

12

CHAPTER

Nutrition Basics



LOOKING AHEAD...

After reading this chapter, you should be able to

- List the essential nutrients, and describe the functions they perform in the body
- Describe the guidelines that have been developed to help people choose a healthy diet, avoid nutritional deficiencies, and reduce their risk of diet-related chronic diseases
- Discuss nutritional guidelines for vegetarians and for special population groups
- Explain how to use food labels and other consumer tools to make informed choices about foods
- Put together a personal nutrition plan based on affordable foods that you enjoy and that promote wellness, today as well as in the future

TEST YOUR KNOWLEDGE

1. It is recommended that all adults consume one serving each of fruits and vegetables every day.
True or false?
2. How many french fries are considered to be one half-cup serving?
 - a. 10
 - b. 15
 - c. 25
3. Candy is the leading source of added sugars in the American diet.
True or false?
4. Which of the following is not a whole grain?
 - a. Brown rice
 - b. Wheat flour
 - c. Popcorn
5. Nutritionists advise reduced intake of trans fats for which of the following reasons?
 - a. They increase levels of low-density lipoproteins (LDL), or “bad” cholesterol.
 - b. They provide more calories than other types of fat.
 - c. They increase the risk of heart disease.

ANSWERS

1. **FALSE.** The recommendation for someone consuming 2000 calories daily is 2½ cups of vegetables and 2 cups of fruit.
2. **A.** Many people underestimate the size of the portions they eat, leading them to consume too many calories and too much fat.
3. **FALSE.** Regular (nondiet) sodas are the leading source of sugar and of calories, with an average of 55 gallons consumed per person per year. Each 12-ounce soda supplies about 10 teaspoons of sugar, or nearly 10% of the calories in a 2000-calorie diet.
4. **B.** Unless labeled as whole wheat, wheat flour is processed to remove the bran and the germ and is not a whole grain.
5. **A AND C.** High intake of trans fats raises LDL levels and the risk of heart disease.

In your lifetime, you'll spend about six years eating—about 70,000 meals and 60 tons of food. What you eat can have profound effects on your health and well-being. Your nutritional habits help determine your risk of major chronic diseases, including heart disease, cancer, stroke, and diabetes. Choosing foods that provide the nutrients you need while limiting the substances linked to disease should be an important part of your daily life.

Choosing a healthy diet is a two-part process. First, you have to know which nutrients you need and in what amounts. Second, you have to translate those require-

ments into a diet consisting of foods you like that are both available and affordable and that fit into your lifestyle. Once you know what constitutes a healthy diet for you, you can adjust your current diet to bring it into line with your goals.

This chapter explains the basic principles of **nutrition**. It introduces the six classes of essential nutrients and explains their roles in the functioning of the body. It also provides guidelines that you can use to design a healthy diet plan. Finally, this chapter offers practical tools and advice to help you apply the guidelines to your own life.

Table 12.1

The Six Classes of Essential Nutrients

NUTRIENT	FUNCTION	MAJOR SOURCES
Proteins (4 calories/gram)	Form important parts of muscles, bone, blood, enzymes, some hormones, and cell membranes; repair tissue; regulate water and acid–base balance; help in growth; supply energy	Meat, fish, poultry, eggs, milk products, legumes, nuts
Carbohydrates (4 calories/gram)	Supply energy to cells in brain, nervous system, and blood; supply energy to muscles during exercise	Grains (breads and cereals), fruits, vegetables, milk
Fats (9 calories/gram)	Supply energy; insulate, support, and cushion organs; provide medium for absorption of fat-soluble vitamins	Animal foods, grains, nuts, seeds, fish, vegetables
Vitamins	Promote (initiate or speed up) specific chemical reactions within cells	Abundant in fruits, vegetables, and grains; also found in meat and dairy products
Minerals	Help regulate body functions; aid in growth and maintenance of body tissues; act as catalysts for release of energy	Found in most food groups
Water	Makes up 50–60% of body weight; provides medium for chemical reactions; transports chemicals; regulates temperature; removes waste products	Fruits, vegetables, liquids

NUTRITIONAL REQUIREMENTS: COMPONENTS OF A HEALTHY DIET

You probably think about your diet in terms of the foods you like to eat. More important for your health, though, are the nutrients contained in those foods. Your body requires proteins, fats, carbohydrates, vitamins, minerals, and water—about 45 **essential nutrients**. In this context, the word *essential* means that you must get these substances from food because your body is unable to manufacture them, or at least do so fast enough, to meet your physiological needs. The six classes of nutrients, along with their functions and major sources, are listed in Table 12.1. The body needs some essential nutrients in relatively large amounts; these **macronutrients** include protein, fat, carbohydrate, and water. **Micronutrients**, such as vitamins and minerals, are required in much smaller amounts.

Your body obtains nutrients through the process of **digestion**, in which the foods you eat are broken down into compounds your gastrointestinal tract can absorb and your body can use (Figure 12.1). A diet that provides enough essential nutrients is vital because various nutrients provide energy,

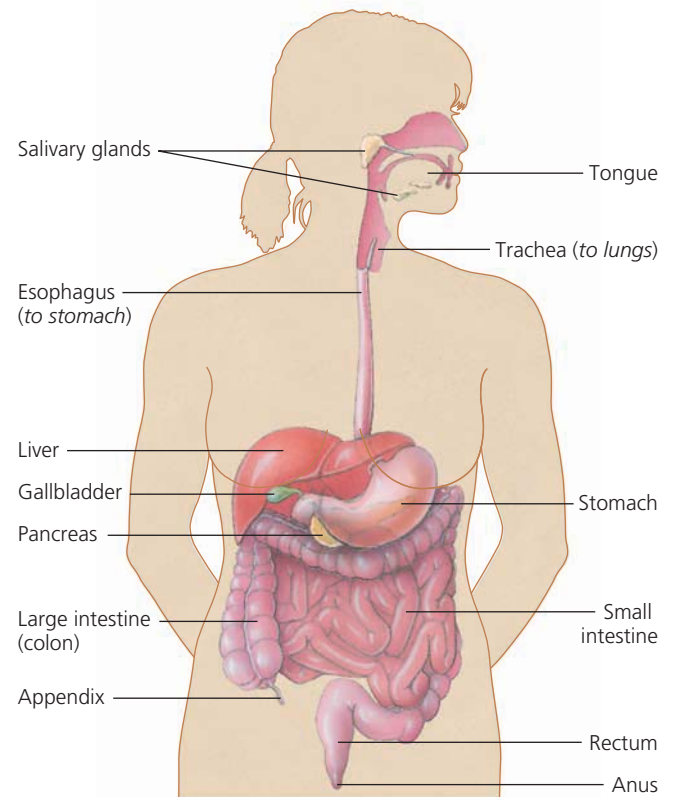


FIGURE 12.1 The digestive system. Food is partially broken down by being chewed and mixed with saliva in the mouth. After traveling to the stomach via the esophagus, food is broken down further by stomach acids and other secretions. As food moves through the digestive tract, it is mixed by muscular contractions and broken down by chemicals. Most absorption of nutrients occurs in the small intestine, aided by secretions from the pancreas, gallbladder, and intestinal lining. The large intestine reabsorbs excess water; the remaining solid wastes are collected in the rectum and excreted through the anus.

nutrition The science of food and how the body uses it in health and disease.

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essential nutrients Substances the body must get from foods because it cannot manufacture them at all or fast enough to meet its needs. These nutrients include proteins, fats, carbohydrates, vitamins, minerals, and water.

macronutrient An essential nutrient required by the body in relatively large amounts.

micronutrient An essential nutrient required by the body in minute amounts.

digestion The process of breaking down foods into compounds the gastrointestinal tract can absorb and the body can use.

help build and maintain body tissues, and help regulate body functions (see the box “Eating Habits and Total Wellness”).

Calories

The energy in foods is expressed as **kilocalories**. One kilocalorie represents the amount of heat required to raise the temperature of 1 liter of water 1°C. A person needs about 2000 kilocalories per day to meet his or her energy needs. In common usage, people usually refer to kilocalories as *calories*, which is technically a much smaller energy unit (1 kilocalorie contains 1000 calories). This text uses the familiar word *calorie* to stand for the larger energy unit; you’ll also find the word *calorie* used on food labels.

Of the six classes of essential nutrients, three supply energy:

- Fat = 9 calories per gram.
- Protein = 4 calories per gram.
- Carbohydrate = 4 calories per gram.

Alcohol, though not an essential nutrient, also supplies energy, providing 7 calories per gram. (One gram equals a little less than .04 ounce.) The high caloric content of fat is one reason why experts often advise against high fat consumption. Most people do not need the extra calories to meet energy needs. Regardless of their source, calories consumed in excess of energy needs are converted to fat and stored in the body.

Just meeting energy needs is not enough. Your body needs enough of the essential nutrients to function properly. Nearly all foods contain combinations of nutrients, although foods are commonly classified according to their predominant nutrient; for example, spaghetti is thought of as a carbohydrate. The following sections discuss the function and sources of each class of nutrients.

Proteins—The Basis of Body Structure

Proteins form important parts of the body’s main structural components: muscles and bones. Proteins also form important parts of blood, enzymes, some hormones, and cell membranes. When consumed, proteins also provide energy (4 calories per gram) for the body.

Amino Acids The building blocks of proteins are called **amino acids**. Twenty common amino acids are found in food.

Nine of these are essential (or indispensable). The other eleven amino acids can be produced by the body, given the presence of the needed components supplied by foods.

Complete and Incomplete Proteins Individual protein sources are considered *complete* if they supply all the essential amino acids in adequate amounts and *incomplete* if they do not. Meat, fish, poultry, eggs, milk, cheese, and soy provide complete proteins. Incomplete proteins, which come from other plant sources such as legumes and nuts, are good sources of most essential amino acids but are usually low in one or more.

Certain combinations of vegetable proteins, such as wheat and peanuts in a peanut butter sandwich, allow each vegetable protein to make up for the amino acids missing in the other protein. The combination yields a complete protein. Many traditional food pairings, such as beans and rice or corn and beans, may have emerged as dietary staples because they are complementary proteins.

It was once believed that vegetarians had to complement their proteins at each meal to receive the benefit of a complete protein. It is now known, however, that proteins consumed throughout the course of the day can complement each other to form a pool of amino acids the body can draw from to produce the necessary proteins in the body. Vegetarians should include a variety of vegetable protein sources in their diets to make sure they get all the essential amino acids in adequate amounts. (Healthy vegetarian diets are discussed later in the chapter.) About two-thirds of the protein in the typical American diet comes from animal sources (meat and dairy products); therefore, the American diet is rich in essential amino acids.

Recommended Protein Intake Adequate daily intake of protein for adults is 0.8 gram per kilogram (0.36 gram per pound) of body weight, corresponding to 50 grams of protein per day for someone who weighs 140 pounds and 65 grams of protein for someone who weighs 180 pounds. Table 12.2 lists some popular food items and the amount of protein each one provides.

QUICK STATS

Worldwide, almost **1 billion people** don’t get enough to eat on a daily basis.

—*Science*, 2010

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kilocalorie A measure of energy content in food; 1 kilocalorie represents the amount of heat needed to raise the temperature of 1 liter of water 1°C; commonly referred to as a *calorie*.

protein An essential nutrient that forms important parts of the body’s main structures (muscles and bones) as well as blood, enzymes, hormones, and cell membranes; also provides energy.

amino acid One of the building blocks of proteins; 20 common amino acids are found in foods.

Table 12.2 Protein Content of Common Food Items

ITEM	PROTEIN (GRAMS)
3 ounces lean meat, poultry, or fish	20–25
½ cup tofu	20–25
1 cup dried beans	15–20
1 cup milk or yogurt	8–12
1½ ounces cheese	8–12
1 serving of cereals, grains, nuts, vegetables	2–4

EMBRACING WELLNESS

Eating Habits and Total Wellness



Healthy eating does more than nourish your body—it enhances your ability to enjoy life to the fullest by improving overall wellness, both physical and mental. One study examined a group of adults who followed a healthy eating plan for four years. At the end of this period, the study subjects were more confident with their food choices and more satisfied with their lives in general than their peers who did not make any dietary changes. The reverse is also true—when people overeat, they often have feelings of guilt, anger, discouragement, and even self-loathing. Out-of-control eating can erode self-confidence and lead to depression.



can have a temporary calming effect. This effect is most pronounced when rapidly digestible carbohydrates are consumed alone, with no fats or proteins in the meal. The practical implications of this research are uncertain.

If you are looking for a mental boost, some scientists think that eating a meal consisting primarily of protein-rich foods may be helpful. The theory is that proteins contain the amino acid tyrosine, which

the body uses to make the neurotransmitters dopamine and norepinephrine. Some researchers think that eating protein-rich foods could increase the synthesis of these neurotransmitters, which can speed reaction time and increase alertness. Whether this really works, especially in well-nourished individuals who have not been lacking these nutrients to begin with, remains unclear. In the meantime, it wouldn't hurt, and might even help, to include some protein in the meal you eat prior to your next big exam.

Can individual foods affect the way we feel? Limited scientific evidence points to some correlation between certain foods and one's mood. Many people, especially women, seem to crave chocolate when they feel slightly depressed. Studies show that chocolate, in small quantities, may indeed give you a lift. Sugary foods tend to temporarily raise serotonin levels in the brain, which can improve mood (serotonin is a neurotransmitter associated with a calm, relaxed state). The fat found in chocolate acts to increase endorphins—brain chemicals that reduce pain and increase feelings of well-being. Chocolate also contains a variety of other less studied chemicals that may have a positive impact on mood.

Some recent research shows that eating certain carbohydrate-rich foods, such as a plain baked potato or a bagel with jelly,

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Most Americans meet or exceed the protein intake needed for adequate nutrition. If you consume more protein than your body needs, the extra energy from protein is synthesized into fat for storage or burned for energy requirements. A little extra protein is not harmful, but it can contribute excess calories and fat to the diet because protein-rich foods can be high in fat (especially saturated fat), as well.

Recommendations for protein intake (and intake of other nutrients) as a percentage of total daily calorie intake have been published by the Food and Nutrition Board of the Institute of Medicine. These recommendations, called Acceptable Macronutrient Distribution Ranges (AMDRs), are based on ensuring adequate intake of essential nutrients while also reducing the risk of chronic diseases. A fairly broad range of protein intakes is associated with good health; the AMDR for protein is 10–35% of total daily calorie intake, depending on the individual's age. Because most people in the United States meet the recommendations for protein, the 2010

Dietary Guidelines for Americans emphasize a variety of low-fat protein choices to encourage people to avoid consuming too many calories.

Fats—Essential in Small Amounts

Fats, also known as *lipids*, are the most concentrated source of energy, at 9 calories per gram. The fats stored in your body represent usable energy, they help insulate your body, and they support and cushion your organs. Fats in the diet help your body to absorb fat-soluble vitamins, and they add important flavor and texture to foods. Fats are the major fuel for the body during rest and light activity.

Two fats, linoleic acid and alpha-linolenic acid, are essential components of the diet. They are used to make compounds that are key regulators of such body functions as the maintenance of blood pressure and the progress of a healthy pregnancy.

Types and Sources of Fats Most of the fats in foods are fairly similar in composition, generally including a molecule of glycerol (an alcohol) with three fatty acid chains attached to it. The resulting structure is called a *triglyceride*. Animal fat, for example, is made primarily of triglycerides.

Within a triglyceride, differences in the fatty acid structure result in different types of fats. Depending on this structure, a fat may be unsaturated, monounsaturated, polyunsaturated, or saturated. (The essential fatty acids—linoleic and alpha-linolenic acids—are both polyunsaturated.) The different types of fatty acids have different characteristics and different effects on your health. The types of fatty acids and their effects on health are summarized in Table 12.3.

Food fats are usually composed of both saturated and unsaturated fatty acids; the dominant type of fatty acid determines the fat's characteristics. Food fats containing large amounts of saturated fatty acids are usually solid at room temperature; they are generally found naturally in animal products. The leading sources of saturated fat in the American diet are red meats (hamburger, steak, roasts), whole milk, cheese, hot dogs, and lunch meats. Food fats containing large amounts

The softer or more liquid a fat is (such as tub or squeeze margarines), the less saturated and trans fat it is likely to contain.

of monounsaturated and polyunsaturated fatty acids usually come from plant sources and are liquid at room temperature. Olive, canola, safflower, and peanut oils contain mostly monounsaturated fatty acids. Soybean, corn, and cottonseed oils contain mostly polyunsaturated fatty acids.

Hydrogenation and Trans Fats When unsaturated vegetable oils undergo the chemical process known as **hydrogenation**, the result is a more solid fat that contains a mixture of saturated and unsaturated fatty acids. Hydrogenation also changes some unsaturated fatty acids to **trans fatty acids**—

hydrogenation A chemical process by which hydrogen atoms are added to molecules of unsaturated fats, increasing the degree of saturation and turning liquid oils into solid fats. Hydrogenation produces a mixture of saturated fatty acids and standard and trans forms of unsaturated fatty acids.

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trans fatty acid A type of unsaturated fatty acid produced during the process of hydrogenation; trans fats have an atypical shape that affects their chemical activity.

Table 12.3 Types of Fatty Acids and Their Possible Effects on Health

	TYPE OF FATTY ACID	FOUND IN ^a	POSSIBLE EFFECTS ON HEALTH
Keep Intake Low	Saturated	<ul style="list-style-type: none"> Animal fats (especially fatty meats and poultry fat and skin) Butter, cheese, and other high-fat dairy products Palm and coconut oils 	<ul style="list-style-type: none"> Raises total cholesterol and LDL cholesterol May increase risk of heart disease May increase risk of certain types of cancers
	Trans	<ul style="list-style-type: none"> Deep-fried fast foods Stick margarines, shortening Packaged cookies and crackers Processed snacks and sweets 	<ul style="list-style-type: none"> Raises total cholesterol and LDL cholesterol Lowers HDL cholesterol May increase risk of heart disease and some cancers
	Monounsaturated	<ul style="list-style-type: none"> Olive, canola, and safflower oils Avocados, olives Peanut butter (without added fat) Many nuts, including almonds, cashews, pecans, and pistachios 	<ul style="list-style-type: none"> Lowers total cholesterol and LDL cholesterol May reduce blood pressure and lower triglycerides (a risk factor for heart disease) May reduce risk of heart disease, stroke, and some cancers
Choose Moderate Amounts	POLYUNSATURATED (two groups) ^b		
	Omega-3	<ul style="list-style-type: none"> Fatty fish, including salmon, white albacore tuna, mackerel, anchovies, and sardines Lesser amounts in walnut, flaxseed, canola, and soybean oils; tofu, walnuts; flaxseeds; and dark green leafy vegetables 	<ul style="list-style-type: none"> Reduces blood clotting and inflammation and inhibits abnormal heart rhythms Lowers triglycerides May lower blood pressure in some people May reduce risk of fatal heart attack, stroke, and some cancers
	Omega-6	<ul style="list-style-type: none"> Corn, soybean, and cottonseed oils (often used in margarine, mayonnaise, and salad dressings) 	<ul style="list-style-type: none"> Lowers total cholesterol and LDL cholesterol May lower HDL cholesterol May reduce risk of heart disease May slightly increase risk of cancer if omega-6 intake is high and omega-3 intake is low

^aFood fats contain a combination of types of fatty acids in various proportions. For example, canola oil is composed mainly of monounsaturated fatty acids (62%) but also contains polyunsaturated (32%) and saturated (6%) fatty acids. Food fats are categorized here according to their predominant fatty acid.

^bThe essential fatty acids are polyunsaturated: linoleic acid is an omega-6 fatty acid and alpha-linolenic acid is an omega-3 fatty acid.

unsaturated fatty acids with an atypical shape that affects their behavior in the body.

Food manufacturers use hydrogenation to increase the stability of an oil so it can be reused for deep frying, to improve the texture of certain foods (to make pie crusts flakier, for example), and to extend the shelf life of foods made with oil. Hydrogenation is also used to transform a liquid oil into margarine or vegetable shortening.

Small amounts of trans fats occur naturally in animal fat, particularly beef, lamb, and dairy products; but the majority of trans fat in the American diet comes from partially hydrogenated oils. Many baked and fried foods are prepared with hydrogenated vegetable oils, so they can be relatively high in saturated and trans fatty acids. Leading sources of trans fats in the American diet are fried fast foods such as french fries and fried chicken (typically fried in vegetable shortening rather than oil), baked and snack foods, and stick margarine.

In general, the more solid a hydrogenated oil is, the more saturated or trans fats it contains; for example, stick margarines typically contain more saturated and trans fats than do tub or squeeze margarines.

Hydrogenated vegetable oils are not the only plant fats that contain saturated fats. Palm and coconut oils, although derived from plants, are also highly saturated. However, fish oils, unlike many oils derived from animal sources, are rich in polyunsaturated fats.

Fats and Health Different types of fats have very different effects on health. Many studies have examined the effects of dietary fat intake on blood **cholesterol** levels and the risk of heart disease. Saturated and trans fatty acids raise blood levels of **low-density lipoprotein (LDL)**, or “bad” cholesterol. Unsaturated fatty acids lower LDL. Monounsaturated fatty acids, such as those found in olive and canola oils, may also increase levels of **high-density lipoproteins (HDL)**, or “good” cholesterol, providing even greater benefits for heart health. In large amounts, trans fatty acids may lower HDL. Thus it is important to choose unsaturated fats instead of saturated and trans fats to reduce the risk of heart disease. (See Chapter 15 for more about cholesterol.)

Most Americans consume 4–5 times as much saturated fat as trans fat (8–10% versus 2% of total daily calories). However, health experts are particularly concerned about trans fats because of their double-negative effect on heart health—they both raise LDL and lower HDL. Consuming trans fats increases the risk of both cardiovascular disease and type 2 diabetes. In recent years, as awareness of these health risks has grown, cities and states have banned the use of trans fats in restaurants and food prepared for retail sale, and food manufacturers have reduced the amount of trans fats they use. According to the Center for Science in the Public Interest, the amount of trans fat added to our food has declined by more than 50% since 2005. By federal regulation, the trans fat content of packaged food items is listed on their labels. Consumers can also check for the presence of trans fats by examining the ingredient list of a food for partially hydrogenated oil or vegetable shortening.

The best way to reduce saturated fat in your diet is to lower your intake of meat and full-fat dairy products (whole milk, cream, butter, cheese, yogurt, ice cream). To lower trans fats, decrease your intake of deep-fried foods and baked goods made with hydrogenated vegetable oils (such as many kinds of crackers and cookies), use liquid oils for cooking, and favor tub or squeeze margarines over stick margarines. Remember: the softer or more liquid a fat is, the less saturated and trans fat it is likely to contain.

Although saturated and trans fats pose health hazards, other fats can be beneficial. When used in place of saturated fats, monounsaturated fatty acids—found in avocados, most nuts, and olive, canola, peanut, and safflower oils—improve cholesterol levels and may help protect against some cancers.

Omega-3 fatty acids, a form of polyunsaturated fat found primarily in fish, may be even more healthful. Foods rich in omega-3s are important because they contain the essential nutrient alpha-linolenic acid. Omega-3s and the compounds the body makes from them have a number of heart-healthy effects: they reduce the tendency of blood to clot, inhibit inflammation and abnormal heart rhythms, and reduce blood pressure and risk of heart attack and stroke in some people. Because of these benefits, nutritionists recommend that Americans increase the proportion of omega-3s in their diet by eating fish two or more times a week. Salmon, tuna, trout, mackerel, herring, sardines, and anchovies are all good sources of omega-3s. Lesser amounts are found in plant foods, including dark-green leafy vegetables; walnuts; flaxseeds; and canola, walnut, and flaxseed oils.

