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Nutrition for Wellness

“Healthy nutrition significantly enhances health and quality of life.”

Objectives

▶ Define nutrition and describe its relationship to health and well-being.
▶ Learn to use the USDA MyPlate guidelines for healthier eating.
▶ Describe the functions of the nutrients—carbohydrates, fiber, fats, proteins, vitamins, minerals, and water—in the human body.
▶ Define the various energy production mechanisms of the human body.
▶ Be able to conduct a comprehensive nutrient analysis and implement changes to meet the Dietary Reference Intakes (DRIs).
▶ Identify myths and fallacies regarding nutrition.
▶ Become aware of guidelines for nutrient supplementation.
▶ Learn the 2010 Dietary Guidelines for Americans.

CENGAGEbrain

Analyze your diet and plan for healthy nutrition. Visit www.cengagebrain.com to access course materials and companion resources for this text including quiz questions designed to check your understanding of the chapter contents. See the preface on page xv for more information.
Should I worry about sugar in my diet? Until recently, the most significant health concerns regarding excessive sugar intake included increased caloric intake, weight gain, obesity, tooth decay, and lower nutrient intake (“empty” or “discretionary” calories with no nutritional benefit whatsoever). A 24-year study of almost 90,000 women published in the 2009 *American Journal of Clinical Nutrition*, however, indicated that consumption of one or two sugar-sweetened beverages per day increased coronary heart disease risk by 23 or 35 percent, respectively. Regular soft drink consumers have about an 80-percent greater risk for developing type 2 diabetes. Excessive body weight increases the risk for metabolic syndrome and heart disease. Excessive added sugar in the diet also raises blood fats known as triglycerides, which along with cholesterol clog up the arteries. People who consume a sugar-heavy diet run a greater risk for pancreatic cancer. At present, there is no evidence that sugar directly causes other types of cancer, hyperactivity, or abnormal behavior.

You do not have to eliminate all sugar from your diet. The latest data released in late 2010 indicate that the typical American consumes about 475 daily calories from added sugar, the equivalent of 30 teaspoons per day. Most people simply cannot afford all those extra daily empty calories. People should strive for a “nutrient-rich” diet—that is, a high nutrient-to-calorie ratio. The American Heart Association recommends no more than six and nine daily teaspoons of added sugar for women and men, respectively. Data also indicate that liquid calories (soft drinks) do not result in less food consumption during a meal.

 Unfortunately, food labels do not differentiate between natural and added sugars, making it difficult to determine the quantity added to foods and drinks. Natural sugars in food (fructose and lactose) are acceptable because these foods contain many other healthful substances. Among others, sugars listed on food labels include ordinary table sugar (sucrose), raw sugar, cane sugar, brown sugar, invert sugar, high-fructose corn syrup (HFCS), corn syrup, corn sweetener, glucose, dextrose, fructose, lactose, maltose, maltodextrin, molasses, honey, agave syrup, maple syrup, malt syrup, fruit juice concentrate, and sorghum.

The American Diabetic Association indicates that soft drinks and sweetened drinks are the biggest source of sugar in the diet, accounting for 38 percent of all added sugar intake (each 12-ounce can of soft drink contains about 10 teaspoons of sugar). Soda consumption in the United States has increased by 500 percent over the past 50 years. The soda industry generates about 47 gallons of soft drink for each American. Other drinks that are loaded with sugar include fruit drinks, iced teas, sports drinks, and energy drinks. Plain sugar, candy, and desserts account for another 34 percent of the added sugar intake.

Many researchers have expressed particular concern over HFCS, a liquid sweetener made from corn starch but greatly enhanced with fructose. HFCS is used in many products including soft drinks, candies, baked goods, and breakfast cereals. HFCS is thought to be a major contributor to obesity, cardiovascular disease, diabetes, and possibly high blood pressure, liver and kidney disease, and systemic inflammation.

Only athletes who participate in vigorous-intensity exercise for longer than 60 minutes at a time can benefit from sports drinks as an additional source of energy. Sports drinks contain between 70 and 100 calories (four to six teaspoons of added sugar) per 12 ounces. Most individuals who participate in 30 to 60 minutes of physical activity/exercise for health/fitness purposes do not need and will not benefit from sports drinks. For proper weight management and healthy living, moderation is a sound principle regarding added sugar consumption.

**Fish is known to be heart healthy, but should we have mercury toxicity concerns?** Fish and shellfish contain high-quality protein, omega-3 fatty acids, and other essential nutrients. Fish is lower in saturated fat and cholesterol than meat or poultry. Data indicate that eating as little as six ounces of fatty fish per week can reduce the risk of premature death from heart disease by one-third and overall death rates by about one-sixth. Fish also appears to have anti-inflammatory properties that can help treat chronic inflammatory kidney disease, osteoarthritis, rheumatoid arthritis, Crohn’s disease, and autoimmune disorders like asthma and lupus. Thus, fish is one of the healthiest foods we can consume.

Potential contaminants in fish, and in particular mercury, have created concerns among some people. Mercury cannot be removed from food. As it accumulates in the body, it harms the brain and nervous system. Mercury is a naturally occurring trace mineral that can be released into the air from industrial pollution. As mercury falls into streams and oceans, it accumulates in the aquatic food chain. Larger fish accumulate larger amounts of mercury because they eat medium- and small-size fish. Of particular concern are shark, swordfish, king mackerel, pike, bass, and tilefish, which have higher levels. Farm-raised salmon also have slightly higher levels of polychlorinated biphenyls (PCBs), which the U.S. Environmental Protection Agency lists as a “probable human carcinogen.”

The American Heart Association recommends consuming fish twice a week. The risk for adverse effects from eating fish is extremely low and primarily theoretical in nature. For most people, eating two servings (up to six ounces) of fish per week poses no health threat. Pregnant and nursing women and young children, however, should avoid mercury in fish. The best recommendation is to balance the risks against the benefits. If you are still concerned, consume no more than 12 ounces per week of a variety of fish and shellfish that are lower in mercury, including canned light tuna, wild salmon, shrimp, pollock, catfish, and scallops. And check local advisories about the safety of fish caught by family and friends in local streams, rivers, lakes, and coastal areas. Many preventive medicine experts now believe that fish is most likely the single most important food an individual can consume for good health.
Are organic foods better than conventional foods?
Concerns over food safety have led many people to turn to organic foods. Currently, there’s no solid evidence that organic food is more nutritious than conventional food, but pesticide residues in organic foods are substantially lower than conventionally grown foods. Health risks from pesticide exposure from foods are relatively small for healthy adults. The health benefits of produce far outweigh the risks. Children, older adults, pregnant and lactating women, and people with weak immune systems, however, may be vulnerable to some types of pesticides.

Organic foods, including crops, meat, poultry, eggs, and dairy products, are produced under strict government regulations. Organic crops have to be grown without the use of conventional pesticides, artificial fertilizers, human waste, or sewage sludge, and have been processed without ionizing radiation or food additives. Harmful microbes in manure must also be destroyed prior to use, and genetically modified organisms may not be used. Organic livestock are raised under certain grazing conditions, using organic feed, and without the use of antibiotics and growth hormones.

Organic foods can just as easily be contaminated with bacteria, pathogens, and heavy metals that pose major health risks. The soil itself may become contaminated, or if the produce comes in contact with feces of grazing cattle, wild animals/birds, farm workers, or any other source, potentially harmful microorganisms can contaminate the produce. Recent Escherichia coli-contaminated spinach, sold nationwide, was grown in a field that was in transition from conventional crops to an organic field. The best safeguard to protect yourself is to follow the food safety guidelines provided on page 107.

What do the terms glycemic index and glycemic load mean? The glycemic index (GI) provides a numeric value that measures the blood glucose (sugar) response following ingestion of individual carbohydrate foods. Carbohydrates that are quickly absorbed and cause a rapid rise in blood glucose are said to have a high GI. Those that break down slowly and gradually release glucose into the blood have a low GI. Consumption of high glycemic foods in combination with some fat and protein, nonetheless, brings down the average index. The glycemic load is calculated by multiplying the GI of a particular food by its carbohydrate content in grams and dividing by 100. The usefulness of the glycemic load is based on the theory that a high-glycemic-index food eaten in small quantities provides a similar effect in blood sugar rise as a consumption of a larger quantity of a low-glycemic food. The most accurate source of the GI and GL of 750 foods has been published in the Journal of Clinical Nutrition at http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2499691/. Additional information on the GI is also provided in Chapter 5, pages 147–149.

What is the difference between antioxidants and phytonutrients? Antioxidants, comprising vitamins, minerals, and phytonutrients, help prevent damage to cells from highly reactive and unstable molecules known as oxygen free radicals (see page 101). Antioxidants are found both in plant and animal foods, whereas phytonutrients are found in plant foods only, including fruits, vegetables, beans, nuts, and seeds. The actions of phytonutrients, however, go beyond those of most antioxidants. In particular, they appear to have powerful anti-cancer properties. For example, at almost every stage of cancer, phytonutrients can block, disrupt, slow, or even reverse the process. In terms of heart disease, they may reduce inflammation, inhibit blood clots, or prevent the oxidation of low-density lipoprotein cholesterol. People should consume ample amounts of plant-based foods to obtain a healthy supply of antioxidants, including a wide array of phytonutrients.

Real Life Story Karina’s Experience

I used to always be in a hurry in the morning before class. I liked to grab a bagel with jam and coffee with lots of cream and sugar for breakfast (unless I skipped breakfast entirely). For lunch I often had plain pasta with marinara sauce, a soda, and a candy bar. I found that around 3:00 p.m. I would get hungry and have no energy. I always needed a “pick-me-up” like coffee and a muffin. At night, I was so hungry that I often raided the refrigerator and practically devoured every food in sight. When we did a nutrient analysis in class, I found that I was eating a high amount of simple carbs every day that contained a lot of sugar. My instructor suggested that eating a balanced breakfast might help curve my cravings and provide greater energy levels later in the day. So I began to get up earlier and go to the cafeteria for a sit-down breakfast. I would get a cup of oatmeal with blueberries, some skim milk, and a small amount of scrambled eggs or low-fat cottage cheese. This breakfast has complex carbohydrates, fiber, protein, and some fat. I find that when I eat this kind of breakfast, I have fewer cravings for snack foods later in the day, steadier energy levels, and I no longer raid the refrigerator at night. I also started paying attention to what I have for lunch and dinner, trying to eat more balanced meals, including fruits, vegetables, 100% whole-wheat products, and fish. Now I find that I have much more energy for my afternoon classes and lacrosse practice!
Personal Nutrition Habits

I. Are you aware of the average daily caloric intake and macronutrient content of your diet? _______ Yes _______ No

If you answered "yes," please indicate your average daily caloric intake: _______ calories and your daily percentage of total calories for CHO _______, fat _______, and protein _______.

II. According to nutritional guidelines, the daily average caloric intake should be distributed so that _______ to _______% of the calories come from carbohydrates, _______ to _______% from fat, and _______ to _______% from protein.

III. Nutrient supplements are encouraged for most people to achieve a balanced diet. _______ True _______ False

IV. Current dietary guidelines for Americans encourage people to balance calories with physical activity to sustain healthy weight and focus on consuming nutrient-dense foods and beverages. _______ True _______ False

V. As a "pediatric disease," osteoporosis can be prevented early in life by making sure that the diet has sufficient calcium and by participating in weight-bearing activities. _______ True _______ False

Proper nutrition is essential to overall health and wellness. Good nutrition means that a person’s diet supplies all the essential nutrients for healthy body functioning, including normal tissue growth, repair, and maintenance. The diet should also provide enough substrates to produce the energy necessary for work, physical activity, and relaxation.

Nutrients should be obtained from a wide variety of sources. Figure 3.1 shows MyPlate nutrition guidelines and recommended daily food amounts according to various caloric requirements. To lower the risk for chronic disease, an effective wellness program must incorporate healthy eating guidelines. These guidelines will be discussed throughout this chapter and in later chapters.

Too much or too little of any nutrient can precipitate serious health problems. The typical U.S. diet is too high in calories, sugar, saturated fat, trans fat, and sodium, and not high enough in whole grains, fruits, and vegetables—factors that undermine good health. On a given day, nearly half of the people in the United States eat no fruit and almost a fourth eat no vegetables.

Food availability is not a problem. The problem is overconsumption of the wrong foods. Diseases of dietary excess and imbalance are among the leading causes of death in many developed countries throughout the world, including the United States.

Diet and nutrition often play a crucial role in the development and progression of chronic diseases. A diet high in saturated fat, trans fat, and cholesterol increases the risk for diseases of the cardiovascular system, including atherosclerosis, coronary heart disease (CHD), and strokes. In sodium-sensitive individuals, high salt intake has been linked to high blood pressure. Up to 50 percent of all cancers may be diet related. Obesity, diabetes, and osteoporosis also have been associated with faulty nutrition.

Nutrients

The essential nutrients that the human body requires are carbohydrates, fat, protein, vitamins, minerals, and water. The first three are called “fuel nutrients” because they are the only substances that the body uses to supply the energy (commonly measured in calories) needed for work and normal body functions. The three others—vitamins, minerals, and water—are regulatory nutrients. They have no caloric value but are still necessary for a person to function normally and maintain good health. Many nutritionists add to this list a seventh nutrient: fiber. This nutrient is vital for good health. Recommended amounts seem to provide protection against several diseases, including cardiovascular disease and some cancers.

Carbohydrates, fats, proteins, and water are termed macronutrients because we need them in proportionately large amounts daily. Vitamins and minerals are required in only small amounts—grams, milligrams, and micrograms instead of, say, ounces—and nutritionists refer to them as micronutrients.

Depending on the amount of nutrients and calories they contain, foods can be classified by their nutrient density. Foods that contain few or a moderate number of

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**Key Terms**

**Nutrition** Science that studies the relationship of foods to optimal health and performance.

**Substrates** Substances acted upon by an enzyme (examples: carbohydrates, fats).

**Nutrients** Substances found in food that provide energy, regulate metabolism, and help with growth and repair of body tissues.

**Nutrient density** A measure of the amount of nutrients and calories in various foods.
Any food made from wheat, rice, oats, cornmeal, barley, or another cereal grain is a grain product. Bread, pasta, oatmeal, breakfast cereals, tortillas, and grits are examples of grain products.

Grains are divided into 2 subgroups: whole grains and refined grains.

All foods made from meat, poultry, seafood, beans, and peas, eggs, processed soy products, nuts, and seeds are considered part of the Protein Foods Group (beans and peas are also part of the Vegetable Group).

Select at least 8 ounces of cooked seafood per week. Meat and poultry choices should be lean or low-fat. Young children need less, depending on their age and calories needs. The advice to consume seafood does not apply to vegetarians. Vegetarian options in the Protein Foods Group include beans and peas, processed soy products, and nuts and seeds.

All fluid milk products and many foods made from milk are considered part of this food group. Most Dairy Group choices should be fat-free or low-fat. Foods made from milk that retain their calcium content are part of the group. Foods made from milk that have little to no calcium, such as cream cheese, cream, and butter, are not. Calcium-fortified soymilk (soy beverage) is also part of the Dairy Group.

### Recommended Daily Amounts

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<tr>
<th></th>
<th>Women</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Vegetables</strong></td>
<td><strong>Fruits</strong></td>
<td><strong>Grains</strong></td>
<td><strong>Protein</strong></td>
<td><strong>Dairy</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19–30 years old</td>
<td>2½ cups</td>
<td>2 cups</td>
<td>6 oz. equivalents</td>
<td>5½ oz. equivalents</td>
<td>3 cups</td>
<td></td>
</tr>
<tr>
<td>31–50 years old</td>
<td>2½ cups</td>
<td>1½ cups</td>
<td>6 oz. equivalents</td>
<td>5 oz. equivalents</td>
<td>3 cups</td>
<td></td>
</tr>
<tr>
<td>51+ years old</td>
<td>2 cups</td>
<td>1 cup</td>
<td>5 oz. equivalents</td>
<td>5 oz. equivalents</td>
<td>3 cups</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Men</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Vegetables</strong></td>
<td><strong>Fruits</strong></td>
<td><strong>Grains</strong></td>
<td><strong>Protein</strong></td>
<td><strong>Dairy</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19–30 years old</td>
<td>3 cups</td>
<td>2 cups</td>
<td>8 oz. equivalents</td>
<td>6½ oz. equivalents</td>
<td>3 cups</td>
<td></td>
</tr>
<tr>
<td>31–50 years old</td>
<td>3 cups</td>
<td>2 cups</td>
<td>7 oz. equivalents</td>
<td>6 oz. equivalents</td>
<td>3 cups</td>
<td></td>
</tr>
<tr>
<td>51+ years old</td>
<td>2½ cups</td>
<td>2 cups</td>
<td>6 oz. equivalents</td>
<td>6½ oz. equivalents</td>
<td>3 cups</td>
<td></td>
</tr>
</tbody>
</table>

Source: [http://www.choosemyplate.gov/](http://www.choosemyplate.gov/). Additional information can be obtained on this site, including an online individualized MyPlate eating plan (Plan a Healthy Menu option on the site) based on your age, gender, weight, height, and activity level.
Carbohydrates

Carbohydrates constitute the major source of calories that the body uses to provide energy for work, to maintain cells, and generate heat. They are necessary for brain, muscle, and nervous system function and help regulate fat and metabolize protein. Each gram of carbohydrates provides the human body with four calories. The major sources of carbohydrates are breads, cereals, fruits, vegetables, and milk and other dairy products. Carbohydrates are classified into simple carbohydrates and complex carbohydrates (Figure 3.2).

Simple Carbohydrates

Often called “sugars,” simple carbohydrates have little nutritive value. Examples are candy, soda, and cakes. Simple carbohydrates are divided into monosaccharides and disaccharides. These carbohydrates—whose names end in “ose”—often take the place of more nutritive foods in the diet.

Monosaccharides. The simplest sugars are monosaccharides. The three most common monosaccharides are glucose, fructose, and galactose.

1. Glucose is a natural sugar found in food and also produced in the body from other simple and complex carbohydrates. It is used as a source of energy, or it may be stored in the muscles and liver in the form of glycogen (a long chain of glucose molecules hooked together). Excess glucose in the blood is converted to fat and stored in adipose tissue.
2. Fructose, or fruit sugar, occurs naturally in fruits and honey and is converted to glucose in the body.
3. Galactose is produced from milk sugar in the mammary glands of lactating animals and is converted to glucose in the body.

Disaccharides. The three major disaccharides are:

1. Sucrose or table sugar (glucose + fructose)
2. Lactose (glucose + galactose)
3. Maltose (glucose + glucose)

These disaccharides are broken down in the body, and the resulting simple sugars (monosaccharides) are used as indicated above.

Complex Carbohydrates

Complex carbohydrates are also called polysaccharides. Anywhere from about 10 to thousands of monosaccharide molecules can unite to form a single polysaccharide. Examples of complex carbohydrates are starches, dextrins, and glycogen.

1. Starch is the storage form of glucose in plants that is needed to promote their earliest growth. Starch is commonly found in grains, seeds, corn, nuts, roots, potatoes, and legumes. In a healthful diet, grains, the richest source of starch, should supply most of the body’s energy. Once eaten, starch is converted to glucose for the body’s own energy use.
2. Dextrins are formed from the breakdown of large starch molecules exposed to dry heat, such as in baking bread or producing cold cereals. These complex carbohydrates of plant origin provide many valuable nutrients and can be an excellent source of fiber.
3. Glycogen is the animal polysaccharide synthesized from glucose and is found in only tiny amounts in meats. In essence, we manufacture it; we don’t consume it. Glycogen constitutes the body’s reservoir of glucose. Thousands of glucose molecules are linked, to be stored as glycogen in the liver and muscle. When a surge of energy is needed, enzymes in the muscle and the liver break down glycogen and thereby make glucose readily available for energy.
transformation. (This process is discussed under “Nutrition for Athletes,” starting on page 108.)

Fiber
Fiber is a form of complex carbohydrate. A high-fiber diet gives a person a feeling of fullness without adding too many calories to the diet. Dietary fiber is present mainly in plant leaves, skins, roots, and seeds. Processing and refining foods removes almost all of their natural fiber. In our diet, the main sources of fiber are whole-grain cereals and breads, fruits, vegetables, and legumes.

Fiber is important in the diet because it decreases the risk for disease, in particular cardiovascular disease. Increased fiber intake may lower the risk for CHD, because saturated fats and trans fats often take the place of fiber in the diet, increasing the absorption and formation of cholesterol. Other health disorders that have been tied to low intake of fiber are infections, respiratory diseases, constipation, diverticulitis, hemorrhoids, gallbladder disease, and obesity. Recent 2011 data showed that individuals who eat the most dietary fiber have a 22-percent lower mortality rate from any cause as compared to those who eat the least amount of fiber.\(^1\)

The recommended fiber intake for adults of age 50 years and younger is 25 grams per day for women and 38 grams for men. As a result of decreased food consumption in people over 50 years of age, an intake of 21 and 30 grams of fiber per day, respectively, is recommended.\(^2\) Most people in the United States eat only 15 grams of fiber per day, putting them at increased risk for disease.

A person can increase fiber intake by eating more fruits, vegetables, legumes, whole grains, and whole-grain cereals. Research provides evidence that increasing fiber intake to 30 grams per day leads to a significant reduction in heart attacks, cancer of the colon, breast cancer, diabetes, and diverticulitis. Table 3.1 provides the fiber content of selected foods. A practical guideline to obtain your fiber intake is to eat at least five daily servings of fruits and vegetables and three servings of whole-grain foods (whole-grain bread, cereal, and rice).

Fiber is typically classified according to its solubility in water:

1. Soluble fiber dissolves in water and forms a gel-like substance that encloses food particles. This property allows soluble fiber to bind and excrete fats from the body. This type of fiber has been shown to lower blood cholesterol and blood sugar levels. Soluble fiber is found primarily in oats, fruits, barley, legumes, and psyllium (an ancient Indian grain added to some breakfast cereals).
2. Insoluble fiber is not easily dissolved in water, and the body cannot digest it. This type of fiber is important because it binds water, causing a softer and bulkier stool that increases peristalsis, the involuntary muscle contractions of intestinal walls that force the stool through the intestines and enable quicker excretion of food residues. Speeding the passage of food residues through the intestines seems to lower the risk for colon cancer, mainly because it reduces the amount of time that cancer-

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**Key Terms**

- **Calorie** The amount of heat necessary to raise the temperature of one gram of water one degree centigrade; used to measure the energy value of food and cost (energy expenditure) of physical activity.
- **Carbohydrates** A classification of a dietary nutrient containing carbon, hydrogen, and oxygen; the major source of energy for the human body.
- **Simple carbohydrates** Formed by simple or double sugar units with little nutritive value; divided into monosaccharides and disaccharides.
- **Monosaccharides** The simplest carbohydrates (sugars), formed by five- or six-carbon skeletons. The three most common monosaccharides are glucose, fructose, and galactose.
- **Adipose tissue** Fat cells in the body.
- **Disaccharides** Simple carbohydrates formed by two monosaccharide units linked together, one of which is glucose. The major disaccharides are sucrose, lactose, and maltose.
- **Complex carbohydrates** Carbohydrates formed by three or more simple sugar molecules linked together; also referred to as polysaccharides.
- **Glycogen** Form in which glucose is stored in the body.
- **Dietary fiber** A complex carbohydrate in plant foods that is not digested but is essential to digestion.
- **Peristalsis** Involuntary muscle contractions of intestinal walls that facilitate excretion of wastes.
causing agents are in contact with the intestinal wall. Insoluble fiber is also thought to bind with carcinogens (cancer-producing substances), and more water in the stool may dilute the cancer-causing agents, lessening their potency. Sources of insoluble fiber include wheat, cereals, vegetables, and skins of fruits.

