricting the total amount of food consumed, anorexics develop personal diet rituals, limiting certain foods and eating them in specific ways. Although they do not consume very much food, they are preoccupied with food and spend an enormous amount of time thinking about food, talking about food, and preparing food for others. Instead of eating, they move the food around the plate and cut it into tiny pieces. Although anorexics keep their weight low by restricting intake, it is estimated that 50% of people with anorexia also use purging as a means of weight control.

Another behavior that is typical of anorexia is hyperactivity and overactivity. This is in contrast to the decrease in activity and fatigue that characterizes other starvation states associated with weight loss. Many anorexics exercise excessively to burn calories. Sometimes the activity is surreptitious, such as going up and down stairs repeatedly or getting off the bus a few stops too early. For others the activity takes the form of strenuous physical exercise. They may become fanatic athletes. The exercise is typically done alone and is performed as a regular rigid routine. They feel guilty if they cannot exercise and may link exercise and eating, so a certain amount of exercise earns them the right to eat and if they eat too much they must pay the price by adding extra exercise. Those who use exercise to increase energy expenditure do not stop when they are tired; instead, they train compulsively beyond reasonable endurance.
The physical symptoms of anorexia are those of starvation. The first obvious physical symptom of anorexia is weight loss. As weight loss becomes severe, symptoms of starvation begin to appear. Starvation affects mental function, causing anorexics to become apathetic, dull, exhausted, and depressed. Physical symptoms include depletion of fat stores; wasting of muscles; inflammation and swelling of the lips; flaking and peeling of skin; growth of fine hair on the body, and dry, thin, brittle hair on the head that may fall out. In females, estrogen levels drop, and menstruation becomes irregular or stops. This can delay sexual maturation and can have long-term effects on bone density. In males, testosterone levels decrease. In the final stages of starvation, symptoms include abnormalities in electrolyte balance, dehydration, edema, cardiac abnormalities, absence of ketones due to fat-store depletion, and infection, which further increases nutritional needs.

Treatment of anorexia nervosa must restore nutritional health. The goal of treatment for anorexia nervosa is to help resolve the psychological and behavioral problems while providing for physical and nutritional rehabilitation. Early treatment of anorexia is important because starvation may cause irreversible damage. The goal of nutrition intervention is to promote weight gain by increasing energy intake and expanding dietary choices. Nutritional rehabilitation in mild cases involves learning about nutrition and meal planning in order to develop healthy eating patterns. In more severe cases, anorexics are hospitalized, and their food intake and exercise behaviors are carefully controlled. Intravenous nutrition may be necessary to keep the individual alive. Some anorexics make full recoveries but about half have poor long-term outcomes—remaining irrationally concerned about weight gain and never achieving normal body weight.

Bulimia nervosa is characterized by cycles of bingeing and purging. “Bulimia” is from the Greek bous (ox) and limos (hunger), denoting hunger of such intensity that a person could eat an entire ox. The modern concept of bulimia nervosa as an eating disorder arose in the early 1970’s, when a set of symptoms was identified and distinguished from anorexia and obesity. Many different names were used for this disorder, including dysorexia, bulimarexia, thin-fat syndrome, binge/purge syndrome, and dietary chaos syndrome. The term bulimia nervosa was coined in 1979 by a British psychiatrist who suggested that bulimia consisted of powerful urges to overeat in combination with a morbid fear of becoming fat and the avoidance of the fattening effects of food by inducing vomiting or abusing purgatives or both. Bulimia nervosa is a disorder that involves frequent episodes of binge eating or bingeing that are almost always followed by purging and other inappropriate compensatory behaviors. A diagnosis of bulimia is based on the frequency with which episodes of binge eating and inappropriate compensatory behaviors occur. Bulimia is subdivided into nonpurging and purging types. Nonpurging bulimics use behaviors such as fasting or excessive exercise to prevent weight gain. Purging bulimics regularly engage in behaviors that may include self-induced vomiting and misuse of enemas, laxatives, diuretics, or other medications.

Preoccupation with body weight dominates bulimia nervosa. As with anorexia, people with bulimia have an intense fear of becoming fat. They have a negative body image accompanied by a distorted perception of their body size. Their self-esteem is highly tied to their impressions of their body shape and weight. They are preoccupied with the fear that once they start eating they will not be able to stop. They may engage in continuous dieting, which leads to a preoccupation with food.

