CHAPTER 2

Starting With Food: Nutrition and Health

CHAPTER OBJECTIVES

- Convey the basic biological process of digestion and metabolism.
- Explain the roles and functions of macronutrients and micronutrients.
- Help develop skills for making healthier food decisions.
- Help develop a stronger understanding of the connection between social nutritional policies and population health outcomes.

You are what you eat. It is a centuries-old statement that remains true today for individuals, families, communities, and even nations.

What you put into your body affects your short-term and long-term energy levels, your mood, your physical performance, and even your long-term overall well-being. Your eating patterns can provide you with energy or sap energy from you. How your mind and body function is often a reaction to what you put into your body. This reaction also depends on your age, sex, weight, allergic disposition, past behaviors, and possibly even your mother's behavior before you were born.

The same is true for families and communities—collectively, we are what we eat. Research continues to discover differences in health outcomes among countries, regions, and even continents. The effects of **regional-level eating patterns** indicate that different cultures can have better overall health outcomes than others, due, in large part, to their diets. For example, the Mediterranean diet, high in vegetables and low in processed foods, seems to yield lower-than-average rates of chronic diseases and higher-than-average life expectancies.[1]

regional-level eating patterns The diet typical to a given region. Studies of regional-level eating patterns indicate that some cultures can have better overall health outcomes than other cultures due, in large part, to their diets.

Different communities that are not far from each other can also see important differences in health outcomes. One neighborhood within a single city or town can have better outcomes compared to another only a quarter of a

Diets high in vegetables, olive oils, and fish, and low in processed foods, are part of a "Mediterranean diet," shown to be associated with higher life expectancy.

mile away, or even just across a major street or train track. In many cases, these health differences arise from cultural, socioeconomic, and demographic factors, such as historical, institutional and racist policies, which may have led to the racial and ethnic health disparities that persist in that community. While each community has its own set of social and environmental factors that affect health disparities, these differences can be seen directly in **nutritional environments**. These environments—both healthy and unhealthy—in turn, affect diet-related population outcomes, including obesity, diabetes, heart disease, and cancer.

nutritional environments
The environment where people purchase and eat food.

This chapter will discuss the basic science of nutrition and how we obtain energy, strength, and vitality through food. Because no person can achieve complete physical, mental, and social well-being in an otherwise unhealthy environment, the focus of the chapter will shift between the individual biological environment and the wider societal view. This will help us develop a more critical understanding of the important environmental and social factors that influence our personal nutritional choices and, consequently, our health.

TRY IT!

Pick two social settings—maybe two schools, two families, two neighborhoods, two different streets. Make five statements about which one of the two is healthier (i.e., smoking is more common in one, one population seems to be overweight, one seems to have higher levels of stress, etc.). Now, think about some factors that may be behind *why* the one seems to be healthier than the other. Does the healthier population have more or less average family income? Are there more fast-food places nearby? More parks? Does education play a role? Are there historical events (e.g., segregation) that may have shaped why these two places are different?

These kinds of observations can help us gain a better understanding about how the decisions we make as a society can help to ensure that everyone has access to the best nutritional environments possible.

Next, we will look at the social factors that influence our health over the course of our lives. There are important developmental periods for each of us, when nutritional choices are especially significant to our long-term health, and the health of our families and communities. The nutritional choices made by an average 58-year-old man are less impactful on long-term health than, for example, is the diet of a 2-year-old boy or an 11-year-old girl. What should that mean for the policies we establish?

Let's start with individual nutrition and consider how the food you eat turns to the energy that allows you to live and, hopefully, thrive.

Digestion and Absorption: What Happens When You Eat or Drink?

Early Stages of Digestion

Digestion begins the moment you put something in your mouth (**FIGURE 2-1**). The first stage, chewing, or mechanical digestion, is influenced by whether or not you have a healthy set of teeth. The health of your teeth will affect the kinds of foods you can eat and how well you break down solid foods. Oral health plays a role in nutritional status, just as sound nutrition is necessary to ensure healthy teeth. People deprived of adequate vitamin C and calcium early in life are, for example, more likely to develop unhealthy teeth as they grow older. Unhealthy teeth, in turn, will limit their ability to achieve nutritional balance over time, continuing the cycle throughout the life span.

For individuals and for populations, nutritional status affects teeth, and oral health affects nutritional status. Proper nutrition helps support healthy teeth, saliva, mucus, musculature, and enzymes that, in turn, help ensure healthy teeth, saliva, mucus, and digestive organs.

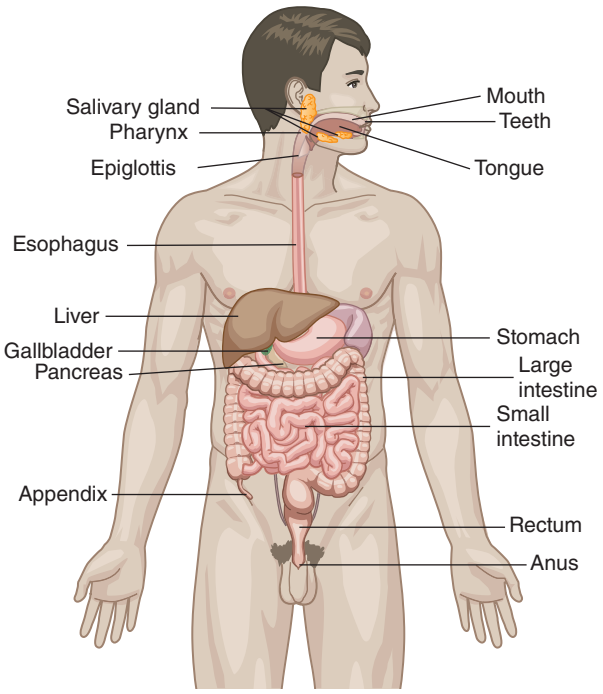
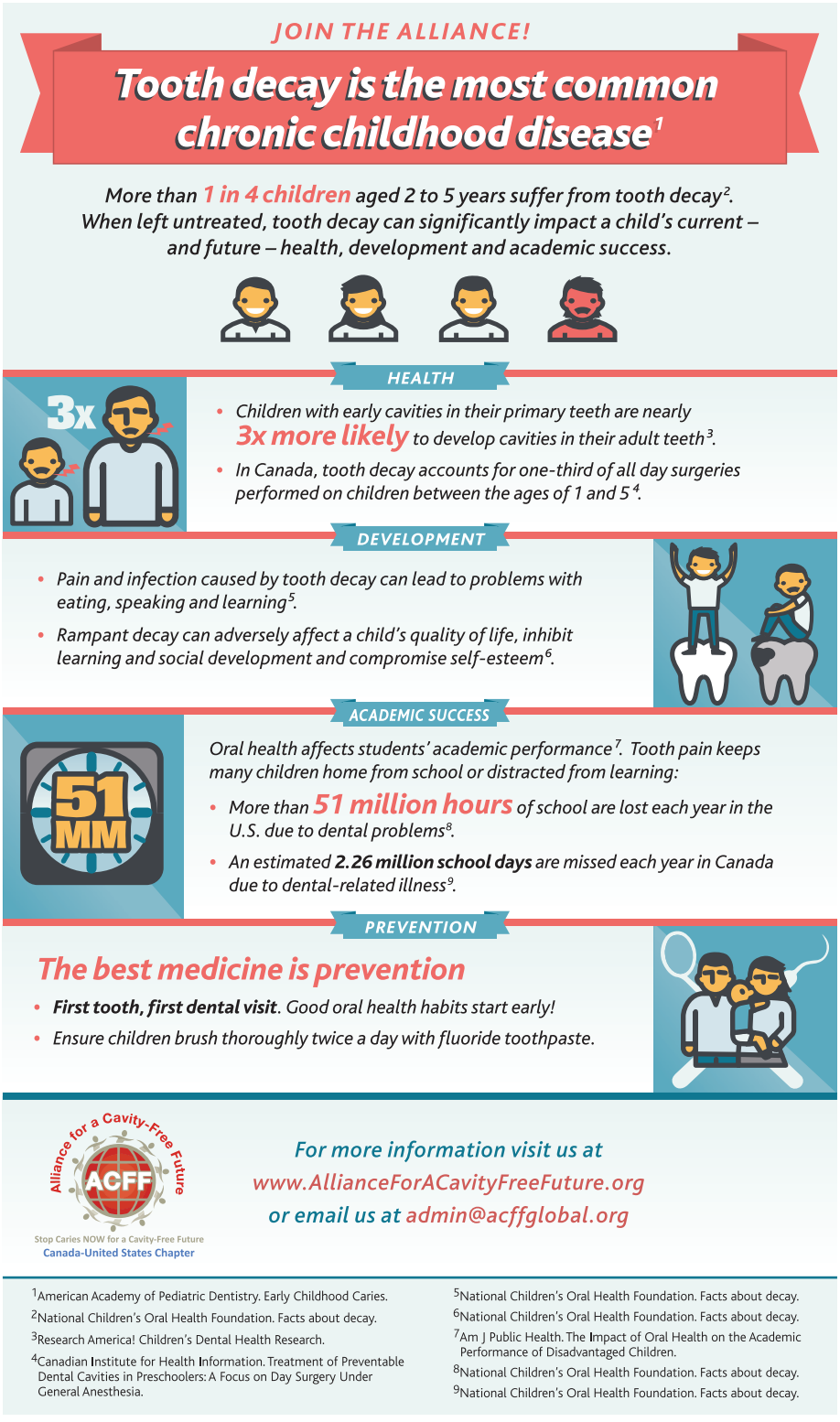