The most common types of fiber are:

1. Cellulose: water-insoluble fiber found in plant cell walls
2. Hemicellulose: water-insoluble fiber found in cereal fibers
3. Pectins: water-soluble fiber found in vegetables and fruits
4. Gums and mucilages: water-soluble fiber also found in small amounts in foods of plant origin

Surprisingly, excessive fiber intake can be detrimental to health. It can produce loss of calcium, phosphorus, and iron, to say nothing of gastrointestinal discomfort. If your fiber intake is below the recommended amount, increase your intake gradually over several weeks to avoid gastrointestinal disturbances. While increasing your fiber intake, be sure to drink more water to avoid constipation and even dehydration. Excellent complex carbohydrate choices include quinoa (one of the best whole grains you can eat, also high in protein—a complete protein), beans, and sweet potatoes.

### Table 3.1 Dietary Fiber Content of Selected Foods

<table>
<thead>
<tr>
<th>Food</th>
<th>Serving Size</th>
<th>Dietary Fiber (gr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Almonds, shelled</td>
<td>¼ cup</td>
<td>3.9</td>
</tr>
<tr>
<td>Apple</td>
<td>1 medium</td>
<td>3.7</td>
</tr>
<tr>
<td>Banana</td>
<td>1 small</td>
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</tr>
<tr>
<td>Beans (red kidney)</td>
<td>¼ cup</td>
<td>8.2</td>
</tr>
<tr>
<td>Blackberries</td>
<td>¼ cup</td>
<td>4.9</td>
</tr>
<tr>
<td>Beets, red, canned (cooked)</td>
<td>¼ cup</td>
<td>1.4</td>
</tr>
<tr>
<td>Brazil nuts</td>
<td>1 oz</td>
<td>2.5</td>
</tr>
<tr>
<td>Broccoli (cooked)</td>
<td>¼ cup</td>
<td>3.3</td>
</tr>
<tr>
<td>Brown rice (cooked)</td>
<td>¼ cup</td>
<td>1.7</td>
</tr>
<tr>
<td>Carrots (cooked)</td>
<td>¼ cup</td>
<td>3.3</td>
</tr>
<tr>
<td>Cauliflower (cooked)</td>
<td>¼ cup</td>
<td>5.0</td>
</tr>
<tr>
<td>Cereal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Bran</td>
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</tr>
<tr>
<td>Cheerios</td>
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</tr>
<tr>
<td>Cornflakes</td>
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<tr>
<td>Fruit and Fibre</td>
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<td>Fruit Wheats</td>
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<tr>
<td>Just Right</td>
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<tr>
<td>Wheaties</td>
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<td>Corn (cooked)</td>
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<td>Eggplant (cooked)</td>
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<tr>
<td>Lettuce (chopped)</td>
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<tr>
<td>Orange</td>
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</tr>
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<td>Parsnips (cooked)</td>
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</tr>
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<td>Pear</td>
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</tr>
<tr>
<td>Peas (cooked)</td>
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<td>4.4</td>
</tr>
<tr>
<td>Popcorn (plain)</td>
<td>1 cup</td>
<td>1.2</td>
</tr>
<tr>
<td>Potato (baked)</td>
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<td>4.9</td>
</tr>
<tr>
<td>Strawberries</td>
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<tr>
<td>Summer squash (cooked)</td>
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<td>1.6</td>
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<tr>
<td>Watermelon</td>
<td>1 cup</td>
<td>0.1</td>
</tr>
</tbody>
</table>

### Tips to Increase Fiber in Your Diet

- Eat more vegetables, either raw or steamed
- Eat salads daily that include a wide variety of vegetables
- Eat more fruit, including the skin
- Choose whole-wheat and whole-grain products
- Choose breakfast cereals with more than 3 grams of fiber per serving
- Sprinkle a teaspoon or two of unprocessed bran or 100 percent bran cereal on your favorite breakfast cereal
- Add high-fiber cereals to casseroles and desserts
- Add beans to soups, salads, and stews
- Add vegetables to sandwiches: sprouts, green and red pepper strips, diced carrots, sliced cucumbers, red cabbage, onions
- Add vegetables to spaghetti: broccoli, cauliflower, sliced carrots, mushrooms
- Experiment with unfamiliar fruits and vegetables—collards, kale, broccoli, asparagus, papaya, mango, kiwi, starfruit
- Blend fruit juice with small pieces of fruit and crushed ice
- When increasing fiber in your diet, drink plenty of fluids

**Try It**  Do you know your average daily fiber intake? If you do not know, keep a 3-day record of daily fiber intake. How do you fare against the recommended guidelines? If your intake is low, how can you change your diet to increase your daily fiber intake?
Fats (Lipids)

The human body uses fats as a source of energy. Also called lipids, fats are the most concentrated energy source, with each gram of fat supplying 9 calories to the body (in contrast to 4 for carbohydrates). Fats are a part of the human cell structure. Deposits of fat cells are used as stored energy and as an insulator to preserve body heat. They absorb shock, supply essential fatty acids, and carry the fat-soluble vitamins A, D, E, and K. Fats can be classified into three main groups: simple, compound, and derived (Figure 3.3). The most familiar sources of fat are whole milk and other dairy products, meats, and meat alternatives such as eggs and nuts.

Simple Fats
A simple fat consists of a glyceride molecule linked to one, two, or three units of fatty acids. Depending on the number of fatty acids attached, simple fats are divided into monoglycerides (one fatty acid), diglycerides (two fatty acids), and triglycerides (three fatty acids). More than 90 percent of the weight of fat in foods and more than 95 percent of the stored fat in the human body are in the form of triglycerides.

The length of the carbon atom chain and the amount of hydrogen saturation (i.e., the number of hydrogen molecules attached to the carbon chain) in fatty acids vary. Based on the extent of saturation, fatty acids are said to be saturated or unsaturated. Unsaturated fatty acids are classified further into monounsaturated and polyunsaturated fatty acids. Saturated fatty acids are mainly of animal origin, and unsaturated fats are found mostly in plant products.

Saturated Fats. In saturated fatty acids (or “saturated fats”), the carbon atoms are fully saturated with hydrogen atoms; only single bonds link the carbon atoms on the chain (Figure 3.4). Foods high in saturated fatty acids are meats, animal fat, lard, whole milk, cream, butter, cheese, ice cream, hydrogenated oils (hydrogenation saturates fat with hydrogens, also known as trans fats), coconut oil, and palm oils. Saturated fats typically do not melt at room temperature. Coconut and palm oils are exceptions. In general, saturated fats raise the blood cholesterol level. The data on coconut and palm oils are controversial, as some research indicates that these oils may be neutral in terms of their effects on cholesterol.

Although saturated fats raise the “bad” LDL cholesterol (in particular the less-damaging larger LDL particles) and daily intake should be limited, data indicate that people who replace saturated fat in the diet with refined carbohydrates such as white bread and pasta and low-fat sweetened baked goods, are at greater risk because the latter tend to decrease the “good” HDL cholesterol and increase triglycerides (blood fats) and the more dangerous smaller LDL particles. Individuals who replace saturated fats with polyunsaturated fats (see discussion that follows) derive significant health benefits. A more thorough discussion on this topic is provided in Chapter 10 (page 346).

Unsaturated Fats. In unsaturated fatty acids (or “unsaturated fats”), double bonds form between unsaturated carbons. These healthy fatty acids include monounsatu-
rated and polyunsaturated fats, which are usually liquid at room temperature. Other shorter fatty acid chains also tend to be liquid at room temperature. Unsaturated fats help lower blood cholesterol. When unsaturated fats replace saturated fats in the diet, the former stimulate the liver to clear cholesterol from the blood.

In monounsaturated fatty acids (MUFA), only one double bond is found along the chain. Monounsaturated fatty acids are found in olive, canola, peanut, and sesame oils. They are also found in avocados, peanuts, and cashews.

Polyunsaturated fatty acids (PUFA) contain two or more double bonds between unsaturated carbon atoms along the chain. Corn, cottonseed, safflower, walnut, sunflower, and soybean oils are high in polyunsaturated fatty acids and are also found in fish, almonds, and pecans.

**Trans Fatty Acids.** Hydrogen often is added to monounsaturated and polyunsaturated fats to increase shelf life and to solidify them so they are more spreadable. During this process, called “partial hydrogenation,” the position of hydrogen atoms may be changed along the carbon chain, transforming the fat into a trans fatty acid. Some margarine, spreads, shortening, pastries, nut butters, crackers, cookies, frozen breakfast foods, dairy products, snacks and chips, cake mixes, meats, processed foods, and fast foods contain trans fatty acids.

Trans fatty acids are not essential and provide no known health benefit. In truth, health-conscious people minimize their intake of these types of fats because diets high in trans fatty acids increase low-density lipoprotein (LDL; “bad”) cholesterol and decrease high-density lipoprotein (HDL; “good”) cholesterol, increase rigidity of the coronary arteries, and contribute to the formation of blood clots that may lead to heart attacks and strokes.

Paying attention to food labels is important, because the words “partially hydrogenated” and “trans fatty acids” indicate that the product carries a health risk just as high or higher than that of saturated fat. The U.S. Food and Drug Administration (FDA) requires that food labels list trans fatty acids so consumers can make healthier choices.

**Polyunsaturated Omega Fatty Acids.** Omega fatty acids have gained considerable attention in recent years. These fatty acids are essential to human health and cannot be manufactured by the body (they have to be consumed in the diet). These essential fatty acids have been named based on where the first double bond appears in the carbon chain—starting from the end of the chain; hence, the term “omega” from the end of the Greek alphabet. Accordingly, omega fats are classified as omega-3 fatty acids and omega-6 fatty acids.

Maintaining a balance between these fatty acids is important for good health. Excessive intake of omega-6 fatty acids may contribute to inflammation (a risk factor for heart disease—see Chapter 10, page 351), cancer, asthma, arthritis, and depression. A ratio of four to one (4:1) omega-6 to omega-3 fatty acids is often recommended to maintain and improve health.

Most critical in the diet are omega-3 fatty acids, which provide substantial health benefits. Omega-3 fatty acids tend to decrease cholesterol, triglycerides, inflammation, blood clots, abnormal heart rhythms, and high blood pressure. They also decrease the risk for heart attack, abnormal heart rhythms, stroke, Alzheimer’s disease, dementia, macular degeneration, and joint degeneration.

Unfortunately, only 25 percent of the U.S. population consumes the recommended amount (approximately 500 mg) of omega eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) on any given day. These are two of the three major types of omega-3 fatty acids, along with alpha-linolenic acid (ALA). The evidence is strongest for EPA and DHA as being cardioprotective. Once consumed, the body converts ALA to EPA and then to DHA, but the process is not very efficient. It is best to increase consumption of EPA and DHA to obtain the greatest health benefit.

Individuals at risk for heart disease are encouraged to get an average of .5 to 1.8 grams (500 to 1,800 mg) of EPA and DHA per day. These fatty acids protect against irregular heartbeat and blood clots, reduce triglycerides and blood pressure, and defend against inflammation.

Fish—especially fresh or frozen salmon, mackerel, herring, tuna, and rainbow trout—are high in EPA and DHA. Table 3.2 presents a listing of total EPA plus DHA content of selected species of fish. Canned fish is best when packed in water. In oil-packed fish, the oil mixes with some of the natural fat in fish. When the oil is drained, some of the omega-3 fatty acids are lost as well.

**Table 3.2 Omega-3 Fatty Acid Content (EPA + DHA) per 100 Grams (3.5 oz) of Fish**

<table>
<thead>
<tr>
<th>Type of Fish</th>
<th>Total EPA + DHA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anchovy</td>
<td>1.4 gr</td>
</tr>
<tr>
<td>Bluefish</td>
<td>1.2 gr</td>
</tr>
<tr>
<td>Halibut</td>
<td>0.4 gr</td>
</tr>
<tr>
<td>Herring</td>
<td>1.7 gr</td>
</tr>
<tr>
<td>Mackerel</td>
<td>2.4 gr</td>
</tr>
<tr>
<td>Sardine</td>
<td>1.4 gr</td>
</tr>
<tr>
<td>Salmon, Atlantic</td>
<td>1.0 gr</td>
</tr>
<tr>
<td>Salmon, Chinook</td>
<td>1.9 gr</td>
</tr>
<tr>
<td>Salmon, Coho</td>
<td>1.2 gr</td>
</tr>
<tr>
<td>Salmon, Pink</td>
<td>1.0 gr</td>
</tr>
<tr>
<td>Salmon, Sockeye</td>
<td>1.3 gr</td>
</tr>
<tr>
<td>Shrimp</td>
<td>0.3 gr</td>
</tr>
<tr>
<td>Trout, Rainbow</td>
<td>0.6 gr</td>
</tr>
<tr>
<td>Trout, Lake</td>
<td>1.6 gr</td>
</tr>
<tr>
<td>Tuna, light (water canned)</td>
<td>0.3 gr</td>
</tr>
<tr>
<td>Tuna, white (Albacore)</td>
<td>0.8 gr</td>
</tr>
</tbody>
</table>
Good sources of omega-3 ALA include flaxseeds, canola oil, walnuts, wheat germ, and green leafy vegetables.

The oil in flaxseeds is high in ALA and has been shown to reduce abnormal heart rhythm and prevent blood clots. Flaxseeds are also high in fiber and plant chemicals known as lignans. Studies are being conducted to investigate the potential cancer-fighting ability of lignans. In one report, the addition of a daily ounce (three to four tablespoons) of ground flaxseeds to the diet seemed to lead to a decrease in the onset of tumors, preventing their formation and even leading to their shrinkage.© Excessive flaxseed in the diet is not recommended. High doses actually may be detrimental to health. Pregnant and lactating women, especially, should not consume large amounts of flaxseed.

Because flaxseeds have a hard outer shell, they should be ground to obtain the nutrients; whole seeds will pass through the body undigested. Flavor and nutrients are best preserved by grinding the seeds just before use. Pre-ground seeds should be kept sealed and refrigerated. Ground flaxseeds can be mixed with salad dressings, salads, wheat flour, pancakes, muffins, cereals, rice, cottage cheese, and yogurt. Flaxseed oil also may be used, but the oil has little or no fiber and lignans and must be kept refrigerated because it spoils quickly. The oil cannot be used for cooking either, because it scorches easily.

Most of the polyunsaturated fatty acid consumption in the United States comes from omega-6. Once viewed as healthy fats, excessive intake may be detrimental to health. Omega-6 fatty acids include linoleic acid (LA), gamma-linolenic acid (GLA), and arachidonic acid (AA). The typical American diet contains 10 to 20 times more omega-6 than omega-3 fatty acids. Most omega-6 fatty acids come in the form of LA from vegetable oils, the primary oil ingredient added to most processed foods, including salad dressing. LA-rich oils include corn, soybean, sunflower, safflower, and cottonseed oils.

Although more research is required, the imbalance between omega-3 and omega-6 fatty acids is thought to be responsible for the increased rate of inflammatory conditions seen in the United States today. Furthermore, in terms of heart health, while omega-6 fatty acids lower the “bad” LDL cholesterol, they also lower the “good” HDL cholesterol; thus its overall effect on cardiac health is neutral. To decrease your intake of LA, watch for corn, soybean, sunflower, and cottonseed oils in salad dressings, mayonnaise, and margarine.

The best source of omega-3 APA and DHA, the fatty acids that provide the most health benefits, is fish. Data suggest that the amount of fish oil obtained by eating two servings of fish weekly lessens the risk for CHD and may contribute to brain, joint, and vision health. A word of caution: People who have diabetes or a history of hemorrhaging or strokes, are on aspirin or blood-thinning therapy, or are presurgical patients should not consume fish oil except under a physician’s instruction.
Chemical compounds that contain nitrogen, organic nutrients essential for normal metabolism, must be provided in the diet because the body cannot manufacture them. *NOTE: Must be provided in the diet because the body cannot manufacture them.*

Excess proteins may be converted to glucose or fat, or used as a source of energy. Proteins can be used as a source of energy, too, but only if sufficient carbohydrates are not available. Each gram of protein yields four calories of energy (the same as carbohydrates). The main sources of protein are meats and meat alternatives, milk, and other dairy products. Excess proteins may be converted to glucose or fat, or even excreted in the urine.

The human body uses 20 amino acids to form various types of protein. Amino acids contain nitrogen, carbon, hydrogen, and oxygen. Of the 20 amino acids, 9 are called essential amino acids because the body cannot produce them. The other 11, termed nonessential amino acids, can be manufactured in the body if food proteins in the diet provide enough nitrogen (see Table 3.3). For the body to function normally, all amino acids shown in Table 3.3 must be present in the diet.

Proteins that contain all the essential amino acids, known as “complete” or “higher-quality” proteins, are usually of animal origin. If one or more of the essential amino acids are missing, the proteins are termed incomplete or lower-quality protein. Individuals have to take in enough protein to ensure nitrogen for adequate production of amino acids and also to get enough high-quality protein to obtain the essential amino acids.

Protein deficiency is not a problem in the typical U.S. diet. Two glasses of skim milk combined with about four ounces of poultry or fish meet the daily protein requirement. But too much animal protein can cause health problems. Some people eat twice as much protein as they need. Protein foods from animal sources are often high in fat, saturated fat, and cholesterol, which can lead to cardiovascular disease and cancer. Too much animal protein also decreases the blood enzymes that prevent precancerous cells from developing into tumors.

As mentioned earlier, a well-balanced diet contains a variety of foods from all five basic food groups, including a wise selection of foods from animal sources (see also “Balancing the Diet” in this chapter). Based on current nutrition data, meat (poultry and fish included) should be replaced by grains, legumes, vegetables, and fruits as main courses. Meats should be used more for flavoring than for volume. Daily consumption of beef, poultry, or fish should be limited to three ounces (about the size of a deck of cards) to six ounces.

**Vitamins**

Vitamins are necessary for normal bodily metabolism, growth, and development. Vitamins are classified into two types based on their solubility:

1. Fat soluble (A, D, E, and K)
2. Water soluble (B complex and C)

The body does not manufacture most vitamins, so they can be obtained only through a well-balanced diet. To decrease loss of vitamins during cooking, natural foods should be microwaved or steamed rather than boiled in water that is thrown out later.

A few exceptions, such as vitamins A, D, and K, are formed in the body. Vitamin A is produced from beta-carotene, found mainly in yellow foods such as carrots, pumpkin, and sweet potatoes. Vitamin D is found in certain foods and is created when ultraviolet light from the sun transforms 7-dehydrocholesterol, a compound in human skin. Vitamin K is created in the body by intestinal bacteria. The major functions of vitamins are outlined in Table 3.4.

Vitamins C, E, and beta-carotene also function as antioxidants, which are thought to play a key role in preventing chronic diseases. (The specific functions of these antioxidant nutrients and of the mineral selenium, also an antioxidant, are discussed under “Antioxidants,” page 101.)

**Minerals**

Approximately 25 minerals have important roles in body functioning. Minerals are inorganic substances contained in all cells, especially those in hard parts of the body (bones, nails, teeth). Minerals are crucial to maintaining water balance and the acid–base balance. They are essential components of respiratory pigments, en-

### Table 3.3 Amino Acids

<table>
<thead>
<tr>
<th>Essential Amino Acids*</th>
<th>Nonessential Amino Acids</th>
</tr>
</thead>
<tbody>
<tr>
<td>Histidine</td>
<td>Alanine</td>
</tr>
<tr>
<td>Isoleucine</td>
<td>Arginine</td>
</tr>
<tr>
<td>Leucine</td>
<td>Asparagine</td>
</tr>
<tr>
<td>Lysine</td>
<td>Aspartic acid</td>
</tr>
<tr>
<td>Methionine</td>
<td>Cysteine</td>
</tr>
<tr>
<td>Phenylalanine</td>
<td>Glutamic acid</td>
</tr>
<tr>
<td>Threonine</td>
<td>Glutamine</td>
</tr>
<tr>
<td>Tryptophan</td>
<td>Glycine</td>
</tr>
<tr>
<td>Valine</td>
<td>Proline</td>
</tr>
<tr>
<td>Tyrosine</td>
<td>Serine</td>
</tr>
</tbody>
</table>

*NOTE: Must be provided in the diet because the body cannot manufacture them.

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**Key Terms**

**Amino acids** Chemical compounds that contain nitrogen, carbon, hydrogen, and oxygen; the basic building blocks the body uses to build different types of protein.

**Vitamins** Organic nutrients essential for normal metabolism, growth, and development of the body.

**Minerals** Inorganic nutrients essential for normal body functions; found in the body and in food.
zymes, and enzyme systems, and they regulate muscular and nervous tissue impulses, blood clotting, and normal heart rhythm. The four minerals mentioned most often are calcium, iron, sodium, and selenium. Calcium deficiency may result in osteoporosis, and low iron intake can induce iron-deficiency anemia (see page 114). High sodium intake may contribute to high blood pressure. Selenium seems to be important in preventing certain types of cancer. Specific functions of some of the most important minerals are given in Table 3.5.