People with bulimia blame all of their problems on their appearance; this allows them to avoid things that are real problems. A bulimic also thinks he or she is the only person in the world with this problem. As a result they are often socially isolated. They may avoid situations that will expose them to food, such as going to parties or out to dinner, further isolating them socially.
The binge/purge behavior distinguishes bulimia. Bulimia typically begins with dieting that is motivated by the desire to be thin. Overwhelming hunger may finally cause the dieting to be interrupted by a period of overeating. Eventually a pattern develops involving semi-starvation interrupted by periods of gorging. During a food binge, a bulimic experiences a sense of lack of control. The amount of food consumed during a binge varies but is typically on the order of 3400 Calories—as much as many teenagers eat in an entire day. One study found that bulimics consumed an average of about 7000 Calories in a 24-hour period. Binges usually last less than 2 hours and occur in secrecy. They stop when the food runs out or when pain, fatigue, or an interruption intervenes (Figure 7.24).

After these binge episodes, most bulimics use purging techniques such as vomiting or abuse of laxatives or diuretics to eliminate the excess calories from their bodies. The most common behavior is self-induced vomiting. It is used at the end of a binge but also after normal eating to eliminate food before it is absorbed and the energy it provides can cause weight gain. Laxatives are taken to induce diarrhea. Although the patients believe the diarrhea prevents calories from being absorbed, in fact, nutrient absorption is almost complete before food enters the colon where laxatives work. The weight loss associated with laxative abuse is due to dehydration. Diuretics also cause water loss, but via the kidney. They do not cause fat loss. A smaller number of bulimia sufferers resort to other methods of eliminating these excess calories, such as extreme exercise or fasting. A few bulimics use a combination of purging and non-purging methods.

Purging can damage the gastrointestinal tract. It is the purging of the binge-purge cycle that is most hazardous to health in bulimia nervosa. Purging by vomiting brings stomach acid into the mouth. Frequent vomiting affects the gastrointestinal tract by causing tooth decay, sores in the mouth and on the lips, swollen jaws and salivary glands, irritation of the throat, esophageal inflammation, and changes in stomach capacity and stomach emptying. It also causes broken blood vessels in the face from the force of vomiting, electrolyte imbalance, dehydration, muscle weakness, and menstrual irregularities. Laxative and diuretic abuse can also cause dehydration and electrolyte imbalance. Rectal bleeding may occur from laxative overuse.

Treatment of bulimia nervosa must separate eating from emotions. The overall goal of therapy for people with bulimia nervosa is to separate eating from their emotions and from their perceptions of success and to promote eating in response to hunger and satiety. Psychological issues related to body
Binge-eating disorder is characterized by bingeing without purging

Binge-eating disorder is probably the most common eating disorder. According to the National Institutes of Health, it affects up to 4 million Americans. Binge-eating disorder affects 2 to 3% of the total adult population and about 8% of the obese population. Unlike anorexia and bulimia, binge-eating disorder is not uncommon in men; it occurs in a female to male ratio of about 1.5 to 1. Compared to anorexia or bulimia, binge-eating disorder occurs in an older population, being most common in those between 30 and 50 years of age. Individuals who suffer from binge-eating disorder engage in recurrent episodes of binge eating but do not regularly engage in purging behaviors such as vomiting, fasting, or excessive exercise (Figure 7.25). These individuals may range from normal weight to obese but are likely to have above-normal body weights and may seek help for treatment of obesity rather than for their binge-eating behavior. About one-quarter to one-third of individuals who attend weight-loss clinics meet the criteria for binge-eating disorder.

Treatment of this disorder involves counseling to improve body image and self-acceptance, a healthy nutritious diet, and increased exercise to promote weight loss, along with behavior therapy to reduce bingeing.

Genetic, psychological, and sociocultural factors increase the risk of eating disorders

Eating disorders occur in people of all ages, races, and socioeconomic backgrounds, but some groups are at a greater risk than others. In the United States, anorexia, bulimia, and binge-eating disorder affect about 5% of girls and women and 1% of boys...
Eating disorders most commonly begin in adolescence, when physical, psychological, and social development are occurring rapidly. We do not know what causes eating disorders, but genetic, psychological, and social and cultural factors contribute to their development.

Genetics contributes to the development of eating disorders. You don't necessarily inherit an eating disorder, but the genes you inherit contribute to personality traits and other biological characteristics that predispose you to developing an eating disorder. For example, inherited abnormalities in the levels of neurotransmitters such as serotonin, which affects food intake, and in levels of the hormone leptin, which helps regulate body weight, have been hypothesized to contribute to the behaviors typical of anorexia and bulimia. Binge-eating disorder may be linked to a defect in a gene called the melanocortin 4 receptor gene. The protein made by this gene helps control hunger and satiety. If this gene is abnormal and makes too little of this protein, the body feels too much hunger. In one study, all carriers of the mutant gene were binge eaters and mutations were found in 5% of obese subjects. Genes such as this contribute to eating disorders, but a single gene is not likely to be the sole cause. These are complex diseases that are the result of the interaction of multiple genes with the environment. When placed in the right environment, an individual who carries such genes will be more likely to develop an eating disorder.