FIGURE 2-1 The digestive system.



The root of it all.

The body is an interconnected organism—every component affects everything else, and nothing is truly isolated. At a community and population level, the same is true. Our individual nutritional habits are inextricably connected to the places where we spend the most time and to the communities and cultures that influence us.[2]

During chewing, in addition to breaking food down mechanically, the mouth introduces salivary gland secretions and mucus, which break down foods for digestion and solubilize nutrients. Receptors transmit taste signals to your brain. Saliva also plays a role in oral hygiene, flushing away bacteria and releasing the enzymes that begin the process of digestion.

After foods are swallowed, they pass through a bundle of muscles within the esophagus called the upper esophageal sphincter, which secretes more mucus and keeps food from passing down your windpipe. The esophagus also warms the food to body temperature, which optimizes digestive efficiency.[3] The esophagus then channels food through the cardiac sphincter and into the stomach, which is where it is stored as food. The stomach's storage function allows you to eat a large meal and process the nutrients from that meal over the course of many hours.

The stomach is a powerful muscle that churns, grinds, and applies hydrochloric acid and enzymes to the food to prepare it for digestion. The digestion that takes place in the stomach is called the **predigestive process**. Acid destroys harmful bacteria and breaks down the food, while mucus protects the body's cells from the stomach acids. The chemical and enzymatic process converts foods into the fine liquid called chyme, which is released slowly into the intestine (also referred to as the gut), where the next phase of digestion occurs.

predigestive process The process by which the stomach churns, grinds, and applies hydrochloric acid and enzymes to ingested food to prepare it for digestion.

Through the Gut

The small intestine is a loosely coiled tube, approximately 20 feet long, held together by a fine membrane. It consists of three sections—the duodenum, the jejunum, and the ileum. Each has a different cellular and digestive function. The duodenum breaks down food, while the other two are responsible for absorbing nutrients into the bloodstream.

A wavelike motion of contractions moves food through the bowel and mixes it with digestive secretions. Along with the secretions from the pancreas, liver, and stomach, the intestinal wall also secretes important digestive enzymes. The enzymes accelerate, or catalyze, the breakdown of **macronutrients** and **micronutrients** during digestion (**FIGURE 2-2**).

Trillions of microscopic organisms live in our gut, and have an enormous influence on our health.[4] These bacteria, which form the body's **microbiome**, produce vitamins from our food, fight disease, and control our weight.[5] These microorganisms have been associated with improving our immune system and our mood and mental health.[6,7] Although research in this area is still relatively recent, scientists are beginning to discover that a diet rich in vegetables and fiber can encourage healthy function of our microbiome and consequently protect us from numerous diseases. A "probiotic" nutrition program encourages

macronutrients Carbohydrates, proteins, and fats that serve as the primary components of a healthy diet.

micronutrients Nutrients, mostly vitamins and minerals, that are essential for optimal health, although only in miniscule amounts. Micronutrients are important for the normal functioning of the body and enable many of the important chemical reactions that promote good health.

microbiome The environment created by the trillions of microscopic organisms living in our gut, which have an enormous influence on our health. They have been found to produce vitamins from our food, fight disease, and control our weight.

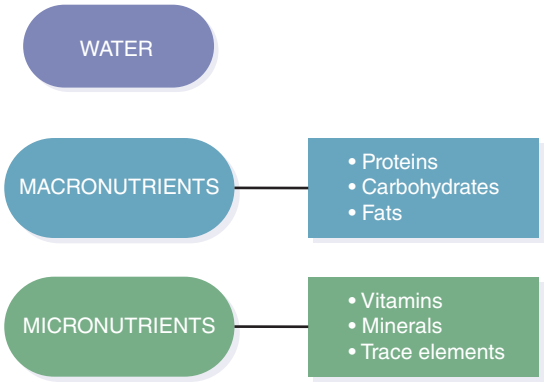


FIGURE 2-2 Macronutrients and micronutrients.

diets that promote a thriving microbiome. Early research indicates that foods such as kimchi, sauerkraut, kefir, and probiotic yogurts may encourage gut bacteria and lead to healthier immune systems, reduced weight gain, and possibly even reduced depression.[8–10]

Breaking Down and Building Up: The Metabolic Process

You have likely heard people referring to their metabolism and whether it is "fast" or "slow." Metabolism is the process the body uses to generate energy and maintain life. Metabolism consists of two fundamental stages. Catabolism is the phase that breaks down nutrients, creating energy through the process of cellular respiration. Anabolism is the constructive phase, where energy builds the proteins, nucleic acids, and cells that make up our body. Your body is metabolizing nutrients continuously. Your rate of metabolism depends on both the amount of exercise you get, and your age, sex, body size, and genetics.[11]

The amount of energy from food is measured in calories. Technically, the calorie we use for food energy is a "kilocalorie," based on 1,000 "small calories" from a measuring system rarely seen today. This is why you will sometimes see the food calorie symbolized as the "kcal." The more calories a meal has, the more energy you can spend—or store as fat.

The current guidelines offered by the USDA Center for Nutrition Policy and Promotion offer a similar perspective on nutritional recommendations for Americans.

Courtesy of U.S. Department of Health and Human Services.

Into the Colon and Then Out

During the last part of the digestive process, the remaining components of the foods that were eaten but were not used for nutrition enter the large intestine, or colon. This is where water is absorbed from the remaining nondigestible waste to form feces, before being expelled via defecation.

Macronutrients and Other Key Components of Nutrition

Carbohydrates

Carbohydrates (also called "carbs") consist of carbon, hydrogen, and oxygen atoms (hence the term *carbo* + *hydrate*). Produced from the sun's energy, carbohydrates hold the energy found in fruits, grains, and plants, and serve as fuel for body and brain function. Carbohydrates are classified by the number of sugar units contained in each molecule. Most carbohydrates are either monosaccharides, containing 1 unit; disaccharides, containing 2 units; or polysaccharides, containing 10 or more units. Carbohydrates are sometimes classified as "simple" (monosaccharides and disaccharides) and "complex" (polysaccharides). **Complex carbohydrates** comprise a long chain of three or more sugars linked together, while carbohydrates in smaller pieces (one or two sugars) are referred to as "simple carbohydrates." Complex carbs, which generally contain more vitamins than simple carbs, include beans, peas, lentils, brown rice, and oatmeal. Simple carbs include sugar, white bread, and white rice. The body tends to digest and absorb **simple carbohydrates** more quickly than complex ones, which partially explains why simple carbs are more likely than complex carbs to end up stored in your body as fat.[12]

complex carbohydrates Sometimes referred to as "good" carbohydrates because they provide useful nutrients to the body, as compared to simple ("bad") carbohydrates, which are more easily converted to fat.

simple carbohydrates Sometimes referred to as "bad" carbohydrates because they are more easily converted to fat, as compared to complex ("good") carbohydrates, which provide useful nutrients to the body.