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Good Sources</th>
<th>Major Functions</th>
<th>Deficiency Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitamin A</td>
<td>Milk, cheese, eggs, liver, yellow and dark green fruits and vegetables</td>
<td>Required for healthy bones, teeth, skin, gums, and hair; maintenance of inner mucous membranes, thereby increasing resistance to infection; adequate vision in dim light.</td>
<td>Night blindness; decreased growth; decreased resistance to infection; rough, dry skin</td>
</tr>
<tr>
<td>Vitamin D</td>
<td>Fortified milk, cod liver oil, salmon, tuna, egg yolk</td>
<td>Necessary for bones and teeth; needed for calcium and phosphorus absorption.</td>
<td>Rickets (bone softening), fractures, muscle spasms</td>
</tr>
<tr>
<td>Vitamin E</td>
<td>Vegetable oils, yellow and green leafy vegetables, margarine, wheat germ, whole-grain breads and cereals</td>
<td>Related to oxidation and normal muscle and red blood cell chemistry.</td>
<td>Leg cramps, red blood cell breakdown</td>
</tr>
<tr>
<td>Vitamin K</td>
<td>Green leafy vegetables, cauliflower, cabbage, eggs, peas, potatoes</td>
<td>Essential for normal blood clotting.</td>
<td>Hemorrhaging</td>
</tr>
<tr>
<td>Vitamin B1 (Thiamin)</td>
<td>Whole-grain or enriched bread, lean meats and poultry, fish, liver, pork, poultry, organ meats, legumes, nuts, dried yeast</td>
<td>Assists in proper use of carbohydrates, normal functioning of nervous system, maintaining good appetite.</td>
<td>Loss of appetite, nausea, confusion, cardiac abnormalities, muscle spasms</td>
</tr>
<tr>
<td>Vitamin B2 (Riboflavin)</td>
<td>Eggs, milk, leafy green vegetables, whole grains, lean meats, dried beans and peas</td>
<td>Contributes to energy release from carbohydrates, fats, and proteins; needed for normal growth and development, good vision, and healthy skin.</td>
<td>Cracking of the corners of the mouth, inflammation of the skin, impaired vision</td>
</tr>
<tr>
<td>Vitamin B6 (Pyridoxine)</td>
<td>Vegetables, meats, whole grain cereals, soybeans, peanuts, potatoes</td>
<td>Necessary for protein and fatty acids metabolism and for normal red blood cell formation.</td>
<td>Depression, irritability, muscle spasms, nausea</td>
</tr>
<tr>
<td>Vitamin B12</td>
<td>Meat, poultry, fish, liver, organ meats, eggs, shellfish, milk, cheese</td>
<td>Required for normal growth, red blood cell formation, nervous system and digestive tract functioning.</td>
<td>Impaired balance, weakness, drop in red blood cell count</td>
</tr>
<tr>
<td>Niacin</td>
<td>Liver and organ meats, meat, fish, poultry, whole grains, enriched breads, nuts, green leafy vegetables, and dried beans and peas</td>
<td>Contributes to energy release from carbohydrates, fats, and proteins; normal growth and development; and formation of hormones and nerve-regulating substances.</td>
<td>Confusion, depression, weakness, weight loss</td>
</tr>
<tr>
<td>Biotin</td>
<td>Liver, kidney, eggs, yeast, legumes, milk, nuts, dark green vegetables</td>
<td>Essential for carbohydrate metabolism and fatty acid synthesis.</td>
<td>Inflamed skin, muscle pain, depression, weight loss</td>
</tr>
<tr>
<td>Folic Acid</td>
<td>Leafy green vegetables, organ meats, whole grains and cereals, dried beans</td>
<td>Needed for cell growth and reproduction and for red blood cell formation.</td>
<td>Decreased resistance to infection</td>
</tr>
<tr>
<td>Pantothenic Acid</td>
<td>All natural foods, especially liver, kidney, eggs, nuts, yeast, milk, dried peas and beans, green leafy vegetables</td>
<td>Related to carbohydrate and fat metabolism.</td>
<td>Depression, low blood sugar, leg cramps, nausea, headaches</td>
</tr>
<tr>
<td>Vitamin C (Ascorbic acid)</td>
<td>Fruits, vegetables</td>
<td>Helps protect against infection; required for formation of collagenous tissue, normal blood vessels, teeth, and bones.</td>
<td>Slow-healing wounds, loose teeth, hemorrhaging, rough scaly skin, irritability</td>
</tr>
</tbody>
</table>
The most important nutrient is **water**, as it is involved in almost every vital body process: in digesting and absorbing food, in producing energy, in the circulatory process, in regulating body heat, in removing waste products, in building and rebuilding cells, and in transporting other nutrients. In men, about 61 percent of total body weight is water. The proportion of body weight in women is 56 percent (Figure 3.5). The difference is due primarily to the higher amount of muscle mass in men.

Almost all foods contain water, but it is found primarily in liquid foods, fruits, and vegetables. Although for decades the recommendation was to consume at least eight cups of water per day, a panel of scientists at the Institute of Medicine of the National Academy of Sciences (NAS) indicated that people are getting enough water from the liquids (milk, juices, sodas, coffee) and the moisture content of solid foods. Most Americans and Canadians remain well hydrated simply by using thirst as their guide. Caffeine-containing drinks also are acceptable as a water source because data indicate that people who regularly consume such...
beverages do not have more 24-hour urine output than those who don’t.

An exception to not waiting for the thirst signal to replenish water loss is when an individual exercises in the heat, or does so for an extended time (see Chapter 9, page 312). Water lost under these conditions must be replenished regularly. If you wait for the thirst signal, you may have lost too much water already. At 2 percent of body weight lost, a person is dehydrated. At 5 percent, one may become dizzy and disoriented, have trouble with cognitive skills and heart function, and even lose consciousness.

Balancing the Diet

One of the fundamental ways to enjoy good health and live life to its fullest is through a well-balanced diet. Several guidelines have been published to help you accomplish this. As illustrated in Table 3.6, the most recent recommended guidelines by the NAS state that daily caloric intake should be distributed so that 45 to 65 percent of total calories come from carbohydrates (mostly complex carbohydrates and less than 25 percent from sugar), 20 to 35 percent from fat, and 10 to 35 percent from protein. The recommended ranges allow for flexibility in planning diets according to individual health and physical activity needs.

In addition to the macronutrients, the diet must include all of the essential vitamins, minerals, and water. The source of fats is also critical. The National Cholesterol Education Program recommends that, of total calories, saturated fat should constitute less than 7 percent, polyunsaturated fat up to 10 percent, and monounsaturated fat up to 20 percent. Rating a particular diet accurately is difficult without a complete nutrient analysis. You have an opportunity to perform this analysis in Activity 3.1.

Table 3.6 The American Diet: Current and Recommended Carbohydrate, Fat, and Protein Intake Expressed as a Percentage of Total Calories

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Current Percentage</th>
<th>Recommended Percentage*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbohydrates</td>
<td>50%</td>
<td>45–65%</td>
</tr>
<tr>
<td>Simple</td>
<td>26%</td>
<td>Less than 25%</td>
</tr>
<tr>
<td>Complex</td>
<td>24%</td>
<td>20–40%</td>
</tr>
<tr>
<td>Fat</td>
<td>34%</td>
<td>20–30%**</td>
</tr>
<tr>
<td>Monounsaturated</td>
<td>11%</td>
<td>Up to 20%</td>
</tr>
<tr>
<td>Polyunsaturated</td>
<td>10%</td>
<td>Up to 10%</td>
</tr>
<tr>
<td>Saturated</td>
<td>13%</td>
<td>Less than 7%</td>
</tr>
<tr>
<td>Protein</td>
<td>16%</td>
<td>10–35%</td>
</tr>
</tbody>
</table>

*Source of recommended % is the 2002 recommended guidelines by the National Academy of Sciences.

**Less than 30% is recommended by major national health organizations. Up to 35% is allowed for individuals with metabolic syndrome who may need additional fat in the diet.

The NAS guidelines vary slightly from those previously issued by major national health organizations, which recommend 50 to 60 percent of total calories from carbohydrates, less than 30 percent from fat, and about 15 percent from protein. These percentages are within the ranges recommended by the NAS. The most drastic difference appears in the NAS-allowed range of fat intake, up to 35 percent of total calories. This higher percentage, however, was included to accommodate individuals with metabolic syndrome (see Chapter 10, page 354), who have an abnormal insulin response to carbohydrates and may need additional fat in the diet. For all other individuals, daily fat intake should not exceed 30 percent of total caloric intake.

The NAS recommendations will be effective only if people consistently replace saturated and trans fatty acids with unsaturated fatty acids. The latter will require changes in the typical “unhealthy” American diet, which is generally high in red meats, whole dairy products, and fast foods—all of which are high in saturated and/or trans fatty acids.

Diets in most developed countries changed significantly in the early 20th century. Today, people eat more calories and fat, fewer carbohydrates, and about the same amount of protein. People also weigh more than they did in 1900, an indication that we are eating more calories and are not as physically active as our forebears.

Nutrition Standards

Nutritionists use a variety of nutrient standards, the most widely known of which is Recommended Dietary Allowance (RDA). Others are the Dietary Reference Intakes (DRI) and the Daily Values (DV) on food labels. Each standard has a different purpose and utilization in dietary planning and assessment.

Dietary Reference Intakes

To help people meet dietary guidelines, the NAS developed the DRIs for healthy people in the United States and Canada, the DRI. The DRI are based on a review of
the most current research on nutrient needs of healthy people. The DRI reports are written by the Food and Nutrition Board of the Institute of Medicine in cooperation with scientists from Canada.

The DRI encompass four types of reference values—including the RDA—for planning and assessing diets and for establishing adequate amounts and maximum safe nutrient intakes in the diet. The other three reference values are Estimated Average Requirement (EAR), Adequate Intakes (AI), and Tolerable Upper Intake Levels (UL). The type of reference value used for a given nutrient and a specific age/gender group is determined according to available scientific information and the intended use of the dietary standard.

**Estimated Average Requirement.** The EAR is the amount of a nutrient that is estimated to meet the nutrient requirement of half the healthy people in specific age and gender groups. At this nutrient intake level, the nutritional requirements of 50 percent of the people are not met. For example, looking at 300 healthy women at age 26, the EAR would meet the nutritional requirement for only half of these women.

**Recommended Dietary Allowance.** The RDA is the daily amount of a nutrient that is considered adequate to meet the known nutrient needs of nearly all healthy people in the United States. RDAs of nutrients are determined by a committee of the Food and Nutrition Board of the NAS. Because the committee must decide what level of intake to recommend for everybody, the RDA is set well above the EAR and covers about 98 percent of the population. Stated another way, the RDA recommendation for any nutrient is well above almost everyone’s actual requirement. The RDA could be considered a goal for adequate intake. The process for determining the RDA

---

**Table 3.7** Dietary Reference Intakes (DRIs): Recommended Dietary Allowances (RDA) and Adequate Intakes (AI) for Selected Nutrients

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Recommended Dietary Allowances (RDA)</th>
<th>Adequate Intakes (AI)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Thiamin (mg)</td>
<td>Riboflavin (mg)</td>
</tr>
<tr>
<td>Males</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14–18</td>
<td>1.2</td>
<td>1.3</td>
</tr>
<tr>
<td>19–30</td>
<td>1.2</td>
<td>1.3</td>
</tr>
<tr>
<td>31–50</td>
<td>1.2</td>
<td>1.3</td>
</tr>
<tr>
<td>51–70</td>
<td>1.2</td>
<td>1.3</td>
</tr>
<tr>
<td>&gt;70</td>
<td>1.2</td>
<td>1.3</td>
</tr>
<tr>
<td>Females</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14–18</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>19–30</td>
<td>1.1</td>
<td>1.1</td>
</tr>
<tr>
<td>31–50</td>
<td>1.1</td>
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<tr>
<td>51–70</td>
<td>1.1</td>
<td>1.1</td>
</tr>
<tr>
<td>&gt;70</td>
<td>1.1</td>
<td>1.1</td>
</tr>
<tr>
<td>Pregnant (19–30)</td>
<td>1.4</td>
<td>1.4</td>
</tr>
<tr>
<td>Lactating (19–30)</td>
<td>1.4</td>
<td>1.6</td>
</tr>
</tbody>
</table>

*Values for these nutrients do not change with pregnancy or lactation. Use the value listed for women of comparable age.

SOURCE: Adapted with permission from Institute of Medicine of the National Academy of Sciences. Courtesy of the National Academies Press, Washington, DC 2011.

The typical American diet is too high in calories and unhealthy fats.
depends on being able to set an EAR, because RDAs are determined statistically from the EAR values. If an EAR cannot be set, no RDA can be established.

**Adequate Intake.** When data are insufficient or inadequate to set an EAR, an AI value is determined instead of the RDA. The AI value is derived from approximations of observed nutrient intakes by a group or groups of healthy people. The AI value for children and adults is expected to meet or exceed the nutritional requirements of a corresponding healthy population.

Nutrients for which a daily DRI has been set are given in Table 3.7.

**Tolerable Upper Intake Level.** The UL establishes the highest level of nutrient intake that seems to be safe for most healthy people, beyond which exists an increased risk for adverse effects. As intakes increase above the UL, so does the risk for adverse effects. Established UL values are presented in Table 3.8.

**Daily Values**

The DVs are reference values for nutrients and food components listed on food-packaging labels. The DVs include measures of fat, saturated fat, and carbohydrates (as a percent of total calories); cholesterol, sodium, and potassium (in milligrams); and fiber and protein (in grams). The DVs for total fat, saturated fat, and carbohydrates are expressed as percentages for a 2,000-calorie diet and therefore may require adjustments depending on an individual’s daily estimated energy requirement (EER) in calories. For example, for a 2,000-calorie diet (the EER), the recommended carbohydrate intake is about 300 grams (about 60 percent of the EER), and the recommendation for fat is 65 grams (about 30 percent of EER). The vitamin, mineral, and protein DV were adapted from the RDA. The DV also are not as specific for age and gender groups as are the DRI. Both the DRI and the DV apply to only healthy adults. They are not intended for people who are ill, who may require additional nutrients. Figure 3.6 shows a food label with U.S. Recommended Daily Values.

**Critical Thinking**

What do the nutrition standards mean to you? • How much of a challenge would it be to apply those standards in your daily life?

**Nutrient Analysis**

The first step in evaluating your diet is to conduct a nutrient analysis. This can be quite educational, because most people do not realize how harmful and non-nutritious many common foods are. The top sources of calories in the American diet are soft drinks, sweet rolls, pastries, doughnuts, cakes, hamburgers, cheeseburgers, meatloaf, pizza, potato and corn chips, and buttered popcorn, all of which are low in essential nutrients and high in fat and/or sugar and calories.

**Key Terms**

**Estimated Average Requirement (EAR)** The amount of a nutrient that meets the dietary needs of half the people.

**Adequate Intake (AI)** The recommended amount of a nutrient intake when sufficient evidence is not available to calculate the EAR and subsequent RDA.

**Tolerable Upper Intake Level (UL)** The highest level of nutrient intake that seems safe for most healthy people, beyond which exists an increased risk of adverse effects.

**Estimated Energy Requirement (EER)** The average dietary energy (caloric) intake that is predicted to maintain energy balance in a healthy adult of defined age, gender, weight, height, and level of physical activity, consistent with good health.
Better by Design
How to recognize the new food labels
The new food labels feature a revamped nutrition panel titled “Nutrition Facts,” with nutrient listings that reflect current health concerns. Now you’ll be able to find information on fat, fiber, and other food components fundamental to lowering your risk of cancer and other chronic diseases. Listings for nutrients like thiamin and riboflavin will no longer be required because Americans generally eat enough of them these days.

Size Up the Situation
All serving sizes are created equal
Now you can compare similar products and know that their serving sizes are basically identical. So when you realize how much fat is packed into that carton of double-dutch-chocolate-caramel-chew ice cream you’re eyeing, you might opt for low-fat frozen yogurt instead. Serving sizes will also be standardized, so manufacturers can’t make nutrition claims for unrealistically small portions. That means a chocolate cake, for example, must be divided into 8 servings sized to satisfy the average person—not 16 servings sized to satisfy the average munchkin.

Look Before You Leap
Use the Daily Values
You will find the Daily Values on the bottom half of the “Nutrition Facts” panel. Some represent maximum levels of nutrients that should be consumed each day for a healthful diet (as with fat), while others refer to minimum levels (as with carbohydrates). They are based on both a 2,000 and 2,500 calorie diet. Your own needs may be more or less, but these figures give you a point from which to compare. For example, the sample label indicates that someone with a 2,000 calorie diet should eat no more than 65 grams of fat per day. This is based on a diet getting 30 percent of calories as fat. If you normally eat less calories or want to eat less than 30 percent of calories as fat, your daily fat consumption will be lower.

Rate It Right
Scan the % Daily Values
The % Daily Values make judging the nutritional quality of a food a snap. For instance, you can look at the % Daily Value column and find that a food has 25 percent of the Daily Value for fiber. This means the product will give you a substantial portion of the recommended amount of fiber for the day. You can also use this column to compare nutrients in similar products. The % Daily Values are based on a 2,000 calorie diet.

Trust Adjectives
Descriptors have legal definitions
Terms like “low,” “high,” and “free” have long been used on food labels. What these words actually mean, however, could vary. Thanks to the new labeling laws, such descriptions must now meet legal definitions. For example, you may be shopping for foods high in vitamin A, which has been linked to lower risk of certain cancers. Under the new label laws, a food described as “high,” in a particular nutrient must contain 20 percent or more of the Daily Value for that nutrient. So if the bottle of juice you’re thinking of buying says “high in vitamin A,” you can now feel confident that it really is a good source of the vitamin.

Read Health Claims with Confidence
The nutrient link to disease prevention
You can also expect to see food packages with health claims linking certain nutrients to reduced risk of cancer and other diseases. The federal government has approved three health claims dealing with cancer prevention: a low-fat diet may reduce your risk for cancer; high-fiber foods may reduce your risk for cancer; and fruits and vegetables may reduce your risk for cancer. A food may not make such a health claim for one nutrient if it contains other nutrients that undermine its health benefits. A high-fiber, but high-fat, jelly doughnut cannot carry a health claim!
### Behavior Modification Planning

#### Caloric and Fat Content of Selected Fast Food Items

<table>
<thead>
<tr>
<th>Item</th>
<th>Calories</th>
<th>Total Fat (grams)</th>
<th>Saturated Fat (grams)</th>
<th>Percent Fat Calories</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Burgers</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>McDonald’s Big Mac</td>
<td>590</td>
<td>34</td>
<td>11</td>
<td>52</td>
</tr>
<tr>
<td>McDonald’s Big N’ Tasty with Cheese</td>
<td>590</td>
<td>37</td>
<td>12</td>
<td>56</td>
</tr>
<tr>
<td>McDonald’s Quarter</td>
<td>530</td>
<td>30</td>
<td>13</td>
<td>51</td>
</tr>
<tr>
<td>Burger King Whopper</td>
<td>760</td>
<td>46</td>
<td>15</td>
<td>54</td>
</tr>
<tr>
<td>Burger King Bacon Double Cheeseburger</td>
<td>580</td>
<td>34</td>
<td>18</td>
<td>53</td>
</tr>
<tr>
<td>Burger King BK Smokehouse Cheddar Griller</td>
<td>720</td>
<td>48</td>
<td>19</td>
<td>60</td>
</tr>
<tr>
<td>Burger King Whopper with Cheese</td>
<td>850</td>
<td>53</td>
<td>22</td>
<td>56</td>
</tr>
<tr>
<td>Burger King Double Whopper</td>
<td>1,060</td>
<td>69</td>
<td>27</td>
<td>59</td>
</tr>
<tr>
<td>Burger King Double Whopper with Cheese</td>
<td>1,150</td>
<td>76</td>
<td>33</td>
<td>59</td>
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<tr>
<td>Wendy’s Baconator</td>
<td>830</td>
<td>51</td>
<td>22</td>
<td>55</td>
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<tr>
<td><strong>Sandwiches</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
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<td>Arby’s Regular Roast Beef</td>
<td>350</td>
<td>16</td>
<td>6</td>
<td>41</td>
</tr>
<tr>
<td>Arby’s Super Roast Beef</td>
<td>470</td>
<td>23</td>
<td>7</td>
<td>44</td>
</tr>
<tr>
<td>Arby’s Roast Chicken Club</td>
<td>520</td>
<td>28</td>
<td>7</td>
<td>48</td>
</tr>
<tr>
<td>Arby’s Market Fresh Roast Beef &amp; Swiss</td>
<td>810</td>
<td>42</td>
<td>13</td>
<td>47</td>
</tr>
<tr>
<td>McDonald’s Crispy Chicken</td>
<td>430</td>
<td>21</td>
<td>8</td>
<td>43</td>
</tr>
<tr>
<td>McDonald’s Filet-O-Fish</td>
<td>470</td>
<td>26</td>
<td>5</td>
<td>50</td>
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<tr>
<td>McDonald’s Chicken McGrill</td>
<td>400</td>
<td>17</td>
<td>3</td>
<td>38</td>
</tr>
<tr>
<td>Wendy’s Chicken Club</td>
<td>470</td>
<td>19</td>
<td>4</td>
<td>36</td>
</tr>
<tr>
<td>Wendy’s Breast Fillet</td>
<td>430</td>
<td>16</td>
<td>3</td>
<td>34</td>
</tr>
<tr>
<td>Wendy’s Grilled Chicken</td>
<td>300</td>
<td>7</td>
<td>2</td>
<td>21</td>
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<tr>
<td>Burger King Specialty Chicken</td>
<td>560</td>
<td>28</td>
<td>6</td>
<td>45</td>
</tr>
<tr>
<td>Subway Veggie Delight*</td>
<td>226</td>
<td>3</td>
<td>1</td>
<td>12</td>
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<tr>
<td>Subway Turkey Breast</td>
<td>281</td>
<td>5</td>
<td>2</td>
<td>16</td>
</tr>
<tr>
<td>Subway Sweet Onion Chicken Teriyaki</td>
<td>374</td>
<td>5</td>
<td>2</td>
<td>12</td>
</tr>
<tr>
<td>Subway Steak &amp; Cheese</td>
<td>390</td>
<td>14</td>
<td>5</td>
<td>32</td>
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<tr>
<td>Subway Cold Cut Trio</td>
<td>440</td>
<td>21</td>
<td>7</td>
<td>43</td>
</tr>
<tr>
<td>Subway Tuna</td>
<td>450</td>
<td>22</td>
<td>6</td>
<td>44</td>
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<tr>
<td><strong>Mexican</strong></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Taco Bell Crunchy Taco</td>
<td>170</td>
<td>10</td>
<td>4</td>
<td>53</td>
</tr>
<tr>
<td>Taco Bell Taco Supreme</td>
<td>220</td>
<td>14</td>
<td>6</td>
<td>57</td>
</tr>
<tr>
<td>Taco Bell Soft Chicken Taco</td>
<td>190</td>
<td>7</td>
<td>3</td>
<td>33</td>
</tr>
<tr>
<td>Taco Bell Bean Burrito</td>
<td>370</td>
<td>12</td>
<td>4</td>
<td>29</td>
</tr>
<tr>
<td>Taco Bell Fiesta Steak Burrito</td>
<td>370</td>
<td>12</td>
<td>4</td>
<td>29</td>
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<tr>
<td>Taco Bell Grilled Steak Soft Taco</td>
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<td>53</td>
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<tr>
<td>Taco Bell Double Decker Taco</td>
<td>340</td>
<td>14</td>
<td>5</td>
<td>37</td>
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<tr>
<td><strong>French Fries</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wendy’s, biggie (5½ oz)</td>
<td>440</td>
<td>19</td>
<td>7</td>
<td>39</td>
</tr>
<tr>
<td>McDonald’s, large (6 oz)</td>
<td>540</td>
<td>26</td>
<td>9</td>
<td>43</td>
</tr>
<tr>
<td>Burger King, large (5½ oz)</td>
<td>500</td>
<td>25</td>
<td>13</td>
<td>45</td>
</tr>
<tr>
<td><strong>Shakes</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Wendy’s Frosty, medium (16 oz)</td>
<td>440</td>
<td>11</td>
<td>7</td>
<td>23</td>
</tr>
<tr>
<td>McDonald’s McFlurry, small (12 oz)</td>
<td>610</td>
<td>22</td>
<td>14</td>
<td>32</td>
</tr>
<tr>
<td>Burger King, Old Fashioned Ice Cream Shake, medium (22 oz)</td>
<td>760</td>
<td>41</td>
<td>29</td>
<td>49</td>
</tr>
<tr>
<td><strong>Hash Browns</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>McDonald’s Hash Browns (2 oz)</td>
<td>130</td>
<td>8</td>
<td>4</td>
<td>55</td>
</tr>
<tr>
<td>Burger King, Hash Browns, small (2½ oz)</td>
<td>230</td>
<td>15</td>
<td>9</td>
<td>59</td>
</tr>
</tbody>
</table>

**Try It** Using the above information, record in your Online Journal or class notebook ways you can restructure fast-food consumption to decrease caloric value and fat and saturated fat content in your diet.

*6-inch sandwich with no mayo

SOURCE: Adapted from Restaurant Confidential by Michael F. Jacobson and Jayne Hurley (Workman, 2002), by permission of Center for Science in the Public Interest.

Most nutrient analyses cover calories, carbohydrates, fats, cholesterol, and sodium, as well as eight essential nutrients: protein, calcium, iron, vitamin A, thiamin, riboflavin, niacin, and vitamin C. If the diet has enough of these eight nutrients, the foods consumed in natural form to provide these nutrients typically contain all the other nutrients the human body needs. To do your own nutrient analysis, keep a three-day record of everything you eat using Activity 3.1 (make additional copies of this form as needed). At the end of each day, look up the nutrient content for those foods in the list of Nutritive Values of Selected Foods (in Appendix A). Record this information on the form in Activity 3.1. If you do not find a food in Appendix A, the information may be on the food container itself.