Most of the polyunsaturated fats currently consumed by Americans are **omega-6 fatty acids**, primarily from corn oil and soybean oil. Foods rich in omega-6s are important because they contain the essential nutrient linoleic acid. The American Heart Association (AHA) recommends consuming at least 5–10% of energy from omega-6 fatty acids as part of a low-saturated-fat and low-cholesterol diet, to reduce the risk of coronary heart disease.

In addition to its effects on heart disease risk, dietary fat can affect health in other ways. Diets high in fatty red meat are associated with an increased risk of certain forms of cancer,

cholesterol A waxy substance in the blood and cells, needed for synthesis of cell membranes, vitamin D, and hormones.

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low-density lipoprotein (LDL) Blood fat that transports cholesterol to organs and tissues; excess amounts result in the accumulation of deposits on artery walls.

high-density lipoprotein (HDL) Blood fat that helps transport cholesterol out of the arteries, thereby protecting against heart disease.

omega-3 fatty acids Polyunsaturated fatty acids commonly found in fish oils; beneficial to cardiovascular health.

omega-6 fatty acids Polyunsaturated fatty acids found commonly in soybean and corn oil; beneficial for cardiovascular health.

especially colon cancer. A high-fat diet can also make weight management more difficult. Because fat is a concentrated source of calories, a high-fat diet is often a high-calorie diet that can lead to weight gain.

Although more research is needed on the precise effects of different types and amounts of fat on overall health, a great deal of evidence points to the fact that most people benefit from keeping their overall fat intake at recommended levels and choosing unsaturated fats instead of saturated and trans fats.

Recommended Fat Intake To meet the body's demand for essential fats, adult men need about 17 grams per day of linoleic acid and 1.6 grams per day of alpha-linolenic acid; adult women need 12 grams of linoleic acid and 1.1 grams of alpha-linolenic acid. It takes only 3–4 teaspoons (15–20 grams) of vegetable oil per day incorporated into your diet to supply the essential fats. Most Americans consume sufficient amounts of the essential fats; limiting unhealthy fats is a much greater health concern.

Limits for total fat, saturated fat, and trans fat intake have been set by a number of government and research organizations. As with protein, a range of levels of fat consumption is associated with good health; the AMDR for total fat is 20–35% of total calories. Although more difficult for consumers to monitor, AMDRs have also been set for omega-6 fatty acids (5–10%) and omega-3 fatty acids (0.6–1.2%) as part of total fat intake. Because any amount of saturated and trans fats increases the risk of heart disease, the Food and Nutrition Board recommends that saturated fat and trans fat intake be kept as low as possible; most fat in a healthy diet should be unsaturated.

For advice on setting individual intake goals, see the box “Setting Intake Goals for Protein, Fat, and Carbohydrate.” To determine how close you are to meeting your personal intake goals for fat, keep a running total over the course of the day. For prepared foods, food labels list the numbers of grams of fat, protein, and carbohydrate. Nutrition information is also available in many grocery stores, in inexpensive published nutrition guides, and online (see “For More Information” at the end of the chapter). By checking these resources, you can keep track of the total grams of fat, protein, and carbohydrate you eat and assess your current diet.

You can still eat high-fat foods, but it makes sense to limit the size of your portions and to balance your intake with low-fat foods. For example, peanut butter is high in fat, with 8 grams (72 calories) of fat in each 90-calorie tablespoon. Two tablespoons of peanut butter eaten on whole-wheat bread and served with a banana, carrot sticks, and a glass of fat-free milk make a nutritious lunch—high in protein and carbohydrate and overall, relatively low in fat (500 calories, 18 grams of total fat, 4 grams of saturated fat). In comparison, four tablespoons of peanut butter on high-fat crackers with potato chips, cookies, and whole milk is a less healthy combination (1000 calories, 62 grams of total fat, 15 grams of saturated fat). So although it's important to evaluate individual food items for their fat content, it's more important to look at them in the context of your overall diet.

Carbohydrates—An Ideal Source of Energy

Carbohydrates are needed in the diet primarily to supply energy for body cells. Some cells, such as those found in the brain and other parts of the nervous system and in blood, use only the carbohydrate glucose for fuel. During high-intensity exercise, muscles also use energy from carbohydrates as their primary fuel source.

When we don't eat enough carbohydrates to satisfy the needs of the brain and red blood cells, our bodies synthesize fuel from proteins. In situations of extreme deprivation, when the diet lacks a sufficient amount of both carbohydrates and proteins, the body turns to its own organs and tissues, breaking down proteins in muscles, the heart, kidneys, and other vital organs to supply carbohydrate needs. This rarely occurs, however, because eating the equivalent of just three or four slices of bread supplies the body's daily minimum need for carbohydrates.

Simple and Complex Carbohydrates Carbohydrates are classified into two groups: simple and complex. *Simple carbohydrates* include single sugar molecules (monosaccharides) and double sugar molecules (disaccharides). The monosaccharides are glucose, fructose, and galactose. Glucose is the most common sugar and is used by both animals and plants for energy. Fructose is a very sweet sugar that is found in fruits, and galactose is the sugar in milk. The disaccharides are pairs of single sugars; they include sucrose or table sugar (fructose + glucose), maltose or malt sugar (glucose + glucose), and lactose or milk sugar (galactose + glucose). Simple carbohydrates add sweetness to foods; they are found naturally in fruits and milk and are added to soft drinks, fruit drinks, candy, and sweet desserts. There is no evidence that any type of simple carbohydrate is more nutritious than any others.

Complex carbohydrates include starches and most types of dietary fiber. Starches are found in a variety of plants, especially grains (wheat, rye, rice, oats, barley, millet), legumes (dry beans, peas, and lentils), and tubers (potatoes and yams). Most other vegetables contain a mixture of complex and simple carbohydrates. Fiber, discussed in the next section, is found in grains, fruits, and vegetables.

During digestion, your body breaks down carbohydrates into simple sugar molecules, such as **glucose**, for absorption. Once glucose is in the bloodstream, the pancreas releases the hormone insulin, which allows cells to take up glucose and use it for energy. The liver and muscles take up glucose to provide carbohydrate storage in the form of a starch called **glycogen**.

carbohydrate An essential nutrient, required for energy for cells; sugars, starches, and dietary fiber are all carbohydrates.

glucose A simple sugar that is the body's basic fuel.

glycogen A starch stored in the liver and muscles.

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Setting Intake Goals for Protein, Fat, and Carbohydrate

The Food and Nutrition Board has established goals to help ensure adequate intake of the essential amino acids, fatty acids, and carbohydrate. The daily goals for adults follow:

	MEN	WOMEN
Protein	56 grams	46 grams
Fat: linoleic acid	17 grams	12 grams
Alpha-linolenic acid	1.6 grams	1.1 grams
Carbohydrate	130 grams	130 grams

Protein intake goals can be calculated more specifically by multiplying your body weight in kilograms by 0.8 or your body weight in pounds by 0.36. (Refer to the “Nutrition Resources” section at the end of the chapter for information for specific age groups and life stages.)

To meet your daily energy needs, you need to consume more than the minimally adequate amounts of the energy-providing nutrients listed here, which alone supply only about 800–900 calories.

The Food and Nutrition Board provides additional guidance in the form of Acceptable Macronutrient Distribution Ranges (AMDRs), as noted in the text. The ranges can help you balance

your intake of the energy-providing nutrients in ways that ensure adequate intake while reducing the risk of chronic disease. The AMDRs for protein, total fat, and carbohydrate follow:

Protein	10–35% of total daily calories
Total fat	20–35% of total daily calories
Carbohydrate	45–65% of total daily calories

To set individual goals, begin by estimating your total daily energy (calorie) needs. If your weight is stable, your current energy intake is the number of calories needed to maintain your weight at your current activity level. Next select percentage goals for protein, fat, and carbohydrate. You can allocate your total daily calories among the three classes of macronutrients to suit your preferences, but make sure that the three percentages you select total 100% and that you meet the minimum intake goals listed. Two samples reflecting different total energy intake and nutrient intake goals appear in the following table.

To translate your own percentage goals into daily intake goals expressed in calories and grams, multiply the appropriate percentages by total calorie intake and then divide the results by the corresponding calories per gram. For example, a fat limit of 35% applied to a 2200-calorie diet would be calculated as follows: $0.35 \times 2200 = 770$ calories of total fat; $770 \div 9$ calories per gram = 86 grams of total fat. (Remember that fat has 9 calories per gram and that protein and carbohydrate have 4 calories per gram.)

Two Sample Macronutrient Distributions

NUTRIENT	AMDR	SAMPLE 1		SAMPLE 2	
		INDIVIDUAL GOALS	AMOUNTS FOR A 1600-CALORIE DIET	INDIVIDUAL GOALS	AMOUNTS FOR A 2800-CALORIE DIET
Protein	10–35%	15%	240 calories = 60 grams	30%	840 calories = 210 grams
Fat	20–35%	30%	480 calories = 53 grams	25%	700 calories = 78 grams
Carbohydrate	45–65%	55%	880 calories = 220 grams	45%	1260 calories = 315 grams

SOURCE: From Food and Nutrition Board, Institute of Medicine. 2010. *Dietary Reference Intakes: The Essential Guide to Nutrient Requirements*. Washington, DC: National Academies Press. Available online at http://www.nap.edu/openbook.php?record_id=11537&page1. Reprinted with permission from the National Academies Press, Copyright 2010, National Academy of Sciences.

Some people have problems controlling blood glucose levels, a disorder called *diabetes mellitus* (Chapter 14).

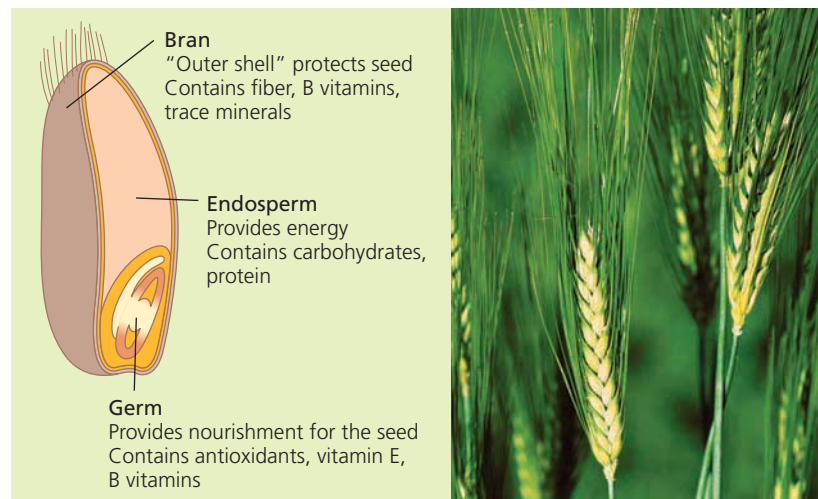
Refined Carbohydrates versus Whole Grains Complex carbohydrates can be further divided into refined, or processed, carbohydrates and unrefined carbohydrates, or whole grains. Before they are processed, all grains are **whole grains**, consisting of an inner layer, the germ; a middle layer, the endosperm; and an outer layer, the bran (Figure 12.2). During processing, the germ and bran are often removed,

leaving just the starchy endosperm. The refinement of whole grains transforms whole-wheat flour into white flour, brown rice into white rice, and so on.

whole grain The entire edible portion of a grain (such as wheat, rice, or oats), consisting of the germ, endosperm, and bran; processing removes parts of the grain, often leaving just the endosperm.

TERMS

FIGURE 12.2 The parts of a whole grain kernel.



Refined carbohydrates usually retain all the calories of their unrefined counterparts, but they tend to be much lower in fiber, vitamins, minerals, and other beneficial compounds. (Many refined grain products are enriched or fortified with vitamins and minerals, but not all of the nutrients lost in processing are replaced.)

Unrefined carbohydrates tend to take longer to chew and digest than refined ones; they also enter the bloodstream more slowly. This slower digestive pace tends to make people feel full sooner and for a longer period. Also, a slower rise in blood glucose levels following the consumption of complex carbohydrates may help in the management of diabetes. Whole grains are also high in dietary fiber and so have all the benefits of fiber (discussed later).

Consumption of whole grains has been linked to a reduced risk of heart disease, diabetes, and cancer and plays an important role in gastrointestinal health and body weight management. For all these reasons, whole grains are recommended over those that have been refined. This does not mean that you should never eat refined carbohydrates such as white bread or white rice—simply that whole-wheat bread, brown rice, and other whole grains are healthier choices. See the box "Choosing More Whole-Grain Foods" for tips on increasing your intake of whole grains.

Glycemic Index Insulin and glucose levels rise and fall following a meal or snack containing any type of carbohydrate. Some foods cause a quick and dramatic rise in glucose and insulin levels, while others have a slower, more moderate effect. A food that has a rapid effect on blood glucose levels is

**QUICK
STATS**

The typical American diet contains **6.4 ounces of grains daily**, but only **0.6 ounces are whole grains.**

—Dietary Guidelines for Americans, 2010

said to have a high **glycemic index**. The glycemic index of a food indicates the type of carbohydrate in that food. High-glycemic-index foods do not, as some popular diets claim, directly cause weight gain beyond the calories they contain.

Attempting to base food choices on glycemic index is a difficult task. Unrefined complex carbohydrates and high-fiber foods generally tend to have a lower glycemic index, but patterns are less clear for other types of foods. The body's response to carbohydrates also depends on other factors, such as what other foods are consumed at the same time, as well as the individual's fitness status.

For people with particular health concerns, such as diabetes, glycemic index may be an important consideration in choosing foods. But for most people, the best bet is to choose a variety of vegetables daily and to limit foods that are high in added sugars and low in other nutrients.

Recommended Carbohydrate Intake On average, Americans consume 200–300 grams of carbohydrate per day—well above the 130 grams needed to meet the body's requirement for essential carbohydrate. A range of intakes is associated with good health; the AMDR for carbohydrates is 45–65% of total daily calories. That's about 225–325 grams of carbohydrate for someone who consumes 2000 calories per day. The focus should be on consuming a variety of foods rich in complex carbohydrates, especially whole grains.

Athletes in training can especially benefit from high-carbohydrate diets (60–70% of total daily calories), which enhance the amount of carbohydrates stored in their muscles and therefore provide more fuel for use during endurance events or long workouts. Carbohydrates consumed during prolonged athletic events (for example, sports beverages and gels) can provide fluid, electrolytes, and glucose to help fuel muscles and extend the availability of glycogen stored in muscles. Caution is in order, however, because overconsumption

glycemic index A measure of how a particular food affects blood glucose levels.

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TAKE CHARGE

Choosing More Whole-Grain Foods



Because whole-grain foods offer so many health benefits, federal dietary guidelines recommend six or more servings of grain products every day, with at least half of those servings from whole grains. Currently, however, Americans average less than one serving of whole grains per day.

What Are Whole Grains?

The first step in increasing your intake of whole grains is to correctly identify them. The following are whole grains:

Whole wheat	Whole-grain corn
Whole rye	Popcorn
Whole oats	Brown rice
Oatmeal	Whole-grain barley

More unusual choices include bulgur (cracked wheat), millet, kasha (roasted buckwheat kernels), quinoa, wheat and rye berries, amaranth, wild rice, graham flour, whole-grain kamut, whole-grain spelt, and whole-grain triticale.

Wheat flour, unbleached flour, enriched flour, and degerminated corn meal are not whole grains. Wheat germ and wheat bran are also not whole grains, but they are the constituents of wheat typically left out when wheat is processed and so are healthier choices than regular wheat flour, which typically contains just the grain's endosperm.

Checking Packages for Whole Grains

To find packaged foods—such as bread or pasta—that are rich in whole grains, read the list of ingredients and check for special health claims related to whole grains. The *first* item on the list of ingredients should be one of the whole grains in the preceding list. Product names and food color can be misleading. *When in doubt, always check the list of ingredients and make sure “whole” is the first word on the list.*

The FDA allows manufacturers to include special health claims for foods that contain 51% or more whole-grain ingredients. Such products may display a statement such as the following on their packaging:

“Rich in whole grain.”

“Made with 100% whole grain.”

“Diets rich in whole-grain foods may help reduce the risk of heart disease and certain cancers.”

However, many whole-grain products do not carry such claims. This is one more reason to check the ingredient list to make sure you're buying a product made from one or more whole grains.

of carbohydrates can lead to fatigue and underconsumption of other nutrients.

Added sugars—sugars that are added to foods—should not be a major contributor to the diet. Added sugars include the white and brown sugar and high-fructose corn syrup that are added to foods like candy, baked goods, and sodas and other sugar-sweetened beverages. Currently, added sugars contribute 16% of the total calories in the typical American diet. Foods high in added sugars are generally high in calories and low in nutrients and fiber, thus providing “empty calories.” The USDA Food Patterns recommendations (based on the Dietary Guidelines for Americans) are designed so that people can meet nutrient needs and have no more than 5–15% of calories from solid fats AND added sugars together. To reduce your intake of added sugars, limit soft drinks, candy, desserts, and sweetened fruit drinks. The sugars in your diet should come mainly from fruits, which are excellent sources of vitamins and minerals, and from low-fat or fat-free milk and other dairy products, which are high in protein and calcium.

Fiber—A Closer Look

Fiber is the term given to nondigestible carbohydrates provided by plants. Instead of being digested, like starch, fiber

moves through the intestinal tract and provides bulk for feces in the large intestine, which in turn facilitates elimination. In the large intestine, bacteria break down some types of fiber into acids and gases, which explains why consuming too much fiber can lead to intestinal gas. Even though humans don't digest fiber, it is necessary for good health.

Types of Fiber The Food and Nutrition Board has defined two types of fiber:

- **Dietary fiber** refers to the nondigestible carbohydrates (and the noncarbohydrate substance *lignin*) that are naturally present in plants such as grains, legumes, and vegetables.
- **Functional fiber** refers to nondigestible carbohydrates that have been either isolated from natural sources or synthesized in a lab and then added to a food product or dietary supplement.

dietary fiber Nondigestible carbohydrates and lignin that are intact in plants.

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functional fiber Nondigestible carbohydrates either isolated from natural sources or synthesized; these may be added to foods and dietary supplements.

Total fiber is the sum of dietary and functional fiber in one's diet.

Fibers have different properties that lead to different physiological effects in the body. For example, **soluble (viscous) fiber** such as that found in oat bran or legumes can delay stomach emptying, slow the movement of glucose into the blood after eating, and reduce absorption of cholesterol. **Insoluble fiber**, such as that found in wheat bran or psyllium seed, increases fecal bulk and helps prevent constipation, hemorrhoids, and other digestive disorders.

A high-fiber diet can help reduce the risk of type 2 diabetes, heart disease, and pulmonary disease, as well as improve gastrointestinal health and aid in the management of metabolic syndrome and body weight. Some studies have linked high-fiber diets with a reduced risk of colon and rectal cancer. Other studies have suggested that other characteristics of diets rich in fruits, vegetables, and whole grains may be responsible for this reduction in risk (see Chapter 16).

Sources of Fiber All plant foods contain some dietary fiber. Fruits, legumes, oats (especially oat bran), and barley all contain the viscous types of fiber that help lower blood glucose and cholesterol levels. Wheat (especially wheat bran), other grains and cereals, and vegetables are good sources of cellulose and other fibers that help prevent constipation. Psyllium, which is often added to cereals or used in fiber supplements and laxatives, improves intestinal health and also helps control glucose and cholesterol levels. The processing of packaged foods can remove fiber, so it is important to rely on fresh fruits and vegetables and foods made from whole grains as your main sources of fiber.

Recommended Fiber Intake To reduce the risk of chronic disease and maintain intestinal health, the Food and Nutrition Board recommends a daily fiber intake of 38 grams for adult men and 25 grams for adult women. Americans currently consume about half this amount. Fiber should come from foods, not supplements, which should be used only under medical supervision.

Even though we don't digest fiber, it is necessary for good health.

Vitamins—Organic Micronutrients

Vitamins are organic (carbon-containing) substances required in small amounts to regulate various processes within living cells (Table 12.4). Humans need 13 vitamins; of these, 4 are fat-soluble (A, D, E, and K), and 9 are water-soluble (C, and the B-complex vitamins thiamin, riboflavin, niacin, vitamin B-6, folate, vitamin B-12, biotin, and pantothenic acid).

Solubility affects how a vitamin is absorbed, transported, and stored in the body. The water-soluble vitamins are absorbed directly into the bloodstream, where they travel freely; excess water-soluble vitamins are detected and removed by the kidneys and excreted in urine. Fat-soluble vitamins require

a more complex absorptive process; they are usually carried in the blood by special proteins and are stored in the liver and in fat tissues rather than excreted.

Functions of Vitamins Many vitamins help chemical reactions take place. They provide no energy to the body directly but help unleash the energy stored in carbohydrates, proteins, and fats. Other vitamins are critical in the production of red blood cells and the maintenance of the nervous, skeletal, and immune systems. Some vitamins act as **antioxidants**, which help preserve the health of cells. Key vitamin antioxidants include vitamin E, vitamin C, and the vitamin A precursor beta-carotene. (Antioxidants are described later in the chapter.)

Sources of Vitamins The human body does not manufacture most of the vitamins it requires and must obtain them from foods. Vitamins are abundant in fruits, vegetables, and grains. In addition, many processed foods, such as flour and breakfast cereals, contain added vitamins. A few vitamins are made in certain parts of the body: the skin makes vitamin D when it is exposed to sunlight, and intestinal bacteria make vitamin K. Nonetheless, we still need vitamin D and vitamin K from foods. Table 12.4 lists good food sources of vitamins.

Vitamin Deficiencies If your diet lacks a particular vitamin, characteristic symptoms of deficiency can develop. (Table 12.4 lists the signs of certain vitamin deficiencies.) Physicians have known about some common deficiency-related ailments for generations. For example, *scurvy* is a potentially fatal illness caused by a long-term lack of vitamin C. Children who do not get enough vitamin D can develop *rickets*, which leads to potentially disabling bone deformations. Vitamin A deficiency may cause blindness, and anemia can develop in people whose diet lacks vitamin B-12. Low intake of folate and vitamins B-6 and B-12 has been linked to an increased risk of heart disease.

TERMS

total fiber The total amount of dietary fiber and functional fiber in the diet.

soluble (viscous) fiber Fiber that dissolves in water or is broken down by bacteria in the large intestine.

insoluble fiber Fiber that does not dissolve in water and is not broken down by bacteria in the large intestine.

vitamins Carbon-containing substances needed in small amounts to help promote and regulate chemical reactions and processes in the body.

antioxidant A substance that can reduce the breakdown of food or body constituents by free radicals; the actions of antioxidants include binding oxygen, donating electrons to free radicals, and repairing damage to molecules.