When you eat more carbohydrates than your body needs, the excess carbohydrates are converted into the compound glycogen, which the body stores in the liver and muscle tissues. Glycogen remains as a potential future source of energy and is stored as fat if not used during physical activity. While the time it takes for glycogen to be converted into fat varies from person to person, eating too much sugar or starch is an easy way to gain body fat.

Glycemic Index and Glycemic Load

While there is no simple way to evaluate the healthfulness of different types of carbohydrate, there are some useful ways to understand them. While "complexity" can be helpful, this classification can be deceiving, since some complex carbohydrates can cause greater blood sugar surges than less complex carbs. A measure called the **glycemic index** provides an indication of how powerfully foods affect blood sugar (glucose). Pure sugar has a glycemic index of 100 and raises a person's blood glucose level at the fastest rate possible. At the other end of the spectrum, carrots and peanuts are more slowly metabolized and cause a slower rise in blood glucose. Meat does not have a glycemic index because it contains no sugar and so does not increase blood glucose.

glycemic index A system that ranks food from 1 to 100 to indicate the food's effect on blood sugar (glucose) levels.

The glycemic index only provides information about the type of carbohydrate without providing information about how carbohydrate-heavy a food can be. Glycemic load, by contrast, classifies carbohydrates according to their impact on the body's blood sugar levels. For example, watermelons have a high

TABLE 2-1 Glycemic Index (GI)/Glycemic Load (GL) for Typical Serving Size (grams) for Common Foods

	Low GI	Medium GI	High GI
Low GL	Apple (120 g) (6/38) Carrot (80 g) (3/47) Peanuts (50 g) (0/7) Strawberries (30 g) (1/40) Hummus (30 g) (0/6)	Beets (60 g) (5/64) Cantaloupe (120 g) (4/65) Pineapple (120 g) (6/66)	Popcorn (20 g) (8/72) Watermelon (120 g) (4/72) Whole-wheat bread (30 g) (9/71)
Medium GL	Banana (12/52) Orange juice (8 oz) (12/50) Corn tortilla (12/52)	Boiled new potatoes (120 g) (12/57) Wild rice (120 g) (18/57)	Cheerios (30 g) (15/74) Shredded wheat (30 g) (15/75)
High GL	Macaroni (120 g) (23/47) Spaghetti (120 g) (20/42)	Couscous (120 g) (23/65) White rice (120 g) (23/64)	Baked potato (28/85) Cornflakes (120 g) (21/81)

Data from International tables of glycemic index (GI) and glycemic load (GL) values: 2008. (2008). *Diabetes Care, 32*(12), 2218–2283.

glycemic index because the type of carbohydrate is simple. However, the food itself is mostly water, so the glycemic load of watermelon is relatively low. In general, foods with a low glycemic index are healthy options, because they contain water, vitamins, and fiber in addition to the carbohydrate. Glycemic load, however, can provide more information about the readiness of carbs to be converted to blood sugar (and, if not counterbalanced with exercise, into fat). The lower the load, the better (**TABLE 2-1**).

While simple carbohydrates (monosaccharides) do not require further breakdown, enzymes (which usually end in "-ase") accelerate chemical reactions and break down foods for energy. Carbohydrates with fewer sugar units are sweeter tasting, while the more complex carbohydrates, consisting of more complex varieties of sugar units, have a starchier flavor. Simple carbohydrates include sugar, honey, fruits, syrups, and juices, while complex carbohydrates include peas, wheat, corn, lettuce, and grains.

Insulin

All digestible simple sugars and starches eventually get converted to glucose in our body. Most types of cells use glucose as their main fuel source. After we eat sugars or starches, our blood glucose level rises, which is where insulin becomes involved.

Insulin is a hormone—a chemical serving as a messenger—that regulates function from one part of the body to another. Insulin is produced and secreted by the pancreas, and its role is to regulate the body to either use glucose for energy or store it for future energy use. Insulin controls the blood glucose level from getting too high (hyperglycemia) or too low (hypoglycemia). Hyperglycemia is particularly dangerous and results if the body does not produce enough insulin or if the insulin is not as effective as it should be.

Type 2 diabetes (previously called adult-onset diabetes) occurs when the cells become resistant to insulin. The pancreas responds to this by producing more and more insulin. When the pancreas can no longer keep up with the demand, and becomes exhausted, it loses control over blood sugar regulation, resulting in the diabetic condition.[13] Long-term complications of diabetes include chronic kidney failure, damage to the eyes, and foot ulcers, which can lead to amputation.

type 2 diabetes Previously called adult-onset diabetes, a condition that occurs when the cells become resistant to insulin. Blood sugar levels rise, and the pancreas responds. When the pancreas can no longer keep up with the demand and becomes exhausted, it loses control over blood sugar regulation, resulting in the diabetic condition.

Diabetes is a powerful example of what can result from preventable poor nutritional environments, in households and in communities. Nutritional choices have consequences for community health, chronic disease, and financial stress. Both affected individuals and communities struggle to pay the long-term healthcare costs of nutrition-related conditions such as diabetes.

Fiber

Fiber is the nondigestible complex carbohydrates found in plant materials. There are two types: soluble (which will dissolve in water) and insoluble (which will not). Cellulose is insoluble fiber, and it is found in parts of plants such as wheat husks, apple peels, and leafy vegetables. Soluble fiber is found inside an apple or pear, for instance, and is often used to bind foods together.

Even though you do not digest fiber, it is highly beneficial for many reasons. It helps regulate sugar metabolism, removes toxins, encourages the growth of healthful bacteria in the lower gut, and provides bulk and moisture in the large intestine. The regulation of sugar metabolism is critical, because when fiber is not present, the absorption of sugar occurs more quickly than nature intended, and that can lead to excess weight gain or, if unchecked, to diseases such as type 2 diabetes and heart disease.[14]

During most of human history, people consumed as much as 100 to 300 grams of fiber per day. However, because the oils in fiber can cause spoiling and reduce shelf life, processing methods were developed to remove fiber from foods. Removing fiber made it easier for manufacturers to store and ship their products. Because of the increase in processed foods consumed in the Western diet over the past several decades, roughly half of Americans do not get the daily amount of fiber recommended by the National Academy of Medicine: 25 grams per day for women and 38 grams per day for men.[15] Because of the important role fiber plays in lowering cholesterol, maintaining healthy weight, controlling blood sugar, and maintaining bowel health, many nutrition scientists believe that consuming enough fiber is one of the most important dietary changes we can make to improve our health.[16–18]

In healthier populations, governments and communities discourage unnecessary food processing and encourage more affordable access to vegetables and other foods naturally rich in fiber. For individuals, this can mean incorporating more fresh fruits, vegetables, and grains into their daily diet. For communities and governments, it means establishing policies such as zoning laws ensuring that healthy foods are accessible to children and families—in schools, parks, and other public environments.

Lipids

Lipids, or fats, are macronutrients that are a necessary component of a healthy diet. Lipids are not soluble in water or blood, and must be transported through structures called lipoproteins.

Fatty acids are the basic building block of lipids and represent the densest form of our dietary energy, providing approximately 9 kilocalories (kcal) per gram—compared to carbohydrates and proteins, which both provide around 4 kcal per gram.[19] Because calories from carbohydrates are quickly burned, your fat stores are a crucial component of an efficient and well-functioning bodily system.[20]

Essential fatty acids are found primarily in meats, dairy, nuts, seeds, olives, and avocados. They are metabolized to give us energy when we need it and when we are not getting enough from our diet. Fats are important in transporting micronutrients, such as the fat-soluble vitamins A, D, E, and K. Fats are an

essential component of the cell membrane and internal fatty tissues, which protect the vital organs from trauma and insulate them from temperature change.[21] Fatty tissue also helps regulate overall body temperature.