When you have recorded the nutritive values for each day, add up each column and write the totals at the bottom of the chart. After the third day, fill in your totals in Activity 3.2 and compute an average for the three days. To rate your diet, compare your figures with those in the RDA (see Table 3.7). The results will give a good indication of areas of strength and deficiency in your current diet.
Some of the most revealing information learned in a nutrient analysis is the source of fat and saturated fat intake in the diet. The average daily fat consumption in the U.S. diet is about 34 percent of the total caloric intake, much of it from saturated fats, which increases the risk for chronic diseases such as cardiovascular disease, cancer, diabetes, and obesity. Although fat provides a smaller percentage of our total daily caloric intake compared with two decades ago (37 percent), the decrease in percentage is simply because Americans now eat more calories than 20 years ago (335 additional daily calories for women and 170 for men).

As illustrated in Figure 3.7, one gram of carbohydrates or protein supplies the body with four calories, and fat provides nine calories per gram consumed (alcohol yields seven calories per gram). Therefore, looking at only the total grams consumed for each type of food can be misleading.

For example, a person who eats 160 grams of carbohydrates, 100 grams of fat, and 70 grams of protein has a total intake of 330 grams of food. This indicates that 30 percent of the total grams of food is in the form of fat (100 grams of fat ÷ 330 grams of total food = 0.30; 0.30 × 100 = 30 percent)—and, in reality, almost half of that diet is in the form of fat calories.

In the sample diet, 640 calories are derived from carbohydrates (160 grams × 4 calories per gram), 280 calories from protein (70 grams × 4 calories per gram), and 900 calories from fat (100 grams × 9 calories per gram), for a total of 1,820 calories. If 900 calories are derived from fat, almost half of the total caloric intake is in the form of fat (900 ÷ 1,820 × 100 = 49.5 percent).

Each gram of fat provides nine calories—more than twice the calories of a gram of carbohydrate or protein. When figuring out the percentage of fat calories of individual foods, you may find Figure 3.8 to be a useful guideline. Multiply the total fat grams by nine and divide by the total calories in that particular food (per serving). Then multiply that number by 100 to get the percentage. For example, the food label in Figure 3.8 lists a total of 120 calories and five grams of fat, and the equation below shows the fat content to be 38 percent of total calories. This simple guideline can help you decrease the fat in your diet.

The fat content of selected foods, given in grams and as a percent of total calories, is presented in Figure 3.9. The percentage of fat is further subdivided into saturated, monounsaturated, polyunsaturated, and other fatty acids.
# Daily Nutrient Intake

<table>
<thead>
<tr>
<th>Foods</th>
<th>Calories (Amount)</th>
<th>Protein (g)</th>
<th>Fat (g)</th>
<th>Sat. Fat (g)</th>
<th>Cholesterol (mg)</th>
<th>Carbohydrates (g)</th>
<th>Dietary Fiber (g)</th>
<th>Calcium (mg)</th>
<th>Iron (mg)</th>
<th>Sodium (mg)</th>
<th>Vit. E (mg)</th>
<th>Vit. C (mg)</th>
<th>Folate (mcg)</th>
<th>Selenium (mcg)</th>
<th>Totals</th>
</tr>
</thead>
</table>
### Analysis of Daily Nutrient Intake

**ACTIVITY 3.2**


<table>
<thead>
<tr>
<th>Day</th>
<th>Calories</th>
<th>Protein (g)</th>
<th>Fat (g)</th>
<th>Sat. Fat (g)</th>
<th>Cholesterol (mg)</th>
<th>Carbohydrates (g)</th>
<th>Dietary Fiber (g)</th>
<th>Calcium (mg)</th>
<th>Iron (mg)</th>
<th>Sodium (mg)</th>
<th>Vit. E (mg)</th>
<th>Folate (mcg)</th>
<th>Vit. C (mg)</th>
<th>Selenium (mcg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>One</td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<td></td>
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</tbody>
</table>

**Percentages**

**Recommended Dietary Allowances**

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Protein Intake</th>
<th>Carbohydrates</th>
<th>Fat</th>
<th>Saturated Fat</th>
<th>Cholesterol</th>
<th>Calcium</th>
<th>Iron</th>
<th>Sodium</th>
<th>Vitamin E</th>
<th>Folate</th>
<th>Vitamin C</th>
<th>Selenium</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men</td>
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<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>14-18 yrs.</td>
<td>20-30%</td>
<td>7%</td>
<td>&lt;300</td>
<td>45-65%</td>
<td>38</td>
<td>1,300</td>
<td>12</td>
<td>2,300</td>
<td>15</td>
<td>400</td>
<td>75</td>
<td>55</td>
</tr>
<tr>
<td>19-30 yrs.</td>
<td>20-30%</td>
<td>7%</td>
<td>&lt;300</td>
<td>45-65%</td>
<td>38</td>
<td>1,000</td>
<td>10</td>
<td>2,300</td>
<td>15</td>
<td>400</td>
<td>90</td>
<td>55</td>
</tr>
<tr>
<td>31-50 yrs.</td>
<td>20-30%</td>
<td>7%</td>
<td>&lt;300</td>
<td>45-65%</td>
<td>38</td>
<td>1,000</td>
<td>10</td>
<td>2,300</td>
<td>15</td>
<td>400</td>
<td>90</td>
<td>55</td>
</tr>
<tr>
<td>51+ yrs.</td>
<td>20-30%</td>
<td>7%</td>
<td>&lt;300</td>
<td>45-65%</td>
<td>30</td>
<td>1,000</td>
<td>10</td>
<td>2,300</td>
<td>15</td>
<td>400</td>
<td>90</td>
<td>55</td>
</tr>
<tr>
<td>Women</td>
<td></td>
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</tr>
<tr>
<td>14-18 yrs.</td>
<td>20-30%</td>
<td>7%</td>
<td>&lt;300</td>
<td>45-65%</td>
<td>25</td>
<td>1,300</td>
<td>15</td>
<td>2,300</td>
<td>15</td>
<td>400</td>
<td>65</td>
<td>55</td>
</tr>
<tr>
<td>19-30 yrs.</td>
<td>20-30%</td>
<td>7%</td>
<td>&lt;300</td>
<td>45-65%</td>
<td>25</td>
<td>1,000</td>
<td>15</td>
<td>2,300</td>
<td>15</td>
<td>400</td>
<td>75</td>
<td>55</td>
</tr>
<tr>
<td>31-50 yrs.</td>
<td>20-30%</td>
<td>7%</td>
<td>&lt;300</td>
<td>45-65%</td>
<td>25</td>
<td>1,000</td>
<td>15</td>
<td>2,300</td>
<td>15</td>
<td>400</td>
<td>75</td>
<td>55</td>
</tr>
<tr>
<td>51+ yrs.</td>
<td>20-30%</td>
<td>7%</td>
<td>&lt;300</td>
<td>45-65%</td>
<td>21</td>
<td>1,200</td>
<td>30</td>
<td>2,300</td>
<td>15</td>
<td>600</td>
<td>85</td>
<td>60</td>
</tr>
<tr>
<td>Pregnant</td>
<td>20-30%</td>
<td>7%</td>
<td>&lt;300</td>
<td>45-65%</td>
<td>25</td>
<td>1,200</td>
<td>30</td>
<td>2,300</td>
<td>15</td>
<td>600</td>
<td>85</td>
<td>60</td>
</tr>
<tr>
<td>Lactating</td>
<td>20-30%</td>
<td>7%</td>
<td>&lt;300</td>
<td>45-65%</td>
<td>25</td>
<td>1,200</td>
<td>15</td>
<td>2,300</td>
<td>19</td>
<td>500</td>
<td>120</td>
<td>70</td>
</tr>
</tbody>
</table>

*Divide totals by 3 or number of days assessed.

*Percentages: protein and carbohydrates = multiply average by 4, divide by average calories, and multiply by 100.

*Fat and saturated fat = multiply average by 9, divide by average calories, and multiply by 100.

*Use Table 5.3 (page 167) for all categories.

*Protein intake should be 0.8 grams per kilogram of body weight. Pregnant women should consume an additional 15 grams of daily protein, and lactating women should have an extra 20 grams.

*Based on recommendations by nutrition experts. Up to 35% is allowed for individuals who suffer from metabolic syndrome.

### Figure 3.9  Fat content of selected foods.

<table>
<thead>
<tr>
<th>Food</th>
<th>Calories</th>
<th>Total fat (grams)</th>
<th>% fat calories</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avocado/Florida (1)</td>
<td>340</td>
<td>27</td>
<td>71.5</td>
</tr>
<tr>
<td>Bacon (3 pieces)</td>
<td>109</td>
<td>9</td>
<td>74.3</td>
</tr>
<tr>
<td>Beef/ground/lean/broiled (4 oz)</td>
<td>318</td>
<td>20</td>
<td>56.6</td>
</tr>
<tr>
<td>Beef/sirloin (4 oz)</td>
<td>320</td>
<td>21</td>
<td>59.1</td>
</tr>
<tr>
<td>Beef/T-bone (4 oz)</td>
<td>338</td>
<td>24</td>
<td>63.9</td>
</tr>
<tr>
<td>Butter (1 lbs)</td>
<td>102</td>
<td>11</td>
<td>97.1</td>
</tr>
<tr>
<td>Cheese/American (1 oz)</td>
<td>93</td>
<td>7</td>
<td>67.7</td>
</tr>
<tr>
<td>Cheese/cheddar (1 oz)</td>
<td>114</td>
<td>9</td>
<td>71.1</td>
</tr>
<tr>
<td>Cheese/cottage 4% (1 cup)</td>
<td>216</td>
<td>9</td>
<td>37.5</td>
</tr>
<tr>
<td>Cheese/cream (1 oz)</td>
<td>99</td>
<td>10</td>
<td>90.9</td>
</tr>
<tr>
<td>Cheese/Parmesan (1 oz)</td>
<td>129</td>
<td>9</td>
<td>62.8</td>
</tr>
<tr>
<td>Cheese/Swiss (1 oz)</td>
<td>106</td>
<td>8</td>
<td>67.9</td>
</tr>
<tr>
<td>Cheeseburger (1)</td>
<td>305</td>
<td>13</td>
<td>38.4</td>
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<tr>
<td>Chicken/breast/no skin (4 oz)</td>
<td>188</td>
<td>4</td>
<td>19.1</td>
</tr>
<tr>
<td>Chicken/thigh/no skin (4 oz)</td>
<td>232</td>
<td>13</td>
<td>50.4</td>
</tr>
<tr>
<td>Egg/hard-cooked (1)</td>
<td>77</td>
<td>5</td>
<td>58.4</td>
</tr>
<tr>
<td>Frankfurter/beef &amp; pork (1)</td>
<td>182</td>
<td>17</td>
<td>84.1</td>
</tr>
<tr>
<td>Halibut/baked (4 oz)</td>
<td>159</td>
<td>3</td>
<td>17.0</td>
</tr>
<tr>
<td>Hamburger (1)</td>
<td>255</td>
<td>9</td>
<td>31.8</td>
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<tr>
<td>Ice cream/vanilla (1 cup)</td>
<td>267</td>
<td>15</td>
<td>50.6</td>
</tr>
<tr>
<td>Ice milk/vanilla (1 cup)</td>
<td>182</td>
<td>6</td>
<td>29.7</td>
</tr>
<tr>
<td>Lamb/lean &amp; fat (4 oz)</td>
<td>293</td>
<td>19</td>
<td>58.4</td>
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<tr>
<td>Margarine (1 lbs)</td>
<td>101</td>
<td>11</td>
<td>98.0</td>
</tr>
<tr>
<td>Mayonnaise (1 lbs)</td>
<td>99</td>
<td>11</td>
<td>100.0</td>
</tr>
<tr>
<td>Milk/2% (1 cup)</td>
<td>121</td>
<td>5</td>
<td>37.2</td>
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<tr>
<td>Milk/skim (1 cup)</td>
<td>85</td>
<td>.5</td>
<td>5.3</td>
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<tr>
<td>Milk/whole (1 cup)</td>
<td>149</td>
<td>8</td>
<td>48.3</td>
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<tr>
<td>Nuts/cashew/oil roasted (1 oz)</td>
<td>163</td>
<td>14</td>
<td>77.3</td>
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<tr>
<td>Nuts/peanuts/oil roasted (1 oz)</td>
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<td>76.4</td>
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<tr>
<td>Oil/canola (1 lbs)</td>
<td>126</td>
<td>14</td>
<td>100.0</td>
</tr>
<tr>
<td>Oil/olive (1 lbs)</td>
<td>124</td>
<td>14</td>
<td>100.0</td>
</tr>
<tr>
<td>Salmon/baked (4 oz)</td>
<td>245</td>
<td>12</td>
<td>44.1</td>
</tr>
<tr>
<td>Sherbet (1 cup)</td>
<td>266</td>
<td>4</td>
<td>13.5</td>
</tr>
<tr>
<td>Shrimp/boiled (3 oz)</td>
<td>85</td>
<td>1</td>
<td>10.6</td>
</tr>
<tr>
<td>Tuna/oil/drained (3 oz)</td>
<td>167</td>
<td>7</td>
<td>37.7</td>
</tr>
<tr>
<td>Tuna/water/drained (3 oz)</td>
<td>99</td>
<td>1</td>
<td>9.1</td>
</tr>
<tr>
<td>Turkey/dark meat/no skin (4 oz)</td>
<td>212</td>
<td>8</td>
<td>34.0</td>
</tr>
<tr>
<td>Turkey/light meat/no skin (4 oz)</td>
<td>117</td>
<td>4</td>
<td>30.8</td>
</tr>
</tbody>
</table>
Achieving a Balanced Diet

Anyone who has completed a nutrient analysis and has given careful attention to Tables 3.3 (vitamins) and 3.4 (minerals) probably will realize that a well-balanced diet entails eating a variety of nutrient-dense foods and monitoring total daily caloric intake. The MyPlate healthy food plan in Figure 3.1 (page 73) contains five major food groups. The food groups are grains, vegetables, fruits, protein, and dairy.

Vegetables, fruits, whole grains, and dairy provide the nutritional base for a healthy diet. When increasing the intake of these food groups, it is important to decrease the intake of low-nutrient foods to effectively balance caloric intake with energy needs. In addition to providing nutrients crucial to health, fruits and vegetables are the sole source of phytonutrients (“phyto” comes from the Greek word for plant). These compounds show promising results in the fight against cancer and heart disease. More than 4,000 phytonutrients have been identified. The main function of phytonutrients in plants is to protect them from sunlight. In humans, phytonutrients seem to have a powerful ability to block the formation of cancerous tumors. Their actions are so diverse that at almost every stage of cancer, phytonutrients have the ability to block, disrupt, slow, or even reverse the process. In terms of heart disease, they may reduce inflammation, inhibit blood clots, or prevent the oxidation of LDL cholesterol.

The consistent message is to eat a diet with ample fruits and vegetables. The daily recommended amount of fruits and vegetables has absolutely no substitute. Science has not yet found a way to allow people to eat a poor diet, pop a few pills, and derive the same benefits.

Whole grains are a major source of fiber as well as other nutrients. Whole grains contain the entire grain kernel (the bran, germ, and endosperm). Examples include whole-wheat flour, whole cornmeal, oatmeal, cracked wheat (bulgur), and brown rice. Refined grains have been milled—a process that removes the bran and germ. The process also removes fiber, iron, and many B vitamins. Refined grains include white flour, white bread, white rice, and degermed cornmeal. Refined grains are often enriched to add back B vitamins and iron. Fiber, however, is not added back.

Milk and milk products (select low-fat or nonfat) can decrease the risk of low bone mass (osteoporosis) throughout life. Besides calcium, other nutrients from milk are potassium, vitamin D, and protein.

Foods in the protein group consist of poultry, fish, eggs, nuts, legumes, and seeds. Nutrients in this group include protein, B vitamins, vitamin E, iron, zinc, and magnesium. Choose low-fat or lean meats and poultry; and bake, grill, or broil them at low temperature (to prevent the formation of advanced glycation end products; see page 98). Most Americans eat sufficient food in this group but need to choose leaner foods and a greater

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**Behavior Modification Planning**

**“Super” Foods**

The following “super” foods that fight disease and promote health should be included often in the diet.

- Acai berries
- Avocados
- Bananas
- Barley
- Beans
- Beets
- Blueberries
- Broccoli
- Butternut squash
- Carrots
- Goji berries
- Grapes
- Kale
- Kiwifruit
- Flaxseeds
- Lentils
- Nuts (Brazil, walnuts)
- Salmon (wild)
- Soy
- Oats and oatmeal
- Olives and olive oil
- Onions
- Oranges
- Peppers
- Pomegranates
- Strawberries
- Spinach
- Sweet potatoes
- Tea (green, black, red)
- Tomatoes
- Yogurt

**Try It**

Using the above list, make a list of which super foods you can add to your diet and when you can eat them (snacks/meals). List meals that you can add these foods to.

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You can restructure your meals so that rice, pasta, beans, breads, and vegetables are in the center of the plate; meats are on the side and added primarily for flavoring; fruits are used for desserts; and low- or nonfat milk products are used.
variety of fish, dry beans, nuts, and seeds. In terms of meat, poultry, and fish, the recommendation is to consume about three ounces and not to exceed six ounces daily. All visible fat and skin should be trimmed off meats and poultry before cooking.

Oils are fats that come from different plants and fish and are liquid at room temperature. Choose carefully and avoid oils that have trans fats (check the food label) or saturated fats. Solid fats at room temperature come from animal sources or can be made from vegetable oils through the process of hydrogenation.

As an aid to balancing your diet, the form in Activity 3.3 enables you to record your daily food intake. This record is much easier to keep than the complete dietary analysis in Activities 3.1 and 3.2. Make one copy for each day you wish to record.

To start the activity, go to http://www.choosemyplate.gov/ and establish your personal MyPlateplan (Plan a Healthy Menu option on the website) based on your age, sex, weight, height, and activity level. Record this information on the form provided in Activity 3.2. Next, whenever you have something to eat, record the food and the amount eaten according to the MyPlate standard amounts (ounce, cup, or teaspoon—Figure 3.1). Do this immediately after each meal so you will be able to keep track of your actual food intake more easily. At the end of the day, evaluate your diet by checking whether you ate the minimum required amounts for each food group. If you meet the minimum required servings at the end of each day and your caloric intake is in balance with the recommended amount, you are taking good steps to a healthier you.

Choosing Healthy Foods

Once you have completed the nutrient analysis and the healthy diet plan (Activities 3.1 and 3.2), you may conduct a self-evaluation of your current nutritional habits. In Activity 3.4, you can also assess your current stage of change regarding healthy nutrition and list strategies to help you improve your diet.

Initially, developing healthy eating habits requires a conscious effort to select nutritious foods (see box on page 96). You must learn the nutritive value of typical foods that you eat. You can do so by reading food labels and looking up the nutritive values using listings such as that provided in Appendix A or by using computer software available for such purposes.

Although not a major concern, be aware that in a few cases there is label misinformation. Whether it is a simple mistake or outright deception is difficult to determine because there is little testing of food products and limited risks (penalties) if label misrepresentation occurs. The FDA simply does not have adequate staffing to regularly check food labels.

A limited number of organizations are trying to help. For example, the Florida Department of Agriculture and Consumer Services has found a 10-percent violation rate in food products tested. As a consumer, you may never know which products are mislabeled, although in a few cases you may be able to discern the truth by yourself. If a product claims to be low in calories and fat but tastes “too good to be true,” that may indeed be the case. For example, a recent independent analysis of Rising Dough Bakery cookies found that the oatmeal cranberry cookie (the size of a compact disk) had more than twice as many calories as those listed on the label.

In most cases, when monitoring caloric intake, doing your own food preparation using healthy cooking methods is a better option than eating out or purchasing processed foods. Healthy eating requires proper meal planning and adequate coping strategies when confronted with situations that encourage unhealthy eating and overindulgence. Additional information on these topics is provided in the weight management chapter (Chapter 5).

Vegetarianism

More than 12 million people in the United States follow vegetarian diets. Vegetarians rely primarily on foods from the bread, cereal, rice, pasta, and fruit and vegetable groups and avoid most foods from animal sources in the dairy and protein groups. The five basic types of vegetarians are as follows:

1. **Vegans** eat no animal products at all.
2. **Ovovegetarians** allow eggs in the diet.
3. **Lactovegetarians** allow foods from the milk group.
4. **Ovolactovegetarians** include egg and milk products in the diet.
5. **Semivegetarians** do not eat red meat, but do include fish and poultry in addition to milk products and eggs in their diet.

Vegetarian diets can be healthful and consistent with the Dietary Guidelines for Americans and can meet the DRIs for nutrients. Vegetarians who do not select their food combinations properly, however, can develop nutritional deficiencies of protein, vitamins, minerals, and even calories. Even greater attention should be paid when planning vegetarian diets for infants and children.

**Key Terms**

**Phytonutrients** Compounds thought to prevent and fight cancer; found in large quantities in fruits and vegetables.

**Vegetarians** Individuals whose diet is of vegetable or plant origin.

**Vegans** Vegetarians who eat no animal products at all.

**Ovovegetarians** Vegetarians who allow eggs in their diet.

**Lactovegetarians** Vegetarians who allow foods from the milk group.

**Ovolactovegetarians** Vegetarians who include eggs and milk products in their diet.

**Semivegetarians** Vegetarians who include milk products, eggs, and fish and poultry in the diet.
# Activity 3.3

## MyPlate Record Form

<table>
<thead>
<tr>
<th>No.</th>
<th>Food*</th>
<th>Calories</th>
<th>Oils (tsp.)</th>
<th>Milk (cups)</th>
<th>Meats and Beans (oz.)</th>
<th>Grains (oz.)</th>
<th>Veggies (cups)</th>
<th>Fruit (cups)</th>
<th>Fat (gm)</th>
</tr>
</thead>
<tbody>
<tr>
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</table>

### Totals

Recommended Amount: Obtain online at [http://choosemyplate.gov](http://choosemyplate.gov) based on age, sex, weight, height, and activity level.

### Deficiencies/Excesses

See list of Nutritive Value of Selected Foods in Appendix B. **Multiply the recommended amount of grams of fat by 9 to obtain the daily-recommended amount of grams of fat.**

---

*Name: __________________________|

*Date: __________________________|

*Age: __________________________|

*Gender: _________________________|

*Course: ________________________|

*Section: ________________________|

---

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ACTIVITY 3.4

Nutrition Behavior Modification Plan

Name: ___________________________ Date: __________________

Course: ___________________ Section: ___________ Gender: _______ Age: _______

Nutrition Stage of Change

Using figure 2.5 (page 61) and Table 2.3 (page 60), identify your current stage of change for nutrition (healthy diet):

________________________

What I Learned and What I Can Do to Improve My Nutrition:

Based on the nutrient analysis and your healthy diet plan, explain what these experiences have taught you, and list specific changes and strategies that you can use to improve your present nutrition habits. Use an extra blank sheet of paper as needed.

Briefly state what you learned from the online MyPlate experience at http://choosemyplate.gov: ____________________________________________

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

Specific changes I plan to make: ________________________________________________

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

Strategies I will use: ____________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

Current number of daily steps: ________ Category (use Table 1.2, page 12): __________
Unless carefully planned, a strict plant-based diet will prevent proper growth and development.