Low self-esteem is common among people with eating disorders. Certain personality characteristics and psychological problems are common among individuals with eating disorders. Often people with eating disorders have a low self-esteem. Self-esteem refers to the judgments people make and maintain about themselves—a general attitude of approval or disapproval that indicates if they think they are worthy and capable. Eating disorders are also rooted in the need for self-control. Those with eating disorders are often perfectionists who set very high standards for themselves and others. In order to be perfect they strive to be in control of their bodies and their lives. They view everything as either a success or a failure. Being fat is seen as failure, thin as success, and thinner as even more successful. In spite of their many achievements, those with eating disorders feel inadequate, defective, and worthless.
People with eating disorders often try to use their relationship with food to gain control over their lives and boost their self-esteem. They believe that controlling their food intake and weight demonstrates their ability to control other aspects of their lives. Their fixation with food and weight loss and their ability to control their intake and weight help them to feel better about themselves. Unfortunately, rather than solving the problem, this control of food intake creates additional physical and psychological problems.

Societal messages about the ideal body may promote eating disorders While genetic and psychological issues may predispose an individual to an eating disorder, societal and cultural factors are an important trigger for the onset of these problems. Eating disorders occur in societies where food is abundant and the body ideal is thin. They do not occur where food is scarce and people must worry about where their next meal is coming from. Cultural ideals about body size are linked to body image and the incidence of eating disorders.

**FIGURE 7.26**  
Thinness has not always been the beauty standard in America. This timeline shows how the female body ideal has changed over the years. (Top three photos: © Bettman/Corbis; bottom photo: Corbis Sygma)  
1900 – Actress Lillian Russell is considered a beauty at about 200 pounds  
1920s – The thinner flapper look becomes popular  
1950s – The curvy figure of Marilyn Monroe becomes the beauty standard  
1960s – Twiggy, who weighs less than 100 pounds, is leading model  
1980s – Jane Fonda’s workout book is a best seller  
Today – The fashion ideal today is thin but well muscled
a pathological concern with body weight and shape, and their body image becomes distorted. A distorted body image means you are unable to judge the size of your own body and do not see yourself as you really are. Distorted body image is common with eating disorders, so even if a young woman achieves a body weight comfortable to that of a fashion model, she may continue to see herself as fat and strive to lose more weight.

Eating disorders are more common in groups concerned with body weight and body image. For example, they are more common in professional dancers and models and are on the rise among athletes, especially those involved in sports that require the athlete to be thin, such as gymnastics and figure skating, or to fit into a particular weight class, such as wrestling. Eating disorders are far more common in women than men. Only an estimated 5 to 15% of people with anorexia or bulimia and an estimated 35% of those with binge-eating disorder are male.

Identifying risks can help prevent eating disorders

To prevent eating disorders, it is important to first recognize factors that increase risk. Excessive concerns about body weight, having friends that are preoccupied with weight, being teased by peers about weight, and problems with one's family all predispose people to eating disorders. There is an association between parental criticism and children's weight preoccupation. Dieting also increases risk. Girls and women who diet are more likely to develop an eating disorder than those who don't diet. Those who have a mother, sister, or friend who diets are also at increased risk. Exposure to media pressure to be thin is also associated with the development of eating disorders.

Those who are at risk for eating disorders should be targeted for intervention. For teens, parents play an important role. Arranging an evaluation with a physician and a mental health specialist when risk factors, such as preoccupation with weight, are first recognized may help prevent the development of an eating disorder. More widespread interventions to prevent eating disorders can target the elimination of weight-related teasing and criticism from peers and family members. Another important target is the media. If the unrealistically thin body ideal presented by the media could be altered, the incidence of eating disorders would likely decrease. Education through schools and communities about the symptoms and complications of eating disorders can help people identify friends and family members at risk and persuade those with early symptoms to seek help. Eating disorders are easier to prevent than to cure.

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<thead>
<tr>
<th>TABLE 7.11</th>
<th>Don’t Fall into the Body Image Trap</th>
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<tr>
<td><strong>Try to</strong></td>
<td>• Accept that healthy bodies come in many shapes and sizes</td>
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<td></td>
<td>• Recognize your positive qualities</td>
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<td></td>
<td>• Remember that you can be your worst critic</td>
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<td></td>
<td>• Explore your internal self, as well as your external appearance</td>
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<td></td>
<td>• Spend your time and energy enjoying the positive things in your life</td>
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<td></td>
<td>• Be aware of your own weight prejudice; explore how those feelings may affect your self-esteem.</td>
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<tr>
<td><strong>And try not to</strong></td>
<td>• Let your body define who or what you are</td>
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<td></td>
<td>• Judge others on the basis of appearance, body size, or shape</td>
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<td></td>
<td>• Forget that society changes its ideas of beauty over the years</td>
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<td></td>
<td>• Forget that you are not alone in your pursuit of self-acceptance</td>
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<td></td>
<td>• Be afraid to enjoy life</td>
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</tbody>
</table>

Adapted from: www.mckinley.uiuc.edu/Handouts/bodyimage.htm.
Chapter 7  Managing Your Weight

**SUMMARY**

1. The incidence of overweight and obesity in America has risen so much over the last 30 years that it has been called an epidemic. Excess body fat increases the risk of chronic diseases such as diabetes, heart disease, high blood pressure, and certain types of cancer.