Each fat molecule is made of one glycerol molecule and three fatty acid chains. These chains can be either saturated, monounsaturated, or polyunsaturated. Fats consisting of a molecular structure where carbon is saturated with hydrogen are called "saturated" fats. **Unsaturated fats** are categorized as monounsaturated or polyunsaturated, depending on the number of carbon bonds in the molecule. **Saturated fats** are solid at room temperature and are often simply referred to as "fats" (e.g., butter, Crisco), while unsaturated fats remain liquid at room temperature and are called "oils" (e.g., olive oil, canola oil). Most food items contain a mixture of both saturated and unsaturated fatty acids, which explains why there can be both liquid and solid fats present in meats and even nuts.

unsaturated fats Fats that remain liquid at room temperature, referred to as "oils."

saturated fats Dietary fats that are solid at room temperature and often referred to simply as "fat."

Only two **fatty acids** are known to be essential for humans (meaning they are necessary to sustain life): alpha-linolenic acid (an omega-3 fatty acid) and linoleic acid (an omega-6 fatty acid). Omega-3 fatty acids are polyunsaturated fatty acids that support numerous functions, such as blood function, brain development, and protection against heart disease and stroke. New studies indicate a protective function for other conditions such as cancer, bowel disease, and other autoimmune diseases, including lupus and rheumatoid arthritis.[22] Among the most abundant sources of omega-3 fatty acids are soybean oil, flaxseed oil, walnuts, brussels sprouts, kale, spinach, salad greens, and fatty fish, such as salmon and tuna.

fatty acids Saturated or unsaturated carboxylic acids with an even number of carbon atoms.

Omega-6 fatty acids are also essential polyunsaturated fatty acids that our bodies cannot make themselves. They have been found to lower levels of low-density lipoprotein (LDL) cholesterol (so-called "bad cholesterol"), reduce inflammation, and otherwise protect against heart disease. Common sources of omega-6 fatty acids include safflower, corn, cottonseed, and soybean oils.

After digestion, most of the fats are carried in the blood and metabolized through different processes, referred to as lipolysis, beta-oxidation, and ketosis. Lipolysis and beta-oxidation occur in the mitochondria, producing energy, carbon dioxide, and water. Ketone bodies are molecules that result from producing energy from fat, and they can be toxic when produced in amounts too high for the body to process. **Ketosis** occurs when the rate of formation of ketones by the liver is greater than the ability of tissues to oxidize them. It occurs during prolonged starvation and when large amounts of fat are eaten in the absence of carbohydrates. This process is often exploited through low-carbohydrate diets, and it can be dangerous if it deprives the body of important nutrients that promote healthy body function and brain activity.

ketosis A metabolic process involving raised ketone body levels; it may occur in people with diabetes or those who follow a low-carb diet.

Proteins

Along with carbohydrates and lipids, protein is an essential macronutrient for the human body. Proteins are the critical building blocks of muscle and cellular tissue, and a source of fuel for energy. As a fuel source, proteins are as efficient as carbohydrates, containing 4 kcal per gram, although not as efficient as lipids (9 kcal per gram). Proteins are complex molecules (polymer chains) that consist of amino acids linked together. They are constantly being broken down and replaced through the amino acids we consume in our foods.

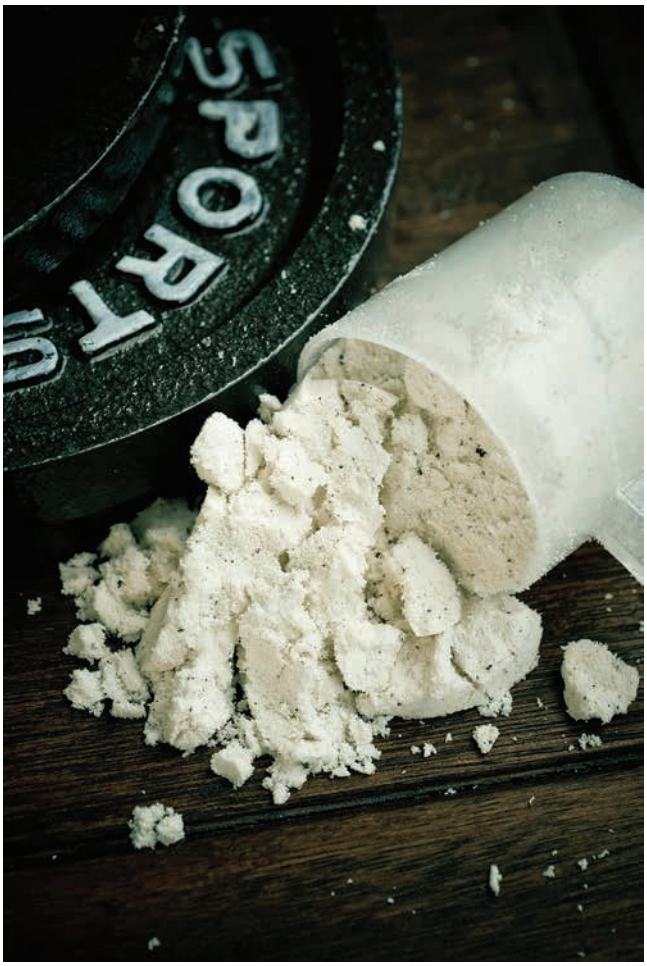
Proteins maintain cell structure and are critical for the function and regulation of all of the body's tissues, particularly muscle tissue, which is composed mostly of protein. Proteins help metabolize fat and produce the satiety that tells us when to stop eating. They also work with insulin to regulate the release

of carbohydrates into the bloodstream, playing an important role in energy release, weight regulation, and the prevention of sugar-related diseases such as diabetes.

There are 20 different amino acids. Nine of these are called "essential," because we require them through our diet. The other 12 are made by our bodies using the energy produced from the essential ones.[14] Nearly all sources of meats, fish, dairy, and eggs contain sufficient quantities of the nine essential amino acids to sustain life. These foods are termed *complete proteins*. For vegans and vegetarians, it is more of a challenge to consume the complete requirements of protein. Although most vegans and vegetarians are in no danger of protein deficiency, it is more difficult for some to consume adequate levels of the amino acids lysine, methionine, and tryptophan their body needs. Vegans and vegetarians should seek a diversified combination of grains and proteins, such as beans and rice, millet and beans, brown rice and sunflower seeds, peanut butter with whole-grain bread, or grains with leafy green vegetables.

The body makes protein from the amino acids consumed through diet, or from storage in muscle. This is why the U.S. Department of Agriculture (USDA) recommends that adults consume at least 50 grams of balanced protein daily (the World Health Organization recommends 1/3 gram of protein per pound of body weight) to provide adequate energy and maintain lean muscle.

One way of classifying protein foods is according to the efficiency with which the body digests them and metabolizes them into energy. This measurement has been called the net protein utilization (NPU), or the ratio of



Protein powders.

UP FOR DEBATE

"Hope in a Can"—Are Protein Powders Worth It?

You see them in gyms, pharmacies, and grocery stores. They are particularly popular among young adults, teens, and moms. In fact, pregnant women are one of the fastest-growing consumer segments of this expanding industry. Often mixed with water or milk to form a shake, protein powders are now being used outside the realm of intense weightlifting workouts, as a meal replacement, in order to save time and money.[23]

The most common bases for protein powders are whey and soy. Whey is produced from milk and is a by-product of cheese making. Because whey contains all nine essential amino acids, it is a complete protein. However, despite the advantages of providing a dense source of protein in an easily consumable form, protein powders have a number of negative attributes.

For one thing, they're expensive. They also may be largely unnecessary. Medical professionals suggest that a diet with adequate meat, fish, dairy, nuts and/or beans is likely to contain enough protein for the body to fully recover and rebuild from nearly any vigorous workout. The body can break down only so much protein at a time—less than 1 gram per kilogram of body weight. The remaining energy is converted to fat or is excreted,[24] which may explain why many users of protein powders report stomach pain and discomfort. Another concern is the amount of sugar often contained in these products. Protein bars, such as Luna, Clif, and Balance, may contain as much as 30 grams of sugar per serving, so it is important to check the amount of sugars listed on the label.