Nutrient Concerns
In some vegetarian diets, protein deficiency can be a concern. Vegans in particular must be careful to eat foods that provide a balanced distribution of essential amino acids, such as grain products and legumes. Strict vegans also need a supplement of vitamin B12. This vitamin is not found in plant foods; its only source is animal foods. Deficiency of this vitamin can lead to anemia and nerve damage.

The key to a healthful vegetarian diet is to eat foods that possess complementary proteins, because most plant-based products lack one or more essential amino acids in adequate amounts. For example, both grains and legumes are good protein sources, but neither provides all the essential amino acids. Grains and cereals are low in the amino acid lysine, and legumes lack methionine. Foods from these two groups—such as combinations of tortillas and beans, rice and beans, rice and soybeans, or wheat bread and peanuts—complement each other and provide all required protein nutrients. These complementary proteins may be consumed over the course of one day, but it is best if they are consumed during the same meal.

Other nutrients likely to be deficient in vegetarian diets—and ways to compensate—are as follows:

1. Given the choice between whole foods and refined, processed foods, choose the former (apples rather than apple pie, potatoes rather than potato chips). No nutrients have been refined out of the whole foods, and they contain less fat, salt, and sugar.
2. Choose the leaner cuts of meat. Select fish or poultry often, beef seldom. Ask for broiled, not fried, to control your fat intake.
3. Use both raw and cooked vegetables and fruits. Raw foods offer more fiber and vitamins, such as folate and thiamin, that are destroyed by cooking. Cooking foods frees other vitamins and minerals for absorption.
4. Include milk, milk products, or other calcium sources for the calcium you need. Use low-fat or non-fat items to reduce fat and calories.
5. Learn to use margarine, butter, and oils sparingly. A little gives flavor, a lot overloads you with fat and calories.
6. Vary your choices. Eat broccoli today, carrots tomorrow, and corn the next day. Eat Chinese today, Italian tomorrow, and broiled fish with brown rice and steamed vegetables the third day.
7. Load your plate with vegetables and unrefined starchy foods. A small portion of meat or cheese is all you need for protein.
8. When choosing breads and cereals, choose the whole-grain varieties.
9. Choose the broiled sandwich with lettuce, tomatoes, and other goodies—and hold the mayo—rather than the fish or chicken patties coated with breadcrumbs and cooked in fat.
10. Select a salad—and use more plain vegetables than those mixed with oily or mayonnaise-based dressings.
11. Order chili with more beans than meat. Choose a soft bean burrito over tacos with fried shells.

To select nutritious fast foods:

- Choose the broiled sandwich with lettuce, tomatoes, and other goodies—and hold the mayo—rather than the fish or chicken patties coated with breadcrumbs and cooked in fat.
- Select a salad—and use more plain vegetables than those mixed with oily or mayonnaise-based dressings.
- Order chili with more beans than meat. Choose a soft bean burrito over tacos with fried shells.
- Drink low-fat milk rather than a cola beverage.

When choosing from a vending machine:

13. Choose cracker sandwiches over chips and pork rinds (virtually pure fat). Choose peanuts, pretzels, and popcorn over cookies and candy.
14. Choose milk and juices over cola beverages.

Try It Based on what you have learned, list strategies you can use to increase food variety, enhance the nutritive value of your diet, and decrease fat and caloric content in your meals.

Most fruits and vegetables contain large amounts of cancer-preventing phytonutrients.

- Vitamin D can be obtained from moderate exposure to the sun or by taking a supplement.
- Riboflavin can be found in green leafy vegetables, whole grains, and legumes.
- Calcium can be obtained from fortified soybean milk or fortified orange juice, calcium-rich tofu, and selected cereals. A calcium supplement is also an option.
- Iron can be found in whole grains, dried fruits and nuts, and legumes. To enhance iron absorption, a good source of vitamin C should be consumed with these foods (calcium and iron are the most difficult nutrients to consume in sufficient amounts in a strict vegan diet).
- Zinc can be obtained from whole grains, wheat germ, beans, nuts, and seeds.

MyPlate also can be used as a guide for vegetarians. The key is food variety. Most vegetarians today eat dairy products and eggs. They can replace meat with legumes, nuts, seeds, eggs, and meat substitutes (tofu, tempeh, soy milk, and commercial meat replacers such as veggie burgers and soy hot dogs). For additional MyPlate healthy eating tips for vegetarians and how to get enough of the previously mentioned nutrients, go to http://choosemyplate.gov/. Those who are interested in vegetarian diets are encouraged to consult additional resources, because special vegetarian diet planning cannot be covered adequately in a few paragraphs.

Nuts
Consumption of nuts, commonly used in vegetarian diets, has received considerable attention in recent years. A few years ago, most people regarded nuts as especially high in fat and calories. Although they are 70- to 90-percent fat, most of this is unsaturated fat. And research indicates that people who eat nuts several times a week have a lower incidence of heart disease. Eating two to three ounces (about one-half cup) of almonds, walnuts, or peanuts a day may decrease high blood cholesterol by about 10 percent. Nuts can even enhance the cholesterol-lowering effects of the Mediterranean diet.

Heart-health benefits are attributed not only to the unsaturated fats but also to other nutrients found in nuts, including vitamin E and folic acid. And nuts are also packed with additional B vitamins, calcium, copper, potassium, magnesium, fiber, and phytonutrients. Many of these nutrients are cancer- and cardio-protective, help lower homocysteine levels, and act as antioxidants (discussed in “Antioxidants,” page 101, and “Folate,” page 104).

Nuts do have a drawback: They are high in calories. A handful of nuts provides as many calories as a piece of cake, so nuts should be avoided as a snack. Excessive weight gain is a risk factor for cardiovascular disease. Nuts are recommended for use in place of high-protein foods such as meats, bacon, and eggs or as part of a meal in fruit or vegetable salads, homemade bread, pancakes, casseroles, yogurt, and oatmeal. Peanut butter is also healthier than cheese or some cold cuts in sandwiches.

Soy Products
The popularity of soy foods, including use in vegetarian diets, is attributed primarily to Asian research that points to less heart disease and fewer hormone-related cancers in people who regularly consume soy foods. A benefit of eating soy is that it replaces unhealthy animal products high in saturated fat. Soy is rich in plant protein, unsaturated fat, and fiber, and some soy is high in calcium.

The benefits of soy lie in its high protein content and plant chemicals, known as isoflavones, that act as antioxidants and are thought to protect against estrogen-related cancers (breast, ovarian, and endometrial). The compound genistein, one of many phytonutrients in soy, may reduce the risk for breast cancer, and soy consumption also may lower the risk for prostate cancer. Limited animal studies have suggested an actual increase in breast cancer risk. Human studies are still inconclusive but tend to favor a slight protective effect in premenopausal women.

Until more data become available, the University of California Wellness Letter has issued the following recommendations:

1. Do not exceed three servings of soy per day (a serving constitutes a half a cup of tofu, edamame, or tempeh; one-fourth cup of roasted soy nuts; or one cup of soy yogurt or soy milk).
2. Limit soy intake to just a few servings per week if you now have or have had breast cancer.
3. Avoid soy supplements, as they may contain higher levels of isoflavones than those found in soy foods. Individuals with a history of breast cancer and women who are pregnant or lactating should especially avoid them altogether.
Probiotics
Yogurt is rated in the “super-foods” category because, in addition to being a good source of calcium, potassium, riboflavin, and protein, it contains **probiotics**. The latter are friendly “for life” microbes that are thought to rebalance the naturally present intestinal bacteria. These microorganisms help break down foods and are thought to prevent disease-causing organisms from settling in. Although low-fat or nonfat yogurt is an excellent choice, you should not consume yogurt expecting miraculous medical benefits. Probiotics have been found to offer protection against gastrointestinal infections and boost immune activity. Additional research, nonetheless, is needed to further investigate probiotic benefits.

Yogurts are cultured with Lactobacillus bulgaricus and Streptococcus thermophilus probiotics. When selecting yogurt, preferably look for low-fat or nonfat products that also contain L-acidophilus, Bifidus, and the prebiotic (substances on which probiotics feed) inulin. The latter, a soluble fiber, appears to enhance calcium absorption. Avoid yogurt with added fruit jam, sugar, and candy. Most yogurts have lots of added sugar and limited fruit. Thus, it is best to buy plain yogurt and add fresh fruit.

Advanced Glycation End Products
A new area of research in nutrition has to do with **advanced glycation end products (AGEs)**, compounds that have been implicated in aging, adverse effects, and chronic diseases by increasing oxidation and inflammation. AGEs are thought to contribute to the development of atherosclerosis, heart disease, diabetes and diabetes-related complications, kidney disease, osteoarthritis, rheumatoid arthritis, and Alzheimer’s disease among others. These compounds are produced when glucose combines with proteins, lipids and other ingredients in foods.

AGEs are found primarily in foods cooked in dry heat, at high temperatures, in processed foods, and in foods high in fat content. Broiling, grilling, and frying create the highest levels of AGEs, whereas braising, steaming, stewing, roasting, boiling, and poaching decrease the levels. French-fried potatoes have about eight times the amount of AGEs compared with the same amount in a baked potato. Fast-food restaurants take advantage of the flavor-enhancing effects of AGEs by adding these toxic compounds to their foods to increase the foods’ appeal to the consumer. The take-home message to the consumer here is once again moderation. You do not have to completely eliminate grilling, frying, and fast foods, but common sense is vital to maintain good health.

The following guidelines can help you decrease AGEs in your diet:

1. Limit cooking meats at high temperatures.
2. Avoid high-fat foods (whole-milk products and meats).
3. Increase intake of fruits, vegetables, grains, fish, and low-fat milk products.
4. Choose unprocessed rather than processed foods by cooking fresh foods from scratch.
5. Eat at home most of the time and avoid prepackaged and fast foods as much as possible.
6. Avoid browning (the process of browning sugars and proteins on food surfaces increases the formation of AGEs).

**Diets from Other Cultures**
Increasingly, Americans are eating foods reflecting the ethnic composition of people from other countries. Learning how to wisely select from the wide range of options is the task of those who seek a healthy diet.

**Mediterranean Diet**
The Mediterranean diet receives much attention because people in that region have notably lower rates of diet-linked diseases and a longer life expectancy. The diet features olive oil, grains (whole, not refined), legumes, vegetables, fruits, and, in moderation, fish, red wine, nuts, and dairy products. Although it is a semivegetarian diet, up to 40 percent of the total daily caloric intake may come from fat—mostly monounsaturated fat from olive oil. Moderate intake of red wine is included.

![The Traditional Healthy Mediterranean Diet Pyramid](source: Oldways Preservation and Exchange Trust. www.oldwayspt.org. Reprinted with permission.)
with meals. The dietary plan also encourages regular physical activity (Figure 3.10).

More than a “diet,” the Mediterranean diet is a dietary pattern that has existed for centuries. According to the largest and most comprehensive research on this dietary pattern, the health benefits and decreased mortality are not linked to any specific component of the diet (such as olive oil or red wine) but are achieved through the interaction of all the components of the pattern.9 Those who adhere most closely to the dietary pattern have a lower incidence of heart disease (33 percent) and deaths from cancer (24 percent). Although most people in the United States focus on the olive oil component of the diet, olive oil is used mainly as a means to increase consumption of vegetables because vegetables sautéed in oil taste better than steamed vegetables.

Ethnic Diets
As people migrate, they take their dietary practices with them. Many ethnic diets are healthier than the typical American diet because they emphasize consumption of complex carbohydrates and limit fat intake. The predominant minority ethnic groups in the United States are African American, Hispanic American, and Asian American. Unfortunately, the generally healthier ethnic diets quickly become Americanized when these groups adapt to the United States. Often, they cut back on vegetables and add meats and salt to the diet in conformity with the American consumer.

Ethnic dishes can be prepared at home. They are easy to make and much healthier when one uses the typical (original) variety of vegetables, corn, rice, spices, and condiments. Ethnic health recommendations also encourage daily physical activity and suggest no more than two alcoholic drinks per day. Three typical ethnic diets are as follows:

- The African American diet (“soul food”) is based on the regional cuisine of the American South. Soul food includes yams, black-eyed peas, okra, and peanuts. The latter have been combined with American foods such as corn products and pork. Today, most people think of soul food as meat, fried chicken, sweet potatoes, and chitterlings.
- Hispanic foods in the United States arrived with the conquistadors and evolved through combinations with other ethnic diets and local foods available in Latin America. For example, Cuban cuisine combined Spanish, Chinese, and native foods; Puerto Rican cuisine developed from Spanish, African, and native products; and Mexican diets evolved from Spanish and native foods. Prominent in all of these diets were corn, beans, squash, chili peppers, avocados, papayas, and fish. The colonists later added rice and citrus foods. Today, the Hispanic diet incorporates a wide variety of foods, including red meat and cheese, but the staple still consists of rice, corn, and beans.
- Asian American diets are characteristically rich in vegetables and use minimal meat and fat. The Okinawan diet in Japan, where some of the healthiest and oldest people in the world live, is high in fresh (versus pickled) vegetables, high in fiber, and low in fat and salt. Chinese cuisine includes more than 200 vegetables, and fat-free sauces and seasoning are used to enhance flavor. The Chinese diet varies by region in China. The lowest in fat is that of southern China, with most meals containing fish, seafood, and stir-fried vegetables. Chinese food in American restaurants contains a much higher percentage of fat and protein than traditional Chinese cuisine.

Table 3.9 provides a list of healthier foods to choose from when dining at selected ethnic restaurants. Additionally, you can consult the box on page 100 for strategies that you can use for healthy dining out.

All healthy diets have similar characteristics: They are high in fruits, vegetables, and grains and low in fat and saturated fat. Healthy diets also use low-fat or fat-free dairy products, and they emphasize portion control—essential in a healthy diet plan.

Many people now think that if a food item is labeled “low fat” or “fat free,” they can consume it in large quantities. “Low fat” or “fat free” does not imply “calorie free.” Many people who consume low-fat diets eat more (and thus increase their caloric intake), which in the long term leads to obesity and its associated health problems.

Nutrient Supplementation
Approximately half of all adults in the United States take daily nutrient supplements. Nutrient requirements for the body normally can be met by consuming as few as 1,500 calories per day, as long as the diet contains the recommended amounts of food from the different food groups. Still, many people consider it necessary to take vitamin supplements.

### Key Terms

**Probiotics** Healthy microbes (bacteria) that help break down foods and prevent disease-causing organisms from settling in the intestines.

**Advanced glycation end products (AGES)** Derivatives of glucose-protein and glucose-lipid interactions that are linked to aging and chronic diseases.

**Mediterranean diet** Typical diet of people around the Mediterranean region, focusing on olive oil, red wine, grains, legumes, vegetables, and fruits, with limited amounts of meat, fish, milk, and cheese.

**Supplements** Tablets, pills, capsules, liquids, or powders that contain vitamins, minerals, antioxidants, amino acids, herbs, or fiber that individuals take to increase their intake of these nutrients.
Strategies for Healthier Restaurant Eating

On average, Americans eat out six times per week. Research indicates that when dining out, most people consume too many calories and too much fat. Such practice is contributing to the growing obesity epidemic and chronic conditions afflicting most Americans in the 21st century. Below are strategies that you can implement to eat healthier when dining out.

- Plan ahead. Decide before you get to the restaurant that you will select a healthy meal. Then stick to your decision. If you are unfamiliar with the menu, you may be able to access the menu at the restaurant’s Internet Web site beforehand or you can obtain valuable nutrition information at HealthyDiningFinder.com. This Web site is maintained by registered dietitians and provides information on many restaurant chains located in your area.
- Be aware of calories in drinks. You can gulp down several hundred extra calories through drinks alone. Restaurants and beverage industries are eager to get your money, and servers wouldn’t mind a larger tip by having you consume additional items on the menu. Water, sparkling soda water, or unsweetened teas are good choices.
- Avoid or limit appetizers, regardless of how tempting they might be. Ask your server not to bring to the table high-fat pre-meal free foods such as tortilla chips, bread and butter, or vegetables to be dipped in high-fat salad dressings. If you do munch on food freebies or appetizers (or make a meal out of them), have your server box up half the entire meal for you to take home. If you box up an entire meal, you now have two additional meals that you can consume at home; that is because most restaurant meals can be split into two meals.
- Request a half-size or a child’s portion. If you are unable to do so, split the meal with your dining partner or box up half the meal before you start to eat.
- Inquire about ingredients and cooking methods. Don’t be afraid to ask for healthy substitutes. For example, you may request that meat be sautéed instead of deep fried or that canola or olive oil be used instead of other oil choices. You can also request a baked potato or brown rice instead of french fries or white rice. Ask for dressing, butter, or sour cream on the side. Request whole-wheat bread for sandwiches. Furthermore, avoid high-fat foods or ingredients such as creamy or cheese sauces, butter, oils, and fatty/fried/crispy meats. When in doubt, ask the server for additional information. If the server can’t answer your questions, select a different meal.

Try It: Implement as many of the above strategies every time you dine out. Take pride in your healthy choices. Your long-term health and well-being are at stake. You will feel much better about yourself following a healthy meal than you would otherwise.

It’s true that our bodies cannot retain water-soluble vitamins as long as fat-soluble vitamins. The body excretes excessive intakes readily, although it can retain small amounts for weeks or months in various organs and tissues. Fat-soluble vitamins, by contrast, are stored in fatty tissue. Therefore, daily intake of these vitamins is not as crucial.

People should not take megadoses of vitamins and minerals. For some nutrients, a dose of five times the RDA taken over several months may create problems. For other nutrients, it may not pose a threat to human health. Vitamin and mineral doses should not exceed the UL (with the possible exception of vitamin D; see page 103). For nutrients that do not have an established UL, one day’s dose should be no more than three times the RDA.

Iron deficiency (determined through blood testing) is more common in women than men. Iron supplementation is frequently recommended for women who have a heavy menstrual flow. Pregnant and lactating women also may require supplements. The average pregnant woman who eats an adequate amount of a variety of foods should take a low dose of iron supplement daily. Women who are pregnant with more than one baby may need additional supplements. Folate supplements also are encouraged prior to and during pregnancy to prevent certain birth defects (see the following discussions of antioxidants and folate). In the above instances, individuals should take supplements under a physician’s supervision.

Adults over the age of 60 may need to supplement with a daily multivitamin. Aging may decrease the body’s abil-
Compounds such as vitamins C and E, beta-carotene, and selenium prevent oxygen from combining with other substances in the body to form harmful compounds. Oxygen free radicals substances formed during metabolism that attack and damage proteins and lipids, in particular the cell membrane and DNA, leading to diseases such as heart disease, cancer, and emphysema.

**Table 3.9 Ethnic Eating Guide**

<table>
<thead>
<tr>
<th>Choose Often</th>
<th>Choose Less Often</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Chinese</strong></td>
<td></td>
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<tr>
<td>Beef with broccoli</td>
<td>Crispy duck</td>
</tr>
<tr>
<td>Chinese greens</td>
<td>Egg rolls</td>
</tr>
<tr>
<td>Steamed rice, brown or white</td>
<td>Fried rice</td>
</tr>
<tr>
<td>Steamed beef with peas</td>
<td>Kung pao chicken (fried)</td>
</tr>
<tr>
<td>Stir-fry dishes</td>
<td>Peking duck</td>
</tr>
<tr>
<td>Teriyaki beef or chicken</td>
<td>Pork spareribs</td>
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<tr>
<td>Wonton soup</td>
<td></td>
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<tr>
<td><strong>Japanese</strong></td>
<td></td>
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<tr>
<td>Chiri nabe (fish stew)</td>
<td>Tempura (fried chicken, shrimp, or vegetables)</td>
</tr>
<tr>
<td>Grilled scallops</td>
<td></td>
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<tr>
<td>Sushi, sashimi (raw fish)</td>
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<tr>
<td>Teriyaki</td>
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<tr>
<td>Yakitori (grilled chicken)</td>
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<tr>
<td><strong>Italian</strong></td>
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<tr>
<td>Cioppino (seafood stew)</td>
<td>Antipasto</td>
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<tr>
<td>Minestrone (vegetarian soup)</td>
<td>Cannelloni, ravioli</td>
</tr>
<tr>
<td>Pasta with marinara sauce</td>
<td>Fettuccini alfredo</td>
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<tr>
<td>Pasta primavera (pasta with vegetables)</td>
<td>Garlic bread</td>
</tr>
<tr>
<td>Steamed clams</td>
<td>White clam sauce</td>
</tr>
<tr>
<td><strong>Mexican</strong></td>
<td></td>
</tr>
<tr>
<td>Beans and rice</td>
<td>Chili rellenos</td>
</tr>
<tr>
<td>Black bean/vegetable soup</td>
<td>Chimichangas</td>
</tr>
<tr>
<td>Burritos, bean chili</td>
<td>Enchiladas, beef or cheese</td>
</tr>
<tr>
<td>Enchiladas, bean fajitas</td>
<td>Flautas</td>
</tr>
<tr>
<td>Gazpacho</td>
<td>Guacamole</td>
</tr>
<tr>
<td>Taco salad</td>
<td>Quesadillas</td>
</tr>
<tr>
<td>Tamales</td>
<td>Tostadas</td>
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<tr>
<td>Tortillas, steamed</td>
<td>Sour cream</td>
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<tr>
<td><strong>Middle Eastern</strong></td>
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<tr>
<td>Tandoori chicken</td>
<td>Falafel</td>
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<tr>
<td>Curry (yogurt-based)</td>
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<tr>
<td>Rice pilaf</td>
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<tr>
<td>Lentil soup</td>
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<tr>
<td>Shish kebab</td>
<td></td>
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<tr>
<td><strong>French</strong></td>
<td></td>
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<tr>
<td>Poached salmon</td>
<td>Beef Wellington</td>
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<tr>
<td>Spinach salad</td>
<td>Escargot</td>
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<tr>
<td>Consommé</td>
<td>French onion soup</td>
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<tr>
<td>Salad nicoise</td>
<td>Sauces in general</td>
</tr>
<tr>
<td><strong>Soul Food</strong></td>
<td></td>
</tr>
<tr>
<td>Baked chicken</td>
<td>Fried chicken</td>
</tr>
<tr>
<td>Baked fish</td>
<td>Fried fish</td>
</tr>
<tr>
<td>Roasted pork (not smothered or “etouffé”)</td>
<td>Smothered pork</td>
</tr>
<tr>
<td>Sauteed okra</td>
<td>Okra in gumbo</td>
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<tr>
<td>Baked sweet potato</td>
<td>Sweet potato caserole or pie</td>
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<tr>
<td><strong>Greek</strong></td>
<td></td>
</tr>
<tr>
<td>Gyros</td>
<td>Baklava</td>
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<tr>
<td>Pita</td>
<td>Moussaka</td>
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<tr>
<td>Lentil soup</td>
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Other people who may benefit from supplementation are those with nutrient deficiencies, alcoholics and street-drug users who do not have a balanced diet, smokers, vegans (strict vegetarians), individuals on low-calorie diets (fewer than 1,500 calories per day), and people with disease-related disorders or who are taking medications that interfere with proper nutrient absorption.

Although supplements may help a small group of individuals, most supplements do not provide benefits to healthy people who eat a balanced diet. Supplements do not seem to prevent chronic diseases or help people run faster, jump higher, relieve stress, improve sexual prowess, cure a common cold, or boost energy levels.

**Antioxidants**

Much research and discussion are taking place regarding the effectiveness of antioxidants in thwarting several chronic diseases. Although foods probably contain more than 4,000 antioxidants, the four most studied antioxidants are vitamins E, C, and beta-carotene (a precursor to vitamin A) and the mineral selenium (technically not an antioxidant but a component of antioxidant enzymes).