Table 12.4 Facts about Vitamins

VITAMIN	IMPORTANT DIETARY SOURCES	MAJOR FUNCTIONS	SIGNS OF PROLONGED DEFICIENCY	TOXIC EFFECTS OF MEGADOSES
Fat-soluble				
Vitamin A	Liver, milk, butter, cheese, fortified margarine, carrots, spinach, orange and deep-green vegetables and fruits	Immune function and maintenance of vision, skin, linings of the nose, mouth, digestive and urinary tracts	Night blindness, scaling skin, increased susceptibility to infection, loss of appetite, anemia, kidney stones	Liver damage, miscarriage, birth defects, headache, vomiting, diarrhea, vertigo, double vision, bone abnormalities
Vitamin D	Fortified milk and margarine, fish oils, butter, egg yolks (sunlight on skin also produces vitamin D)	Development and maintenance of bones and teeth, promotion of calcium absorption	Rickets (bone deformities) in children; bone softening, loss, and fractures in adults	Kidney damage, calcium deposits in soft tissues, depression, death
Vitamin E	Vegetable oils, whole grains, nuts and seeds, green leafy vegetables, asparagus, peaches	Protection and maintenance of cellular membranes	Red blood cell breakage and anemia, weakness, neurological problems, muscle cramps	Relatively nontoxic, but may cause excess bleeding or formation of blood clots
Vitamin K	Green leafy vegetables; smaller amounts widespread in other foods	Production of factors essential for blood clotting and bone metabolism	Hemorrhaging	None reported
Water-soluble				
Biotin	Cereals, yeast, egg yolks, soy flour, liver; widespread in foods	Synthesis of fat, glycogen, and amino acids	Rash, nausea, vomiting, weight loss, depression, fatigue, hair loss	None reported
Folate	Green leafy vegetables, yeast, oranges, whole grains, legumes, liver	Amino acid metabolism, synthesis of RNA and DNA, new cell synthesis	Anemia, weakness, fatigue, irritability, shortness of breath, swollen tongue	Masking of vitamin B-12 deficiency
Niacin	Eggs, poultry, fish, milk, whole grains, nuts, enriched breads and cereals, meats, legumes	Conversion of carbohydrates, fats, and protein into usable forms of energy	Pellagra (symptoms include diarrhea, dermatitis, inflammation of mucous membranes, dementia)	Flushing of the skin, nausea, vomiting, diarrhea, liver dysfunction, glucose intolerance
Pantothenic acid	Animal foods, whole grains, broccoli, potatoes; widespread in foods	Metabolism of fats, carbohydrates, and proteins	Fatigue, numbness and tingling of hands and feet, gastrointestinal disturbances	None reported
Riboflavin	Dairy products, enriched breads and cereals, lean meats, poultry, fish, green vegetables	Energy metabolism, maintenance of skin, mucous membranes, and nervous system structures	Cracks at corners of mouth, sore throat, skin rash, hypersensitivity to light, purple tongue	None reported
Thiamin	Whole-grain and enriched breads and cereals, organ meats, lean pork, nuts, legumes	Conversion of carbohydrates into usable forms of energy, maintenance of appetite and nervous system function	Beriberi (symptoms include muscle wasting, mental confusion, anorexia, enlarged heart, nerve changes)	None reported
Vitamin B-6	Eggs, poultry, fish, whole grains, nuts, soybeans, liver, kidney, pork	Metabolism of amino acids and glycogen	Anemia, convulsions, cracks at corners of mouth, dermatitis, nausea, confusion	Neurological abnormalities and damage
Vitamin B-12	Meat, fish, poultry, fortified cereals	Synthesis of blood cells, other metabolic reactions	Anemia, fatigue, nervous system damage, sore tongue	None reported
Vitamin C	Peppers, broccoli, spinach, brussels sprouts, citrus fruits, strawberries, tomatoes, potatoes, cabbage, other fruits and vegetables	Maintenance and repair of connective tissue, bones, teeth, and cartilage; promotion of healing; absorption of iron	Scurvy, anemia, reduced resistance to infection, loosened teeth, joint pain, poor wound healing, hair loss, poor iron absorption	Urinary stones in some people, acid stomach from ingesting supplements in pill form, nausea, diarrhea, headache, fatigue

SOURCES: Food and Nutrition Board, Institute of Medicine. 2006. *Dietary Reference Intakes: The Essential Guide to Nutrient Requirements*. Washington, DC: The National Academies Press. Available online at http://www.nap.edu/openbook.php?record_id=11537&page1; Shils, M. E., et al., eds. 2005. *Modern Nutrition in Health and Disease*, 10th ed. Baltimore: Lippincott Williams & Wilkins.

New research is tying vitamin deficiencies with other health risks, as well. For example, experts once thought that vitamin D was the only vitamin that played a role in bone health. Now scientists know that vitamins C and K, as well as several B vitamins, are also important in the prevention of osteoporosis. A great deal of recent research has focused on vitamin D, with surprising results. A systematic review of 17 studies suggests that vitamin D supplementation can reduce the risk of cardiovascular disease. Other studies also link low vitamin D levels to an increased risk of several cancers.

Vitamin deficiency diseases are most often seen in developing countries; they are relatively rare in the United States because vitamins are readily available from our food supply. Still, many Americans consume lower-than-recommended amounts of several vitamins. Even in the face of new findings, however, experts warn that there is not yet enough evidence to suggest that everyone should begin taking vitamin supplements. Supplementation is discussed in detail later in this chapter.

Vitamin Excesses Extra vitamins in the diet can also be harmful, especially when taken as supplements. Megadoses of fat-soluble vitamins are particularly dangerous because the excess is stored in the body rather than excreted, increasing the risk of toxicity. Even when vitamins are not taken in excess, relying on supplements for an adequate intake of vitamins can be a problem. There are many substances in foods other than vitamins and minerals, and some of these compounds may have important health effects. Later this chapter discusses specific recommendations for vitamin intake and when a vitamin supplement is advisable. For now, keep in mind that it's best to get most of your vitamins from foods rather than supplements.

Keeping the Nutrient Value in Food Vitamins and minerals can be lost or destroyed during the storage and cooking of foods. To retain nutrients, eat or process vegetables as soon as possible after purchasing. Store fruits and vegetables in the refrigerator in covered containers or plastic bags to minimize moisture loss. Freeze foods that won't be eaten within a few days. Frozen and canned vegetables are usually as high in nutrients as fresh vegetables because nutrients are locked in when produce is frozen or canned. To reduce nutrient losses during food preparation, minimize the amount of water used and the total cooking time. Baking, steaming, broiling, grilling, and microwaving are all good methods of preparing vegetables.

Minerals—Inorganic Micronutrients

Minerals are inorganic (non-carbon-containing) elements you need in relatively small amounts to help regulate body functions, aid in the growth and maintenance of body tissues, and help release energy (Table 12.5). There are about 17 essential

minerals. The major minerals, which the body needs in amounts exceeding 100 milligrams per day, include calcium, phosphorus, magnesium, sodium, potassium, and chloride. The essential trace minerals, which you need in minute amounts, include copper, fluoride, iodide, iron, selenium, and zinc.

Characteristic symptoms develop if an essential mineral is consumed in a quantity too small or too large for good health. The minerals commonly lacking in the American diet are iron, calcium, potassium, and magnesium. Iron-deficiency **anemia** is a problem in many age groups, and researchers fear that poor calcium intakes in childhood are sowing the seeds for future **osteoporosis**, especially in women. See Chapter 22 for more information about osteoporosis; in this chapter, the box “Eating for Healthy Bones” has tips for building and maintaining bone density.

Water—Vital but Often Ignored

Water is the major component in both foods and the human body: we are composed of about 50–60% water. Our need for other nutrients, in terms of weight, is much less than our need for water. We can live up to 50 days without food but only a few days without water.

Water is distributed all over the body, among lean and other tissues and in blood and other body fluids. Water is used in the digestion and absorption of food and is the medium in which most of the chemical reactions take place within the body. Some water-based fluids, like blood, transport substances around the body, whereas other fluids serve as lubricants or cushions. Water also helps regulate body temperature.

Water is contained in almost all foods, particularly in liquids, fruits, and vegetables.

The foods and beverages you consume provide 80–90% of your daily water intake; the remainder is generated through metabolism. You lose water each day in urine, feces, and sweat and through evaporation from your lungs.

Most people can maintain a healthy water balance by consuming beverages at meals and drinking fluids in response to thirst. The Food and Nutrition Board has set levels of adequate water intake to maintain hydration. All fluids, including those containing caffeine, can count toward your total daily fluid intake. Under these guidelines, men need about 3.7 total liters of water daily, with 3.0 liters (about 13 cups) coming

QUICK STATS

An estimated **10 million Americans have osteoporosis, and 34 million more are at risk due to low bone mass.**

—National Osteoporosis Foundation, 2012

TERMS

minerals Inorganic compounds needed in relatively small amounts for regulation, growth, and maintenance of body tissues and functions.

anemia A deficiency in the oxygen-carrying material in the red blood cells.

osteoporosis A condition in which the bones become thin and brittle over time and break easily; due largely to insufficient calcium intake.

Table 12.5 Facts about Selected Minerals

MINERAL	IMPORTANT DIETARY SOURCES	MAJOR FUNCTIONS	SIGNS OF PROLONGED DEFICIENCY	TOXIC EFFECTS OF MEGADOSES
Calcium	Milk and milk products, tofu, fortified orange juice and bread, green leafy vegetables, bones in fish	Formation of bones and teeth, control of nerve impulses, muscle contraction, blood clotting	Stunted growth in children, bone mineral loss in adults, urinary stones	Kidney stones, calcium deposits in soft tissues, inhibition of mineral absorption, constipation
Fluoride	Fluoridated water, tea, marine fish eaten with bones	Maintenance of tooth and bone structure	Higher frequency of tooth decay	Increased bone density, mottling of teeth, impaired kidney function
Iodine	Iodized salt, seafood, processed foods	Essential part of thyroid hormones, regulation of body metabolism	Goiter (enlarged thyroid), cretinism (birth defect)	Depression of thyroid activity, hyperthyroidism in susceptible people
Iron	Meat and poultry, fortified grain products, dark green vegetables, dried fruit	Component of hemoglobin, myoglobin, and enzymes	Iron-deficiency anemia, weakness, impaired immune function, gastrointestinal distress	Nausea, diarrhea, liver and kidney damage, joint pains, sterility, disruption of cardiac function, death
Magnesium	Widespread in foods and water (except soft water); especially found in grains, legumes, nuts, seeds, green vegetables, milk	Transmission of nerve impulses, energy transfer, activation of many enzymes	Neurological disturbances, cardiovascular problems, kidney disorders, nausea, growth failure in children	Nausea, vomiting, diarrhea, central nervous system depression, coma; death in people with impaired kidney function
Phosphorus	Present in nearly all foods, especially milk, cereal, peas, eggs, meat	Bone growth and maintenance, energy transfer in cells	Impaired growth, weakness, kidney disorders, cardiorespiratory and nervous system dysfunction	Drop in blood calcium levels, calcium deposits in soft tissues, bone loss
Potassium	Meats, milk, fruits, vegetables, grains, legumes	Nerve function and body water balance	Muscular weakness, nausea, drowsiness, paralysis, confusion, disruption of cardiac rhythm	Cardiac arrest
Selenium	Seafood, meat, eggs, whole grains	Defense against oxidative stress, regulation of thyroid hormone action	Muscle pain and weakness, heart disorders	Hair and nail loss, nausea and vomiting, weakness, irritability
Sodium	Salt, soy sauce, salted foods, tomato juice	Body water balance, acid–base balance, nerve function	Muscle weakness, loss of appetite, nausea, vomiting; deficiency is rarely seen	Edema (excess fluid buildup), hypertension in sensitive people
Zinc	Whole grains, meat, eggs, liver, seafood (especially oysters)	Synthesis of proteins, RNA, and DNA; wound healing; immune response; ability to taste	Growth failure, loss of appetite, impaired taste acuity, skin rash, impaired immune function, poor wound healing	Vomiting, impaired immune function, decline in blood HDL levels, impaired copper absorption

SOURCES: Food and Nutrition Board, Institute of Medicine. 2006. *Dietary Reference Intakes: The Essential Guide to Nutrient Requirements*. Washington, DC: The National Academies Press. Available online at http://www.nap.edu/openbook.php?record_id=11537&page1; Shils, M. E., et al., eds. 2005. *Modern Nutrition in Health and Disease*, 10th ed. Baltimore: Lippincott Williams & Wilkins.

from beverages; women need 2.7 total liters, with 2.2 liters (about 9 cups) coming from beverages. (See Table 1 in the Nutrition Resources section at the end of the chapter for information about specific age groups.) If you exercise vigorously or live in a hot climate, you need to consume additional fluids to maintain a balance between water consumed and water lost. Severe dehydration causes weakness and can lead to death.

Other Substances in Food

Many substances in food are not essential nutrients but may influence health.

Antioxidants When the body uses oxygen or breaks down certain fats or proteins as a normal part of metabolism, it gives rise to substances called **free radicals**. Environmental factors such as cigarette smoke, exhaust fumes, radiation, excessive sunlight, certain drugs, and stress can increase free

free radical An electron-seeking compound that can react with fats, proteins, and DNA, damaging cell membranes and mutating genes in its search for electrons; produced through chemical reactions in the body and by exposure to environmental factors such as sunlight and tobacco smoke.

TERMS



TAKE CHARGE

Eating for Healthy Bones

Osteoporosis is a condition in which the bones become dangerously thin and fragile over time. An estimated 10 million Americans over age 50 have osteoporosis, and another 34 million are at risk. Women account for about 80% of osteoporosis cases.

Most of our adult bone mass is built by age 18 in girls and age 20 in boys. After bone density peaks between ages 25 and 35, bone mass is lost over time. To prevent osteoporosis, the best strategy is to build as much bone as possible during your youth and do everything you can to maintain it as you age. Up to 50% of bone loss is determined by controllable lifestyle factors. Key nutrients for bone health include the following:

- **Calcium.** Getting enough calcium is important throughout life to build and maintain bone mass. Milk, yogurt, and calcium-fortified orange juice, bread, and cereals are all good sources.
- **Vitamin D.** Vitamin D is necessary for bones to absorb calcium; a daily intake of 600 IU is recommended for individuals aged 1–70. Vitamin D can be obtained from foods and is manufactured by the skin when exposed to sunlight. Candidates for vitamin D supplements include people who don't eat many foods rich in vitamin D; those who don't expose their faces, arms, and hands to the sun (without sunscreen) for 5–15 minutes a few times each week; and people who live north of an imaginary line

roughly between Boston and the Oregon–California border (where the sun is weaker).

- **Vitamin K.** Vitamin K promotes the synthesis of proteins that help keep bones strong. Broccoli and leafy green vegetables are rich in vitamin K.
- **Other nutrients.** Other nutrients that may play an important role in bone health include vitamin C, magnesium, potassium, phosphorus, fluoride, manganese, zinc, copper, and boron.

Several dietary substances may have a *negative* effect on bone health, especially if consumed in excess. These include alcohol, sodium, caffeine, and retinol (a form of vitamin A). Drinking lots of soda, which often replaces milk in the diet, has been shown to increase the risk of bone fractures in teenage girls.

The effect of protein intake on bone mass depends on other nutrients. Protein helps build bone as long as calcium and vitamin D intake are adequate. But if intake of calcium and vitamin D is low, high protein intake can lead to bone loss.

Weight-bearing aerobic exercise helps maintain bone mass throughout life, and strength training improves bone density, muscle mass, strength, and balance. Drinking alcohol only in moderation, refraining from smoking, and managing depression and stress are also important for maintaining strong bones. For people who develop osteoporosis, a variety of medications are available to treat the condition.

radical production. A free radical is a chemically unstable molecule that reacts with fats, proteins, and DNA, damaging cell membranes and mutating genes. Free radicals have been implicated in aging, cancer, cardiovascular disease, and other degenerative diseases like arthritis.

Antioxidants found in foods can help protect the body from damage by free radicals in several ways. Some prevent or reduce the formation of free radicals; others remove free radicals from the body; still others repair some types of free radical damage after it occurs. Some antioxidants, such as vitamin C, vitamin E, and selenium, are also essential nutrients. Others—such as the carotenoids found in yellow, orange, and deep-green vegetables—

are not. Some of the top antioxidant-containing foods and beverages include blackberries, walnuts, strawberries, artichokes, cranberries, brewed coffee, raspberries, pecans, blueberries, cloves, grape juice, unsweetened baking chocolate, sour cherries, and red wine. Also high in antioxidants are brussels sprouts, kale, cauliflower, and pomegranates.

Phytochemicals Antioxidants fall into the broader category of **phytochemicals**, which are substances found in plant foods that may help prevent chronic disease. In just the past 30 years, researchers have identified and studied hundreds of different compounds found in foods, and many findings are promising. For example, certain substances found in soy foods may help lower cholesterol levels. Sulforaphane, a compound isolated from broccoli and other **cruciferous vegetables**, may

Ask Yourself

QUESTIONS FOR CRITICAL THINKING AND REFLECTION

Experts say that two of the most important factors in a healthy diet are eating the “right” kinds of carbohydrates and eating the “right” kinds of fats. Based on what you’ve read so far in this chapter, which are the “right” carbohydrates and fats? How would you say your own diet stacks up when it comes to carbs and fats?



phytochemical A naturally occurring substance found in plant foods that may help prevent and treat chronic diseases like cancer and heart disease; *phyto* means plant.

TERMS

cruciferous vegetables Vegetables of the cabbage family, including cabbage, broccoli, brussels sprouts, kale, and cauliflower; the flower petals of these plants form the shape of a cross, hence the name.



Berries are rich in antioxidants, vitamins, and dietary fiber.

render some carcinogenic compounds harmless. Allyl sulfides, a group of chemicals found in garlic and onions, appear to boost the activity of immune cells. Carotenoids found in green vegetables may help preserve eyesight with age. Further research on phytochemicals may extend the role of nutrition to the prevention and treatment of many chronic diseases.

If you want to increase your intake of phytochemicals, it is best to eat a variety of fruits, vegetables, and grains rather than relying on supplements. Like many vitamins and minerals, isolated phytochemicals may be harmful if taken in high doses. In many cases, their health benefits could be the result of many chemical substances working in combination. The role of phytochemicals in disease prevention is discussed further in Chapters 15 and 16.

NUTRITIONAL GUIDELINES: PLANNING YOUR DIET

Scientific and government groups have created a variety of tools to help people design healthy diets:

- The **Dietary Reference Intakes (DRIs)** are standards for nutrient intake designed to prevent nutritional deficiencies and reduce the risk of chronic diseases.
- The **Dietary Guidelines for Americans** were established to promote health and reduce the risk of major chronic diseases through diet and physical activity.
- **MyPlate (formerly MyPyramid)** provides a food guidance system to help people apply the Dietary Guidelines for Americans to their own diets.

Dietary Reference Intakes (DRIs)

The Food and Nutrition Board establishes dietary standards, or recommended intake levels, for Americans of all ages. The current set of standards, called Dietary Reference Intakes (DRIs), was introduced in 1997. The DRIs are frequently reviewed and are updated as substantial new nutrition-related information becomes available. The DRIs present different categories of nutrients in easy-to-read table format. The DRIs have a broad focus, being based on research that looks not just at the prevention of nutrient deficiencies but also at the role of nutrients in promoting health and preventing chronic diseases such as cancer, osteoporosis, and heart disease.

The DRIs include a set of four reference values used as standards for both recommended intakes and maximum safe intakes. The recommended intake of each nutrient is expressed as either *Recommended Dietary Allowance (RDA)* or *Adequate Intake (AI)*. An AI is set when there is not enough information available to set an RDA value; regardless of the type of standard used, however, the DRI represents the best available estimate of intake for optimal health. Used primarily in nutrition policy and research, the *Estimated Average Requirement (EAR)* is the average daily nutrient intake level estimated to meet the requirement of half the healthy individuals in a given gender and life stage. The *Tolerable Upper Intake Level (UL)* is the maximum daily intake that is unlikely to cause health problems in a healthy person. For example, the RDA for calcium for an 18-year-old female is 1300 mg per day; the UL is 3000 mg per day.

Because of lack of data, ULs have not been set for all nutrients. This does not mean that people can tolerate chronic intakes of these vitamins and minerals above recommended levels. Like all chemical agents, nutrients can produce adverse effects if intakes are excessive. There is no established benefit from consuming nutrients at levels above the RDA or AI. The DRIs can be found in the “Nutrition Resources” section at the end of the chapter.

Dietary Reference Intakes (DRIs) An umbrella term for four types of nutrient standards designed to prevent nutritional deficiencies and reduce the risk of chronic diseases. Estimated Average Requirement (EAR) is the amount estimated to meet the nutrient needs of half the individuals in a population group; Adequate Intake (AI) and Recommended Dietary Allowance (RDA) are levels of intake considered adequate to prevent nutrient deficiencies and reduce the risk of chronic disease for most individuals in a population group; Tolerable Upper Intake Level (UL) is the maximum daily intake that is unlikely to cause health problems.

Dietary Guidelines for Americans National nutritional recommendations issued jointly by the U.S. Department of Agriculture and the U.S. Department of Health and Human Services every five years; designed to promote health and reduce the risk of chronic diseases.

MyPlate The USDA food guidance system designed to help Americans make healthy food choices.

TERMS

Because the DRIs are too cumbersome to use as a basis for food labels, the U.S. Food and Drug Administration (FDA) uses another set of dietary standards, the **Daily Values**. The Daily Values are based on several different sets of guidelines and include standards for fat, cholesterol, carbohydrate, dietary fiber, and selected vitamins and minerals. The Daily Values represent appropriate intake levels for a 2000-calorie diet. The percentage Daily Value shown on a food label shows how well that food contributes to your recommended daily intake, assuming you follow a 2000-calorie-per-day diet. Food labels are described in detail later in the chapter.

Dietary Guidelines for Americans

To provide general guidance for choosing a healthy diet, the U.S. Department of Agriculture (USDA) and the U.S. Department of Health and Human Services (DHHS) issue the Dietary Guidelines for Americans, revising them every five years. These guidelines are intended for all healthy Americans, including children aged 2 and older.

Following these guidelines promotes health and reduces risk of chronic disease, including heart disease, cancer, diabetes, stroke, osteoporosis, and obesity. Each of the guidelines is supported by an extensive review of scientific and medical evidence.

The 2010 Dietary Guidelines are designed to help Americans make healthy and informed food choices. The main objective of the 2010 report is to encourage improved nutrition and physical activity in the American population, two-thirds of whom are overweight or obese and yet undernourished in several key nutrients. It focuses on the total diet and how to integrate the recommendations into a practical eating pattern that is nutrient-dense and calorie-balanced. And it includes findings on the broad environmental and societal aspects of the American diet—that is, the “food environment.”

The 2010 Dietary Guidelines point out the large discrepancy between the recommendations and the actual American diet, which includes too few vegetables, fruits, high-fiber whole grains, low-fat milk and milk products, and seafood and too much added sugar, solid fat, refined grains, and sodium. A variety of dietary patterns can help Americans meet the recommendations.

Daily Values A simplified version of the RDAs used on food labels; also included are values for nutrients with no RDA per se.

TERMS

Two-thirds of Americans are overweight or obese, yet many are undernourished in several key nutrients.

The environment affects both sides of the calorie balance equation—promoting overconsumption of calories and discouraging calorie expenditure in the form of physical activity.

General Guidelines The Dietary Guidelines present two overarching recommendations:

- *Maintain calorie balance over time to achieve and sustain a healthy weight.*
- *Focus on consuming nutrient-dense foods and beverages.*

The report acknowledges the challenges that make it difficult for Americans to reach their food and fitness goals, and it calls for a coordinated strategic plan that includes all sectors of society, from families to food producers and restaurants to policymakers. According to the report, adopting a healthy eating pattern and the recommendations in the Dietary Guidelines for Americans in their entirety will go a long way toward improving health and reducing the risk of chronic disease in every life stage. The Dietary Guidelines for Americans 2010 highlight several key areas—balancing calories to manage weight, reducing certain dietary components, increasing other dietary components, building healthy eating patterns, and making healthy choices in the context of the current food and physical activity environment. Specific recommendations for putting the Dietary Guidelines into practice are provided in MyPlate (discussed in the next section).