A 2010 investigation by *Consumer Reports* confirmed that protein drinks can pose health risks due to the presence of harmful heavy metals.[23] In a test of 15 of the most popular powders, each drink contained high enough levels of lead, arsenic, cadmium, and/or mercury to concern the researchers. This poses a risk for pregnant women and people who consume more than one protein shake per day. Also of concern is the high level of soy, too much of which has been linked to endocrine disruption, hormone interference, and, in some cases, cancer, birth defects, and developmental disorders.[25]

Marketing campaigns for these powders—commonly seen in shopping malls—target teens and young adults, who are easily convinced by advertisers' inaccurate message that you need more than a balanced and healthy diet consisting of plenty of water to recover from a workout. Teens are particularly vulnerable to the promise of "hope in a can," as protein powders and shakes are most commonly used by boys 12 to 18 years of age.

Although protein supplementation has been found to be effective at promoting increases in mass and muscle endurance in high-intensity weight training programs, the money you spend on supplemental protein shakes can probably be more effectively spent elsewhere, with no adverse effect on your overall health.

What do you think? Do you take supplements? Do you think they are a marketing scam? Should they be more regulated? Or, is the "hope" they engender a good enough reason to allow them to be marketed as they are today, aggressively and boldly?

amino acid converted to proteins to the ratio of amino acids supplied. Eggs are considered to have protein with highest known NPU. Following eggs, in descending order, are fish, milk and cheese, brown rice, red meat, and poultry.[5]

Water—The Most Essential Nutrient of All

While water is sometimes misclassified as a macronutrient, rather than the chemical compound that it is, there is no dispute that water is essential to human life. While you can survive without food for weeks, you can survive without water for only a few days.

About three-fourths of all muscle tissue is composed of water, and water helps regulate body temperature, cushions bones and vital organs, and contributes critical functions to the digestive system, such as transporting nutrients and eliminating waste.

An analysis from the *Journal of the American Dietetic Association* estimated that the average sedentary adult should consume 4 to 8 pints (2 to 4 liters) of water by drinking pure water or consuming soups or water-rich fruits and vegetables such as citrus, cucumber, and peppers.[26] If your diet is healthy

and well balanced, then drinking four 12-ounce glasses (about 1.4 liters) of water per day is probably enough to supplement what you are getting from fruits and vegetables.[27] Of course, that number increases the more physically active you are.

Research indicates that many Americans suffer from dehydration, or underconsumption of water, which can increase the risk of urinary diseases, obesity, cancers, asthma, and heart disease.[28] For public health professionals, the issue of dehydration can be particularly frustrating, given how plentiful and available water is throughout the United States. While many populations around the world struggle to gain access to clean and adequate water supplies, most people in the United States do not have that problem (Flint, Michigan, in the mid-2010s is an important exception). However, this country — and increasingly the world — does have a food and beverage industry dedicated to selling as much sugar-infused product as possible. The beverage industry is known to categorize highly sweetened sports and energy drinks as "healthy," even though the amounts of sugar contained in these drinks can prevent hydration! Furthermore, the health concerns of soft drinks may go beyond sugary drinks: Some scientists attribute the surprising connection between *diet* sodas and obesity as possibly related to the dehydrating effect of artificially sweetened drinks.[29]

In the United States, virtually every municipal water system produces water that is as safe and nutritious, and less expensive, as water sold in bottles. While water is not as heavily marketed as beverages tagged with terms such as "energy," "sports," and "vitamin," pure water is your best bet for a healthy beverage choice—before, during, and after exercise.

Micronutrients—Necessities in Small Bits

Micronutrients are the vitamins and minerals that are essential for optimal health, although only in miniscule amounts. While they do not provide energy the way carbohydrates, lipids, and proteins do, micronutrients are important for the normal functioning of the body, and they enable many of the important chemical reactions that promote good health.

Vitamins assist **metabolism**, growth, and development and help regulate and enhance cell function, working together with enzymes and other substances that are necessary for a healthy life. Vitamins are either fat-soluble or water-soluble. When consumed in excess, fat-soluble vitamins are stored in the body's fatty tissues and are therefore not excreted easily. You do not need to consume them as often as water-soluble vitamins, and because the body cannot flush them out as easily as water-soluble vitamins, fat-soluble vitamins can actually cause toxicity in large doses.

metabolism The process that occurs inside the body at the cellular and the physiological levels to generate energy and maintain life. Metabolism consists of two fundamental stages—catabolism and anabolism.

Water-soluble vitamins are excreted in urine when consumed in excess. For this reason, they need to be consumed regularly, ideally in food, and pose less of a threat from overconsumption. Although vitamins do not produce energy, some vitamins, such as some of the B vitamins, facilitate energy-producing chemical reactions initiated by micronutrients (**TABLE 2-2**).

Minerals are classified into macrominerals and microminerals (or trace minerals). Macrominerals are those that your body requires in relatively larger amounts and include calcium, potassium, iron, sodium, and magnesium. Iron, for example, is a constituent of hemoglobin, a protein molecule found in blood, which is why iron is an essential mineral for strong blood health. Microminerals include copper, zinc, and chromium—necessary in minute amounts for the function of enzymes in the body (**TABLE 2-3**).

TABLE 2-2 Important Vitamins, Recommended Daily Allowance (RDA),* Functions, and Sources

Vitamin	RDA, Men	RDA, Women	Best Sources	Functions
A (carotene)	900 µg	700 µg	Yellow or orange fruits and vegetables, liver, dairy products	Helps maintain skin, hair, and mucous membranes, eye function, bone and tooth growth
B_1 (thiamine)	1.2 mg	1.1 mg	Fortified cereals and oatmeal, meats, rice and pasta, whole grains, liver	Helps body release energy from carbohydrates during metabolism; aids in growth and muscle tone
B_2 (riboflavin)	1.3 mg	1.1 mg	Whole grains, green leafy vegetables, organ meats, milk, eggs	Helps body release energy from protein, fat, and carbohydrates during metabolism
B_6 (pyridoxine)	1.3 mg	1.3 mg	Fish, poultry, lean meats, bananas, prunes, dried beans, whole grains, avocado	Helps body build tissues; aids in metabolism of protein
B_{12} (cobalamin)	2.4 µg	2.4 µg	Meats, milk products, seafood	Aids cell development, functioning of nervous system, and metabolism of fat and protein
Folate (folic acid and folacin)	400 µg	400 µg	Green leafy vegetables, organ meats, dried peas, beans, lentils	Aids in genetic material development and in red cell production
Niacin	16 mg	14 mg	Meat, poultry, fish, enriched cereals, peanuts, potatoes, dairy products, eggs	Involved in carbohydrate, protein, and fat metabolism
C (ascorbic acid)	90 mg	75 mg	Citrus fruits, berries, vegetables (especially peppers)	Essential for bone and cartilage strength and for healthy muscles and blood vessels; helps maintain capillaries and gums; aids in absorption of iron
D	5 µg	5 µg	Fortified milk, sunlight, fish, eggs, butter	Aids in bone and tooth formation; helps maintain heart action and nervous system
E	15 mg	15 mg	Fortified and multigrain cereals, nuts, wheat germ, vegetable oils, green leafy vegetables	Protects blood cells, body tissue, and essential fatty acids from harmful destruction
K	120 µg	90 µg	Green leafy vegetables, fruit, dairy products, grains	Essential for blood clotting functions

µg, micrograms (one millionth of a gram, or one thousandth of a milligram); mg, milligrams.

*Average daily level of intake sufficient to meet the nutrient requirements of nearly most healthy people, also referred to as RDA.