Oxygen is used during metabolism to change carbohydrates and fats into energy. During this process, oxygen is transformed into stable forms of water and carbon dioxide. A small amount of oxygen, however, ends up in an unstable form, referred to as oxygen-free radicals. A free radical molecule has a normal proton nucleus with a single unpaired electron. Having only one electron makes the free radical extremely reactive, and it looks constantly to pair its electron with one from another molecule. When a free radical steals a second electron from another molecule, that other molecule in turn becomes a free radical. This chain reaction goes on until two free radicals meet to form a stable molecule.

Free radicals attack and damage proteins and lipids—in particular, cell membranes and DNA. This damage is thought to contribute to the development of conditions such as cardiovascular disease, cancer, emphysema, cataracts, Parkinson’s disease, and premature aging. Solar radiation, cigarette smoke, air pollution, radiation, some drugs, injury, infection, chemicals (such as pesticides),
and other environmental factors also seem to encourage the formation of free radicals. Antioxidants are thought to offer protection by absorbing free radicals before they can cause damage and also by interrupting the sequence of reactions once damage has begun, thwarting certain chronic diseases (Figure 3.11).

The body’s own defense systems typically neutralize free radicals so they don’t cause any damage. When free radicals are produced faster than the body can neutralize them, they can damage the cells. Research, however, indicates that the body’s antioxidant defense system improves as fitness improves. Antioxidants are found abundantly in food, especially in fruits and vegetables. Unfortunately, most Americans do not eat the minimum recommended amounts of fruits and vegetables.

Antioxidants work best in the prevention and progression of disease, but they cannot repair damage that has already occurred or cure people who have disease. The benefits are obtained primarily from food sources themselves, and controversy surrounds the benefits of antioxidants taken in supplement form.

For years people believed that taking antioxidant supplements could further prevent free radical damage, but adding to the controversy, a report published in the Journal of the American Medical Association indicated that antioxidant supplements actually increase the risk of death. Vitamin E, beta-carotene, and vitamin A increased the risk for mortality by 4 percent, 7 percent, and 16 percent, respectively. Vitamin C had no effect on mortality, while selenium decreased risk by 9 percent. Some researchers, however, have questioned the design and conclusions of this report. More research is definitely required to settle the controversy.

Vitamin E

The RDA for vitamin E is 15 mg or 22 IU (international units). Although no evidence indicates that vitamin E supplementation below the upper limit of 1,000 mg per day is harmful, little or no clinical research supports any health benefits. Vitamin E is found primarily in oil-rich seeds and vegetable oils. Foods high in vitamin E include almonds, hazelnuts, peanuts, canola oil, safflower oil, cottonseed oil, kale, sunflower seeds, shrimp, wheat germ, sweet potato, avocado, and tomato sauce. You should incorporate some of these foods regularly in the diet to obtain the RDA.

Vitamin C

Studies have shown that vitamin C may offer benefits against heart disease, cancer, and cataracts. People who consume the recommended amounts of daily fruits and vegetables, nonetheless, need no supplementation because they obtain their daily vitamin C requirements through the diet alone.

Vitamin C is water soluble, and the body eliminates it in about 12 hours. For best results, consume food rich in vitamin C twice a day. High intake of a vitamin C supplement, above 500 mg per day, is not recommended. The body absorbs very little vitamin C beyond the first 200 mg per serving or dose. Foods high in vitamin C include oranges and other citrus fruit, kiwi fruit, cantaloupe, apple, bell peppers, strawberries, broccoli, kale, cauliflower, and tomatoes.

Beta-Carotene

Obtaining the daily recommended dose of beta-carotene (20,000 IU) from food sources rather than supplements is preferable. Clinical trials have found that beta-carotene supplements do not offer protection against heart disease or cancer or provide any other health benefits. Therefore, the recommendation is to “skip the pill and eat the carrot.” One medium raw carrot contains about 20,000 IU of beta-carotene. Other foods high in beta-carotene include sweet potatoes, pumpkin, cantaloupe, squash, kale, broccoli, tomatoes, peaches, apricots, mangos, papaya, turnip greens, and spinach.

Selenium

Early research on individuals who took 200 micrograms selenium daily indicates that it decreased the risk for prostate, colorectal, and lung cancers by about 50 per-
Nutrition for Wellness

Measure of nutrients in foods.

Multivitamin complex.

compared with people with deficient diets who take a
have a low risk of cardiovascular disease and cancer
with ample amounts of fruits, vegetables, and grains,
mins are not magic pills. They don’t provide energy, fi-

Multivitamins

Although much interest has been generated in the previ-
ously mentioned individual supplements, the American
people still prefer multivitamins as supplements. At
present, there is no solid scientific evidence that they
decrease the risk for either cardiovascular disease or
cancer. The most convincing data came in a 2009 study
on more than 161,000 postmenopausal women taking
multivitamin pills.12 The results showed no benefits in
terms of cardiovascular, cancer, or premature mortality
risk reduction in women taking a multivitamin complex
for an average of eight years compared with those who
did not. A panel of experts from the National Institutes
of Health (NIH) has indicated that there aren’t enough
data to support the use of multivitamins.

If you take a multivitamin for general health reasons,
it doesn’t grant you a license to eat carelessly. Multivita-
mins are not magic pills. They don’t provide energy, fi-
ber, or phytonutrients. People who eat a healthy diet,
with ample amounts of fruits, vegetables, and grains,
have a low risk of cardiovascular disease and cancer
compared with people with deficient diets who take a
multivitamin complex.

Vitamin D

Vitamin D is attracting a lot of attention because research
suggests that the vitamin possesses anticancer proper-
ties, especially against breast, colon, and prostate cancers
and possibly lung and digestive cancers. It also de-
creases inflammation, fighting cardiovascular disease,
periodontal disease, and atherosclerosis. Furthermore,
vitamin D strengthens the immune system, controls
blood pressure, helps maintain muscle strength, de-
creases the risk for arthritis and dementia, prevents birth
defects, and may help deter diabetes, fight depression;
and it is necessary for absorption of calcium, a nutrient
critical for building and maintaining bones to prevent
osteoporosis and for dental health.

The theory that vitamin D protects against cancer is
based on studies showing that people who live farther
north (who have less sun exposure during the winter
months) have a higher incidence of cancer. Furthermore,
people diagnosed with breast, colon, or prostate cancer
during the summer months, when vitamin D production
by the body is at its highest, are 30 percent less likely to
die from cancer, even 10 years following the initial diag-
nosis. Researchers believe that vitamin D level at the
time of cancer onset affects survival rates.

Technically, vitamin D is a prohormone. Its metabolic
product, calcitrol, is a secosteroid hormone that impacts
more than 2,000 genes affecting health and well-being.
The current recommended daily intake ranges between
200 and 600 IU (5 and 15 mcg, based on your age), an
amount believed to be too low for most individuals, es-
pecially during the winter months. The UL has been set
at 2,000 IU (50 mcg). Experts believe that this figure
needs revision because there are no data implicating
toxic effects up to 10,000 IU (250 mcg) a day.13

During the winter months, most people in the United
States living north of latitude 35 degrees (above the
states of Georgia and Texas) and in Canada are not get-
ting enough vitamin D. The body uses ultraviolet B
(UVB) rays to generate vitamin D. UVB rays are shorter
than ultraviolet A (UVA) rays, so they penetrate the
atmosphere at higher angles. During the winter season,
the sun is too far south for the UVB rays to get through.

In 2010, the Institute of Medicine of the National
Academy of Sciences increased the recommended daily
intake level of vitamin D to 600 IU for children and
adults up to 70 years of age. Older adults should get
800 IU per day. This level is not as high as vitamin D
experts had hoped for. Preliminary evidence suggests
that people should get between 1,000 and 2,000 IU (25 to
50 mcg) of vitamin D per day.14

The most accurate test to measure how much vitamin
D is in the body is the 25-hydroxyvitamin D test. Blood
levels should remain between 50 and 80 ng/mL all year
long. To increase your levels, the Vitamin D Council rec-
ommends that all adults supplement their diets with
5,000 IU of vitamin D daily for three months and then
take a 25-hydroxyvitamin D test.15 You may then adjust
your supplement dosage based on your test results,
daily sun exposure, and the season of the year.

Depending on skin tone and sun intensity, about
15 minutes of unprotected sun exposure (without sun-
screen) of the face, arms, hands, and lower legs during
peak daylight hours (10:00 a.m. and 4:00 p.m.—when
your shadow is shorter than your actual height) gener-
ates between 2,000 and 5,000 IU of vitamin D. Thus, it
makes no sense that the UL is set at 2,000 when the hu-
man body manufactures more than that in just 15 min-
utes of unprotected sun exposure. The UL of 2,000 IU
will most likely be revised in the next update of the DRI.

Key Terms

International unit (IU) Measure of nutrients in foods.
Good sources of vitamin D in the diet include salmon, mackerel, tuna, and sardines. Fortified milk, yogurt, orange juice, margarines, and cereals are also good sources. To obtain up to 2,000 IU per day from food sources alone, however, is difficult (see Table 3.10). Thus, daily safe sun exposure and/or supplementation (especially during the winter months) is highly recommended.

The best source of vitamin D is sunshine. UVB rays lead to the production on the surface of the skin of inactive oil-soluble vitamin D$_3$. The inactive form is then transformed by the liver, and subsequently the kidneys, into the active form of vitamin D. Sun-generated vitamin D is better than that obtained from foods or supplements.

Vitamin D$_3$ generated on the surface of the skin, however, doesn’t immediately penetrate into the blood. It takes up to 48 hours to absorb most of the vitamin. Because it is an oil-soluble compound, experts recommend that you avoid using soap following safe sun exposure, as it would wash off most of the vitamin. You may use soap for your armpits, groin area, and feet, but avoid using soap on the newly sun-exposed skin.

Excessive sun exposure can lead to skin damage and skin cancer. It is best to strive for daily safe sun exposure, that is, 10 to 20 minutes (based on skin tone and sun intensity) of unprotected sun exposure during peak hours of the day a few times a week. Generating too much vitamin D from the sun is impossible because the body generates only what it needs. If you have sensitive skin, you may start with five minutes and progressively increase sun exposure by one minute per day. If your skin turns a slight pink, following exposure, you have overdone it and need to cut back on the time that you are out in the sun.

People at the highest risk for low vitamin D levels are older adults, those with dark skin (they make less vitamin D), and individuals who spend most of their time indoors and get little sun exposure. Two studies have found that over a span of six to seven years, individuals 65 and over with low blood levels of vitamin D are two and a half times more likely to die in that time frame than those with high levels. People with darker skin also need five to 10 times the sun exposure of lighter-skinned people to generate the same amount of vitamin D. The skin’s dark pigment reduces the ability of the body to synthesize vitamin D from the sun by up to 95 percent.

In the United States and Canada, most of the population does not make vitamin D from the sun during the winter months when UVB rays do not get through, most people’s time is spent indoors, and extra clothing is worn to protect against the cold. According to the National Health and Nutrition Examination Survey published in 2011, 41.6 percent of the U.S. population doesn’t have a 25-hydroxyvitamin D level of even 20 ng/mL. The highest deficiency rate is seen in Blacks and Hispanics, with 82.1 percent and 69.2 percent deficiency rates respectively. During periods of limited sun exposure, you should consider a daily vitamin D$_3$ supplement of up to 2,000 IU per day (some vitamins contain vitamin D$_2$, which is a less potent form of the vitamin).

### Folate

Although it is not an antioxidant, 400 mcg of folate (a B vitamin) is recommended for all premenopausal women. Folate helps prevent some birth defects and seems to offer protection against colon and cervical cancers. Women who might become pregnant should plan to take a folate supplement, because studies have shown that folate before and during pregnancy can prevent serious birth defects (in particular spina bifida). Some of these defects occur during the first few days and weeks of pregnancy. Adequate folate intake can also prevent congenital heart defects, early miscarriages, and premature birth. Thus, women who may become pregnant need to have adequate folate levels before conception and throughout pregnancy.

Some evidence also indicates that adequate intake of folate along with vitamins B$_6$ and B$_12$ prevents heart attacks by reducing homocysteine levels in the blood (see Chapter 10). High concentrations of homocysteine accelerate the process of plaque formation (atherosclerosis) in the arteries. Five servings of fruits and vegetables per day usually meet the needs for these nutrients. Almost 9 of 10 adults in the United States do not obtain the recommended 400 mcg of folate per day.

With the possible exception of women of childbearing age, obtaining your daily folate RDA from natural foods is preferable to getting it from supplements. The UL for folate has been set at 1,000 mcg/day. Recent evidence suggests that exceeding 1,000 mcg through a combination of diet and supplements may actually fuel the progression of precancerous growths and cancer.$^{16}$ A daily multivitamin or a serving of a highly fortified cereal each provides 400 mcg of folate. In combination with a supplement, one can easily exceed the UL of 1,000 mcg/day. To date, no data have linked folate obtained from natural foods to increased cancer risk. On the contrary, nat-

---

**Table 3.10**

<table>
<thead>
<tr>
<th>Food</th>
<th>Amount</th>
<th>IU*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multivitamins (most brands)</td>
<td>daily dose</td>
<td>400</td>
</tr>
<tr>
<td>Salmon</td>
<td>3.5 oz</td>
<td>360</td>
</tr>
<tr>
<td>Mackerel</td>
<td>3.5 oz</td>
<td>345</td>
</tr>
<tr>
<td>Sardines (oil/drained)</td>
<td>3.5 oz</td>
<td>250</td>
</tr>
<tr>
<td>Shrimp</td>
<td>3.5 oz</td>
<td>200</td>
</tr>
<tr>
<td>Orange juice (D-fortified)</td>
<td>8 oz</td>
<td>100</td>
</tr>
<tr>
<td>Milk (any type/D-fortified)</td>
<td>8 oz</td>
<td>100</td>
</tr>
<tr>
<td>Margarine (D-fortified)</td>
<td>1 tbsp</td>
<td>60</td>
</tr>
<tr>
<td>Yogurt (D-fortified)</td>
<td>6–8 oz</td>
<td>60</td>
</tr>
<tr>
<td>Cereal (D-fortified)</td>
<td>¾–1 c</td>
<td>40</td>
</tr>
<tr>
<td>Egg</td>
<td>1</td>
<td>20</td>
</tr>
</tbody>
</table>

*IU = international units

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16. A daily multivitamin or a serving of a highly fortified cereal each provides 400 mcg of folate. In combination with a supplement, one can easily exceed the UL of 1,000 mcg/day. To date, no data have linked folate obtained from natural foods to increased cancer risk. On the contrary, nat-
ual foods have been found to have a cancer-protective effect.

**Benefits of Foods**

In its latest position statement on nutrient supplements, the American Dietetic Association stated, “The best nutrition-based strategy for promoting optimal health and reducing the risk of chronic disease is to wisely choose a wide variety of foods. Additional nutrients from supplements can help some people meet their nutrient needs as specified by science-based nutrition standards such as the Dietary Reference Intakes.”

Fruits and vegetables are the richest sources of antioxidants and phytonutrients. For example, researchers at the U.S. Department of Agriculture (USDA) compared the antioxidant effects of vitamins C and E with those of various common fruits and vegetables. The results indicated that three-fourths of a cup of cooked kale (which contains only 11 IU of vitamin E and 76 mg of vitamin C) neutralized as many free radicals as did approximately 800 IU of vitamin E or 600 mg of vitamin C. A list of top antioxidant foods is presented in Table 3.11.

Many people who eat unhealthily think that they need supplementation to balance their diets. This is a fallacy about nutrition. The problem here is not necessarily a lack of vitamins and minerals but, rather, a diet too high in calories, saturated fat, trans fats, and sodium. Vitamin, mineral, and fiber supplements do not supply all of the nutrients and other beneficial substances present in food and needed for good health.

Wholesome foods contain vitamins, minerals, carbohydrates, fiber, proteins, fats, and phytonutrients, along with other substances not yet discovered. Researchers do not know whether the protective effects are caused by the antioxidants alone, by a combination of antioxidants with other nutrients or by some other nutrients in food that have not been investigated yet. Many nutrients work in synergy, enhancing chemical processes in the body.

Supplementation will not offset poor eating habits. Pills are no substitute for common sense. If you think your diet is not balanced, you first need to conduct a nutrient analysis (see Activities 3.1 and 3.2, pages 89–90) to determine which nutrients you lack in sufficient amounts. Eat more of them, as well as foods that are high in antioxidants and phytonutrients. Following a nutrient assessment, a registered dietitian can help you decide what supplement(s), if any, might be necessary.

Furthermore, the American Heart Association does not recommend antioxidant supplements either, until more definite research is available. If you take any supplements in pill form, however, look for products that meet the disintegration standards of the U.S. Pharmacopoeia (USP) on the bottle. The USP standard suggests that the supplement should completely dissolve in 45 minutes or less. Supplements that do not dissolve, of course, cannot get into the bloodstream.

### Critical Thinking

Do you take supplements? • If so, for what purposes are you taking them—and do you think you could restructure your diet so that you could do without them?

### Functional Foods

**Functional foods** are foods or food ingredients that offer specific health benefits beyond those supplied by the traditional nutrients they contain. Many functional foods come in their natural forms. A tomato, for example, is a functional food because it contains the phytonutrient lycopene, thought to reduce the risk for prostate cancer. Other examples of functional foods are kale, broccoli, blueberries, red grapes, and green tea.

The term “functional food,” however, has been used primarily as a marketing tool by the food industry to attract consumers. Unlike **fortified foods**, which have been modified to help prevent nutrient deficiencies, functional foods are created by the food industry by the addition of ingredients aimed at treating or preventing...
Behavior Modification Planning

Guidelines for a Healthy Diet

- Base your diet on a large variety of foods.
- Consume ample amounts of green, yellow, and orange fruits and vegetables.
- Eat foods high in complex carbohydrates, including at least three 1-ounce servings of whole-grain foods per day.
- Obtain most of your vitamins and minerals from food sources.
- Eat foods rich in vitamin D.
- Maintain adequate daily calcium intake and consider a bone supplement with vitamin D3.
- Consume protein in moderation.
- Limit meat consumption to 3 to 6 ounces per day.
- Limit daily fat, trans fat, and saturated fat intake.
- Limit cholesterol consumption to less than 300 mg per day.
- Limit sodium intake to 2,300 mg per day.
- Limit sugar intake.
- If you drink alcohol, do so in moderation (one daily drink for women and two for men).
- Consider taking a daily multivitamin (preferably one that includes vitamin D3).

Try It

Carefully analyze the above guidelines and note the areas where you can improve your diet. Work on one guideline each week until you are able to adhere to all of the above guidelines.

In functional foods, the added ingredient(s) is typically not found in the food item in its natural form but is added to allow manufacturers to make appealing health claims.

In most cases, only one extra ingredient is added (a vitamin, mineral, phytonutrient, or herb). An example is calcium added to orange juice to make the claim that this brand offers protection against osteoporosis. Food manufacturers now offer cholesterol-lowering margarines (enhanced with plant stanol), cancer-protective ketchup (fortified with lycopene), memory-boosting candy (with ginkgo added), calcium-fortified chips, and corn chips containing kava kava (to enhance relaxation).

The use of some functional foods, however, may undermine good nutrition. Margarines still may contain saturated fats or partially hydrogenated oils. Regularly consuming ketchup on top of large orders of fries adds many calories and fat to the diet. Sweets are also high in calories and sugar. Chips are high in calories, salt, and fat. In all of these cases, the consumer would be better off taking the specific ingredient in a supplement form rather than consuming the functional food with its extra calories, sugar, salt, and/or fat.

Functional foods can provide added benefits if used in conjunction with a healthful diet. You may use nutrient-dense functional foods in your overall wellness plan as an adjunct to health-promoting strategies and treatments.

Genetically Modified Crops

In a genetically modified organism (GMO), the DNA (or basic genetic material) is manipulated to obtain certain results. This is done by inserting genes with desirable traits from one plant, animal, or microorganism into another one to either introduce new traits or enhance existing traits.

Crops are genetically modified to make them better resist disease and extreme environmental conditions (such as heat and frost), require fewer fertilizers and pesticides, last longer, and improve their nutrient content and taste. GMOs could help save billions of dollars by producing more crops and helping to feed the hungry in developing countries around the world.

Concern over the safety of genetically modified (GM) foods has led to heated public debates in Europe and, to a lesser extent, in the United States. The concern is that genetic modifications create “transgenic” organisms that have not previously existed and that have potentially unpredictable effects on the environment and on humans. Also, there is some concern that GM foods may cause illness or allergies in humans and that cross-pollination may destroy other plants or create “superweeds” with herbicide-resistant genes.

Genetically modified crops were first introduced into the United States in 1996. This technology is moving forward so rapidly that the USDA already has approved more than 50 GM crops. Today, about 40 percent of U.S. cropland produced GM foods. Now, more than 80 percent of our soybeans, 73 percent of cotton, 50 percent of canola, and 40 percent of corn come from GM crops.

Completely avoiding GM foods is difficult because more than 60 percent of processed foods on the market today contain GMOs. If people do not wish to consume GM foods, organic foods are an option because organic trade organizations do not certify foods with genetic modifications. Produce bought at the local farmers’ market also may be an option, because small farmers are less likely to use this technology.

At this point, no evidence indicates that GM foods are harmful—but no compelling evidence guarantees that they are safe, either. Many questions remain, and much
research is required in this field. As a consumer, you will have to continue educating yourself as more evidence becomes available in the next few years.

Energy Substrates for Physical Activity

The two main fuels that supply energy for physical activity are glucose (sugar) and fat (fatty acids). The body uses amino acids, derived from proteins, as an energy substrate when glucose is low, such as during fasting, prolonged aerobic exercise, or a low-carbohydrate diet.

Glucose is derived from foods that are high in carbohydrates, such as breads, cereals, grains, pasta, beans, fruits, vegetables, and sweets in general. Glucose is stored as glycogen in muscles and the liver. Fatty acids (discussed on pages 77–79) are the product of the breakdown of fats. Unlike glucose, an almost unlimited supply of fatty acids, stored as fat in the body, can be used during exercise.

Energy (ATP) Production

The energy derived from food is not used directly by the cells. It is first transformed into adenosine triphosphate (ATP). The subsequent breakdown of this compound provides the energy used by all energy-requiring processes of the body (Figure 3.12).

ATP must be recycled continually to sustain life and work. ATP can be resynthesized in three ways:

1. ATP-CP system. The body stores small amounts of ATP and creatine phosphate (CP). These stores are

   - Wash your hands thoroughly before and after touching raw produce.
   - Do not place raw fruits and vegetables next to uncooked meat, poultry, or fish.
   - Trim all visible fat from meat, remove the skin from poultry and fish prior to cooking (pesticides concentrate in animal fat).
   - Use a scrub brush to wash fresh produce under running water. Pay particular attention to crevices in the produce. Washing fresh produce reduces pesticide levels but does not completely eliminate them. Eat a variety of foods to decrease exposure to any given pesticide.
   - Select produce that is free of dirt and does not have holes or cuts or other signs of spoilage.
   - Discard the outermost leaves of leafy vegetables such as lettuce and cabbage.
   - Cut your own fruits and vegetables instead of getting them precut. Wash all produce thoroughly before cutting, even melons and avocados. Cutting into potentially contaminated (unwashed) inedible rinds of fruit can contaminate the inside of the fruit. Always use a knife to remove orange peels instead of biting into them. Peel waxed fruits and vegetables, and other produce as necessary (cucumbers, carrots, peaches, apples).
   - Store produce in the refrigerator in clean containers or clean plastic bags (previously used bags that are not kept cold can grow harmful bacteria).
   - For some produce, consider buying certified organic foods. Look for the “USDA Organic” seal. According to data from the Environmental Working Group, a nonprofit consumer activist organization, conventional produce with the most pesticide residue include peaches, apples, sweet bell peppers, celery, nectarines, strawberries, cherries, grapes, lettuce, imported grapes, pears, spinach, and potatoes. Among the least contaminated are onions, avocados, sweet corn, pineapples, mangoes, sweet peas, asparagus, kiwifruit, bananas, cabbage, broccoli, and eggplant (list of foods downloaded from www.foodnews.org).