Balancing Calories to Manage Weight Calorie balance—the balance between calories consumed and calories expended—is the key to weight management. Current high rates of overweight and obesity can be attributed at least in part to people consuming more calories in foods and beverages than they expend in physical activity. In other words, many Americans are overweight because they are in calorie imbalance. Americans regardless of age are encouraged to achieve and maintain a healthy body weight by balancing the calories they consume with the calories they expend.

The guidelines recognize that many aspects of American life promote obesity, leading to an “obesogenic food environment.” The environment affects both sides of the calorie balance equation—promoting overconsumption of calories and discouraging calorie expenditure in the form of physical activity. Factors contributing to this environment include an increase in the number of fast-food restaurants in communities, an increase in meals eaten outside the home, increased portion sizes, sedentary work and home environments, limited availability of safe outdoor walking and recreational spaces, and increased dependence on transportation and technological advances that lead to lower calorie expenditure on everyday tasks.

Still, managing body weight means that individuals need to carefully consider their total calorie intake, and for people who

Nutrient	Recommended Daily Intake* 2000 calories		Orange Juice 168 calories		Low-Fat (1%) Milk 150 calories		Regular Cola 152 calories		Bottled Iced Tea 150 calories	
		% Daily	Nutrient value	% Daily	Nutrient value	% Daily	Nutrient value	% Daily	Nutrient value	
Carbohydrate	300 g	14%	40.5 g	6%	18 g	13%	38 g	13%	37.5 g	
Added sugars	32 g					119%	38 g +	108%	34.5 g +	
Fat	65 g			6%	3.9 g					
Protein	55 g			22%	12 g					
Calcium	1000 mg	3%	33 mg	45%	450 mg	1%	11 mg			
Potassium	4700 mg	15%	710 mg	12%	570 mg	<1%	4 mg			
Vitamin A	700 µg	4%	30 µg	31%	216 µg					
Vitamin C	75 mg	193%	145.5 mg +	5%	3.6 mg					
Vitamin D	15 µg			25%	3.7 µg					
Folate	400 µg	40%	160 µg	5%	20 µg					

Bars show percentage of recommended daily intake or limit
 + = Greater than 100% of recommended

*Recommended intakes and limits appropriate for a 20-year-old woman consuming 2000 calories per day.

FIGURE 12.3 Nutrient density of 12-ounce portions of selected beverages.

are overweight or obese, this means consuming fewer calories from foods and beverages. The guidelines encourage people to become more conscious of what, when, why, and how much they eat; to deliberately make better choices; to seek ways to be more physically active, striving to meet the recommendations in the 2008 Physical Activity Guidelines for Americans; and to maintain a healthy weight at all stages of life. The guidelines also urge people to cook at home more and eat out less, to eat smaller portions, to limit screen time, and not to eat while watching TV.

Foods and Food Components to Reduce In addition to overall calories, Americans tend to eat certain foods and food components in excess—in particular, sodium, solid fats, added sugars, and refined grains. Foods high in these items often replace foods with needed nutrients in the diet. Key recommendations include the following:

- Reduce daily sodium intake to less than 2,300 milligrams (mg) and further reduce intake to 1,500 mg if you are 51 or older, are African American, or have hypertension, diabetes, or chronic kidney disease. The 1500 mg recommendation applies to about half the U.S. population, including children and the majority of adults. The average sodium intake for all Americans is estimated at 3400 mg; for boys and men between the ages of 12 and 50, it is estimated at more than 4000 mg. High sodium intake is associated with high blood pressure. Most salt in the diet comes from salt added during food processing.
- Limit intake of saturated fats, trans fats, and dietary cholesterol. Consume less than 10% of calories from saturated fatty acids by replacing them with monounsaturated and polyunsaturated fatty acids. Keep trans fatty acid consumption as

low as possible, especially by limiting foods that contain synthetic sources of trans fats, such as partially hydrogenated oils. Consume less than 300 mg per day of dietary cholesterol.

- Reduce the intake of calories from solid fats and added sugars. Together, solid fats and added sugars contribute about 35% of the calories consumed by Americans without contributing many nutrients (Figure 12.3). Most people should consume no more than 5–15% of daily calories from foods in these categories. Sodas, energy drinks, and sports drinks are the biggest source of added sugars in the American diet.
- Limit the consumption of foods that contain refined grains, especially refined grain foods that contain solid fats, added sugars, and sodium.
- 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 In general, Americans don't eat a wide enough variety of nutrient-dense foods to obtain all the nutrients they need in the amounts for optimal health. Recommendations include these:

- Eat more fruits and vegetables, and eat a variety of vegetables, especially dark-green, red, and orange vegetables and beans and peas.
- Consume at least half of all grains as whole grains, which are a source of iron, B vitamins, and dietary fiber. Increase whole-grain intake by replacing refined grains with whole grains.
- Increase intake of fat-free or low-fat milk and milk products, such as milk, yogurt, cheese, or fortified soy beverages.

They are important sources of calcium, potassium, magnesium, vitamin D, and vitamin A. Milk and yogurt are preferable to cheese.

- Choose a variety of protein foods, including seafood, lean meat and poultry, eggs, beans and peas, soy products, and unsalted nuts and seeds. Increase the amount and variety of seafood, and reduce protein foods that are high in solid fats and calories. In addition to protein, these foods provide B vitamins, vitamin E, zinc, and magnesium. Seafood provides omega-3 fatty acids, which are associated with reduced risk of heart disease.
- Use oils to replace solid fats where possible.
- 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.
- Other nutrients are a concern for certain specific population groups, such as folic acid and iron for women who are pregnant or may become pregnant and vitamin B-12 for adults aged 50 or older.

Building Healthy Eating Patterns There are many different ways to incorporate the individual recommendations of the 2010 Dietary Guidelines into healthy eating patterns that (1) meet nutrient needs; (2) stay within calorie limits; (3) accommodate cultural, ethnic, traditional, and personal preferences; and (4) take into account food cost and availability. In other words, people can eat healthfully in many different ways. (For tips on eating healthfully in a variety of ethnic restaurants, see the box “Ethnic Foods.”)

Three eating plans that show how to put the Dietary Guidelines recommendations into action are the USDA Food Patterns, vegetarian adaptations of the USDA Food Patterns, and the DASH Eating Plan. The USDA Food Patterns and their vegetarian variations were developed to assist people in implementing the Dietary Guidelines. The DASH Eating Plan was developed to help people control high blood pressure. All of these plans emphasize fruits, vegetables, whole grains, beans and peas, fat-free and low-fat milk and milk products, and healthy oils. They include less red meat and more seafood than the typical American diet.

A general principle in all these diets is that people should eat nutrient-dense foods—foods with little or no solid fats and added sugars—so they get all the needed nutrients without exceeding calorie limits. Another principle is that people should get their nutrients from foods rather than from dietary supplements, although supplements or fortification may be helpful for certain populations. The guidelines encourage people to take into account all the foods and beverages they consume, particularly beverages with added sugars, which are a major source of calories.

The USDA Food Patterns set recommended amounts of food to eat from each of five food groups and subgroups at

different calorie levels. They also allow a certain amount of oils, and they limit the number of calories that should be consumed from solid fats and added sugars (SoFAS). You can use the chart shown in Figure 12.4 to find out the recommended intake of foods in each food group at your calorie level. For help determining your calorie level, refer to Table 12.6.

The vegetarian adaptations of the USDA Food Patterns include changes in the protein group and, for vegans, in the dairy group. The vegetarian variations, especially the vegan variation, rely on some fortified foods to ensure that the diet provides all required nutrients, such as calcium and vitamin B-12.

The DASH Eating Plan emphasizes fruits, vegetables, fat-free and low-fat milk and milk products, whole grains, fish, poultry, seeds, and nuts. It has less sodium, fat, and red meat and fewer sweets and added sugars than the typical American diet. The DASH Eating Plan has been shown to help people lower their blood pressure and cholesterol levels, and it is associated with a lower risk of cardiovascular disease. For more details on the DASH Eating Plan, see the Nutrition Resources section at the end of the chapter.

The eating pattern associated with many cultures bordering the Mediterranean Sea and referred to as the Mediterranean diet or the Mediterranean-style eating pattern has many features in common with the USDA Food Patterns and the DASH Eating Plan. It emphasizes fruits and vegetables, nuts, olive oil, and grains, often whole grains, and includes only small amounts of meat and full-fat milk and milk products. The Mediterranean diet has been associated with lower rates of heart disease and lower rate of total mortality.

Helping Americans Make Healthy Choices A final area covered by the 2010 Dietary Guidelines for Americans is the environment in which people make their food choices. To make healthy choices, individuals need opportunities to obtain healthy foods and engage in physical activity. Significant numbers of Americans—notably members of racial and ethnic minorities, people with disabilities, and people with lower incomes—lack access to affordable, nutritious foods and/or opportunities for safe physical activity in their neighborhoods. The guidelines also recognize the need for *food security* in the United States—defined as the ability to acquire adequate food to meet nutritional needs in a socially acceptable manner. Nearly 15% of the population is not able to obtain sufficient food to meet basic nutritional needs, and as already noted, many more Americans have diets that provide adequate calories but are deficient in essential nutrients.

The Dietary Guidelines propose the Social Ecological Model as a way to understand and address these complex problems. This model considers the interaction among individual factors (such as gender, income, and race/ethnicity), environmental settings (such as schools, workplaces, and restaurants), various sectors of influence (such as health care systems, agriculture, and

QUICK STATS

Soda, energy drinks, and sports drinks contribute almost **36% of added sugars** in the diets of Americans aged 2 years and older.

—Dietary Guidelines for Americans, 2010

DIVERSITY MATTERS

Ethnic Foods



No single ethnic diet clearly surpasses all others in providing people with healthful foods. However, every diet has advantages and disadvantages and, within each cuisine, some foods are better choices. The dietary guidance described in this chapter can be applied to any ethnic cuisine. For additional guidance, refer to the table below.

	Choose More Often	Choose Less Often
Chinese	Dishes that are steamed, poached (jum), boiled (chu), roasted (kow), barbecued (shu), or lightly stir-fried Hoisin sauce, oyster sauce, wine sauce, plum sauce, velvet sauce, or hot mustard Fresh fish and seafood, skinless chicken, tofu Mixed vegetables, Chinese greens Steamed rice, steamed spring rolls, soft noodles	Fried wontons or egg rolls Crab rangoon Crispy (Peking) duck or chicken Sweet-and-sour dishes made with breaded and deep-fried meat, poultry, or fish Fried rice Fried or crispy noodles
French	Dishes prepared au vapeur (steamed), en brochette (skewered and broiled), or grillé (grilled) Fresh fish, shrimp, scallops, or mussels or skinless chicken, without sauces Clear soups	Dishes prepared à la crème (in cream sauce), au gratin or gratinée (baked with cream and cheese), or en croûte (in pastry crust) Drawn butter, hollandaise sauce, and remoulade (mayonnaise-based sauce)
Greek	Dishes that are stewed, broiled, or grilled, including shish kebabs (souvlaki) Dolmas (grape leaves) stuffed with rice Tzatziki (yogurt, cucumbers, and garlic) Tabouli (bulgur-based salad) Pita bread, especially whole wheat	Moussaka, saganaki (fried cheese) Vegetable pies such as spanakopita and tyropita Baba ghanoush (eggplant and olive oil) Deep-fried falafel (chickpea patties) Gyros stuffed with ground meat Baklava
Indian	Dishes prepared masala (curry), tandoori (roasted in a clay oven), or tikke (pan roasted); kebabs Raita (yogurt and cucumber salad) and other yogurt-based dishes and sauces Dal (lentils), pullao or pilau (basmati rice) Chapati (baked bread)	Ghee (clarified butter) Korma (meat in cream sauce) Samosas, pakoras (fried dishes) Molee and other coconut milk–based dishes Poori, bhatura, or paratha (fried breads)
Italian	Pasta primavera or pasta, polenta, risotto, or gnocchi with marinara, red or white wine, white or red clam, or light mushroom sauce Dishes that are grilled or prepared cacciatore (tomato-based sauce), marsala (broth and wine sauce), or piccata (lemon sauce) Cioppino (seafood stew) Vegetable soup, minestrone or fagioli (beans)	Antipasto (cheese, smoked meats) Dishes that are prepared alfredo, frito (fried), crema (creamed), alla panna (with cream), or carbonara Veal scaloppini Chicken, veal, or eggplant parmigiana Italian sausage, salami, and prosciutto Buttered garlic bread Cannoli
Japanese	Dishes prepared nabemono (boiled), shabu-shabu (in boiling broth), mushimono (steamed), nimono (simmered), yaki (broiled), or yakimono (grilled) Sushi or domburi (mixed rice dish) Steamed rice or soba (buckwheat), udon (wheat), or rice noodles	Tempura (battered and fried) Agemono (deep fried) Katsu (fried pork cutlet) Sukiyaki Fried tofu
Mexican	Soft corn or wheat tortillas Burritos, fajitas, enchiladas, soft tacos, and tamales filled with beans, vegetables, or lean meats Refried beans, nonfat or low-fat; rice and beans Ceviche (fish marinated in lime juice) Salsa, enchilada sauce, and picante sauce Gazpacho, menudo, or black bean soup Fruit or flan for dessert	Crispy, fried tortillas Dishes that are fried, such as chile relleños, chimichangas, flautas, and tostadas Nachos and cheese, chili con queso, and other dishes made with cheese or cheese sauce Guacamole, sour cream, and extra cheese Refried beans made with lard Fried ice cream
Thai	Dishes that are barbecued, sautéed, broiled, boiled, steamed, braised, or marinated Sâté (skewered and grilled meats) Fish sauce, basil sauce, chili or hot sauces Bean thread noodles, Thai salad	Coconut milk soup Peanut sauce or dishes topped with nuts Mee-krob (crispy noodles) Red, green, and yellow curries, which typically contain coconut milk

SOURCES: National Heart, Lung and Blood Institute. 2006. *Guidelines on Overweight and Obesity: Electronic Textbook* (http://www.nhlbi.nih.gov/guidelines/obesity/e_txtbk/index.html); Duyff, R. L. 2012. *The American Dietetic Association's Complete Food and Nutrition Guide*, 4th ed. Hoboken, NJ: Wiley.



Daily Amount of Food from Each Group
Food group amounts shown in cups (c) or ounce-equivalents (oz-eq)

Calorie level of pattern	1600	1800	2000	2200	2400	2600	2800	3000
Fruits	1.5 c	1.5 c	2 c	2 c	2 c	2 c	2.5 c	2.5 c
Vegetables	2 c	2.5 c	2.5 c	3 c	3 c	3.5 c	3.5 c	4 c
Dark-green	1.5 c/wk	1.5 c/wk	1.5 c/wk	2 c/wk	2 c/wk	2.5 c/wk	2.5 c/wk	2.5 c/wk
Red and orange	4 c/wk	5.5 c/wk	5.5 c/wk	6 c/wk	6 c/wk	7 c/wk	7 c/wk	7.5 c/wk
Beans and peas (legumes)	1 c/wk	1.5 c/wk	1.5 c/wk	2 c/wk	2 c/wk	2.5 c/wk	2.5 c/wk	3 c/wk
Starchy	4 c/wk	5 c/wk	5 c/wk	6 c/wk	6 c/wk	7 c/wk	7 c/wk	8 c/wk
Other	3.5 c/wk	4 c/wk	4 c/wk	5 c/wk	5 c/wk	5.5 c/wk	5.5 c/wk	7 c/wk
Grains	5 oz-eq	6 oz-eq	6 oz-eq	7 oz-eq	8 oz-eq	9 oz-eq	10 oz-eq	10 oz-eq
Whole grains	3 oz-eq	3 oz-eq	3 oz-eq	3.5 oz-eq	4 oz-eq	4.5 oz-eq	5 oz-eq	5 oz-eq
Enriched grains	2 oz-eq	3 oz-eq	3 oz-eq	3.5 oz-eq	4 oz-eq	4.5 oz-eq	5 oz-eq	5 oz-eq
Protein foods	5 oz-eq	5 oz-eq	5.5 oz-eq	6 oz-eq	6.5 oz-eq	6.5 oz-eq	7 oz-eq	7 oz-eq
Seafood	8 oz/wk	8 oz/wk	8 oz/wk	9 oz/wk	10 oz/wk	10 oz/wk	11 oz/wk	11 oz/wk
Meat poultry, eggs	24 oz/wk	24 oz/wk	26 oz/wk	29 oz/wk	31 oz/wk	31 oz/wk	34 oz/wk	34 oz/wk
Nuts, seeds, soy products	4 oz/wk	4 oz/wk	4 oz/wk	4 oz/wk	5 oz/wk	5 oz/wk	5 oz/wk	5 oz/wk
Dairy	3 c	3 c	3 c	3 c	3 c	3 c	3 c	3 c
Oils	22 g	24 g	27 g	29 g	31 g	34 g	36 g	44 g
Maximum SoFAS limit, calories (% of calories)	121 (8%)	161 (9%)	258 (13%)	266 (12%)	330 (14%)	362 (14%)	395 (14%)	459 (15%)

FIGURE 12.4 USDA Food Patterns. To determine an appropriate amount of food from each food group, find the column for your estimated daily calorie level. That column shows the recommended daily intake from each group. For a personalized intake plan, visit ChooseMyPlate.gov.

SOURCE: U.S. Department of Agriculture and U.S. Department of Health and Human Services. 2010. *Dietary Guidelines for Americans, 2010*. 7th edition. Washington, DC: U.S. Government Printing Office.

media), and social and cultural norms and values (such as assumptions regarding body weight, types of foods consumed, and amount of physical activity incorporated into one's free time). All these factors play a role in a person's food and physical activity choices—and ultimately in a person's health risks and outcomes.

The guidelines call on all elements of society, ranging from educators to communities to government policymakers, to implement strategies aimed at improving the food and activity environment in the United States. Examples of such strategies are expanding access to grocery stores, farmers' markets, and other sources of healthy food; ensuring that meals and snacks served in schools are consistent with the Dietary Guidelines;

encouraging physical activity in schools; developing policies to limit food and beverage marketing to children; supporting sustainable agricultural practices; and providing nutrition assistance programs. Such measures have the potential to improve the health of current and future generations by making healthy physical activity and eating choices the norm.

USDA's MyPlate

To further help consumers put the Dietary Guidelines for Americans into practice, the USDA also issues the food guidance system known as MyPlate (formerly MyPyramid).

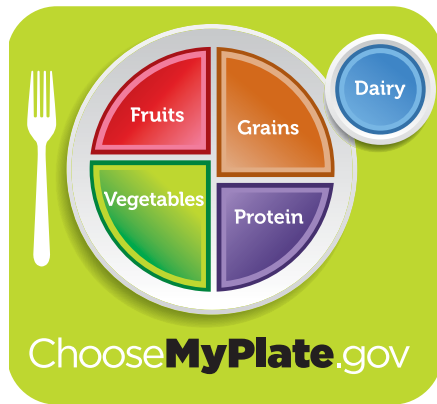


FIGURE 12.5 How to eat for health. Released in 2011, the USDA's MyPlate is designed as a simple graphic to help Americans apply the Dietary Guidelines for Americans to their own diets. MyPlate contains five main food groups and seven key messages for consumers: Enjoy your food, but eat less; avoid oversized portions; make half your plate fruits and vegetables; make at least half your grains whole; switch to fat-free or low-fat (1%) milk; compare the sodium in your foods; drink water instead of sugary drinks.

SOURCE: U.S. Department of Agriculture. 2010. *Choose MyPlate* (<http://www.choosemyplate.gov>).

MyPlate provides a simple graphic showing how to use the five good groups to build a healthy plate at each meal (Figure 12.5). Key messages include the following:

- Balancing calories:
 - Enjoy your food, but eat less.
 - Avoid oversized portions.
- Foods to increase:
 - Make half your plate fruits and vegetables.
 - Make at least half your grains whole grains.
 - Switch to fat-free or low-fat (1%) milk.
- Foods to reduce:
 - Compare sodium in foods like soup, bread, and frozen meals and choose the foods with lower numbers.
 - Drink water instead of sugary drinks.

MyPlate encourages individuals to take advantage of the customization made possible by the Internet. You can get a personalized version of MyPlate recommendations by visiting www.ChooseMyPlate.gov. Using the daily food plan feature, you can determine the amount of each food group you need daily based on your calorie allowance. Your plan is personalized based on your age, gender, weight, height, and level of physical activity. Another feature available at ChooseMyPlate.gov is the SuperTracker, which helps consumers create a personalized food and activity plan, look up and track individual foods, compare food choices to recommendations, and get suggestions and support to make healthier choices. MyPlate is available in Spanish, and there are special recommendations for dieters, preschoolers aged 2–5, children aged 6–11, and pregnant and breastfeeding women.

Each food group is described briefly in the following sections. Many Americans have trouble identifying serving sizes,

so recommended daily intakes from each group are given in terms of cups and ounces; see the box “Judging Portion Sizes” for additional advice.

Whole and Refined Grains Foods from this group are usually low in fat and rich in complex carbohydrates, dietary fiber (if grains are unrefined), and vitamins and minerals, including thiamin, riboflavin, iron, niacin, folic acid (if enriched or fortified), and zinc. A 2000-calorie diet should include 6 ounce-equivalents each day, with half of those servings from whole grains such as whole-grain bread, whole-wheat pasta, high-fiber cereal, or brown rice. The key message for consumers is this: *Make at least half of your grains whole grains.* The following items count as a 1 ounce-equivalent:

- 1 slice of bread
- 1 small (2½-inch diameter) muffin
- 1 cup ready-to-eat cereal flakes
- ½ cup cooked cereal, rice, grains, or pasta
- 1 6-inch tortilla

Choose foods that are typically made with little fat or sugar (bread, rice, pasta) over those that are high in fat and sugar (croissants, chips, cookies).

Vegetables Vegetables contain carbohydrates, dietary fiber, carotenoids, vitamin C, folate, potassium, and other nutrients. They are naturally low in fat. A 2000-calorie diet should include 2½ cups of vegetables daily. The key message for the vegetable group is this: *Make half your plate fruits and vegetables.* Each of the following counts as 1 cup from the vegetable group:

- 1 cup raw or cooked vegetables
- 2 cups raw leafy salad greens
- 1 cup vegetable juice

Because vegetables vary in the nutrients they provide, it is important to eat a variety of vegetables to obtain maximum nutrition. MyPlate recommends weekly servings from five different subgroups within the vegetables group (see Figure 12.4). Try to eat vegetables from several subgroups each day.

Fruits Fruits are rich in carbohydrates, dietary fiber, and many vitamins, especially vitamin C. A 2000-calorie diet should include 2 cups of fruits daily. The key message for the fruit group is this: *Make half your plate fruits and vegetables.* Each of the following counts as 1 cup from the fruit group:

- 1 cup fresh, canned, or frozen fruit
- 1 cup fruit juice (100% juice)
- 1 small whole fruit
- ½ cup dried fruit

Choose whole fruits often; they are higher in fiber and often lower in calories than fruit juices. Fruit *juices* typically contain more nutrients and less added sugar than fruit *drinks*. When buying canned fruits, choose those packed in 100% fruit juice or water rather than in syrup.