Alan Freishtat-Certified Wellness Coach and Certified Personal Trainer www.alanfitness.com

TABLE 2-3 Important Minerals, Recommended Daily Allowance (RDA), Functions, and Sources

Mineral	RDA, Men	RDA, Women	Best Sources	Functions
Calcium	1,000 mg	1,000 mg	Milk and milk products	Aids in strong bones, teeth, muscle tissue; regulates heartbeat, muscle action, and nerve function; aids in blood clotting
Fluoride	4 mg	3 mg	Fluorinated water, teas, marine fish	Stimulates bone formation; inhibits or even reverses dental caries
Iodine	150 µg	150 µg	Seafood, iodized salt	Component of hormone thyroxine, which controls metabolism
Iron	8 mg	18 mg	Meats, especially organ meats, legumes	Aids in hemoglobin formation; improves blood quality; increases resistance to stress and disease
Magnesium	420 mg	320 mg	Nuts, green vegetables, whole grains	Helps maintain acid–alkaline balance; important in metabolism of carbohydrates, minerals, and sugar (glucose)
Potassium	4,700 mg	4,700 mg	Lean meat, vegetables, fruits	Helps maintain fluid balance; controls activity of heart muscle, nervous system, and kidneys
Selenium	55 µg	55 µg	Seafood, organ meats, lean meats, grains	Protects body tissue against oxidative damage from radiation, pollution, and normal metabolic processing
Zinc	11 mg	8 mg	Lean meats, liver, eggs, seafood, whole grains	Involved in digestion and metabolism; important in development of reproductive system; aids in healing

µg, micrograms; mg, milligrams.

Data from National Academy of Sciences, 2002.

TRY IT!

Making Sense of Nutrition Labels

The Nutrition Facts label is required on most packaged food sold in the United States and many other countries (**FIGURE 2-3**). In the United States, the label begins with standard serving measurement, followed by calories, and such components as fat, sodium, carbohydrates and protein. The U.S. Food and Drug Administration (FDA) updates the label periodically, in an effort to make it easier for people to understand what is on the label and in the package. The most recent changes include making the "servings per container" and "serving size" numbers in larger and/or bolder type. In addition, serving sizes were updated to be more realistic in reflecting the sizes people normally go with. You'll notice that 2,000 calories per day is used as a healthy number of calories that the average person of average size is meant to consume but, in reality, this number ranges dramatically, depending on age, sex, height, and your daily level of physical activity. The Ingredient List is ordered from the most to least, according to weight. Take a look at the U.S. FDA "Nutrition Facts" label below with its instructions from the U.S. Food and Drug Administration, and then find a label in your own kitchen and decide for yourself: Is it healthy or not? Why?

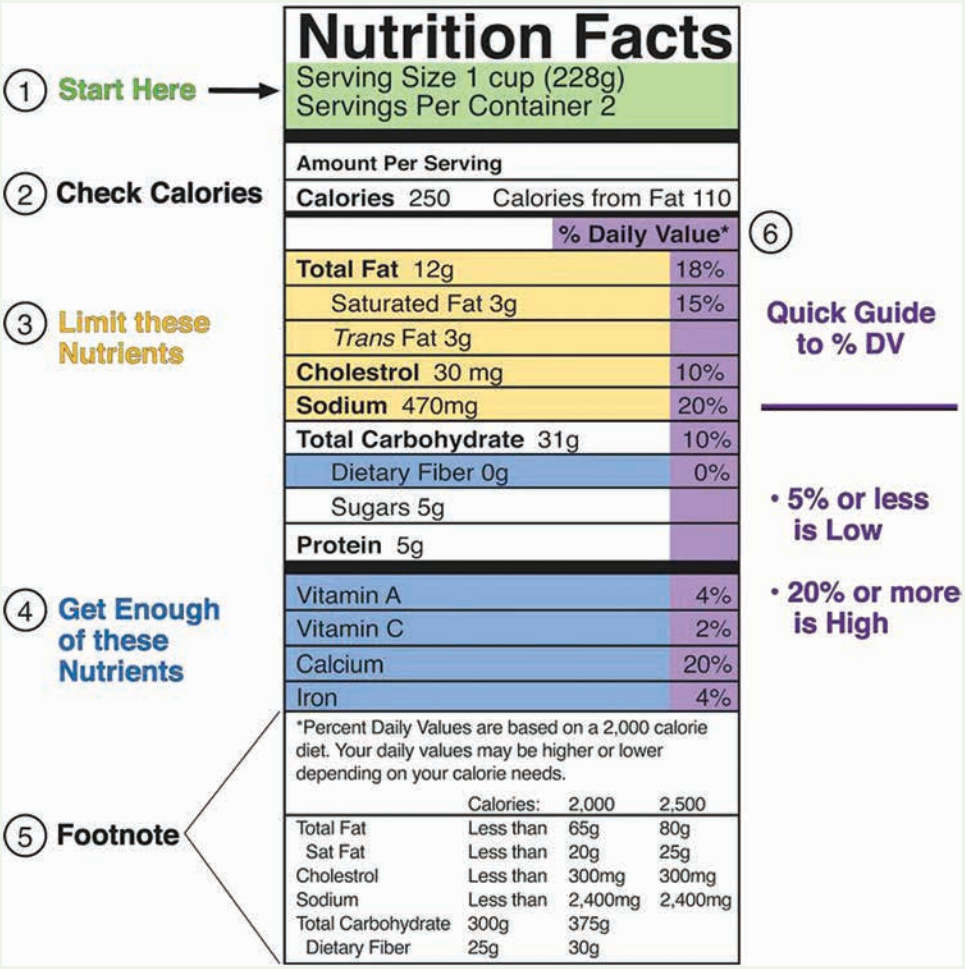


FIGURE 2-3 The U.S. FDA Nutrition Facts label.

Courtesy of U.S. Food and Drug Administration.

While not technically classified as micronutrients, phytochemicals are plant-based chemicals, many of which have been shown to benefit cell function and immunity. Foods that are naturally rich in phytochemicals are also rich in fiber and water and are naturally low in calories.

Eating Wisely—As Individuals and Communities

What should you do to eat well? With the thousands of nutrition-related studies completed each year, and at least as many nutrition experts, publications, and journals releasing new recommendations and advice for our benefit every single day, it can be challenging to know where to start. It seems like every day there is a new diet to try! The following are evidence-based, time-tested nutrition principles that are likely to stay relevant for many years to come.

Getting Your Nutrients From Food

According to the World Health Organization, the best way to prevent micronutrient malnutrition is to ensure that you eat a balanced diet that is adequate

in every nutrient. However, maintaining such a diet tends to be easier with affluence: Wealthier families in the United States tend to consume a more complete intake of micronutrients, while families in lower-income communities consume a more nutrient-deprived diet.[30] This disparity may be related to differences in education levels, but it often relates to different nutritional opportunities between wealthier and less wealthy communities.

In developing nations around the world, and even many communities in the United States, the challenge of ensuring adequate nutrition is more difficult, making a process known as **food fortification** an important solution for this international issue. In fact, fortification has been used for nearly a century in industrialized countries as a means of restoring micronutrients lost by food processing. Do you know how your food is fortified? In the United States, examples of supplementation include adding vitamin D to milk, folic acid to bread, and iodine to salt.[31]

food fortification A method used for nearly a century in industrialized countries to restore micronutrients lost by food processing. In the United States, examples of supplementation include adding vitamin D to milk, folic acid to bread, and iodine to salt.

Yet year after year, researchers conclude that many forms of vitamin supplementation show no results—or worse—cause toxicity or bodily harm. A large clinical trial in 2015 showed no meaningful effect on cancer rates from a decade of vitamin C or E supplements. Another study found no benefit of vitamins C and E for heart disease. In 2014, a major trial studying whether selenium could lower a man's risk for prostate cancer was stopped when it was discovered that treatments may have been doing harm.[32] A Johns Hopkins School of Medicine review of 19 vitamin E clinical trials showed that high doses of vitamin E increased a person's risk of dying. Another study linked daily vitamin E to a higher risk of heart failure.[22] One systematic review concluded that there was no overall benefit of vitamin C for preventing colds. The review did, however, show a reduction in colds among extremely active people, such as marathon runners and soldiers exposed to significant cold or physical stress.[33]

Recent findings confirm a long-held understanding within the medical and public health community: It is safest, and best for your health, to get your micronutrients the way you get your macronutrients, through pure, unprocessed, healthy food. In fact, recent research has shown linkages between herbs and spices and important health benefits, such as cancer risk reduction and even modification of cancer tumor growth. A growing body of evidence points to herbs and spices as having multiple anticancer characteristics. Today, many ethnic cuisines are recognized for their reliance on herbs and spices for healing properties. For example, turmeric, cinnamon, basil, garlic, oregano, and ginger have all been found to have anticancer characteristics. Cherries, too, demonstrate anticancer benefits. Research continues to indicate that the phytochemical compounds in foods produce benefits that are unable to be replicated through nutritional supplements.[34] While taking vitamin supplements may help some people who are deficient in specific vitamins, the longstanding advice to "eat the rainbow" (i.e., a wide color variety of fruits, vegetables, and spices) has proven to be the best advice for getting the vitamins and minerals needed by the average person.