2. The risks associated with body weight can be assessed by determining Body Mass Index, body composition, and the location of body fat. Body fat located in the abdominal region (visceral fat) is a greater health risk than subcutaneous fat in the hips and thighs.

3. The genes you inherit affect how much you weigh by coding for proteins that help regulate how much you eat from meal to meal and the amount of fat you store over the long term. Signals from the gastrointestinal (GI) tract, hormones, and circulating nutrients regulate short-term hunger and satiety. Signals from fat cells, such as the release of leptin, regulate long-term energy intake and expenditure. Defects in one or more of the genes that regulate body weight (called obesity genes) could lead to the storage of too much body fat.

4. Although what we weigh is greatly affected by genetics, environmental factors such as the availability of high-calorie foods and labor-saving devices, as well as personal choices concerning the amount and type of food consumed and activity level, also affect body weight.

5. The principle of energy balance states that if energy intake equals energy needs, body weight will remain constant. Energy is provided to the body by the carbohydrate, fat, and protein in the food we eat. This energy is used for basal metabolism, activity, and the thermic effect of food (TEF). Basal metabolism is the energy needed to maintain body functions that keep us alive and is usually the largest component of energy expenditure. The amount of energy expended for activity can vary a great deal from person to person. TEF is the energy needed to digest and metabolize food.

6. When excess energy is consumed, it is stored for later use. Fat is preferentially stored, while carbohydrate is used for energy and amino acids are used to meet protein needs. When energy in the diet does not meet needs, body energy stores are used.

7. The energy needs of healthy people can be predicted by calculating estimated energy requirements (EER). Your EER depends on your gender, age, life stage, height,
weight, and level of physical activity. As your level of physical activity increases, so does the number of calories you need to maintain your weight.

8. More Americans are overweight today because as a population we are taking in more calories, due to poor food choices and larger portion sizes, and moving less, due to modern lifestyles that include computers, cars, and other conveniences that reduce energy expended in work and play.

9. Weight management involves adjusting energy intake and expenditure and modifying long-term behaviors to keep weight in a healthy range. Whether you need to lose weight depends on how much body fat you have, where that fat is located, and what your health risks are. To lose a pound of fat, expenditure must be increased or intake decreased by approximately 3500 Calories. Slow, steady weight loss of 1/2 to 2 pounds per week is more likely to be maintained than rapid weight loss.

10. There are thousands of diets that promise weight loss. All cause short-term weight loss because they decrease energy intake. A good weight-loss diet is one that allows a wide variety of food choices, does not require the purchase and consumption of special foods or combinations of foods, and can be followed for life.

11. Drug therapy and surgery may be effective approaches to weight management in certain obese individuals. However, to be effective they must be accompanied by long-term changes in diet and lifestyle.

12. Eating disorders are psychological disorders that involve dissatisfaction with body weight. Anorexia involves self-starvation resulting in an abnormally low body weight. Bulimia nervosa is characterized by repeated cycles of binge eating followed by purging and other behaviors to prevent weight gain. Binge-eating disorder is characterized by binging without purging, and people with this disorder are typically overweight.

13. Eating disorders are caused by a combination of genetic, psychological, and sociocultural factors. The lean body ideal in the United States is believed to contribute to eating disorders. Treatment involves psychological counseling to change attitudes about body size and improve eating habits while supplying an adequate diet.

**REFERENCES**


**REVIEW QUESTIONS**

1. What health problems are associated with excess body fat?
2. Is Body Mass Index a measure of body composition?
3. How does the distribution of body fat affect the risks of excess weight?
4. Define what is meant by a healthy weight.
5. What is EER and what factors are used in its calculation?
6. What is energy balance?
7. Which nutrients provide energy? How much does each provide?
8. List three components of energy expenditure.
9. What is basal metabolic rate?
10. List some environmental factors that affect energy balance. How might these affect an individual’s genetic predisposition to a particular weight?
11. Discuss the advantages and disadvantages of three different approaches to reducing energy intake.
12. What is the best approach to weight management? Why?
13. What are the characteristics of anorexia nervosa?
14. What are the differences between bulimia nervosa and binge-eating disorder?
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