Table 12.6

Estimated Daily Calorie Needs

AGE (YEARS)	SEDENTARY ^a	MODERATELY ACTIVE ^b	ACTIVE ^c
Female			
2–3	1000	1000–1400	1000–1400
4–8	1200–1400	1400–1600	1400–1800
9–13	1400–1600	1600–2000	1800–2200
14–18	1800	2000	2400
19–30	1800–2000	2000–2200	2400
31–50	1800	2000	2200
51+	1600	1800	2000–2200
Male			
2–3	1000–1200	1000–1400	1000–1400
4–8	1400–1600	1400–1600	1600–2000
9–13	1600–2000	1800–2200	2000–2600
14–18	2000–2400	2400–2800	2800–3200
19–30	2400–2600	2600–2800	3000
31–50	2200–2400	2400–2600	2800–3000
51+	2000–2200	2200–2400	2400–2800

^aA lifestyle that includes only the light physical activity associated with typical day-to-day life

^bA lifestyle that includes physical activity equivalent to walking about 1.5 to 3 miles per day at 3 to 4 miles per hour (30–60 minutes a day of moderate physical activity), in addition to the light physical activity associated with typical day-to-day life

^cA lifestyle that includes physical activity equivalent to walking more than 3 miles per day at 3 to 4 miles per hour (60 or more minutes a day of moderate physical activity), in addition to the light physical activity associated with typical day-to-day life

SOURCE: U.S. Department of Health and Human Services and U.S. Department of Agriculture. 2011. *Dietary Guidelines for Americans, 2010* (<http://www.cnpp.usda.gov/publications/dietaryguidelines/2010/policydoc/policydoc.pdf>).

Dairy This group includes milk and milk products, such as yogurt and cheeses that retain their calcium, as well as calcium-fortified soy milk. Foods from this group are high in protein, carbohydrate, calcium, potassium, riboflavin, and vitamin D (if fortified). Dairy choices should be fat-free or low-fat as much as possible to reduce calories and limit saturated fats. The key message for the dairy group is this: *Switch to fat-free or low-fat (1%) milk*. A 2000-calorie diet should include 3 cups of milk or the equivalent daily. Each of the following counts as the equivalent of 1 cup:

- 1 cup milk
- 1 cup yogurt
- ½ cup ricotta cheese
- 1½ ounces natural cheese
- 2 ounces processed cheese

Cottage cheese is lower in calcium than most other cheeses; ½ cup is equivalent to ¼ cup milk. Ice cream is also lower in

calcium and higher in sugar and fat than many other dairy products; one scoop counts as ⅓ cup milk.

Protein Foods This group includes meat, poultry, fish, dried beans and peas, eggs, nuts, and seeds, and processed soy foods. These foods provide protein, niacin, iron, vitamin B-6, zinc, and thiamin. The animal foods in this group also provide vitamin B-12. A 2000-calorie diet should include 5½ ounce-equivalents daily. Each of the following counts as equivalent to 1 ounce:

- 1 ounce cooked lean meat, poultry, or fish
- ¼ cup cooked dried beans (legumes) or tofu
- 1 egg
- 1 tablespoon peanut butter
- ½ ounce nuts or seeds

Choose lean meats and skinless poultry, select a variety of protein foods, and watch serving sizes carefully. Choose at least one serving of plant proteins, such as black beans, lentils, or tofu, every day, and include at least 8 ounces of cooked seafood per week.

Oils Included in this category are oils and fats that are liquid at room temperature; they come mostly from plant and fish sources. Also included are soft margarines, soft vegetable oil table spreads, mayonnaise, and some salad dressings that have no trans fats. These are major sources of vitamin E and unsaturated fatty acids, including essential fatty acids, but they are not a food group. A 2000-calorie diet should include 6 teaspoons (27g) of oils per day. One teaspoon is the equivalent of the following:

- 1 teaspoon vegetable oil or soft margarine
- 1 tablespoon mayonnaise-type salad dressing

Foods that are mostly oils include nuts, olives, avocados, and some fish. The following portions include about 1 teaspoon of oil: 8 large olives, ⅓ medium avocado, ½ tablespoon peanut butter, and ⅓ ounce roasted nuts. Food labels can help you identify the types and amounts of fat in various foods.

Solid Fats and Added Sugars (SoFAs) If you consistently choose nutrient-dense foods that are fat-free or low-fat and that contain no added sugars, you can also have a small amount of additional calories in the form of solid fats and added sugars (SoFAS). Figure 12.4 shows the maximum number of SoFAS calories allowed at each calorie level in MyPlate. The average American consumes nearly 800 calories daily from solid fats and added sugars—far higher than the recommended limits.

People who are trying to lose weight may choose not to ingest SoFAS calories. For those wanting to maintain weight, these calories may be used to increase the amount of food from a food group; to consume foods that contain solid fats or added sugars; or to consume alcohol.

The current American diet includes higher levels of sugar intake and more calories per day from sugar than recommended. In particular, experts advise consumers to

TAKE CHARGE Judging Portion Sizes



Studies have shown that most people underestimate the size of their food portions, in many cases by as much as 50%. If you need to retrain your eye, try using measuring cups and spoons and an inexpensive kitchen scale when you eat at home. With a little practice, you'll learn the difference between 3 and 8 ounces of chicken or meat and what a half-cup of rice really looks like. For quick estimates, use the following equivalents:

- 1 teaspoon of margarine = the tip of your thumb
- 1 ounce of cheese = your thumb, four dice stacked together, or an ice cube
- 3 ounces of chicken or meat = a deck of cards
- 1 cup of pasta = a small fist or a tennis ball

- ½ cup of rice or cooked vegetables = an ice cream scoop or one-third of a can of soda
- 2 tablespoons of peanut butter = a ping-pong ball or a large marshmallow
- 1 medium potato = a computer mouse
- 2-ounce muffin or roll = a plum or a large egg
- 2-ounce bagel = a hockey puck or a yo-yo
- 1 medium fruit (apple or orange) = a baseball
- ¼ cup nuts = a golf ball
- Small cookie or cracker = a poker chip

be wary of products containing high-fructose corn syrup. Although this sweetener is not harmful in itself, it is high in calories and very low in nutritional value. High-fructose corn syrup is found in many products, especially soft drinks and processed foods. Research has linked high consumption of high-fructose corn syrup with obesity, diabetes, and other health problems.

For an evaluation of your diet, complete the activity in the box “Your Diet versus MyPlate Recommendations.”

Physical Activity The Dietary Guidelines for Americans and MyPlate strongly encourage all Americans to be physically active as much as possible. Daily physical activity improves health, reduces the risk of chronic diseases, and helps people manage body weight. The MyPlate recommendation for adults is 2½ hours of moderate physical activity or 1¼ hours of vigorous physical activity per week, equivalent to the 150 minutes of moderate activity or 75 minutes of vigorous activity recommended in the 2008 Physical Activity Guidelines for Americans.

The Vegetarian Alternative

Vegetarians choose a diet with one basic difference from the diets described previously—they restrict or exclude foods of animal origin (meat, poultry, fish, eggs, and milk). Vegetarian diets tend to be lower in total calories and calories from fat, saturated fat, cholesterol, and animal protein while being higher in complex carbohydrates, dietary fiber, potassium, folate, vitamins C and E, carotenoids, and phytochemicals. Individuals who follow a vegetarian diet generally have a lower body mass index than nonvegetarians. Many people adopt a vegetarian diet for health reasons, while others do so

out of concern for the environment, for financial reasons, or for reasons related to ethics or religion.

Types of Vegetarian Diets There are various vegetarian styles. The wider the variety of the diet eaten, the easier it is to meet nutritional needs.

- *Vegans* eat only plant foods.
- *Lacto-vegetarians* eat plant foods and dairy products.
- *Lacto-ovo-vegetarians* eat plant foods, dairy products, and eggs.

Table 12.7

Top Ten Sources of Calories in the American Diet, from the National Health and Nutrition Examination Survey (NHANES), 2005–2006

FOOD	CALORIES PER DAY
Grain-based desserts	138
Yeast breads	129
Chicken and chicken-mixed dishes	121
Soda/energy/sports drinks	114
Pizza	98
Alcoholic beverages	82
Pasta and pasta dishes	81
Mexican mixed dishes	80
Beef and beef mixed dishes	64
Dairy desserts	62

NOTE: For teenagers aged 14–18, the top source of calories is soda/energy/sports drinks, accounting for 226 calories per day.

SOURCE: U.S. Department of Health and Human Services and U.S. Department of Agriculture. 2011. Dietary Guidelines for Americans, 2010 (<http://www.cnpp.usda.gov/publications/dietaryguidelines/2010/policydoc/policydoc.pdf>).

vegetarian Someone who follows a diet that restricts or eliminates foods of animal origin.

TERMS



You can track your diet and physical activity and create a personal diet plan by using the online tools at ChooseMyPlate.gov.

Others can be categorized as partial vegetarians, semivegetarians, or pescovegetarians. These people eat plant foods, dairy products, eggs, and usually a small selection of poultry, fish, and other seafood. Many other people choose vegetarian meals frequently but are not strictly vegetarians. Including some animal protein (such as dairy products) in a vegetarian diet makes planning easier, but it is not necessary.

A Food Plan for Vegetarians Adapting the USDA Food Patterns and MyPlate for vegetarians requires only a few key modifications. For the meat and beans group, vegetarians can focus on the nonmeat choices of dry beans, nuts, seeds, eggs, and soy foods like tofu. Vegans and other vegetarians who do not consume any dairy products must find other rich sources of calcium. Fruits, vegetables, and whole grains are healthy choices for people following all types of vegetarian diets.

A healthy vegetarian diet emphasizes a wide variety of plant foods. Although plant proteins are generally of lower quality than animal proteins, choosing a variety of plant foods will supply all of the essential amino acids. Choosing minimally processed and unrefined foods will maximize nutrient value and provide ample dietary fiber. Daily consumption of a variety of plant foods in amounts that meet total energy needs can provide all needed nutrients, except vitamin B-12 and possibly calcium, iron, zinc, and vitamin D. Strategies for obtaining nutrients of concern include the following:

- *Vitamin B-12* occurs naturally only in animal foods. If dairy products and eggs are limited or avoided, B-12 can be

obtained from fortified foods such as ready-to-eat cereals, soy beverages, meat substitutes, and special yeast products or from supplements.

- *Vitamin D* can be obtained by spending 5–15 minutes a day in the sun (without sunscreen), from vitamin D–fortified products like ready-to-eat cereals, fortified orange juice, and soy or rice milk, or by taking a supplement.

- *Calcium* is found in legumes, tofu processed with calcium, dark green leafy vegetables, nuts, tortillas made from lime-processed corn, and fortified orange juice, soy milk, bread, and other foods.

- *Iron* can be obtained from whole grains, fortified bread and breakfast cereals, dried fruits, green leafy vegetables, nuts and seeds, legumes, and soy foods. The iron in plant foods is more difficult for the body to absorb than is the iron from animal sources; consuming a good source of vitamin C with most meals is helpful because vitamin C improves iron absorption.

- *Zinc* is found in whole grains, nuts, legumes, and soy foods.

If you're a vegetarian, remember that it's especially important to eat as wide a variety of foods as possible to ensure that all your nutritional needs are satisfied. Consulting with a registered dietitian will make your meal planning easier. Vegetarian diets for children, teens, and pregnant and lactating women warrant professional guidance.

QUICK STATS

5% of American adults identify themselves as vegetarians.

—The Vegetarian Resource Group, 2011

ASSESS YOURSELF

Your Diet versus MyPlate Recommendations



1. *Keep a food record:* To evaluate your daily diet, begin by keeping a record of everything you eat on a typical day. To help with your analysis, break down each food item into its component parts and note your portion sizes. For example, you might list a turkey sandwich as 2 slices of sourdough bread, 3 ounces of turkey, 1 tomato, 1 tablespoon of mayonnaise, and so on.
2. *Compare your servings to the recommendations of MyPlate:* Complete the following chart to compare your daily diet to the USDA Food Intake Patterns and MyPlate. See Figure 12.4 for the recommended amount or servings for your calorie level.

Food Group	Recommended Daily Amounts/Servings for Your Energy Intake	Your Actual Daily Intake (Amounts/Servings)	Serving Sizes and Equivalents
Grains (total)			1 ounce-equivalent = 1 slice of bread; 1 small muffin; 1 cup ready-to-eat cereal flakes; or ½ cup cooked cereal, rice, grains, or pasta
Whole grains			
Refined grains			
Vegetables (total)			1 cup or equivalent (1 serving) = 1 cup raw or cooked vegetables; 2 cup raw leafy salad greens; or 1 cup vegetable juice
Dark green*			
Deep yellow*			
Legumes*			
Starchy*			
Other*			
Fruits			1 cup or equivalent (1 serving) = 1 cup fresh, canned, or frozen fruit; 1 cup fruit juice; 1 small whole fruit; or ½ cup dried fruit
Dairy			1 cup or equivalent = 1 cup milk or yogurt; 1½ oz natural cheese; or 2 oz processed cheese
Protein foods			1 ounce-equivalent = 1 oz lean meat, poultry, or fish; ¼ cup cooked dry beans or tofu; 1 egg; 1 tablespoon peanut butter; or ½ oz nuts or seeds
Seafood*			
Meat, poultry, eggs*			
Nuts, seeds, soy products*			
Oils			1 teaspoon or equivalent = 1 teaspoon vegetable oil or 1 tablespoon mayonnaise-type salad dressing
Maximum SoFAS			

*Calculate daily intake from the weekly amounts shown in Figure 12.4.

It may be difficult to track values for added sugars, and especially for oils and fats, but be as accurate as you can. Check food labels for information about fat and sugar. (NOTE: For a more complete and accurate analysis of your diet, keep food records for three days and then average the results.) ChooseMyPlate.gov has additional guidelines for counting discretionary calories.

3. *Further evaluate your food choices within the groups:* Based on the data you collected and what you learned in this chapter, what were the especially healthy choices you made (for example, whole grains and citrus fruits), and what were your less healthy choices? Identify and list foods in the latter category because these are areas where you can make changes to improve your diet. In particular, you may want to limit your intake of the following: processed, sweetened grains; high-fat meats and poultry skin; deep-fried fast foods; full-fat dairy products; regular sodas, sweetened teas, and fruit drinks; alcoholic beverages; and other foods that provide primarily sugar and fat and few other nutrients.
4. *Make healthy changes:* Bring your diet in line with MyPlate by adding servings from food groups for which you fall short of the recommendations. To maintain a healthy weight, you may need to balance these additions by making reductions in other areas—by eliminating some of the fats, oils, sweets, and alcohol you consume; by cutting extra servings from food groups for which your intake is more than adequate; or by making healthier choices within the food groups. Make a list of foods to add and a list of foods to eliminate, and post your lists in a prominent location.

For a more detailed and customized analysis of your current diet, including intakes of specific nutrients, use the online SuperTracker tool available at MyPlate.gov.



WELLNESS ON CAMPUS

Eating Strategies for College Students

All the Time

- Eat a colorful, varied diet. The more colorful your diet is, the more varied and rich in fruits and vegetables it will be. Fruits and vegetables are typically inexpensive, delicious, nutritious, and low in fat and calories.
- Eat breakfast. You'll have more energy in the morning and be less likely to grab an unhealthy snack later on.
- Choose healthy snacks—fruits, vegetables, whole grains, and cereals.
- Drink nonfat milk, water, mineral water, or 100% fruit juice more often than soft drinks or sweetened beverages.
- Pay attention to portion sizes.
- Combine physical activity with healthy eating.

Eating in the Dining Hall

- Choose a meal plan that includes breakfast.
- Decide what you want to eat before you get in line, and stick to your choices.
- Build your meals around whole grains and vegetables. Ask for small servings of meat and high-fat main dishes.
- Choose leaner poultry, fish, or bean dishes rather than high-fat meats and fried entrees.
- Ask that gravies and sauces be served on the side; limit your intake.
- Choose broth-based or vegetable soups, not cream soups.
- At the salad bar, load up on leafy greens, beans, and fresh vegetables. Avoid mayonnaise-coated salads, bacon, croutons,

and high-fat dressings. Put dressing on the side, and dip your fork into it rather than pouring it over the salad.

- Choose fruit for dessert rather than baked goods.

Eating in Fast-Food Restaurants

- Most fast-food chains can provide a brochure with the nutritional content of their menu items. Ask for it, or check the restaurant's website for nutritional information. Order small single burgers with no cheese instead of double burgers with many toppings. If possible, get them broiled instead of fried.
- Ask for items to be prepared without mayonnaise, tartar sauce, sour cream, or other high-fat sauces. Ketchup, mustard, and fat-free mayonnaise or sour cream are better choices and are available at many fast-food restaurants.
- Choose whole-grain bread for burgers and sandwiches.
- Choose chicken items made from chicken breast, not processed chicken.
- Order vegetable pizzas without extra cheese.
- Try a salad or fruit as a side item. If you can't resist french fries or onion rings, get the smallest size.

Eating on the Run

- When you need to eat in a hurry, remember that you can carry healthy foods in your backpack or a small insulated lunch sack (with a frozen gel pack to keep fresh food from spoiling).
- Carry items that are small and convenient but nutritious, such as fresh fruits or vegetables, whole-wheat buns or muffins, snack-size cereal boxes, and water.
- When buying beverages from vending machines, choose water or 100% fruit juice. When buying snacks, choose whole-grain crackers, pretzels, nuts or seeds, baked chips, low-fat popcorn, or low-fat granola bars.



Functional Foods

The American diet already contains numerous *functional foods*. Two of the earliest functional foods introduced in the United States were iodized salt and milk fortified with vitamins A and D. More recently, manufacturers began fortifying breads and grains with folic acid to reduce the incidence of neural tube defects.

Although experts suggest that all foods are “functional,” in general, functional foods are defined as foods to which health-promoting or disease-preventing components have been added. They include foods that are fortified, enriched, or enhanced or that contain dietary components with additional potential to benefit health. Some examples of functional foods are calcium-fortified orange juice, margarine enriched with sterols or stanols to lower the risk of heart

disease, sports bars for energy and improved athletic performance, and vitamin B-12-enriched soy milk for vegetarians.

Dietary Challenges for Various Population Groups

The Dietary Guidelines for Americans and MyPlate can help nearly anyone create a healthy diet. However, some population groups face special dietary challenges.

Children and Teenagers Young people often need to be encouraged to eat. Perhaps the best thing a parent can do for younger children is to provide them with a variety of foods. Allowing children to help prepare meals is another good way to increase food variety and develop a child's interest in eating

well. Many children and teenagers enjoy eating at fast-food restaurants, but they should be encouraged to select the healthiest choices from fast-food menus and to balance the day's diet with low-fat, nutrient-rich foods.

College Students Convenient foods are not always the healthiest choices. Students who eat in buffet-style dining halls can easily overeat, and the foods offered are not necessarily high in nutrients or low in fat. The same is true of meals at fast-food restaurants. See the box "Eating Strategies for College Students" for tips on making healthy eating convenient and affordable.

Pregnant and Breastfeeding Women Good nutrition is essential to a healthy pregnancy. Before conception, nutrition counseling can help a woman establish a balanced eating plan and healthy body weight for pregnancy. During pregnancy and while breastfeeding, women have special nutritional needs and are often advised to take a nutrient supplement (discussed in more detail later in this chapter).

Older Adults Nutrient needs do not change much as people age, but because older adults tend to become less active, they don't need as many calories to maintain body weight. At the same time, older adults absorb some nutrients less efficiently because of age-related changes in the digestive tract. For these reasons, older adults should focus on eating nutrient-dense foods. Foods fortified with vitamin B-12 and/or B-12 supplements are recommended for people over age 50, and calcium and vitamin D supplements may be recommended for older adults to reduce bone loss and lower the risk of osteoporosis. Antioxidants from fruits and vegetables are important in older adults to reduce age-related changes in vision and cognitive functioning. Because constipation is a common problem for older adults, eating high-fiber foods and drinking enough fluids are important goals.

Athletes Key dietary concerns for athletes are meeting their increased energy requirements and drinking enough fluids during practice and throughout the day to remain fully hydrated. Endurance athletes and athletes in heavy training may also benefit from increasing the amount of carbohydrate in the diet to 60–70% of total daily calories; this increase should take the form of complex, rather than simple, carbohydrates. Athletes who need to maintain a low body weight—such as skaters, gymnasts, and wrestlers—must avoid unhealthy eating patterns, which can lead to eating disorders. Eating for exercise is discussed in more detail in Chapter 13; see Chapter 14 for information about eating disorders.

People with Special Health Concerns Many Americans have special health concerns that affect their dietary needs. For example, women who are pregnant or breastfeeding require extra calories, vitamins, and minerals (see Chapter 8).

People with diabetes benefit from a well-balanced diet that is low in simple sugars, high in complex carbohydrates, and rich in monounsaturated fats. People with high blood pressure need to control their weight and limit their sodium consumption. If you have a health concern that requires a special diet, discuss your situation with a physician or registered dietitian.

A PERSONAL PLAN: MAKING INFORMED CHOICES ABOUT FOOD

Understanding the basics of good nutrition should get you started on creating a healthy diet that works for you. But eating for health involves other skills, as well. For example, it's helpful to be able to interpret the labels on food products and dietary supplement labels. Everyone who handles and prepares food should know how to avoid foodborne illnesses and environmental contaminants. And in addition to understanding the nutritional content of foods, you can be an even smarter consumer if you know about other food content, such as additives, and the various ways foods can be processed before going to market. The following sections address these issues.

Reading Food Labels

All processed foods regulated by either the FDA or the USDA include standardized nutrition information on their labels. Every food label shows serving sizes and the amounts of fat, saturated fat, trans fat, cholesterol, sodium, total carbohydrate, dietary fiber, sugars, and protein in each serving. To make intelligent choices about food, learn to read and *understand* food labels (see the box "Using Food Labels").

Fresh meat, poultry, fish, fruits, and vegetables are not required to have food labels, and many of these products are not packaged. You can find information about the nutrient content of these items from basic nutrition books, registered dietitians, nutrient analysis computer software, the Internet, and the companies that produce or distribute these foods. Supermarkets may also have large posters or pamphlets listing the nutrient contents of these foods.

Dietary Supplements

All government food guidance systems encourage people to meet their nutritional needs with food rather than with vitamin and mineral supplements. Supplements lack the fiber and potentially beneficial phytochemicals that are found only in whole foods. Most Americans can get the vitamins and minerals they need by eating a nutritionally balanced diet of various foods. The use of supplements to reduce heart disease or cancer risk remains controversial, so experts suggest that you avoid taking any nutrient at a level exceeding the Tolerable Upper Intake Level (UL).

Dietary supplements are not recommended for healthy people, but they can be helpful for people with certain needs.

Although dietary supplements are sold over the counter, that doesn't necessarily mean they are safe. Some vitamins and minerals are dangerous when taken in excess. Large doses of particular nutrients can also cause health problems by affecting the absorption of certain vitamins or minerals or interacting with medications. For this reason, ask your doctor or a dietician before taking any high-dosage supplement.