Some foods are so nutritionally dense that they are referred to as "superfoods." While there is no clear definition and no single list of foods that fall into this category, some examples of foods that have numerous health effects include spinach, kale, blueberries, almonds, and wild salmon.

Sugar: More Important to Avoid Than Ever

Over the past few decades, increasing evidence has linked the consumption of sugar, particularly soda and other sweetened drinks, to diabetes, heart disease,

and cancers.[35] Research also indicates that sweet drinks play a significant role in driving current obesity trends. According to the USDA, the average American consumes more than 150 pounds of sugar per year. A century ago, it was only about 4 pounds.[36]

refined sugar A form of sugar made from sugar cane or sugar beets. Once the sugar is extracted, it is processed into white sugar. Also known as sucrose.

high-fructose corn syrup A popular sweetener used in sodas and other beverages. Inexpensive production of corn led to its development.

Refined sugar, found in foods and beverages in the form of sucrose or **high-fructose corn syrup**, leaches vitamins and minerals from the body through its digestion and elimination. Minerals such as sodium (from salt), potassium and magnesium (from vegetables), and calcium (from the bones) are all mobilized and expelled in combating the toxic effects of sugar, thus linking sugar consumption to general malnutrition.[37]

High-fructose corn syrup was first widely introduced to the U.S. market in 1975, and today, because of federal government subsidies, it is so cheap that it has found its way into breads, pretzels, cereals, and most condiments, sauces, and dressings found in the United States.[38]

Regularly eating or drinking refined sugar produces a continuously overactive condition where the body requires more and more minerals to rectify the imbalance resulting from the elimination of the sugar. To protect the blood, calcium is taken from the bones and teeth, which can cause decay and general weakening. Excess sugar is initially stored in the liver in the form of glucose (glycogen) but eventually affects every organ in the body. Because the liver's capacity is limited by sugar consumption, too much refined sugar makes the liver expand like a balloon. When this happens, the excess glycogen is returned to the blood in the form of fatty acids, leading to weight gain or, worse, obesity.[30] Sucrose and high-fructose corn syrup consumption are considered the primary causes of a public health issue referred to as the "metabolic syndrome," which is a combination of obesity, diabetes, hypertension, and cardiovascular disease. Metabolic syndrome affects approximately one-third of American adults and affects our economy through the reduced productivity among people affected by this combination of conditions.[35]

Researchers have also found that excess sugar consumption causes increases in triglycerides and decreases in high-density lipoprotein (HDL) cholesterol (often called "good cholesterol"), each of which can increase the risk of heart disease.[39,40]

Liquid Sugar: Soda, Sports Drinks, and Juice

Recent studies have suggested that an additional mechanism by which sugar-sweetened beverages may lead to weight gain is the low satiety of liquid carbohydrates and the resulting incomplete compensation of energy at subsequent meals. So, in more simple terms: People who consume sugar through liquid do not feel as full as if they had eaten the same number of calories through solid food. That is, you'd likely feel more full by eating one donut than by drinking three cans of Coca-Cola. This may be one of the reasons sweetened beverages are even more closely related to rising levels of obesity and weight gain in the United States than are food products such as candy and desserts.[30]

While there is no limit to the number of diet approaches (and diet books and videos) out there, many of the most popular fall into basic categories (**TABLE 2-4**). Overall, the healthiest diets encourage eating plenty of vegetables and avoiding refined sugar and bleached white flour. Getting enough exercise and drinking lots of water are as important to health as your diet, so be sure to combine them all for best results.

TABLE 2-4 Popular Diets

Basic Approach	Popular Names	Benefits	Concerns
Vegan/Vegetarian (vegan = no animal products [i.e., meat, cheese, eggs]; vegetarian = no meat)	Plant-based Alkaline	Practitioners say this diet leads to a greater sense of well-being. Associated with clear skin, colon health, heart health, reduced chronic diseases, and longevity. Positively associated with environmental health.	Getting adequate protein can be difficult for some people. Because sugars and processed foods can be consumed by some of these regimes, vegans/vegetarians can still have unhealthy diets.
Low carbohydrate	Atkins Paleo South Beach Dukan Low-carb	Can lead to rapid weight loss and high muscle-to-fat ratio.	Weight gain can return quickly if the diet cannot be sustained. The diet can be unhealthy if inadequate fiber is consumed.
Mediterranean (mostly natural foods such as vegetables, salads, fruits, pastas and rice, with meat eaten in moderation)	Mediterranean	Associated with heart health and longevity Avoids processed foods.	Weight loss can be difficult for some under this program – especially when flours and starches are not kept in check.
Gluten-free (no wheat of any kind)	Gluten-free Celiac disease diet	Avoids many unhealthy and fattening foods (donuts, pizza, cake, cookies, etc.). Provides relief for many people with allergies.	Many gluten-free substitutes contain more sugar and fat than the original wheat-based product. Many gluten-free products are highly processed.
Fasting (i.e., for one day or longer every few days)	Intermittent fasting 5:2 (5 days eating normally and 2 days completely or partially fasting)	Associated with weight loss, reduced chronic diseases, and increased mental acuity.	Can be dangerous and can cause malnutrition, and even death, if improperly done.

Selective Diets: The Common Good . . . and the Bad

You can see them in your local bookstore, in your grocery store, on Facebook, or in pop-up Internet ads: Diets are everywhere, and they promise everything. Consume a Mediterranean diet to achieve the longevity enjoyed by so many Greeks, Spaniards, and Italians. Eat a Paleolithic diet and become fit and strong like our hunter–gatherer ancestors. Different ways of eating are promoted by celebrities, athletes, and medical doctors and promise healthy weight, energy, and clean skin if you follow their strict—but delicious—path to dietary righteousness (**FIGURE 2-4**). But do they work? Why? How? Or, in many cases, why not?

Before considering these questions, it is important to note that, according to some estimates, at least 20% of people who start a specific dietary plan abandon it within 30 days, which can lead to a number of feelings relating to failure and despondency.[41]



FIGURE 2-4 Examples of the many celebrities who have been associated with specific diets include Thom Yorke of Radiohead (vegan), Penelope Cruz (Mediterranean diet), and Jessica Biel (paleo).

Because diets can be associated with the idea of deprivation, they are likewise seen as something that has a beginning and an end, but the ideal "diet" is a pattern of eating that promotes health and can be sustained indefinitely. Many diets are difficult to adhere to but have been shown to be extremely satisfying for those who do so. These include vegan, vegetarian, and gluten-free diets, all of which can be adopted with success for better health, to avoid allergies, or for philosophical reasons. In the end, most health-promoting diets share some common elements.

TRY IT!

Common Elements of All Healthy Diets

1. Avoid processed foods, especially sugar and high-fructose corn syrup. These foods also include white flours, white breads, and pasta.
2. Eat a variety of raw green leafy vegetables, such as lettuce, spinach, and kale.
3. Seek out foods high in fiber (fruits, vegetables, beans, grains, and nuts).
4. Drink plenty of water.

These basic guidelines allow plenty of flexibility to build your diet around vegetarian preferences, or to include more meat protein. They are also consistent with the key principles of several popular regimens, such as the Atkins, South Beach, Paleolithic, gluten-free, vegan, and Full Plate diets, as well as guidelines from the U.S. government via the USDA (**FIGURE 2-5**).

University of California professor and nutrition author Michael Pollan provides a simple dietary mantra: "Eat food. Not too much. Mostly plants." This reminds us to avoid processed foods such as convenience store snacks and soda, which some would argue are so nutritionally compromised that they are not actually food.