Try It Lifestyle behavior patterns are difficult to change. The above recommendations can minimize your risk of food contamination and ingestion of pesticide residues. Make a copy of the above recommendations and determine how many of these suggestions you are able to include in daily life over the course of the next 7 days.

Most food is safe to eat, but there is no 100 percent guarantee that all produce is free of contamination.

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Because oxygen is required, a person’s capacity to utilize oxygen is crucial for successful athletic performance in aerobic events. The higher one’s maximal oxygen uptake (VO_{2\text{max}}) (see pages 193–194), the greater is one’s capacity to generate ATP through the aerobic system—and the better is one’s athletic performance in long-distance events. From the previous discussion, it becomes evident that for optimal performance, both recreational and highly competitive athletes make the required nutrients a part of their diet.

### Nutrition for Athletes

During resting conditions, fat supplies about two-thirds of the energy to sustain the body’s vital processes. During exercise, the body uses both glucose (glycogen) and fat in combination to supply the energy demands. The proportion of fat to glucose changes with the intensity of exercise. When a person is exercising below 60 percent of his or her maximal work capacity (VO_{2\text{max}}), fat is used as the primary energy substrate. As the intensity of exercise increases, so does the percentage of glucose utilization—up to 100 percent during maximal work that can be sustained for only two to three minutes.

In general, athletes do not require special supplementation or any other special type of diet. Unless the diet is deficient in basic nutrients, no special secret or magic diet will help people perform better or develop faster as a result of what they eat. As long as they eat a balanced diet—that is, based on a large variety of nutrients from all basic food groups—athletes do not require additional supplements. Even in strength training and body building, protein in excess of 20 percent of total daily caloric intake is not necessary. The recommended daily protein intake ranges from 0.8 gram per kilogram of body weight for sedentary people to 1.5 grams per kilogram for extremely active individuals (Table 3.12).

The main difference between a sensible diet for a sedentary person and a sensible diet for a highly active individual is the total number of calories required daily and the amount of carbohydrate intake needed during prolonged physical activity. People in training consume more calories because of their greater energy expenditure—which is required as a result of intense physical training.

#### Table 3.12 Recommended Daily Protein Intake

<table>
<thead>
<tr>
<th>Activity Level</th>
<th>Intake in Grams per kg (2.2 lb) of Body Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sedentary</td>
<td>0.8</td>
</tr>
<tr>
<td>Lightly active</td>
<td>0.9</td>
</tr>
<tr>
<td>Moderately active</td>
<td>1.1</td>
</tr>
<tr>
<td>Very active</td>
<td>1.3</td>
</tr>
<tr>
<td>Extremely active</td>
<td>1.5</td>
</tr>
</tbody>
</table>

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Carbohydrate Loading

On a regular diet, the body is able to store between 1,500 and 2,000 calories in the form of glycogen. About 75 percent of this glycogen is stored in muscle tissue. This amount, however, can be increased greatly through carbohydrate loading.

A regular diet should be altered during several days of heavy aerobic training or when a person is going to participate in a long-distance event of more than 90 minutes (e.g., marathon, triathlon, road cycling). For events shorter than 90 minutes, carbohydrate loading does not seem to enhance performance.

During prolonged exercise, glycogen is broken down into glucose, which then is readily available to the muscles for energy production. In comparison with fat, glucose frequently is referred to as the “high-octane fuel,” because it provides about 6 percent more energy per unit of oxygen consumed.

Heavy training over several consecutive days leads to depletion of glycogen faster than it can be replaced through the diet. Glycogen depletion with heavy training is common in athletes. Signs of depletion include chronic fatigue, difficulty in maintaining accustomed exercise intensity, and lower performance.

On consecutive days of exhaustive physical training (this means several hours daily), a carbohydrate-rich diet—70 percent of total daily caloric intake or eight grams of carbohydrate per kilogram (2.2 pounds) of body weight—is recommended. This diet often restores glycogen levels in 24 hours. Along with the high-carbohydrate diet, a day of rest often is needed to allow the muscles to recover from glycogen depletion following days of intense training. For people who exercise less than an hour a day, a 60-percent carbohydrate diet, or six grams of carbohydrate per kilogram of body weight, is enough to replenish glycogen stores.

Following an exhaustive workout, eating a combination of carbohydrates and protein (such as a tuna sandwich) within 30 minutes of exercise seems to speed up glycogen storage even more. Protein intake increases insulin activity, thereby enhancing glycogen replenishment. A 70 percent carbohydrate intake then should be maintained throughout the rest of the day.

By following a special diet and exercise regimen five days before a long-distance event, highly (aerobically) trained individuals are capable of storing two to three times the amount of glycogen found in the average person. Athletic performance may be enhanced for long-distance events of more than 90 minutes by eating a regular balanced diet (50 to 60 percent carbohydrates), along with intensive physical training on the fifth and fourth days before the event, followed by a diet high in carbohydrates (about 70 percent) and a gradual decrease in training intensity over the last three days before the event.

The amount of glycogen stored as a result of a carbohydrate-rich diet does not seem to be affected by the proportion of complex and simple carbohydrates. The intake of simple carbohydrates (sugars) can be raised while on a 70-percent carbohydrate diet, as long as it doesn’t exceed 25 percent of the total calories. Complex carbohydrates provide more nutrients and fiber, making them a better choice for a healthier diet.

On the day of the long-distance event, carbohydrates are still the recommended choice of substrate. As a general rule, athletes should consume one gram of carbohydrate for each kilogram (2.2 pounds) of body weight one hour prior to exercise (i.e., if you weigh 160 pounds, you should consume 160 + 2.2 = 72 grams). If the pre-event meal is eaten earlier, the amount of carbohydrate can be increased to two, three, or four grams per kilogram of weight two, three, or four hours, respectively, before exercise.

During the long-distance event, researchers recommend that the athlete consume 30 to 60 grams of carbohydrates (120 to 240 calories) every hour. This is best accomplished by drinking 8 ounces of a 6- to 8-percent carbohydrate sports drink every 15 minutes (check labels to ensure proper carbohydrate concentration). This

Key Terms

Lactic acid End product of anaerobic glycolysis (metabolism).

Carbohydrate loading Increasing intake of carbohydrates during heavy aerobic training or prior to aerobic endurance events that last longer than 90 minutes.
also lessens the chance of dehydration during exercise, which hinders performance and endangers health. The percentage of the carbohydrate drink is determined by dividing the amount of carbohydrate (in grams) by the amount of fluid (in milliliters) and then multiplying by 100. For example, 18 grams of carbohydrate in 240 milliliters (8 ounces) of fluid yields a drink that is 7.5 percent \((18 \div 240 \times 100)\) carbohydrate.

**Hyponatremia**

In some cases, athletes participating in long- or ultra-long-distance races may suffer from hyponatremia, or low sodium concentration in the blood. The longer the race, the greater the risk of hyponatremia. This condition occurs as lost sweat, which contains salt and water, is replaced by only water (no salt) during a very long-distance race. Although the athlete is overhydrated, blood sodium is diluted and hyponatremia occurs. Typical symptoms are similar to those of heat illness and include fatigue, weakness, disorientation, muscle cramps, bloating, nausea, dizziness, confusion, slurred speech, fainting, and even seizures and coma in severe cases.

Based on estimates, about 30 percent of the participants in the Hawaii Ironman Triathlon suffer from hyponatremia. The condition, however, is rare in the everyday exerciser. To help prevent hyponatremia, athletes should ingest extra sodium prior to the event and then adequately monitor fluid intake during the race to prevent overhydration. Sports drinks that contain sodium (ingest about one gram of sodium per hour) should be used during the race to replace electrolytes lost in sweat and to prevent blood sodium dilution.

**Creatine Supplementation**

Creatine is an organic compound obtained in the diet primarily from meat and fish. In the human body, creatine combines with inorganic phosphate and forms creatine phosphate (CP), a high-energy compound. CP then is used to resynthesize ATP during short bursts of all-out physical activity. Individuals on a normal mixed diet consume an average of one gram of creatine per day. Each day, one additional gram is synthesized from various amino acids. One pound of meat or fish provides approximately two grams of creatine.

Creatine supplementation is popular among individuals who want to increase muscle mass and improve athletic performance. Creatine monohydrate—a white, tasteless powder that is mixed with fluids prior to ingestion—is the form most popular among people who use the supplement. Supplementation can result in an approximate 20 percent increase in the amount of creatine that is stored in muscles. Most of this creatine binds to phosphate to form CP, and 30 to 40 percent remains as free creatine in the muscle. Increased creatine storage is believed to enable individuals to train more intensely—thereby building more muscle mass and enhancing performance in all-out activities of very short duration (less than 30 seconds).

Creatine supplementation has two phases: the loading phase and the maintenance phase. During the loading phase, the person consumes between 20 and 25 grams (one teaspoonful is about five grams) of creatine per day for five to six days, divided into four or five dosages of five grams each throughout the day (this amount represents the equivalent of consuming 10 or more pounds of meat per day). Research also suggests that the amount of creatine stored in muscle is enhanced by taking creatine in combination with a high-carbohydrate food. Once the loading phase is complete, taking two grams per day seems to be sufficient to maintain the increased muscle stores.

To date, no serious side effects have been documented in people who take up to 25 grams of creatine per day for five days. Stomach distress and cramping have been reported only in rare instances. The two grams taken per day during the maintenance phase is just slightly above the average intake in our daily diet. Long-term effects of creatine supplementation on health, however, have not been established.

A frequently documented result following five to six days of creatine loading is an increase of two to three pounds in body weight. This increase appears to be related to the increased water retention necessary to maintain the additional creatine stored in muscles. Some data, however, suggest that the increase in stored water and CP stimulates protein synthesis, leading to an increase in lean body mass.

The benefits of elevated creatine stores may be limited to high-intensity/short-duration activities such as sprinting, strength training (weight lifting), and sprint cycling. Supplementation is most beneficial during exercise training itself, rather than as an aid to enhance athletic performance a few days before competition.

Enhanced creatine stores do not benefit athletes competing in aerobic endurance events, because CP is not used in energy production for long-distance events. Actually, the additional weight can be detrimental in long-distance running and swimming events, because the athlete must expend more energy to carry the extra weight during competition.

**Bone Health and Osteoporosis**

Osteoporosis, literally meaning “porous bones,” is a condition in which bones lack the minerals required to keep them strong. In osteoporosis, bones—primarily of the hip, wrist, and spine—become so weak and brittle that they fracture readily. The process begins slowly in the third and fourth decades of life. Women are espe-
cially susceptible after menopause because of the accompanying loss of estrogen, which increases the rate at which bone mass is broken down.

According to the National Osteoporosis Foundation, 10 million Americans (8 million women and 2 million men) already have the disease and another 34 million have low bone density, placing them at increased risk for osteoporosis and bone fractures. About 30 percent of postmenopausal women have osteoporosis, but only about 2 percent are actually diagnosed and treated for this condition.

Osteoporosis is the leading cause of serious morbidity and functional loss in the elderly population. One of every two women and one in eight men over age 50 will have an osteoporotic-related fracture at some point in their lives. The chances of a postmenopausal woman developing osteoporosis are much greater than her chances of developing breast cancer or incurring a heart attack or stroke. Up to 20 percent of people who have a hip fracture die within a year because of complications related to the fracture. As alarming as these figures are, they do not convey the pain and loss of quality of life in people who suffer the crippling effects of osteoporotic fractures.

Although osteoporosis is viewed primarily as a woman’s disease, more than 30 percent of all men will be affected by age 75. About 100,000 of the yearly 300,000 hip fractures in the United States occur in men.

Despite the strong genetic component, osteoporosis is preventable. Maximizing bone density at a young age and subsequently decreasing the rate of bone loss later in life are critical factors in preventing osteoporosis.

Normal hormone levels prior to menopause and adequate calcium intake and physical activity throughout life cannot be overemphasized. These factors are all crucial in preventing osteoporosis. The absence of any one of these three factors leads to bone loss for which the other two factors never completely compensate. Smoking and excessive use of alcohol and corticosteroid drugs also accelerate the rate of bone loss in women and men alike. And osteoporosis is more common in whites, Asians, and people with small frames. Figure 3.13 depicts these variables.

Bone health begins at a young age. Some experts have called osteoporosis a “pediatric disease.” Bone density can be promoted early in life by making sure the diet has sufficient calcium and participating in weight-bearing activities. Adequate calcium intake in women and men alike is also associated with a reduced risk for colon cancer. The RDA for calcium is between 1,000 and 1,300 mg per day, but leading researchers in this area recommend higher intakes (see Table 3.13). Although the recommended daily intakes can be met easily through diet alone, some experts recommend calcium supplements even for children before puberty.

**Key Terms**

- **Hyponatremia** A low sodium concentration in the blood caused by overhydration with water.
- **Electrolytes** Substances that become ions in solution and are critical for proper muscle and neuron activation (include sodium, potassium, chloride, calcium, magnesium, phosphate, and bicarbonate among others).
- **Creatine** An organic compound derived from meat, fish, and amino acids that combines with inorganic phosphate to form creatine phosphate.
- **Creatine phosphate (CP)** A high-energy compound that the cells use to resynthesize ATP during all-out activities of very short duration.
- **Osteoporosis** A condition of softening, deterioration, or loss of bone mineral density that leads to disability, bone fractures, and even death from medical complications.
- **Estrogen** Female sex hormone essential for bone formation and conservation of bone density.
To obtain your daily calcium requirement, get as much calcium as possible from calcium-rich foods, including calcium-fortified foods. If you don’t get enough (most people don’t), take calcium supplements.

Supplemental calcium can be obtained in the form of calcium citrate and calcium carbonate. Calcium citrate seems to be equally well absorbed with or without food, whereas calcium carbonate is not well absorbed without food. Thus, if your supplement contains calcium carbonate, always take the supplement with meals. Do not take it with a meal or in conjunction with an iron-containing multi-vitamin. Because calcium interferes with iron absorption, the intake of these two minerals should be separated. The benefit of taking a calcium supplement without food (calcium citrate) is that, for instance, in a young menstruating woman who needs iron, calcium won’t interfere with the absorption of iron.

Table 3.14 provides a list of selected foods and their calcium content. Along with having an adequate calcium intake, taking a minimum of 400 to 800 IU of vitamin D daily is recommended for optimal calcium absorption (for overall health benefits, 1,000 to 2,000 IU of vitamin D is preferable). People over age 50 may require 800 to 1,000 IU of calcium daily. Close to half of people over age 50 are also vitamin D deficient. Without vitamin D, it is practically impossible for the body to absorb sufficient calcium to protect the bones.

Protein is also necessary for the continuous rebuilding of bones. Excessive protein, however, is detrimental to bone health because it makes the blood more acidic. To neutralize the acid, calcium is taken from the bones and released into the bloodstream. The more protein we eat, the higher the calcium content in the urine (i.e., the more calcium excreted). This might be the reason that countries with a high protein intake, including the United States, also have the highest rates of osteoporosis. Nonetheless, because people who consume too little protein (less than 35 grams per day) lose more bone mass than those who eat too much (more than 100 grams per day). The RDA for protein is about 50 grams per day for adults.

Vitamin B₁₂ may also be a key nutrient in the prevention of osteoporosis. Several reports have shown an association between low vitamin B₁₂ and lower bone mineral density in both men and women. Vitamin B₁₂ is found primarily in dairy products, meats, poultry, fish, and some fortified cereals. Other nutrients vital for bone health are potassium (also neutralizes acid), vitamin K (works with bone-building proteins), and magnesium (also keep bone from becoming too brittle).

Soft drinks and alcoholic beverages also can contribute to a loss in bone density if consumed in large quantities. Although they may not cause the damage directly, they often take the place of dairy products in the diet.
Exercise plays a key role in preventing osteoporosis by decreasing the rate of bone loss following the onset of menopause. Active people are able to maintain bone density much more effectively than their inactive counterparts. A combination of weight-bearing exercises, such as walking or jogging and weight training, is especially helpful.

The benefits of exercise go beyond maintaining bone density. Exercise strengthens muscles, ligaments, and tendons—all of which provide support to the bones (skeleton). Exercise also improves balance and coordination, which can help prevent falls and injuries.

People who are active have higher bone mineral density than inactive people do. Similar to other benefits of participating in exercise, there is no such thing as “bone in the bank.” To have good bone health, people need to participate in a regular lifetime exercise program.

Prevailing research also tells us that estrogen is the most important factor in preventing bone loss. Lumbar bone density in women who have always had regular menstrual cycles exceeds that of women with a history of oligomenorrhea and amenorrhea interspersed with regular cycles. Furthermore, the lumbar density of these two groups of women is higher than that of women who have never had regular menstrual cycles.

For instance, athletes with amenorrhea (who have lower estrogen levels) have lower bone mineral density than even nonathletes with normal estrogen levels. Studies have shown that amenorrheic athletes at age 25 have the bones of women older than 50. It has become clear that sedentary women with normal estrogen levels have better bone mineral density than active amenorrheic athletes. Many experts believe that the best predictor of bone mineral content is the history of menstrual regularity.

As a baseline, women age 65 and older should have a bone density test to establish the risk for osteoporosis. Younger women who are at risk for osteoporosis should discuss a bone density test with their physician at menopause. The test also can be used to monitor changes in bone mass over time and to predict the risk of future fractures. The bone density test is a painless scan requiring only a small amount of radiation to determine bone mass of the spine, hip, wrist, heel, or fingers. The amount of radiation is so low that technicians administering the test can sit next to the person receiving it. The procedure often takes less than 10 minutes.

Following menopause, every woman should consider some type of therapy to prevent bone loss. The various therapy modalities available should be discussed with a physician.

Hormone-Replacement Therapy

For decades, hormone-replacement therapy (HRT) was the most common treatment modality to prevent bone loss following menopause. A large study (16,000 healthy women, ages 50 to 79) was terminated three years early because the results showed that taking estrogen and progesterin, a common form of HRT, actually increased the risk for disease. The study was the first major long-term (8 years) clinical trial investigating the association between HRT and age-related diseases, including cardiovascular disease, cancer, and osteoporosis. Although the risk for hip fractures and colorectal cancer decreased, the risk for developing breast cancer, blood clots, strokes, and heart attacks increased.

HRT may still be the most effective treatment to relieve acute (short-term) symptoms of menopause, such as hot flashes, mood swings, sleep difficulties, and vaginal dryness. For women entering menopause, especially the 25 percent who struggle with severe hot flashes, insomnia, or lack of energy, low-dose aspirin in conjunction with custom-tailored doses of bioidentical hormones (hormones just like those made by your body) substantially cut the abovementioned risks. Researchers and physicians, however, now must determine how long women can remain on HRT, how to best taper off treatment to provide maximal physical and emotional relief, and how to protect women from osteoporosis and other age-related diseases.

Alternative treatments to prevent bone loss are being developed. Miacalcin, a synthetic form of the hormone calcitonin, is FDA approved for women who have osteoporosis and are at least five years postmenopausal. Calcitonin is a thyroid hormone that helps maintain the body’s delicate balance of calcium by taking calcium from the blood and depositing it in the bones. Although it is effective in preventing bone loss, it does not help much in rebuilding bone. The drug seems to have no side effects and is available in injectable and nasal spray forms.

Two promising nonhormonal drugs, alendronate (Fosamax) and risedronate (Actonel), prevent bone loss and, furthermore, actually help increase bone mass. Alendronate (recommended for women who already have osteoporosis) is used primarily for bone health and does not provide benefits to the cardiovascular system. Although the research is limited, this drug seems to be safe and effective.

Selective estrogen receptor modulators (SERMs) also are used to prevent bone loss. These compounds have a positive effect on blood lipids and pose no risk to breast and uterine tissue. Data indicate that SERMs contribute a 1 to 2 percent increase in bone density over a period of four years but are less effective against osteoporosis than alendronate and risedronate. One SERM used currently to prevent osteoporosis is raloxifene (Evista).

Key Terms

Oligomenorrhea Irregular menstrual cycles.
Amenorrhea Cessation of regular menstrual flow.
Iron Deficiency

Iron is a key element of hemoglobin in blood. The RDA for iron for adult women is between 15 and 18 mg per day (8 to 11 mg for men). Inadequate iron intake is often seen in children, teenagers, women of childbearing age, and endurance athletes. If iron absorption does not compensate for losses or if dietary intake is low, iron deficiency develops. As many as half of American women have an iron deficiency. Over time, excessive depletion of iron stores in the body leads to iron-deficiency anemia, a condition in which the concentration of hemoglobin in the red blood cells is lower than it should be.

Physically active individuals, in particular women, have a greater than average need for iron. Heavy training creates a demand for iron that is higher than the recommended intake because small amounts of iron are lost through sweat, urine, and stools. Mechanical trauma, caused by the pounding of the feet on the pavement during extensive jogging, may also lead to destruction of iron-containing red blood cells.

A large percentage of female endurance athletes are reported to have iron deficiency. The blood ferritin levels of women who participate in intense physical training should be checked frequently.

The 2010 Dietary Guidelines for Americans

The secretaries of the Department of Health and Human Services (DHHS) and the USDA appoint an expert Dietary Guidelines advisory committee every five years to issue a report and make recommendations concerning dietary guidelines for Americans. The guidelines should be used as a goal to help people achieve a healthier life.