People Who Benefit from Supplements In setting the DRIs, the Food and Nutrition Board recommended supplements of particular nutrients for specific groups:

- Women who are capable of getting pregnant should get 400 µg per day of folic acid (the synthetic form of the vitamin folate) from fortified foods and/or supplements in addition to folate from a varied diet. This level of folate can reduce the risk of neural tube defects in a developing fetus. Enriched breads, flours, cornmeal, rice, noodles, and other grain products are fortified with folic acid. Folate is found naturally in leafy green vegetables, legumes, oranges, and strawberries.

- As noted earlier, people over age 50 should eat foods fortified with vitamin B-12, take a B-12 supplement, or combine the two to meet the RDA of 2.4 µg daily. Up to 30% of people over 50 may have trouble absorbing protein-bound B-12 in foods.

- Because of the oxidative stress caused by smoking, smokers should get 35 mg more vitamin C per day than the RDA set for their age and sex. Supplements aren't usually necessary, however, because this extra vitamin C can easily be found in foods. For example, an 8-ounce glass of orange juice has about 100 mg of vitamin C.

Supplements may be recommended in other cases. Women with heavy menstrual flows, for example, may need extra iron. Older adults, people with dark skin, and people exposed to little sunlight may need extra vitamin D. Other people may benefit from supplementation based on their physical condition, the medicines they take, or their dietary habits.

Before deciding whether to take a vitamin or mineral supplement, consider whether you already eat a fortified breakfast cereal every day. Many breakfast cereals contain almost as many nutrients as a multivitamin pill. If you elect to take a supplement, choose one that contains 50–100% of the Daily Values for vitamins and minerals. Avoid supplements containing large doses of particular nutrients.

Reading Supplement Labels Dietary supplements include vitamins, minerals, amino acids, herbs, glandular extracts, enzymes, and other compounds. They are available as tablets, capsules, liquids, and powders. Although dietary supplements are often thought to be safe and “natural,” they can contain powerful bioactive chemicals that have the potential for harm. About one-quarter of all pharmaceutical drugs are derived from botanical sources—

morphine from poppies and digoxin from foxglove, for example. And as described earlier, even essential vitamins and minerals can have toxic effects if consumed in excess.

In the United States, dietary supplements are not legally considered drugs and are not regulated the same way drugs are. Before a drug is approved by the FDA and put on the market, it must undergo clinical studies to determine safety, effectiveness, side effects and risks, possible interactions with other substances, and appropriate dosages. The FDA does not authorize or test dietary supplements, and supplement manufacturers are not required to demonstrate either safety or effectiveness prior to marketing. Although dosage guidelines exist for some of the compounds in dietary supplements, dosages for many are not well established.

There are also key differences in how drugs and supplements are manufactured. FDA-approved medications are standardized for potency, and quality control and proof of purity are required. Dietary supplement manufacture is not as closely regulated, and there is no guarantee that a product even contains a given ingredient, let alone in the appropriate amount. The potency of herbal supplements tends to vary widely due to differences in growing and harvesting conditions, preparation methods, and storage. Some manufacturers attempt to standardize their products by isolating the compounds believed to be responsible for an herb's action. However, potency is often still highly variable, and when several compounds are thought to be responsible for an herb's effect, often only one is standardized. In addition, herbs can be contaminated or misidentified at any stage from harvest to packaging. (See Chapter 20 for more about herbal remedies.)

The FDA has recalled several products due to the presence of dangerous contaminants, including heavy metals and pharmaceutical drugs.

To provide consumers with more reliable and consistent information about supplements, the FDA requires supplements to have labels similar to those found on foods (see the box “Using Dietary Supplement Labels” for more information). Label statements and claims about supplements are also regulated.

Finally, it is important to remember that dietary supplements are no substitute for a healthy diet. Supplements do not provide all the known—or yet-to-be-discovered—benefits of whole foods. Supplements should also not be used as a replacement for medical treatment for serious illnesses.

Protecting Yourself against Foodborne Illness

Many people worry about additives or pesticide residues in their food, but a greater threat comes from microorganisms that cause foodborne illnesses. Raw or undercooked animal products, such as chicken, hamburger, and oysters, pose the greatest

QUICK STATS

Salmonella infection was the most common foodborne infection reported in 2010 and was associated with the largest number of hospitalizations (2,290) and deaths (29).

—CDC, 2011

CRITICAL CONSUMER Using Food Labels



The Nutrition Facts panel on a food label is designed to help consumers make food choices based on the nutrients that are most important to good health. In addition to listing nutrient content by weight, the label puts the information in the context of a daily diet of 2000 calories that includes no more than 65 grams of fat (approximately 30% of total calories). For example, if a serving of a particular product has 13 grams of fat, the label will show that the serving represents 20% of the daily fat allowance. If your daily diet contains fewer or more than 2000 calories, you need to adjust these calculations accordingly.

Food labels contain uniform serving sizes. This means that if you look at different brands of salad dressing, for example, you can compare calories and fat content based on the serving amount. It is important to keep in mind, however, that food label serving sizes may be larger or smaller than MyPlate serving size equivalents. Regulations also require that foods meet strict definitions if their packaging includes the terms *light*, *low-fat*, or *high-fiber*. Health claims such as “good source of dietary fiber” or “low in saturated fat” on packages are signals that those products can wisely be included in your diet. Overall, the food label is an important tool to help you choose a diet that conforms to MyPlate and the Dietary Guidelines.

Selected Nutrient Claims and What They Mean

Healthy A food that is low in fat, is low in saturated fat, has no more than 360–480 mg of sodium and 60 mg of cholesterol, and provides 10% or more of the Daily Value for vitamin A, vitamin C, protein, calcium, iron, or dietary fiber.

Light or lite 33% fewer calories or 50% less fat than a similar product.

Reduced or fewer At least 25% less of a nutrient than a similar product; can be applied to fat (“reduced fat”), saturated fat, cholesterol, sodium, and calories.

Extra or added 10% or more of the Daily Value per serving when compared to what a similar product has.

Good source 10–19% of the Daily Value for a particular nutrient per serving.

High, rich in, or excellent source of 20% or more of the Daily Value for a particular nutrient per serving.

Low calorie 40 or fewer calories per serving.

High fiber 5 g or more of fiber per serving.

Good source of fiber 2.5–4.9 g of fiber per serving.

Fat-free Less than 0.5 g of fat per serving.

Low-fat 3 g of fat or less per serving.

Saturated fat-free Less than 0.5 g of saturated fat and 0.5 g of trans fatty acids per serving.

Low saturated fat 1 g or less of saturated fat per serving and no more than 15% of total calories.

Cholesterol-free Less than 2 mg of cholesterol and 2 g or less of saturated fat per serving.

Low cholesterol 20 mg or less of cholesterol and 2 g or less of saturated fat per serving.

Low sodium 140 mg or less of sodium per serving.

Very low sodium 35 mg or less of sodium per serving.

Lean Cooked seafood, meat, or poultry with less than 10 g of fat, 4.5 g or less of saturated fat, and less than 95 mg of cholesterol per serving.

Extra lean Cooked seafood, meat, or poultry with less than 5 g of fat, 2 g of saturated fat, and 95 mg of cholesterol per serving.

NOTE: The FDA has not yet defined nutrient claims relating to carbohydrates, so foods labeled low- or reduced-carbohydrate do not conform to any approved standard.

SOURCE: FDA, Food. Appendix C: Health Claims (<http://www.fda.gov/Food/GuidanceComplianceRegulatoryInformation/GuidanceDocuments/FoodLabelingNutrition/FoodLabelingGuide/ucm064919.htm>).

1. **Serving size:** Determine how many servings there are in the food package and compare it to how much you actually eat. You may need to adjust the rest of the nutrient values based on your typical serving size.

2. **Calories and calories from fat:** Note whether a serving is high in calories and fat. The sample food shown here is low in fat, with only 30 of its 235 calories from fat.

3. **Daily Values:** Based on a 2000-calorie diet, Daily Value percentages tell you whether the nutrients in a serving of food contribute a lot or a little to your total daily diet.
5% or less is low
20% or more is high

4. **Limit these nutrients:** Look for foods low in fat, saturated fat, trans fat, cholesterol, and sodium.

5. **Get enough of these nutrients:** Look for foods high in dietary fiber, vitamin A, vitamin C, calcium, and iron.



Nutrition Facts			
Serving Size 1 cup (265g)			
Servings per Container 2			
Amount per Serving			
Calories 235	Calories from Fat 30		
% Daily Value*			
Total Fat 3g	5%		
• Saturated Fat 1g	5%		
• Trans Fat 0.5g			
Cholesterol 30mg	10%		
Sodium 775mg	32%		
Total Carbohydrate 34g	11%		
• Dietary Fiber 9g	36%		
• Sugars 5g			
Protein 18g			
Vitamin A 25%	• Vitamin C 0%		
Calcium 12%	• Iron 20%		
*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:			
	Calories	2,000	2,500
Total Fat	Less than	65g	80
Sat Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g
Calories per gram:			
Fat	9	• Carbohydrate	4
		• Protein	4

Footnote: This section shows recommended daily intake for two levels of calorie consumption and values for dietary calculations; it's the same on all labels.



CRITICAL CONSUMER

Using Dietary Supplement Labels

Since 1999 specific types of information have been required on the labels of dietary supplements. In addition to basic information about the product, labels include a “Supplement Facts” panel, modeled after the “Nutrition Facts” panel used on food labels (see the label illustrated below). Under the Dietary Supplement Health and Education Act (DSHEA) and food labeling laws, supplement labels can make three types of health-related claims:

- **Nutrient content claims**, such as “high in calcium,” “excellent source of vitamin C,” or “high potency.” The claims “high in” and “excellent source of” mean the same as they do on food labels. A “high-potency” single-ingredient supplement must contain 100% of that nutrient’s Daily Value; a “high-potency” multi-ingredient product must contain 100% or more of the Daily Value of at least two-thirds of the nutrients present for which Daily Values have been established.
- **Health claims**, if they have been authorized by the FDA or another authoritative scientific body. The association between adequate calcium intake and lower risk of osteoporosis is an example of an approved health claim. Since 2003 the FDA has also allowed so-called *qualified* health claims for situations in which there is emerging but as yet inconclusive evidence for a particular claim. Such claims must include qualifying language such as “scientific evidence suggests but does not prove” the claim.
- **Structure–function claims**, such as “antioxidants maintain cellular integrity” or “this product enhances energy levels.” Because these claims are not reviewed by the FDA, they must carry a disclaimer (see the sample label).

Tips for Choosing and Using Dietary Supplements

- Check with your physician before taking a supplement. Many are not meant for children, older adults, women who are pregnant or breast-

feeding, people with chronic illnesses or upcoming surgery, or people taking prescription or OTC medications. When you visit your doctor, bring a list of all dietary supplements you are taking. Do not take megadoses (more than double the DRI levels) without your doctor’s approval.

- Choose brands made by nationally known food and drug manufacturers or house brands from large retail chains. Due to their size and visibility, such sources are likely to have high manufacturing standards.
- Look for the USP verification mark on the label, indicating that the product meets minimum safety and purity standards developed under the Dietary Supplement Verification Program by the United States Pharmacopeia (USP). The USP mark means that the product (1) contains the listed ingredients, (2) has the declared amount and strength of ingredients, (3) will dissolve effectively, (4) has been screened for harmful contaminants, and (5) has been manufactured using safe, sanitary, and well-controlled procedures. The National Nutritional Foods Association (NNFA) has a self-regulatory testing program for its members; other associations and labs, including ConsumerLab.Com, also test and rate dietary supplements.
- Follow the label’s cautions, directions for use, and dosage.
- If you experience side effects, stop using the product and contact your physician. Report any serious reactions to the FDA’s MedWatch monitoring program (800-FDA-1088 or online at <http://www.fda.gov/Safety/MedWatch/default.htm>).

For More Information about Dietary Supplements

ConsumerLab.Com: <http://www.consumerlab.com>

Food and Drug Administration: <http://www.fda.gov/food/DietarySupplements/default.htm>

National Institutes of Health, Office of Dietary Supplements: <http://ods.od.nih.gov>

U.S. Department of Agriculture: <http://fnic.nal.usda.gov/dietary-supplements>

Statement of identity and net quantity

Structure-function claim

Directions for use and storage

Warnings may appear on some labels

Disclaimer accompanying structure-function claim

**MOOD ENHANCER
DIETARY SUPPLEMENT**

60 capsules

*Specially formulated to enhance your mood, maintain healthy energy levels, and help you deal with daily stresses.**

DIRECTIONS FOR USE: Take one capsule twice daily with a meal.

Keep out of reach of children. Store in a cool, dry place, tightly closed. Color variation is normal in this product.

WARNING: FOR ADULTS ONLY. Do not exceed the recommended dosage. Do not use if you are pregnant, lactating, or taking prescription antidepressant or anti-anxiety medication. Do not use with alcohol. Do not use if you have allergies to the ragweed family. Limit exposure to the sun as St. John’s wort may cause increased sensitivity to light. Discontinue use in the event of a rash.

PHENYLKETONURICS:
CONTAINS PHENYLALANINE.

*This statement has not been evaluated by the Food and Drug Administration. This product is not intended to diagnose, treat, cure, or prevent any disease.

Supplement Facts

Serving Size 1 capsule

Amount per capsule	% Daily Value*
Vitamin B₆ (as pyridoxine hydrochloride) 2.0 mg	100%
Folic acid 200 mcg	50%
Vitamin B₁₂ (as cyanocobalamin) 6 mcg	100%
St. John’s wort aerial parts extract 300 mg <i>(Hypericum perforatum)</i>	†
Kava root extract 250 mg <i>(Piper methysticum)</i>	†
Siberian ginseng root extract 200 mg <i>(Eleutherococcus senticosus)</i>	†
Phenylalanine (as L-phenylalanine hydrochloride) 100 mg	†

*Percent Daily Values are based on a 2000 calorie diet.
†Daily Value not established.

Other ingredients: Rice flour, gelatin, water.

Standardization levels: St. John’s wort: 0.3% hypericin; kava: 30% kavalactones; Siberian ginseng: 1% eleutherosides.

Made by JKS Herbal Supplements, P.O. Box 2000, San Francisco, CA 94444.

Serving size

Source and amount of ingredients with established Daily Values

Name, source, and amount of ingredients without established Daily Values

Standardization levels may appear on some labels

Address to write to for more product information

threat, although in recent years contaminated fruits and vegetables have been catching up.

The CDC estimates that about 1000 reported disease outbreaks and approximately 48 million illnesses, 128,000 hospitalizations, and 3000 deaths occur each year in the United States due to foodborne illnesses. Symptoms include diarrhea, vomiting, fever, pain, headache, and weakness. Although the effects of foodborne illnesses are usually not serious, some groups, such as children, pregnant women, and the elderly, are more at risk for severe complications such as rheumatic diseases, seizures, blood poisoning, and death.

Causes of Foodborne Illnesses Most cases of foodborne illness are caused by **pathogens**—disease-causing microorganisms. Food can be contaminated with pathogens through improper handling, and pathogens can grow if food is prepared or stored improperly. According to the CDC, about 90% of foodborne illnesses, hospitalizations, and deaths in 2010 were due to seven pathogens: *Salmonella* (most often found in eggs, on vegetables, and on poultry); norovirus (most often found in salad ingredients and shellfish); *Campylobacter jejuni* (most often found in meat and poultry); *Toxoplasma* (most often found in meat); *Escherichia coli* (*E. coli*) O157:H7 (most often found in meat and water); *Listeria monocytogenes* (most often found in lunch meats, sausages, and hot dogs); and *Clostridium perfringens* (most often found in meat and gravy). *Salmonella* was the leading cause of hospitalizations and deaths, accounting for 28% of deaths and 35% of hospitalizations. About 60% of illness, but a much smaller percentage of severe illness, was caused by norovirus.

Other causes of foodborne illness include the bacteria *Clostridium perfringens*, *Vibrio vulnificus*, and *Yersinia enterocolytica*; the hepatitis A virus; the parasites *Trichinella spiralis* (found in pork and wild game), *Anisakis* (found in raw fish), *Giardia lamblia*, *Cyclospora cayetanensis*, and tapeworms; and certain molds.

Another potential threat from food is bovine spongiform encephalopathy (BSE), or “mad cow disease”—a fatal degenerative neurological disease caused by an abnormal protein that forms deposits in the brain. A variant form of the human version of this disease, known as Creutzfeldt-Jakob disease (CJD), is believed to be caused by eating beef contaminated with central nervous system tissue from BSE-infected cows. There have been at least 217 confirmed cases in 11 countries of this variant CJD among the hundreds of thousands of people who may have consumed BSE-contaminated products. In December 2003 the first BSE-infected cow in the United States was identified; no meat or organs from this animal had made it into the food supply. Although the USDA states that the risk to human health from BSE is extremely low, additional steps are being taken to prevent the BSE protein from entering the food supply.

Preventing and Treating Foodborne Illnesses Because every teaspoon of the soil that our food grows in contains about 2 billion bacteria (only some of them pathogenic),

we are always exposed to the possibility of a foodborne illness. You can't tell by taste, smell, or sight whether a food is contaminated. Raw foods are the most common source of foodborne illnesses; examples include raw meat and poultry that may have become contaminated during slaughter and produce such as spinach, lettuce, tomatoes, sprouts, and melons that become contaminated with salmonella, shigella, or *E. coli* during growing, harvesting, processing, storing, shipping, or final preparation. One in 10,000 eggs may be contaminated with *Salmonella* inside the egg shell.

Although foodborne illness outbreaks associated with food-processing plants make headlines, most cases of illness trace back to poor food handling in the home or in restaurants. The Dietary Guidelines for Americans encourage people to follow four basic food safety principles:

- **Clean** hands, food contact surfaces, and vegetables and fruits.
- **Separate** raw, cooked, and ready-to-eat foods while shopping, storing, and preparing foods.
- **Cook** foods to a safe temperature.
- **Chill** (refrigerate) perishable foods promptly.

If you think you may be having a bout of foodborne illness, drink plenty of fluids to prevent dehydration and consult a physician. For more details on handling food safely, see the box “Safe Food Handling.”

Although pathogens are usually destroyed during cooking, the U.S. government has taken steps to bring down levels



Careful food handling greatly reduces the risk of foodborne illness.

pathogen A microorganism that causes disease.

TERMS



TAKE CHARGE

Safe Food Handling

- Don't buy food in containers that leak, bulge, or are severely dented. Refrigerated foods should be cold and frozen foods should be solid when you buy them.
- Refrigerate perishable items as soon as possible after purchase. Use or freeze fresh meats within 3–5 days and fresh poultry, fish, and ground meat within 1–2 days.
- Store raw meat, poultry, fish, and shellfish in containers in the refrigerator so that the juices don't drip onto other foods. Keep these items away from other foods, surfaces, utensils, or serving dishes to prevent cross-contamination.
- Thaw frozen food in the refrigerator or in the microwave oven, not on the kitchen counter. Cook foods immediately after thawing.
- Thoroughly wash your hands with warm soapy water for 20 seconds before and after handling food, especially raw meat, fish, shellfish, poultry, or eggs.
- Make sure counters, cutting boards, dishes, utensils, and other equipment are thoroughly cleaned before and after use using hot soapy water. Wash dishcloths frequently.
- If possible, use separate cutting boards for meat, poultry, and seafood and for foods that will be eaten raw. Replace cutting boards once they become worn or develop hard-to-clean grooves.
- Thoroughly rinse and scrub fruits and vegetables with a brush, if possible, or peel off the skin.
- Cook foods thoroughly, especially beef, poultry, fish, pork, wild game, and eggs; cooking kills most microorganisms. Use a food thermometer to ensure that foods are cooked to a safe temperature. Hamburgers should be cooked to at least 160°F. Turn or stir microwaved food to make sure it is heated evenly throughout. When eating out, order hamburger cooked well-done and make sure foods are served piping hot.
- Keep hot foods hot (140°F or above) and cold foods cold (40°F or below). Harmful bacteria can grow rapidly between these two

temperatures. Refrigerate foods within two hours of purchase or preparation, and within one hour if the air temperature is above 90°F. Refrigerate foods at or below 40°F and freeze at or below 0°F. Use refrigerated leftovers within 3–4 days.

- Don't eat raw animal products, including raw eggs in homemade hollandaise sauce or eggnog. Use only pasteurized milk and juice, and look for pasteurized eggs, which are now available in some states.
- Cook eggs until they're firm, and fully cook foods containing eggs. Store eggs in the coldest part of the refrigerator, not in the door, and use them within 3–5 weeks.
- Avoid raw sprouts. Even sprouts grown under clean conditions in the home can be risky because bacteria may be present in the seeds. Cook sprouts before eating them.
- Read the food label and package information, and follow safety instructions such as "Keep Refrigerated" and the "Safe Handling Instructions."
- According to the USDA, "When in doubt, throw it out." Even if a food looks and smells fine, it may not be safe. If you aren't sure that a food has been prepared, served, and stored safely, don't eat it.

Additional precautions are recommended for people at particularly high risk for foodborne illness—pregnant women, young children, older people, and people with weakened immune systems or certain chronic illnesses. If you are a member of one of these groups, don't eat or drink any of the following products: unpasteurized juices; raw sprouts; unpasteurized (raw) milk and products made from unpasteurized milk; raw or undercooked meat, poultry, eggs, fish, and shellfish; and soft cheeses such as feta, Brie, Camembert, or blue-veined cheeses. To protect against *Listeria*, avoid ready-to-eat foods such as hot dogs, luncheon meats, and cold cuts unless they are reheated until they are steaming hot.

of contamination by improving national surveillance and testing. Raw meat and poultry products are now sold with safe handling and safe cooking instructions, and all packaged, unpasteurized fresh fruit and vegetable juices carry warnings about potential contamination. In 2011 the Food Safety Modernization Act (FSMA) was signed into law to reform the food safety system in the United States and further ensure the safety of the U.S. food supply. The FSMA allows the FDA to focus more on preventing food safety problems than on reacting to problems after they occur.

Environmental Contaminants

In addition to pathogens, environmental contaminants are also present in the food-growing environment. They include

various minerals, antibiotics, hormones, pesticides, industrial chemicals known as **PCBs (polychlorinated biphenyls)**, metals such as methyl mercury, and naturally occurring substances such as cyanogenic glycosides (found in lima beans and the pits of some fruits) and certain molds. Their effects depend on many factors, including concentration, length of exposure, and the age and health status of the person involved. Safety regulations attempt to keep our exposure to

polychlorinated biphenyl (PCB) An industrial chemical linked to certain cancers; banned worldwide in 1977 but persistent in the environment.

TERMS

contaminants at safe levels, but monitoring is difficult, and many substances (such as pesticides) persist in the environment long after being banned from use.

Organic Foods

Some people who are concerned about pesticides and other environmental contaminants choose to buy foods that are **organic**. To be certified as organic by the USDA, foods must meet strict production, processing, handling, and labeling criteria. Organic crops must meet limits on pesticide residues. For meat, milk, eggs, and other animal products to be certified organic, animals must be given organic feed and access to the outdoors and may not be given antibiotics or growth hormones. The use of genetic engineering, ionizing radiation, and sewage sludge is prohibited. Products can be labeled “100% organic” if they contain all organic ingredients and “organic” if they contain at least 95% organic ingredients; all such products may carry the USDA organic seal. A product with at least 70% organic ingredients can be labeled “made with organic ingredients” but cannot use the USDA seal.



Although organic foods may be contaminated with pesticides used on neighboring lands or on foods transported in the same train or truck, they tend to have lower levels of pesticide residues than conventionally grown crops. Some experts recommend that consumers who want to buy organic produce spend their money on those fruits and vegetables that have the highest levels of pesticide residue when grown conventionally (the “dirty dozen”): apples, bell peppers, celery, cherries, imported grapes, nectarines, peaches, pears, potatoes, red raspberries, spinach, and strawberries. Experts also recommend buying organic beef, poultry, eggs, dairy products, and baby food. Fruits and vegetables that carry little pesticide residue whether grown conventionally or organically include asparagus, avocados, bananas, broccoli, cauliflower, corn, kiwi, mangoes, onions, papaya, pineapples, and peas. All foods are subject to strict pesticide limits; the debate about the health effects of small amounts of residue is ongoing.

Whether organic foods are better for your health or not, organic farming is better for the environment. Benefits include sustainable farming practices, preservation of biodiversity, healthier soil, protection of water supplies, reduced use of fossil fuels, improved animal welfare, protection of ecosystems, and safer conditions for farmworkers. Buying organic food, buying locally grown foods, and participating in a community garden are ways to support food production that benefits and sustains the environment.

Guidelines for Fish Consumption

A specific area of concern has been mercury contamination in fish. Overall, fish and shellfish are healthy sources of protein, omega-3 fats, and other nutrients. Prudent choices can minimize the risk of any possible negative health effects. High mercury concentrations are most likely to be found in predator

fish—large fish that eat smaller fish. Mercury can cause brain damage in fetuses and young children.

According to FDA and Environmental Protection Agency (EPA) guidelines, as well as the Dietary Guidelines for Americans, women who are or who may become pregnant and nursing mothers should follow these guidelines to minimize their exposure to mercury:

- Do not eat shark, swordfish, king mackerel, or tilefish.
- Eat 8–12 ounces a week of a variety of fish and shellfish that is lower in mercury, such as shrimp, canned light tuna, salmon, pollock, and catfish. Limit consumption of albacore tuna to 6 ounces per week.
- Check advisories about the safety of recreationally caught fish from local lakes, rivers, and coastal areas; if no information is available, limit consumption to 6 ounces per week.

The same FDA/EPA guidelines apply to children, although they should consume smaller servings.

Additives in Food

Today approximately 3000 substances are intentionally added to foods to maintain or improve nutritional quality, to maintain freshness, to help in processing or preparation, or to alter taste or appearance. The most widely used food additives are sugar, salt, and corn syrup; these three plus citric acid, baking soda, vegetable colors, mustard, and pepper account for 98% by weight of all food additives used in the United States.

Some additives may be of concern for certain people, either because they are consumed in large quantities or because they cause some type of reaction. Additives having potential health concerns include nitrates and nitrites, used in processed meats and associated with the synthesis of cancer-causing agents in the stomach; BHA and BHT, used to maintain freshness and possibly associated with an increased risk of some cancers; sulfites, used to keep vegetables from turning brown and associated with severe reactions in sensitive people; and monosodium glutamate (MSG), used as a flavor enhancer and associated with episodes of increased blood pressure and sweating in sensitive people.

Food additives pose no significant health hazard to most people because the levels used are well below any that could produce toxic effects. To avoid potential problems, eat a variety of foods in moderation. If you are sensitive to an additive, check food labels when you shop, and ask questions when you eat out.

organic A designation applied to foods grown and produced according to strict guidelines limiting the use of pesticides, nonorganic ingredients, hormones, antibiotics, irradiation, genetic engineering, and other practices.

TERMS

Food Biotechnology

Food biotechnology techniques, such as crossbreeding, have been used by farmers for thousands of years to improve productivity and develop desirable qualities in animals and crops. Modern biotechnology tools, such as genetic engineering and cloning, allow for more precise, productive, and efficient development of crops and livestock. In 2005, 21 countries planted biotech crops covering a total of 222 million acres. In the United States, biotechnology is used in about 85% of the current soybean crop and 75% of cotton crops. The USDA, FDA, and EPA are the three federal agencies in charge of the regulatory oversight of biotechnology.

Irradiation Food irradiation is the treatment of foods with gamma rays, X-rays, or high-voltage electrons to kill potentially harmful pathogens, including bacteria, parasites, insects, and fungi that cause foodborne illness. Irradiation also reduces spoilage and extends a product's shelf life. For example, irradiated strawberries stay unspoiled in the refrigerator up to 3 weeks, versus only 3–5 days for untreated berries. The government permits the irradiation of certain foods, including wheat and flour, white potatoes, pork, herbs and spices, fruits and vegetables, raw poultry, red meat, and certain leafy green vegetables.

Even though irradiation has been generally endorsed by agencies such as the WHO, the CDC, and the American Medical Association (AMA), few irradiated foods are currently on the market due to consumer resistance and skepticism. Studies indicate that when consumers are given information about the process of irradiation and the benefits of irradiated foods, most want to purchase them. All primary irradiated foods (meat, vegetables, and so on) are labeled with the flowerlike radura symbol and a brief information label; spices and foods that are merely ingredients do not have to be so labeled.

When given information about irradiation and its benefits, most consumers want to purchase irradiated food products.



Genetically Modified Foods Genetic engineering involves altering the characteristics of a plant, animal, or microorganism by adding, rearranging, or replacing genes in its DNA; the result is a **genetically modified (GM) organism**. New DNA may come from related species or from entirely different types of organisms. Many GM crops are already grown in the United States. For example, some soybean crops in the United States have been genetically modified to be resistant to an herbicide used to kill weeds, and some GM corn crops carry genes for herbicide resistance or pest resistance. Products made with GM organisms include juice, soda, nuts, tuna, frozen pizza, spaghetti sauce, canola oil, chips, salad dressings, and soup.

The potential benefits of GM foods cited by supporters include improved yields overall and in difficult growing conditions, increased disease resistance, improved nutritional content, lower prices, and less pesticide use. Critics of biotechnology

argue that unexpected effects may occur. Gene manipulation could elevate levels of naturally occurring toxins or allergens, permanently change the gene pool, reduce biodiversity, and produce pesticide-resistant insects through the transfer of genes. Experience has shown that GM products are difficult to keep separate from non-GM products. Animal escapes, cross-pollination, and contamination during processing are just a few ways in which GM organisms could potentially appear unexpectedly in the food supply or the environment.

Animal Cloning In early 2008 the FDA concluded that meat and milk from cloned animals is no different from the meat and milk from naturally reproduced animals, and is thus safe for human consumption. Cloning allows producers to create animals with highly desirable characteristics, such as disease resistance and more predictable fat-to-lean meat ratios. Cloned animals are similar to identical

twins. The FDA's regulations regarding cloned animals state that cloned cattle, pigs, and goats (as well as their offspring) are safe for human consumption.

Labeling of GM Foods Surveys indicate that most Americans want to know if their food contains GM ingredients or comes from cloned organisms. The FDA does not require special labeling for foods from genetically modified or cloned food sources. Under current rules, the FDA requires special labeling only when a food's composition is changed significantly or when a known allergen such as a peanut gene is introduced into a food. The only foods guaranteed not to contain GM ingredients are those certified as organic.

Food Allergies and Food Intolerances

For some people, consuming a particular food causes symptoms such as itchiness, swollen lips, or abdominal pain. Adverse reactions like these may be due to a food allergy or a food intolerance, and symptoms may range from annoying to life-threatening. If you've had an adverse reaction to a food, it's important to determine whether your symptoms are due to an allergy or an intolerance so that you can take appropriate action.

Food Allergies A true **food allergy** is a reaction of the body's immune system to a food or food ingredient, usually a

food irradiation The treatment of foods with gamma rays, X-rays, or high-voltage electrons to kill potentially harmful pathogens and increase shelf life.

TERMS

genetically modified (GM) organism A plant, animal, or microorganism in which genes have been added, rearranged, or replaced through genetic engineering.

food allergy An adverse reaction to a food or food ingredient in which the immune system perceives a particular substance (allergen) as foreign and acts to destroy it.

protein. The immune system perceives the reaction-provoking substance, or allergen, as foreign and acts to destroy it. This immune reaction can occur within minutes of ingesting the food, resulting in symptoms that affect the skin (hives), gastrointestinal tract (cramps or diarrhea), respiratory tract (asthma), or mouth (swelling of the lips or tongue). The most severe response is a systemic reaction called *anaphylaxis*, which involves a potentially life-threatening drop in blood pressure.

Food allergies affect only about 2% of the adult population and up to 5% of infants and young children. Although numerous food allergens have been identified, just eight foods account for more than 90% of the food allergies in the United States: cow's milk, eggs, peanuts, tree nuts (walnuts, cashews, and so on), soy, wheat, fish, and shellfish. Food labels are now required to state the presence of the eight most common allergens in plain language in the ingredient list. Individuals with food allergies, especially those prone to anaphylaxis, must diligently avoid trigger foods. This involves carefully reading food labels and asking questions about ingredients when eating out. People at risk are usually advised to carry medications to treat anaphylaxis, such as injectable epinephrine. Refer to Chapter 17 for more about allergies.

Food Intolerances Many people who believe they have food allergies may actually suffer from a much more common source of adverse food reactions—a **food intolerance**. In the case of a food intolerance, the problem usually lies with metabolism rather than with the immune system. Typically the body cannot adequately digest a food or food component, often because of some type of chemical deficiency; in other cases, the body reacts to a particular compound in a food. Lactose intolerance is a fairly common food intolerance. A more serious condition is intolerance of gluten, a protein component of some grains; in affected individuals, consumption of gluten damages the lining of the small intestine. Sulfite, a common food additive, can produce severe asthmatic reactions in sensitive individuals. Food intolerances have also been attributed to tartrazine (a yellow food coloring), MSG, and the sweetener aspartame.

Food intolerance reactions often produce symptoms similar to those of food allergies, such as diarrhea or cramps, but reactions are typically localized and not life-threatening.

Ask Yourself

QUESTIONS FOR CRITICAL THINKING AND REFLECTION

What is the least healthy food you eat every day (either during meals or as a snack)? Identify at least one substitute that would be healthier but just as satisfying.

food intolerance An adverse reaction to a food or food ingredient that doesn't involve the immune system; intolerances are often due to a problem with metabolism.

TERMS

Many people with food intolerances can consume small amounts of the food that affects them; exceptions are gluten and sulfite, which must be avoided by sensitive individuals. Through trial and error, most people with food intolerances can adjust their intake of the trigger food to an appropriate level.

If you suspect that you have a food allergy or intolerance, a good first step is to keep a food diary. Note everything you eat or drink, any symptoms you develop, and how long after eating the symptoms appear. Then make an appointment with your physician to go over your diary and determine if any additional tests are needed.

connect™

Connect to Your Choices

Have you ever thought about why you eat the things you eat? Many factors can influence the food choices we make, some not as obvious as others. Do you buy packaged foods because they are convenient or seem less expensive? Do you eat at fast-food restaurants because they're on your way home? Do you have a "comfort food" that you eat when you're tired or upset?

What external factors influence your choices about food? What are your inner motivations and core values, and how do they affect your choices? Based on what you learned in this chapter, will you make some different choices in the future? If so, what will they be?

Go online to Connect to complete this activity:
www.mcgraw-hillconnect.com

TIPS FOR TODAY AND THE FUTURE

Opportunities to improve your diet present themselves every day, and small changes add up.

RIGHT NOW YOU CAN:

- Substitute a healthy snack for an unhealthy one.
- Drink a glass of water and put a reusable water bottle in your backpack for tomorrow.
- Plan to make healthy selections when you eat out, such as steamed vegetables instead of french fries or salmon instead of steak.

IN THE FUTURE YOU CAN:

- Visit the MyPlate website at www.choosemyplate.gov and use the online tools to create a personalized nutrition plan and begin tracking your eating habits.
- Learn to cook healthier meals. There are hundreds of free websites and low-cost cookbooks that provide recipes for healthy dishes.

SUMMARY

- To function at its best, the human body requires about 45 essential nutrients in specific proportions. People get these nutrients from foods; the body cannot synthesize most of them.
- Proteins, made up of amino acids, form muscles and bones and help make up blood, enzymes, hormones, and cell membranes. Foods from animal sources provide complete proteins; plants provide incomplete proteins. Protein intake should be 10–35% of total daily calories.
- Fats, a concentrated source of energy, also help insulate the body and cushion the organs; 1 tablespoon of vegetable oil per day supplies the essential fats. Dietary fat intake should be 20–35% of total daily calories. Unsaturated fats should be favored over saturated and trans fats.
- Carbohydrates supply energy to the brain and other parts of the nervous system as well as to red blood cells. The body needs about 130 grams of carbohydrates a day, but more is recommended. Carbohydrates should make up 45–65% of total daily calories.
- Fiber includes nondigestible carbohydrates provided mainly by plants. Adequate intake of fiber (38 grams per day for men and 25 grams per day for women) can help people manage diabetes and high cholesterol levels and improve intestinal health.
- The 13 vitamins needed in the diet are organic substances that promote specific chemical and cell processes within living tissue. Deficiencies or excesses can cause serious illnesses and even death.
- The approximately 17 minerals needed in the diet are inorganic substances that regulate body functions, aid in the growth and maintenance of body tissues, and help in the release of energy from foods.
- Water is used to digest and absorb food, transport substances around the body, and regulate body temperature.
- Foods contain other substances such as phytochemicals, which may not be essential nutrients but may help reduce chronic disease risk.
- Dietary Reference Intakes (DRIs) are recommended intakes for essential nutrients that meet the needs of healthy people.
- The Dietary Guidelines for Americans are designed to help people make healthy and informed food choices. Following the guidelines promotes health and reduces the risk of chronic disease. The 2010 Dietary Guidelines for Americans present recommendations in several areas: balancing calories to manage weight, reducing certain food components, increasing other food components, building healthy eating patterns, and making healthy choices in the context of the current food and physical activity environment.
- Choosing the right amount of foods from each food group in MyPlate every day ensures that you get enough necessary nutrients without overconsuming calories.
- A vegetarian diet can meet human nutritional needs.
- Almost all foods have labels that show how much fat, cholesterol, protein, fiber, and sodium they contain. Serving sizes are standardized, and health claims are carefully regulated. Dietary supplements also have uniform labels.

- Foodborne illnesses are a greater threat to health than additives and environmental contaminants. Other dietary issues of concern to some people include organic foods, food irradiation, genetic modification of foods, and food allergies and intolerances.

FOR MORE INFORMATION

BOOKS

Byrd-Bredbenner, C., et al. 2012. *Wardlaw's Perspectives in Nutrition*, 9th ed. New York: McGraw-Hill. *An easy-to-understand review of major concepts in nutrition.*

Duyff, R. L. 2012. *ADA Complete Food and Nutrition Guide*, 4th ed. Hoboken, NJ: Wiley. *An excellent review of current nutrition information.*

Insel, P., D. Ross, K. McMahon, and M. Bernstein. 2011. *Nutrition*, 4th ed. Sudbury, MA: Jones & Bartlett. *An introductory nutrition textbook covering a variety of key topics.*

Nestle, M. 2007. *What to Eat*. New York: North Point Press. *A nutritionist examines the marketing of food and explains how to interpret food-related information while shopping.*

Selkowitz, A. 2005. *The College Student's Guide to Eating Well on Campus*, revised ed. Bethesda, MD: Tulip Hill Press. *Provides practical advice for students, including how to make healthy choices when eating in a dorm or restaurant and how to stock a first pantry.*

Warshaw, H. 2008. *Eat Out Eat Right: The Guide to Healthier Restaurant Eating*. 3rd ed. Agate Surrey. *A registered dietitian provides realistic, informative guidelines for restaurant eating to enable diners to make healthy menu choices from a wide variety of foods and cuisines.*

NEWSLETTERS

Environmental Nutrition (<http://www.environmentalnutrition.com>)

Nutrition Action Health Letter (<http://cspinet.org/nah>)

Tufts University Health & Nutrition Letter (<http://www.tuftshealthletter.com>)

ORGANIZATIONS, HOTLINES, AND WEBSITES

American Diabetes Association. An organization with the aim of leading the fight against the deadly consequences of diabetes and fighting for those affected by diabetes.

<http://www.diabetes.org>

Academy of Nutrition and Dietetics (formerly the American Dietetic Association). Provides a wide variety of nutrition-related educational materials.

<http://www.eatright.org>

The Dietary Guidelines. The official site for the Dietary Guidelines for Americans, 2010.

<http://www.dietaryguidelines.gov>

FDA Center for Food Safety and Applied Nutrition. Offers information about topics such as food labeling, food additives, dietary supplements, and foodborne illness.

<http://www.fda.gov/food>

Food Safety Hotlines. Provide information on safe purchase, handling, cooking, and storage of food.

888-SAFEFOOD (FDA)

800-535-4555 (USDA)

Fruit and Veggies: More Matters. A nonprofit organization designed to increase consumption of fruits and vegetables to five or more servings a day to improve the health of Americans.

<http://www.fruitsandveggiesmorematters.org>

Gateways to Government Nutrition Information. Provide access to government resources relating to food safety and nutrition.

<http://www.foodsafety.gov>

<http://www.nutrition.gov>

Harvard School of Public Health: The Nutrition Source. Provides recent key research findings, an overview of the Healthy Eating Plate, and suggestions for building a healthful diet.

<http://www.hsph.harvard.edu/nutritionsource>

Mayo Clinic: Nutrition Basics. Medical, nutrition, and health information and tools for healthy living.

<http://www.mayoclinic.com/health/nutrition-and-healthy-eating/MY00431>

MyPlate. Provides personalized dietary plans and interactive food and activity tracking tools.

<http://www.ChooseMyPlate.gov>

National Academies' Food and Nutrition Board. Provides information about the Dietary Reference Intakes and related guidelines.

<http://iom.edu/About-IOM/Leadership-Staff/Boards/Food-and-Nutrition-Board.aspx>

USDA Center for Nutrition Policy and Promotion. Includes information about the Dietary Guidelines and MyPlate.

<http://www.cnpp.usda.gov/>

USDA Food and Nutrition Information Center. Provides a variety of materials and extensive links relating to the Dietary Guidelines, food labels, MyPlate, and many other topics.

<http://www.nal.usda.gov/fnic>

See also the resources listed in Chapters 13–16 and 22.

SELECTED BIBLIOGRAPHY

- A guide to the best and worst drinks. 2006. *Consumer Reports on Health*, July: 8–9.
- American Heart Association. 2012. *Diet and Lifestyle Recommendations* (http://www.heart.org/HEARTORG/GettingHealthy/Diet-and-Life-style-Recommendations_UCM_305855_Article.jsp).
- American Heart Association. 2012. *Fish and Omega-3 Fatty Acids* (http://www.heart.org/HEARTORG/GettingHealthy/NutritionCenter/HealthyDietGoals/Fish-and-Omega-3-Fatty-Acids_UCM_303248_Article.jsp).
- American Heart Association. 2012. Frequently Asked Questions about “Bad” Fats (http://www.heart.org/HEARTORG/General/Frequently-Asked-Questions-About-Bad-Fats_UCM_306349_Article.jsp).
- Centers for Disease Control and Prevention. 2011. Vital signs: incidence and trends of infection with pathogens transmitted commonly through food—Foodborne Diseases Active Surveillance Network, 10 U.S. sites, 1996–2010. *Morbidity and Mortality Weekly Report*, 60(2): 749–755.
- Centers for Disease Control and Prevention. 2012. *CDC and the Food Safety Modernization Act* <http://www.cdc.gov/foodsafety/fsma.html>.
- Centers for Disease Control and Prevention. 2012. Vital signs: food categories contributing the most to sodium consumption—United States, 2007–2008. *Morbidity and Mortality Weekly Report* 61(5): 92–98.
- Council for Responsible Nutrition. 2009. *Dietary Supplements: Safe, Regulated and Beneficial* (http://www.crnusa.org/pdfs/CRN_FACT_DSSafeRegulatedBeneficial_09.pdf).
- El Khoury, D., et al. 2011. Beta glucan: health benefits in obesity and metabolic syndrome. *Journal of Nutrition and Metabolism*, 20, Article ID 851362, 28 pages.
- Fink, S. W. 2012. Key articles of dietary interventions that influence cardiovascular mortality. *Pharmacotherapy*, 32(4): e54–87.
- Finkelstein, E. A., et al. 2012. Obesity and severe obesity forecasts through 2030. *American Journal of Preventive Medicine Online* (http://www.ajpmonline.org/webfiles/images/journals/amepre/AMEPRE_33853-stamped2.pdf).
- Food and Nutrition Board, Institute of Medicine. 2005. *Dietary Reference Intakes for Energy, Carbohydrate, Fiber, Fat, Fatty Acids, Cholesterol, Protein, and Amino Acids*. Washington, DC: National Academy Press.
- Food and Nutrition Board, Institute of Medicine. 2005. *Dietary Reference Intakes for Water, Potassium, Sodium, Chloride, and Sulfate*. Washington, DC: National Academy Press.
- Food and Nutrition Board, Institute of Medicine. 2011. *Dietary Reference Intakes for Calcium and Vitamin D*. Washington, DC: National Academy Press.
- Harris, W. S., et al. 2009. Omega-6 fatty acids and risk for cardiovascular disease: a science advisory from the American Heart Association Nutrition Subcommittee of the Council on Nutrition, Physical Activity, and Metabolism; Council on Cardiovascular Nursing; and Council on Epidemiology and Prevention. *Circulation* 119(6): 902–907.
- Harvard School of Public Health, Department of Nutrition. 2010. *The Nutrition Source: Knowledge for Healthy Eating* (<http://www.hsph.harvard.edu/nutritionsource>).
- Hasler, C. M., et al. 2009. Position of the American Dietetic Association: functional foods. *Journal of the American Dietetic Association* 109(4): 735–736.
- The Hunger Project. 2012. *Know Your World: Facts about Hunger and Poverty* (http://www.thp.org/learn_more/issues/know_your_world_facts_about_hunger_and_poverty?gclid=COWvien49q0CFYQKkgodX3wFw).
- Johnson, R. K., et al. 2009. Dietary sugars intake and cardiovascular health: a scientific statement from the American Heart Association. *Circulation* 120(11): 1011–1020.
- Jonnalagadda, S. S., et al. 2011. Putting the whole grain puzzle together: health benefits associated with whole grains—Summary of American Society for Nutrition 2010 Satellite Symposium. *Journal of Nutrition*, 14(5): 1011S–1022S.
- Lasater, G., C. Piernas, and B. M. Popkin. 2011. Beverage patterns and trends among school-age children in the U.S., 1989–2008. *Nutrition Journal* 10:103.
- Lichtenstein, A. H., et al. 2006. Diet and lifestyle recommendations, revision 2006: a scientific statement from the American Heart Association Nutrition Committee. *Circulation* 114(1): 82–96.
- Maki, K. C., et al. 2010. Whole-grain ready-to-eat oat cereal, as part of a dietary program for weight loss, reduces low-density lipoprotein cholesterol in adults with overweight and obesity more than a dietary program including low-fiber control foods. *Journal of the American Dietetic Association* 110(2): 205–214.
- Mosaffarian, D., et al. 2006. Trans fatty acids and cardiovascular disease. *New England Journal of Medicine* 354(15): 1601–1613.
- Nicholls, S. J., et al. 2006. Consumption of saturated fat impairs the anti-inflammatory properties of high-density lipoproteins and endothelial function. *Journal of the American College of Cardiology* 48(4): 715–720.
- Siri-Tarino, P. W., et al. 2010. Meta-analysis of prospective cohort studies evaluating the association of saturated fat with cardiovascular disease. *American Journal of Clinical Nutrition* 91(3): 535–546.
- Trump, D. L., et al. 2010. Vitamin D: considerations in the continued development as an agent for cancer prevention and therapy. *Cancer Journal* 16(1): 1–9.
- Tucker, K. L. 2009. Osteoporosis prevention and nutrition. *Current Osteoporosis Reports* 7(4): 111–117.
- U.S. Department of Agriculture. 2011. Choose MyPlate (<http://www.choosemyplate.gov>).
- U.S. Department of Agriculture and Centers for Disease Control and Prevention. 2010. *What We Eat in America* (<http://www.ars.usda.gov/Services/docs.htm?docid=15044>).
- U.S. Department of Health and Human Services and U.S. Department of Agriculture. 2010. *Dietary Guidelines for Americans, 2010*. 7th edition. Washington, DC: U.S. Government Printing Office.
- U.S. Environmental Protection Agency. 2012. *Fish Consumption Advisories* (<http://www.epa.gov/hg/advisories.htm>).
- U.S. Food and Drug Administration. 2012. *Food Allergies: What You Need to Know* (<http://www.fda.gov/food/resourcesforyou/consumers/ucm079311.htm>).