The 2010 Dietary Guidelines for Americans are intended for healthy people two years and older. Due to the dramatic increase in obesity, eating and physical activity patterns that are focused on consuming fewer calories, making informed food choices, and being physically active are emphasized to help people attain and maintain a healthy weight, reduce their risk of

Table 3.15  Iron-Rich Foods

<table>
<thead>
<tr>
<th>Food</th>
<th>Amount</th>
<th>Iron (mg)</th>
<th>Calories</th>
<th>% Calories From Fat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beans, red kidney, cooked</td>
<td>1 cup</td>
<td>3.2</td>
<td>218</td>
<td>4</td>
</tr>
<tr>
<td>Beef, ground lean (21% fat)</td>
<td>3 oz</td>
<td>2.1</td>
<td>237</td>
<td>57</td>
</tr>
<tr>
<td>Beef, sirloin, lean only</td>
<td>3 oz</td>
<td>2.9</td>
<td>171</td>
<td>36</td>
</tr>
<tr>
<td>Beef, liver, fried</td>
<td>3 oz</td>
<td>5.3</td>
<td>184</td>
<td>33</td>
</tr>
<tr>
<td>Beet, greens, cooked</td>
<td>½ cup</td>
<td>1.4</td>
<td>19</td>
<td>—</td>
</tr>
<tr>
<td>Broccoli, cooked, drained</td>
<td>1 cup</td>
<td>1.3</td>
<td>44</td>
<td>—</td>
</tr>
<tr>
<td>Burrito, bean (no cheese)</td>
<td>1</td>
<td>2.3</td>
<td>225</td>
<td>28</td>
</tr>
<tr>
<td>Egg, hard-cooked</td>
<td>1</td>
<td>.7</td>
<td>77</td>
<td>58</td>
</tr>
<tr>
<td>Farina (Cream of Wheat), cooked</td>
<td>½ cup</td>
<td>5.2</td>
<td>65</td>
<td>—</td>
</tr>
<tr>
<td>Instant Breakfast, nonfat milk</td>
<td>1 cup</td>
<td>4.8</td>
<td>216</td>
<td>4</td>
</tr>
<tr>
<td>Peas, frozen, cooked, drained</td>
<td>½ cup</td>
<td>1.3</td>
<td>62</td>
<td>—</td>
</tr>
<tr>
<td>Shrimp, boiled</td>
<td>3 oz</td>
<td>2.7</td>
<td>87</td>
<td>10</td>
</tr>
<tr>
<td>Spinach, raw</td>
<td>1 cup</td>
<td>1.5</td>
<td>12</td>
<td>—</td>
</tr>
<tr>
<td>Vegetables, mixed, cooked</td>
<td>1 cup</td>
<td>1.5</td>
<td>108</td>
<td>—</td>
</tr>
</tbody>
</table>

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chronic disease, and promote overall health. The improved recommendations give individuals the necessary information to make thoughtful choices of healthier foods in the right portions and to complement those choices with physical activity. Two key concepts are emphasized in the 2010 guidelines:

- Balance calories with physical activity to sustain a healthy weight.
- Focus on consuming nutrient-dense foods and beverages. This includes a greater consumption of certain foods and nutrients such as fruits, vegetables, whole grains, fat-free and low-fat dairy products, and seafood; and decreased consumption of foods with sodium (salt), saturated fats, trans fats, cholesterol, added sugars, and refined grains.

The 2010 dietary guidelines include 20 key recommendations for the general population and nine additional key recommendations for specific population groups. The recommendations are intended to help people choose an overall healthy diet.

**Balancing Calories to Manage Weight**

1. Prevent and/or reduce overweight and obesity through improved eating and physical activity behaviors.
2. Control total calorie intake to manage body weight. For people who are overweight or obese, this will mean consuming fewer calories from foods and beverages.
3. Increase physical activity and reduce time spent in sedentary behaviors.
4. Maintain appropriate calorie balance during each stage of life—childhood, adolescence, adulthood, pregnancy and breastfeeding, and older age.
5. Reduce daily sodium intake to less than 2,300 milligrams (mg) and further reduce intake to 1,500 mg among persons who are 51 and older and those of any age who are African American or have hypertension, diabetes, or chronic kidney disease. The 1,500 mg recommendation applies to about half of the U.S. population, including children, and the majority of adults.
6. Consume less than 10 percent of calories from saturated fatty acids by replacing them with monounsaturated and polyunsaturated fatty acids.
7. Consume less than 300 mg per day of dietary cholesterol.
8. Keep trans fatty acid consumption as low as possible by limiting foods that contain synthetic sources of trans fats, such as partially hydrogenated oils, and by limiting other solid fats.
9. Reduce the intake of calories from solid fats and added sugars.
10. Limit the consumption of foods that contain refined grains, especially refined grain foods that contain solid fats, added sugars, and sodium.
11. If alcohol is consumed, it should be consumed in moderation—up to one drink per day for women and two drinks per day for men—and only by adults of legal drinking age.

**Foods and Nutrients to Increase**

Individuals should meet the following recommendations as part of a healthy eating pattern while staying within their calorie needs.

12. Increase vegetable and fruit intake.
13. Eat a variety of vegetables, especially dark-green and red and orange vegetables and beans and peas.
14. Consume at least half of all grains as whole grains. Increase whole-grain intake by replacing refined grains with whole grains.
15. Increase intake of fat-free or low-fat milk and milk products, such as milk, yogurt, cheese, or fortified soy beverages.
16. Choose a variety of protein foods, which include seafood, lean meat and poultry, eggs, beans and peas, soy products, and unsalted nuts and seeds.
17. Increase the amount and variety of seafood consumed by choosing seafood in place of some meat and poultry.
18. Replace protein foods that are higher in solid fats with choices that are lower in solid fats and calories and/or are sources of oils.
19. Use oils to replace solid fats where possible.
20. Choose foods that provide more potassium, dietary fiber, calcium, and vitamin D, which are nutrients of concern in American diets. These foods include vegetables, fruits, whole grains, and milk and milk products.

**Recommendations for Specific Population Groups**

Women Capable of Becoming Pregnant

1. Choose foods that supply heme iron, which is more readily absorbed by the body, additional iron sources, and enhancers of iron absorption such as vitamin C-rich foods.

**Key Terms**

- **Hemoglobin**: Protein–iron compound in red blood cells that transports oxygen in the blood.
- **Ferritin**: Iron stored in the body.
2. Consume 400 micrograms (mcg) per day of synthetic folic acid (from fortified foods and/or supplements) in addition to food forms of folate from a varied diet.

Pregnant or Breastfeeding Women
1. Consume 8 to 12 ounces of seafood per week from a variety of seafood types.
2. Due to their high methyl mercury content, limit white (albacore) tuna to six ounces per week and do not eat the following four types of fish: tilefish, shark, swordfish, and king mackerel.
3. If pregnant, take an iron supplement, as recommended by an obstetrician or other health care provider.

For Individuals 50 Years and Older
1. Consume foods fortified with vitamin B₁₂, such as fortified cereals, or dietary supplements.

Building Healthy Eating Patterns
1. Select an eating pattern that meets nutrient needs over time at an appropriate calorie level.
2. Account for all foods and beverages consumed and assess how they fit within a total healthy eating pattern.
3. Follow food safety recommendations when preparing and eating foods to reduce the risk of food-borne illnesses.

Additional information on these guidelines is posted at www.DietaryGuidelines.gov/.

Proper Nutrition: A Lifetime Prescription for Healthy Living

The three factors that do the most for health, longevity, and quality of life are proper nutrition, a sound exercise program, and quitting (or never starting) smoking. Achieving and maintaining a balanced diet is not as difficult as most people think. If everyone were more educated about their own nutrition habits and the nutrition habits of their children, the current magnitude of nutrition-related health problems would be much smaller. Although treatment of obesity is important, we should place far greater emphasis on preventing obesity in youth and adults in the first place.

Children tend to eat the way their parents do. If parents adopt a healthy diet, children most likely will follow. The difficult part for most people is to retrain themselves—to closely examine the eating habits they learned from their parents—to follow a lifetime healthy nutrition plan that includes lots of grains, legumes, fruits, vegetables, and low-fat dairy products, with moderate use of animal protein, junk food, sodium, and alcohol.

Critical Thinking

What factors in your life and the environment have contributed to your current dietary habits? • Do you need to make changes? • What may prevent you from doing so?

In spite of the ample scientific evidence linking poor dietary habits to early disease and mortality rates, many people remain precontemplators: They are not willing to change their eating patterns. Even when faced with obesity, elevated blood lipids, hypertension, and other nutrition-related conditions, people do not change. The motivating factor to change one’s eating habits seems to be a major health breakdown, such as a heart attack, a stroke, or cancer—by which time the damage has been done already. In many cases it is irreversible and, for some, fatal.

An ounce of prevention is worth a pound of cure. The sooner you implement the dietary guidelines presented in this chapter, the better your chances of preventing chronic diseases and reaching a higher state of wellness.
Assess Your Behavior

Log on to www.cengagebrain.com to access CengageNOW and the Behavior Change Planner where you can assess your eating habits and create a plan for healthier eating.

1. Are whole grains, fruits, and vegetables the staples of your diet?
2. Are you meeting your personal MyPlate recommendations for daily fruits, vegetables, grains, protein, and dairy?
3. Will the information presented in this chapter change in any manner the way you eat?
4. Are there dietary changes that you need to implement to meet energy, nutrition, and disease risk-reduction guidelines and improve health and wellness? If so, list these changes and indicate what you will do to make it happen.

Assess Your Knowledge

Evaluate how well you understand the concepts presented in this chapter using the chapter-specific quizzing available in the online materials at www.cengagebrain.com.

1. The science of nutrition studies the relationship of
   a. vitamins and minerals to health.
   b. foods to optimal health and performance.
   c. carbohydrates, fats, and proteins to the development and maintenance of good health.
   d. the macronutrients and micronutrients to physical performance.
   e. kilocalories to calories in food items.

2. Faulty nutrition often plays a crucial role in the development and progression of which disease?
   a. cardiovascular disease
   b. cancer
   c. osteoporosis
   d. diabetes
   e. All are correct choices.

3. According to MyPlate, daily vegetable consumption is measured in
   a. servings.
   b. ounces.
   c. cups.
   d. calories.
   e. all of the above.

4. The recommended amount of fiber intake for adults 50 years and younger is
   a. 10 grams per day for women and 12 grams for men.
   b. 21 grams per day for women and 30 grams for men.
   c. 28 grams per day for women and 35 grams for men.
   d. 25 grams per day for women and 38 grams for men.
   e. 45 grams per day for women and 50 grams for men.

5. Unhealthy fats include
   a. unsaturated fatty acids.
   b. monounsaturated fats.
   c. polyunsaturated fatty acids.
   d. saturated fats.
   e. all of the above.

6. The daily recommended carbohydrate intake is:
   a. 45 to 65 percent of the total calories.
   b. 10 to 35 percent of the total calories.
   c. 20 to 35 percent of the total calories.
   d. 60 to 75 percent of the total calories.
   e. 35 to 50 percent of the total calories.

7. The amount of a nutrient that is estimated to meet the nutrient requirement of half the healthy people in specific age and gender groups is known as the
   a. estimated average requirement.
   b. recommended dietary allowance.
   c. daily values.
   d. adequate intake.
   e. dietary reference intake.

8. The percent fat intake for an individual who on a given day consumes 2,385 calories with 106 grams of fat is
   a. 44 percent of total calories.
   b. 17.7 percent of total calories.
   c. 40 percent of total calories.
   d. 31 percent of total calories.
   e. 22.5 percent of total calories.

9. Carbohydrate loading is beneficial for
   a. endurance athletes.
   b. people with diabetes.
   c. strength athletes.
   d. sprinters.
   e. All of the above are correct.

10. Osteoporosis is
    a. a crippling disease.
    b. more prevalent in women.
    c. more prevalent in people who were calcium deficient at a young age.
    d. linked to heavy drinking and smoking.
    e. All are correct choices.

Correct answers can be found at the back of the book.
Chapter 3

Notes

3. “Saturated Fat: Not Quite so Bad After All?,” University of California at Berkeley Wellness Letter (June 2010).
7. See note 2.
Answer Key

This page contains answers for this chapter only

Chapter 3
1. b 2. e 3. c 4. d 5. d 6. a 7. a 8. c 9. a 10. e
Percent fat calories = (grams of fat × 9) – calories per serving × 100
5 grams of fat × 9 calories per grams of fat = 45 calories from fat
45 calories from fat = 120 calories per serving ×

### Nutrition Facts

- **Serving Size**: 1 cup (240 ml)
- **Servings Per Container**: 4

<table>
<thead>
<tr>
<th>Amount Per Serving</th>
<th>Calories</th>
<th>Calories from Fat</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Fat</strong></td>
<td>5g</td>
<td>8%</td>
</tr>
<tr>
<td>Saturated Fat</td>
<td>3g</td>
<td>15%</td>
</tr>
<tr>
<td>Trans Fat</td>
<td>0g</td>
<td>0%</td>
</tr>
<tr>
<td><strong>Cholesterol</strong></td>
<td>20mg</td>
<td>7%</td>
</tr>
<tr>
<td><strong>Sodium</strong></td>
<td>120mg</td>
<td>5%</td>
</tr>
<tr>
<td><strong>Total Carbohydrate</strong></td>
<td>12g</td>
<td>4%</td>
</tr>
<tr>
<td>Dietary Fiber</td>
<td>0g</td>
<td>0%</td>
</tr>
<tr>
<td>Sugars</td>
<td>12g</td>
<td>0%</td>
</tr>
<tr>
<td><strong>Protein</strong></td>
<td>8g</td>
<td>0%</td>
</tr>
</tbody>
</table>

### Percentage Daily Values

- **Vitamin A**: 10% • **Vitamin C**: 4%
- **Calcium**: 30% • **Iron**: 0%

**Percent Daily Values** are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs.

Calories: 2,000 | 2,500
---|---
Total Fat: Less than 65g | Less than 78g
Saturated Fat: Less than 20g | Less than 24g
Cholesterol: Less than 300mg | Less than 300mg
Sodium: Less than 2,300mg | Less than 2,500mg
Total Carbohydrate: Less than 300g | Less than 375g
Dietary Fiber: 25g | 30g

**Calories per gram**
- Fat: 9
- Carbohydrate: 4
- Protein: 4

This page contains studycards for this chapter only.
### Caloric and Fat Content of Selected Fast Foods

<table>
<thead>
<tr>
<th>Burgers</th>
<th>Calories</th>
<th>Total Fat (grams)</th>
<th>Saturated Fat (grams)</th>
<th>Percent Fat Calories</th>
</tr>
</thead>
<tbody>
<tr>
<td>McDonald’s Big Mac</td>
<td>590</td>
<td>34</td>
<td>11</td>
<td>52</td>
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<tr>
<td>McDonald’s Big N’Tasty with Cheese</td>
<td>590</td>
<td>37</td>
<td>12</td>
<td>56</td>
</tr>
<tr>
<td>McDonald’s Quarter Pounder with Cheese</td>
<td>530</td>
<td>30</td>
<td>13</td>
<td>51</td>
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<tr>
<td>Burger King Whopper</td>
<td>760</td>
<td>46</td>
<td>15</td>
<td>54</td>
</tr>
<tr>
<td>Burger King Bacon</td>
<td>580</td>
<td>34</td>
<td>18</td>
<td>53</td>
</tr>
<tr>
<td>Double Cheeseburger</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Burger King BK Smokehouse</td>
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<td>19</td>
<td>60</td>
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<tr>
<td>Cheddar Griller</td>
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<td></td>
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<tr>
<td>Burger King Whopper with Cheese</td>
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<td>22</td>
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<tr>
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<tr>
<td>Burger King Double Whopper with Cheese</td>
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<td>33</td>
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<tr>
<td>Wendy’s Baconator</td>
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<td>51</td>
<td>22</td>
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<table>
<thead>
<tr>
<th>Mexican</th>
<th>Calories</th>
<th>Total Fat (grams)</th>
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<tbody>
<tr>
<td>Taco Bell Crunchy Taco</td>
<td>170</td>
<td>10</td>
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<tr>
<td>Taco Bell Taco Supreme</td>
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<td>14</td>
<td>6</td>
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<tr>
<td>Taco Bell Soft Chicken Taco</td>
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<td>7</td>
<td>3</td>
<td>33</td>
</tr>
<tr>
<td>Taco Bell Bean Burrito</td>
<td>370</td>
<td>12</td>
<td>4</td>
<td>29</td>
</tr>
<tr>
<td>Taco Bell Fiesta Steak Burrito</td>
<td>370</td>
<td>12</td>
<td>4</td>
<td>29</td>
</tr>
<tr>
<td>Taco Bell Grilled Steak Soft Taco</td>
<td>290</td>
<td>17</td>
<td>4</td>
<td>53</td>
</tr>
<tr>
<td>Taco Bell Double Decker Taco</td>
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### Mexican

<table>
<thead>
<tr>
<th>Caloric and Fat Content of Selected Fast Foods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calories</td>
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<tr>
<td>170</td>
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### French Fries

<table>
<thead>
<tr>
<th>Fried Foods</th>
<th>Calories</th>
<th>Total Fat (grams)</th>
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<tbody>
<tr>
<td>Wendy’s, biggie (5½ oz)</td>
<td>440</td>
<td>19</td>
<td>7</td>
<td>39</td>
</tr>
<tr>
<td>McDonald’s, large (6 oz)</td>
<td>540</td>
<td>26</td>
<td>9</td>
<td>43</td>
</tr>
<tr>
<td>Burger King, large (5½ oz)</td>
<td>500</td>
<td>25</td>
<td>13</td>
<td>45</td>
</tr>
</tbody>
</table>

### Selecting Nutritious Foods

Do you regularly follow the habits below?

**To select nutritious foods:**

1. Given the choice between whole foods and refined, processed foods, choose the former (apples rather than apple pie, potatoes rather than potato chips). No nutrients have been refined out of the whole foods, and they contain less fat, salt, and sugar.

2. Choose the leaner cuts of meat. Select fish or poultry often, beef seldom. Ask for broiled, not fried, to control your fat intake.

3. Use both raw and cooked vegetables and fruits. Raw foods offer more fiber and vitamins, such as folate and thiamin, that are destroyed by cooking. Cooking foods frees other vitamins and minerals for absorption.

4. Include milk, milk products, or other calcium sources for the calcium you need. Use low-fat or non-fat items to reduce fat and calories.

5. Learn to use margarine, butter, and oils sparingly. A little gives flavor, a lot overloads you with fat and calories, and increases disease risk.

---

The following “super” foods that fight disease and promote health should be included often in your diet. Are you eating these foods regularly?

- Acai berries
- Avocados
- Bananas
- Barley
- Beans
- Beets
- Blueberries
- Broccoli
- Butternut squash
- Carrots
- Flaxseeds
- Goji berries
- Grapes
- Kale
- Kiwifruit
- Lentils
- Nuts (Brazil, walnuts)
- Oats and oatmeal
- Olives and olive oil
- Onions
- Oranges
- Peppers
- Pomegranates
- Salmon (wild)
- Soy
- Strawberries
- Spinach
- Sweet potatoes
- Tea (green, black, red)
- Tomatoes
- Yogurt
### Caloric and Fat Content of Selected Fast Foods

<table>
<thead>
<tr>
<th>Sandwiches</th>
<th>Calories</th>
<th>Total Fat (grams)</th>
<th>Saturated Fat (grams)</th>
<th>Percent Fat Calories</th>
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<tbody>
<tr>
<td>Arby’s Regular Roast Beef</td>
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<td>16</td>
<td>6</td>
<td>41</td>
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<tr>
<td>Arby’s Super Roast Beef</td>
<td>470</td>
<td>23</td>
<td>7</td>
<td>44</td>
</tr>
<tr>
<td>Arby’s Roast Chicken Club</td>
<td>520</td>
<td>28</td>
<td>7</td>
<td>48</td>
</tr>
<tr>
<td>Arby’s Market Fresh Roast Beef &amp; Swiss</td>
<td>810</td>
<td>42</td>
<td>13</td>
<td>47</td>
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<tr>
<td>McDonald’s Crispy Chicken</td>
<td>430</td>
<td>21</td>
<td>8</td>
<td>43</td>
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<tr>
<td>McDonald’s Filet-O-Fish</td>
<td>470</td>
<td>26</td>
<td>5</td>
<td>50</td>
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<tr>
<td>McDonald’s Chicken</td>
<td>400</td>
<td>17</td>
<td>3</td>
<td>38</td>
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<tr>
<td>Wendy’s Chicken Club</td>
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<td>4</td>
<td>36</td>
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<td>Wendy’s Breast Fillet</td>
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<td>16</td>
<td>3</td>
<td>34</td>
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<tr>
<td>Wendy’s Grilled Chicken</td>
<td>300</td>
<td>7</td>
<td>2</td>
<td>21</td>
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<tr>
<td>Burger King Specialty Chicken</td>
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<td>6</td>
<td>45</td>
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<tr>
<td>Subway Veggie Delight*</td>
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<td>12</td>
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<tr>
<td>Subway Turkey Breast</td>
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<td>2</td>
<td>16</td>
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<tr>
<td>Subway Sweet Onion</td>
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<td>5</td>
<td>2</td>
<td>12</td>
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<tr>
<td>Chicken Teriyaki</td>
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<tr>
<td>Subway Steak &amp; Cheese</td>
<td>390</td>
<td>14</td>
<td>5</td>
<td>32</td>
</tr>
<tr>
<td>Subway Cold Cut Trio</td>
<td>440</td>
<td>21</td>
<td>7</td>
<td>43</td>
</tr>
<tr>
<td>Subway Tuna</td>
<td>450</td>
<td>22</td>
<td>6</td>
<td>44</td>
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</table>

<table>
<thead>
<tr>
<th>Shakes</th>
<th>Calories</th>
<th>Total Fat (grams)</th>
<th>Saturated Fat (grams)</th>
<th>Percent Fat Calories</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wendy’s Frosty, medium</td>
<td>440</td>
<td>11</td>
<td>7</td>
<td>23</td>
</tr>
<tr>
<td>McDonald’s McFlurry, small</td>
<td>610</td>
<td>22</td>
<td>14</td>
<td>32</td>
</tr>
<tr>
<td>Burger King, Old</td>
<td>760</td>
<td>41</td>
<td>29</td>
<td>49</td>
</tr>
<tr>
<td>Fashioned Ice Cream Shake, medium (22 oz)</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Hash Browns</th>
<th>Calories</th>
<th>Total Fat (grams)</th>
<th>Saturated Fat (grams)</th>
<th>Percent Fat Calories</th>
</tr>
</thead>
<tbody>
<tr>
<td>McDonald’s Hash Browns (2 oz)</td>
<td>130</td>
<td>8</td>
<td>4</td>
<td>55</td>
</tr>
<tr>
<td>Burger King, Hash Browns, small (2½ oz)</td>
<td>230</td>
<td>15</td>
<td>9</td>
<td>59</td>
</tr>
</tbody>
</table>

*6-inch sandwich with no mayo

**Source:** Adapted from Restaurant Confidential by Michael F. Jacobson and Jayne Hurley (Workman, 2002), by permission of Center for Science in the Public Interest.

### Check Yourself

#### Guidelines for a Healthy Diet

- Base your diet on a large variety of foods.
- Consume ample amounts of green, yellow, and orange fruits and vegetables.
- Eat foods high in complex carbohydrates, including at least three 1-ounce servings of whole-grain foods per day.
- Obtain most of your vitamins and minerals from food sources.
- Eat foods rich in vitamin D.
- Maintain adequate daily calcium intake and consider a bone supplement with vitamin D3.
- Consume protein in moderation.
- Limit meat consumption to 3 to 6 ounces per day.
- Limit daily fat, trans fat, and saturated fat intake.
- Limit cholesterol consumption to less than 300 mg per day.
- Limit sodium intake to 2,300 mg per day.
- Limit sugar intake.
- If you drink alcohol, do so in moderation (one daily drink for women and two for men).
- Consider taking a daily multivitamin (preferably one that includes vitamin D3).

#### Selecting Nutritious Foods

- 6. Vary your choices. Eat broccoli today, carrots tomorrow, and corn the next day. Eat Chinese today, Italian tomorrow, and broiled fish with brown rice and steamed vegetables the third day.
- 7. Load your plate with vegetables and unrefined starchy foods. A small portion of meat or cheese is all you need for protein.
- 8. When choosing breads and cereals, choose the whole-grain varieties.

**To select nutritious fast foods:**

- 9. Choose the broiled sandwich with lettuce, tomatoes, and other goodies—and hold the mayo—rather than the fish or chicken patties coated with breadcrumbs and cooked in fat.
- 10. Select a salad—and use more plain vegetables than those mixed with oily or mayonnaise-based dressings.
- 11. Order chili with more beans than meat. Choose a soft bean burrito over tacos with fried shells.

**When choosing from a vending machine:**

- 14. Choose milk and juices over cola beverages.