BEHAVIOR CHANGE STRATEGY

Improving Your Diet by Choosing Healthy Beverages

After reading this chapter and completing the dietary assessment, you can probably identify several ways to improve your diet. As an example here, we focus on choosing healthy beverages to increase intake of nutrients and decrease intake of empty calories from added sugars and fat. This model can be applied to any change you want to make to your diet.

Gather Data and Establish a Baseline

Begin by tracking your beverage consumption in a journal. Write down the types and amounts of beverages you drink, including water. Also note where you were at the time and whether you got the beverage there or brought it with you. At the same time, investigate your options. Find out what other beverages you can easily find during your daily routine. This information will help you put together a successful plan for change.

Analyze Your Data and Set Goals

Evaluate your beverage consumption by dividing your typical daily consumption between healthy and less healthy choices. Use the following guide as a basis, and add other beverages to the lists as needed:

Choose More Often	Servings Daily	Choose Less Often	Servings Daily
Water: plain, mineral, sparkling		Regular soda	
Low-fat or fat-free milk		Whole milk	
Fruit juice (100%)		Fruit beverages made with little fruit juice	
Unsweetened herbal tea		Sugar-sweetened beverages such as iced tea and sports drinks	
Others		Others	

How many beverages do you consume daily from each category? What would be a healthy and realistic goal for change? For example, if your beverage consumption is currently evenly divided between the “choose more often” and “choose less often” categories (four from each list), you might set a final goal for your behavior change program of increasing your healthy choices by two (to six from the “more often” list and two from the “less often” list).

Develop a Plan for Change

Once you’ve set your goal, you need to develop strategies that will help you choose healthy beverages more often. Consider the following possibilities:

- Keep healthy beverages on hand. If you live in a dorm, rent a small refrigerator or keep water in a reusable bottle and other healthy choices in the dorm kitchen’s refrigerator.
- Plan ahead, and carry a reusable bottle with water or 100% juice in your backpack every day.
- Check food labels on beverages for serving sizes, calories, and nutrients; comparison shop to find the healthiest choices, and watch your serving sizes. Use this information to make your “choose more often” list longer and more specific.
- If you eat out frequently, examine all the beverages available at the places you typically eat your meals. You’ll probably find that plain water or other healthy choices are available.

You may also need to make changes in your routine to decrease the likelihood that you’ll make unhealthy choices. For example, your journal might reveal that you always buy a soda after class when you pass a particular vending machine. If this is the case, try another route that bypasses the machine. Guard against impulse buying by carrying water or a healthy snack with you every day.

To complete your plan, try some of the other behavior change strategies described in Chapter 1: develop and sign a contract, set up a system of rewards, involve other people in your program, and develop strategies for challenging situations. Once your plan is complete, take action. Keep track of your progress by continuing to monitor and evaluate your beverage consumption.

Nutrition Resources

Table 1 Dietary Reference Intakes (DRIs): Recommended Levels for Individual Intake

LIFE STAGE	GROUP	BIOTIN (μ G/DAY)	CHOLINE (MG/DAY) ^a	FOLATE (μ G/DAY) ^b	NIACIN (MG/DAY) ^c	PANTOTHENIC ACID (MG/DAY)	RIBOFLAVIN (MG/DAY)
Infants	0–6 months	5	125	65	2	1.7	0.3
	7–12 months	6	150	80	4	1.8	0.4
Children	1–3 years	8	200	150	6	2	0.5
	4–8 years	12	250	200	8	3	0.6
Males	9–13 years	20	375	300	12	4	0.9
	14–18 years	25	550	400	16	5	1.3
	19–30 years	30	550	400	16	5	1.3
	31–50 years	30	550	400	16	5	1.3
	51–70 years	30	550	400	16	5	1.3
	>70 years	30	550	400	16	5	1.3
Females	9–13 years	20	375	300	12	4	0.9
	14–18 years	25	400	400 ⁱ	14	5	1.0
	19–30 years	30	425	400 ⁱ	14	5	1.1
	31–50 years	30	425	400 ⁱ	14	5	1.1
	51–70 years	30	425	400 ⁱ	14	5	1.1
	>70 years	30	425	400	14	5	1.1
Pregnancy	≤18 years	30	450	600 ⁱ	18	6	1.4
	19–30 years	30	450	600 ^j	18	6	1.4
	31–50 years	30	450	600 ^j	18	6	1.4
Lactation	≤18 years	35	550	500	17	7	1.6
	19–30 years	35	550	500	17	7	1.6
	31–50 years	35	550	500	17	7	1.6
<i>Tolerable Upper Intake Levels for Adults (19–70)</i>			3500	1000 ^k	35 ^k		

LIFE STAGE	GROUP	THIAMIN (MG/DAY)	VITAMIN A (μ G/DAY) ^d	VITAMIN B-6 (MG/DAY)	VITAMIN B-12 (μ G/DAY)	VITAMIN C (MG/DAY) ^e	VITAMIN D (IU/DAY) ^f	VITAMIN E (MG/DAY) ^g
Infants	0–6 months	0.2	400	0.1	0.4	40	400*	4
	7–12 months	0.3	500	0.3	0.5	50	400*	5
Children	1–3 years	0.5	300	0.5	0.9	15	600	6
	4–8 years	0.6	400	0.6	1.2	25	600	7
Males	9–13 years	0.9	600	1.0	1.8	45	600	11
	14–18 years	1.2	900	1.3	2.4	75	600	15
	19–30 years	1.2	900	1.3	2.4	90	600	15
	31–50 years	1.2	900	1.3	2.4	90	600	15
	51–70 years	1.2	900	1.7	2.4 ^h	90	600	15
	>70 years	1.2	900	1.7	2.4 ^h	90	800	15
Females	9–13 years	0.9	600	1.0	1.8	45	600	11
	14–18 years	1.0	700	1.2	2.4	65	600	15
	19–30 years	1.1	700	1.3	2.4	75	600	15
	31–50 years	1.1	700	1.3	2.4	75	600	15
	51–70 years	1.1	700	1.5	2.4 ^h	75	600	15
	>70 years	1.1	700	1.5	2.4 ^h	75	800	15
Pregnancy	≤18 years	1.4	750	1.9	2.6	80	600	15
	19–30 years	1.4	770	1.9	2.6	85	600	15
	31–50 years	1.4	770	1.9	2.6	85	600	15
Lactation	≤18 years	1.4	1200	2.0	2.8	115	600	19
	19–30 years	1.4	1300	2.0	2.8	120	600	19
	31–50 years	1.4	1300	2.0	2.8	120	600	19
<i>Tolerable Upper Intake Levels for Adults (19–70)</i>			3000	100		2000	4000	1000 ^k

NOTE: The table includes values for the type of DRI standard—Adequate Intake (AI) or Recommended Dietary Allowance (RDA)—that has been established for that particular nutrient and life stage; RDAs are shown in **bold type**. The final row of the table shows the Tolerable Upper Intake Levels (ULs) for adults; refer to the full DRI report for information on other ages and life stages. A UL is the maximum level of daily nutrient intake that is likely to pose no risk of adverse effects. There are insufficient data to set ULs for all nutrients, but this does not mean that there is no potential for adverse effects; source of intake should be from food only to prevent high levels of intake of nutrients without established ULs. In healthy individuals, there is no established benefit from nutrient intakes above the RDA or AI.

^aAlthough AIs have been set for choline, there are few data to assess whether a dietary supply of choline is needed at all stages of the life cycle, and it may be that the choline requirement can be met by endogenous synthesis at some of these stages.

^bAs dietary folate equivalents (DFE): 1 DFE = 1 μ g food folate = 0.6 μ g folate from fortified food or as a supplement consumed with food = 0.5 μ g of a supplement taken on an empty stomach.

^cAs niacin equivalents (NE): 1 mg niacin = 60 mg tryptophan.

^dAs retinol activity equivalents (RAEs): 1 RAE = 1 μ g retinol, 12 μ g β -carotene, or 24 μ g α -carotene or β -cryptoxanthin. Preformed vitamin A (retinol) is abundant in animal-derived foods; provitamin A carotenoids are abundant in some dark yellow, orange, red, and deep-green fruits and vegetables. For preformed vitamin A and for provitamin A carotenoids in supplements, 1 RE = 1 RAE; for provitamin A carotenoids in foods, divide the REs by 2 to obtain RAEs. The UL applies only to preformed vitamin A.

Table 1

Dietary Reference Intakes (DRIs): Recommended Levels for Individual Intake
(continued)

LIFE STAGE	GROUP	VITAMIN K (μ G/DAY)	CALCIUM (MG/DAY)	CHROMIUM (μ G/DAY)	COPPER (μ G/DAY)	FLUORIDE (MG/DAY)	IODINE (μ G/DAY)	
Infants	0–6 months	2.0	200*	0.2	200	0.01	110	
	7–12 months	2.5	260*	5.5	220	0.5	130	
Children	1–3 years	30	700	11	340	0.7	90	
	4–8 years	55	1000	15	440	1	90	
Males	9–13 years	60	1300	25	700	2	120	
	14–18 years	75	1300	35	890	3	150	
	19–30 years	120	1000	35	900	4	150	
	31–50 years	120	1000	35	900	4	150	
	51–70 years	120	1000	30	900	4	150	
	>70 years	120	1200	30	900	4	150	
Females	9–13 years	60	1300	21	700	2	120	
	14–18 years	75	1300	24	890	3	150	
	19–30 years	90	1000	25	900	3	150	
	31–50 years	90	1000	25	900	3	150	
	51–70 years	90	1200	20	900	3	150	
	>70 years	90	1200	20	900	3	150	
Pregnancy	≤8 years	75	1300	29	1000	3	220	
	19–30 years	90	1000	30	1000	3	220	
	31–50 years	90	1000	30	1000	3	220	
Lactation	≤18 years	75	1300	44	1300	3	290	
	19–30 years	90	1000	45	1300	3	290	
	31–50 years	90	1000	45	1300	3	290	
Tolerable Upper Intake Levels for Adults (19–70)			2500		10,000	10	1100	
LIFE STAGE	GROUP	IRON (MG/DAY) ^l	MAGNESIUM (MG/DAY)	MANGANESE (MG/DAY)	MOLYBDENUM (μ G/DAY)	PHOSPHORUS (MG/DAY)	SELENIUM (MG/DAY)	ZINC (MG/DAY) ^m
Infants	0–6 months	0.27	30	0.003	2	100	15	2
	7–12 months	11	75	0.6	3	275	20	3
Children	1–3 years	7	80	1.2	17	460	20	3
	4–8 years	10	130	1.5	22	500	30	5
Males	9–13 years	8	240	1.9	34	1250	40	8
	14–18 years	11	410	2.2	43	1250	55	11
	19–30 years	8	400	2.3	45	700	55	11
	31–50 years	8	420	2.3	45	700	55	11
	51–70 years	8	420	2.3	45	700	55	11
	>70 years	8	420	2.3	45	700	55	11
Females	9–13 years	8	240	1.6	34	1250	40	8
	14–18 years	15	360	1.6	43	1250	55	9
	19–30 years	18	310	1.8	45	700	55	8
	31–50 years	18	320	1.8	45	700	55	8
	51–70 years	8	320	1.8	45	700	55	8
	>70 years	8	320	1.8	45	700	55	8
Pregnancy	≤8 years	27	400	2.0	50	1250	60	13
	19–30 years	27	350	2.0	50	700	60	11
	31–50 years	27	360	2.0	50	700	60	11
Lactation	≤18 years	10	360	2.6	50	1250	70	14
	19–30 years	9	310	2.6	50	700	70	12
	31–50 years	9	320	2.6	50	700	70	12
Tolerable Upper Intake Levels for Adults (19–70)			45	350 ^k	11	2000	400	40

*Individuals who smoke require an additional 35 mg/day of vitamin C over that needed by nonsmokers; nonsmokers regularly exposed to tobacco smoke should ensure they meet the RDA for vitamin C.

^lAs cholecalciferol: 1 μ g cholecalciferol = 40 IU vitamin D. DRI values are based on the absence of adequate exposure to sunlight.

^gAs α -tocopherol. Includes naturally occurring RRR- α -tocopherol and the 2R-stereoisomeric forms from supplements; does not include the 2S-stereoisomeric forms from supplements.

^hBecause 10–30% of older people may malabsorb foodbound B-12, those over age 50 should meet their RDA mainly with supplements or foods fortified with B-12.

ⁱIn view of evidence linking folate intake with neural tube defects in the fetus, it is recommended that all women capable of becoming pregnant consume 400 μ g from supplements or fortified foods in addition to consuming folate from a varied diet.

^jIt is assumed that women will continue consuming 400 μ g from supplements or fortified food until their pregnancy is confirmed and they enter prenatal care, which ordinarily occurs after the end of the periconceptual period—the critical time for formation of the neural tube.

^kThe UL applies only to intake from supplements, fortified foods, and/or pharmacological agents and not to intake from foods.

^lBecause the absorption of iron from plant foods is low compared to that from animal foods, the RDA for strict vegetarians is approximately 1.8 times higher than the values established for omnivores (14 mg/day for adult male vegetarians; 33 mg/day for premenopausal female vegetarians). Oral contraceptives (OCs) reduce menstrual blood losses, so women taking them need less daily iron; the RDA for premenopausal women taking OCs is 10.9 mg/day. For more on iron requirements for other special situations, refer to *Dietary Reference Intakes for Vitamin A, Vitamin K, Arsenic, Boron, Chromium, Copper, Iodine, Iron, Manganese, Molybdenum, Nickel, Silicon, Vanadium, and Zinc* (visit <http://www.nap.edu> for the complete report).

^mZinc absorption is lower for those consuming vegetarian diets, so the zinc requirement for vegetarians is approximately twofold greater than for those consuming a nonvegetarian diet.

Table 1

Dietary Reference Intakes (DRIs): Recommended Levels for Individual Intake
(continued)

LIFE STAGE	GROUP	POTASSIUM (G/DAY)	SODIUM (G/DAY)	CHLORIDE (G/DAY)	CARBOHYDRATE		TOTAL FIBER	TOTAL FAT
					RDA/AI (G/DAY)	AMDR ^o (%)	RDA/AI (G/DAY)	AMDR ^o (%)
Infants	0–6 months	0.4	0.12	0.18	60	ND ^q	ND	r
	7–12 months	0.7	0.37	0.57	95	ND ^q	ND	r
Children	1–3 years	3.0	1.0	1.5	130	45–65	19	30–40
	4–8 years	3.8	1.2	1.9	130	45–65	25	25–35
Males	9–13 years	4.5	1.5	2.3	130	45–65	31	25–35
	14–18 years	4.7	1.5	2.3	130	45–65	38	25–35
	19–30 years	4.7	1.5	2.3	130	45–65	38	20–35
	31–50 years	4.7	1.5	2.3	130	45–65	38	20–35
	51–70 years	4.7	1.3	2.0	130	45–65	30	20–35
	>70 years	4.7	1.2	1.8	130	45–65	30	20–35
Females	9–13 years	4.5	1.5	2.3	130	45–65	26	25–35
	14–18 years	4.7	1.5	2.3	130	45–65	26	25–35
	19–30 years	4.7	1.5	2.3	130	45–65	25	20–35
	31–50 years	4.7	1.5	2.3	130	45–65	25	20–35
	51–70 years	4.7	1.3	2.0	130	45–65	21	20–35
	>70 years	4.7	1.2	1.8	130	45–65	21	20–35
Pregnancy	≤18 years	4.7	1.5	2.3	175	45–65	28	20–35
	19–30 years	4.7	1.5	2.3	175	45–65	28	20–35
	31–50 years	4.7	1.5	2.3	175	45–65	28	20–35
Lactation	≤18 years	5.1	1.5	2.3	210	45–65	29	20–35
	19–30 years	5.1	1.5	2.3	210	45–65	29	20–35
	31–50 years	5.1	1.5	2.3	210	45–65	29	20–35
Tolerable Upper Intake Levels for Adults (19–70)			2.3	3.6				
LIFE STAGE	GROUP	LINOLEIC ACID		ALPHA-LINOLENIC ACID		PROTEIN ⁿ		WATER ^p (L/DAY)
		RDA/AI (G/DAY)	AMDR ^o (%)	RDA/AI (G/DAY)	AMDR ^o (%)	RDA/AI (G/DAY)	AMDR ^o (%)	
Infants	0–6 months	4.4	ND ^q	0.5	ND ^q	9.1	ND ^q	0.7
	7–12 months	4.6	ND ^q	0.5	ND ^q	13.5	ND ^q	0.8
Children	1–3 years	7	5–10	0.7	0.6–1.2	13	5–20	1.3
	4–8 years	10	5–10	0.9	0.6–1.2	19	10–30	1.7
Males	9–13 years	12	5–10	1.2	0.6–1.2	34	10–30	2.4
	14–18 years	16	5–10	1.6	0.6–1.2	52	10–30	3.3
	19–30 years	17	5–10	1.6	0.6–1.2	56	10–35	3.7
	31–50 years	17	5–10	1.6	0.6–1.2	56	10–35	3.7
	51–70 years	14	5–10	1.6	0.6–1.2	56	10–35	3.7
	>70 years	14	5–10	1.6	0.6–1.2	56	10–35	3.7
Females	9–13 years	10	5–10	1.0	0.6–1.2	34	10–30	2.1
	14–18 years	11	5–10	1.1	0.6–1.2	46	10–30	2.3
	19–30 years	12	5–10	1.1	0.6–1.2	46	10–35	2.7
	31–50 years	12	5–10	1.1	0.6–1.2	46	10–35	2.7
	51–70 years	11	5–10	1.1	0.6–1.2	46	10–35	2.7
	>70 years	11	5–10	1.1	0.6–1.2	46	10–35	2.7
Pregnancy	≤18 years	13	5–10	1.4	0.6–1.2	71	10–35	3.0
	19–30 years	13	5–10	1.4	0.6–1.2	71	10–35	3.0
	31–50 years	13	5–10	1.4	0.6–1.2	71	10–35	3.0
Lactation	≤18 years	13	5–10	1.3	0.6–1.2	71	10–35	3.8
	19–30 years	13	5–10	1.3	0.6–1.2	71	10–35	3.8
	31–50 years	13	5–10	1.3	0.6–1.2	71	10–35	3.8

^qDaily protein recommendations are based on body weight for reference body weights. To calculate for a specific body weight, use the following values: 1.5 g/kg for infants, 1.1 g/kg for 1–3 years, 0.95 g/kg for 4–13 years, 0.85 g/kg for 14–18 years, 0.8 g/kg for adults, and 1.1 g/kg for pregnant (using prepregnancy weight) and lactating women.

^oAcceptable Macronutrient Distribution Range (AMDR), expressed as a percentage of total daily calories, is the range of intake for a particular energy source that is associated with reduced risk of chronic disease while providing intakes of essential nutrients. If an individual consumes in excess of the AMDR, there is a potential for increasing the risk of chronic diseases and/or insufficient intakes of essential nutrients.

ⁿTotal water intake from fluids and food.

^pNot determinable due to lack of data of adverse effects in this age group and concern with regard to lack of ability to handle excess amounts. Source of intake should be from food only to prevent high levels of intake.

^rFor infants, adequate intake of total fat is 31 grams/day (0–6 months) and 30 grams per day (7–12 months) from breast milk and, for infants 7–12 months, complementary food and beverages.

SOURCE: From Food and Nutrition Board, Institute of Medicine, National Academies, 2010, *Dietary Reference Intakes: The Essential Guide to Nutrient Requirements*. Washington, DC: National Academies Press. <http://www.iom.edu/Activities/Nutrition/SummaryDRIs/DRI-Tables.aspx>. Reprinted with permission from the National Academies Press, Copyright 2010, National Academy of Sciences.

Nutrition Resources

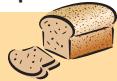




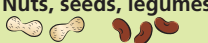


Food groups	Number of servings per day (or per week, as noted)				Serving sizes and notes
	1600 calories	2000 calories	2600 calories	3100 calories	
Grains 	6	6–8	10–11	12–13	1 slice bread, 1 oz dry cereal, 1/2 cup cooked rice, pasta, or cereal; choose whole grains
Vegetables 	3–4	4–5	5–6	6	1 cup raw leafy vegetables, 1/2 cup cooked vegetables, 1/2 cup vegetable juice
Fruits 	4	4–5	5–6	6	1/2 cup fruit juice, 1 medium fruit, 1/4 cup dried fruit, 1/2 cup fresh, frozen, or canned fruit
Low-fat or fat-free dairy foods 	2–3	2–3	3	3–4	1 cup milk; 1 cup yogurt, 1-1/2 oz cheese; choose fat-free or low-fat types
Meat, poultry, fish 	3–6	6 or less	6	6–9	1 oz cooked meats, poultry, or fish: select only lean; trim away visible fats; broil, roast, or boil instead of frying; remove skin from poultry
Nuts, seeds, legumes 	3 servings/week	4–5 servings/week	1	1	1/3 cup or 1-1/2 oz nuts, 2 Tbsp or 1/2 oz seeds, 1/2 cup cooked dry beans/peas, 2 Tbsp peanut butter
Fats and oils 	2	2–3	3	4	1 tsp soft margarine; 1 Tbsp low-fat mayonnaise, 2 Tbsp light salad dressing, 1 tsp vegetable oil; DASH has 27% of calories as fat (low in saturated fat)
Sweets 	0	5 servings/week or less	2	2	1 Tbsp sugar, 1 Tbsp jelly or jam, 1/2 cup sorbet, 1 cup lemonade; sweets should be low in fat

FIGURE 1 The DASH Eating Plan.

SOURCE: National Institutes of Health, National Heart, Lung, and Blood Institute. 2006. *Your Guide to Lowering Your Blood Pressure with DASH*. (http://www.nhlbi.nih.gov/health/public/heart/hbp/dash/new_dash.pdf; retrieved May 8, 2012).

FIGURE 2 Healthy Eating Plate. The Healthy Eating Plate is an alternative food group plan developed by researchers at the Harvard School of Public Health. The Healthy Eating Plate distinguishes among the various dietary sources of fat, protein, carbohydrate, and fluids, and it includes a reminder to be physically active. Copyright © 2011 Harvard University. For more information about The Healthy Eating Plate, please see *The Nutrition Source*, Department of Nutrition, Harvard School of Public Health, <http://www.thenutritionsource.org> and Harvard Health Publications, health.harvard.edu.