Pollan's directive also encourages us to be aware of the amount of food we eat, indicating that diets high in nutrient-rich foods require fewer calories to achieve adequate cell growth and energy. Note, however, that for athletes and others who burn large amounts of energy, the "not too much" phrase is relative.

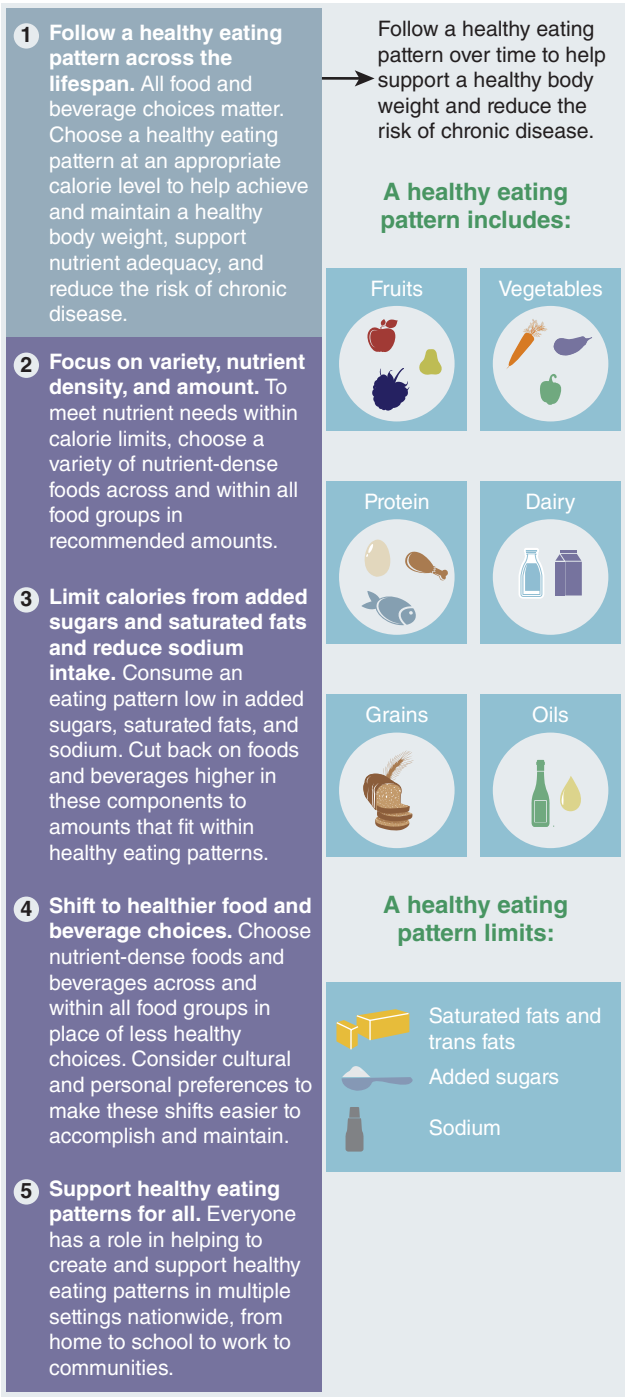


FIGURE 2-5 USDA dietary guidelines. The current guidelines offered by the USDA Center for Nutrition Policy and Promotion offer a similar perspective on nutritional recommendations for Americans.

Courtesy of U.S. Department of Health and Human Services.

Moving Ahead to Parenthood: The First Thousand Days

Research indicates that our health is determined by nutritional choices made for us early in life. We now know that our risk of chronic diseases such as type 2 diabetes, heart disease, stroke, and some cancers may be affected by the foods eaten right before and during a mother's pregnancy, and for the first years of a child's life.[45]

The seemingly innocuous white potato.

Women, Infants, and Children (WIC) A federal nutrition assistance program for pregnant women and their newborn babies. The program provides vouchers for mothers, which can be spent only on nutritious foods.

TALES OF PUBLIC HEALTH

The White Potato: In or Out?

Mashed? Baked? Fried? Boiled? The white potato, or *Solanum tuberosum*, is a member of the perennial nightshade family, which includes tomatoes, eggplant, and chili peppers. Originally from the Andes mountains, it is now cultivated throughout the world, and its place on the American table has been unanimously accepted for centuries.

That changed in 2015, when the simple white potato found itself at the center of a fierce argument in Washington, DC. The debate called into question whether the potato is nutritious enough to be included in the federal nutrition assistance program for pregnant women and their newborn babies.

The **Women, Infants, and Children (WIC)** program provides nutrition at the crucial time in human development when human growth and cellular resilience are taking shape—in the womb and during the first few years of childhood. The program provides vouchers for mothers, which can be spent only on foods deemed "exceptionally nutritious" by the USDA, such as milk, cereal, eggs, fruits, vegetables, beans, and peanut butter. The USDA takes its guidance from the National Academy of Medicine (NAM), a nongovernmental nonprofit organization that provides unbiased guidance for policy decisions related to health and health care.

In 2006, the medical and nutritional scientists at the NAM determined that potatoes were not healthy enough to be considered a "crucial" food for women and postpartum babies and thus ineligible for WIC reimbursement. For the potato industry, the financial implications were enormous. WIC had distributed around $7 billion in vouchers in 2006,[42] and removing an item from WIC funding has a major effect on jobs and profits for large industrial food producers, as well as small farmers, whether they're raising potatoes or peanuts.

After a long campaign of communications, lobbying, and financial contributions, the potato industry got what it wanted. In February 2015, the NAM announced that white potato would be returned to the list of approved WIC foods. It was a victory for the potato farmers, but what about the health impact? In the United States, most potatoes are whipped, deep-fried, or processed into chips and other products that are not "crucial" nutrition for pregnant women and new mothers. This was the concern expressed by the American Public Health Association, which protested that this was not a "health" decision but one based on political and financial influence. The American Academy of Pediatrics (AAP) said they were "tremendously concerned" about industry intervening in WIC regulations. The AAP argued that including potatoes would "override the sound scientific judgment of our nation's leading nutrition science experts."[43] New York University nutrition professor Marion Nestle wrote, "I have a hard time believing that WIC recipients are suffering from lack of potatoes in their diets. Potatoes are fine foods, but highly caloric when prepared in the usual ways. Encouraging WIC recipients to choose leafy greens and other vegetables seems like a good idea."[44]

The food industry has influenced USDA dietary guidelines since the first recommendations in 1894. This influence has been in lobbying Congress, funding nutrition research, and forming partnerships with professional nutrition organizations.

Each sector of American life (governments, companies, nonprofit organizations) has a different perspective on health, and in America, the public and private sectors both have influence on our diets. Reaching a better understanding of these areas through critical discussion and open reporting may help all of us to become healthier eaters, and consequently, healthier people.

Research first conducted in England in the 1980s[46] demonstrated how chronic diseases such as diabetes, high blood pressure, and heart disease can be "programmed" into people's bodies when they are deprived of important nutrients as fetuses and babies. Poor nutrition slows fetal growth and can cause stress during development that can affect long-term health. Low birth weight has been shown to increase the risk of heart disease and diabetes later in life by up to seven times.[47] The nutritional decisions we face as individuals are important to the health of our children. When we consider how these choices can be affected by disadvantaged living conditions, the challenge of making nutritious foods available and affordable to all people becomes a critical issue of public health.

The moment of conception through 2 years of age is when organs develop most quickly. Nutritional deprivation early on can lead to metabolism and hormonal feedback that makes the body gain weight or become more susceptible to heart attacks later in life. Research now indicates that our genes are affected by the conditions mothers experience before and during pregnancy.[46]

One illustration of this effect is "the Dutch Hunger Winter" of 1944–1945, when the people of Holland endured a devastatingly cold winter during World War II. A German blockade caused a major reduction in food to the region, and the entire population suffered severely. More than 20,000 people died, and those who survived experienced health problems for the rest of their lives. When the country recovered, the Dutch national health system tracked the outcomes of these people and their descendants for generations. They found that the children of malnourished mothers had higher obesity rates and a greater incidence of other health problems throughout their lives. Even the grandchildren of the malnourished pregnant mothers had more health problems than the rest of the population. This is termed an *epigenetic* effect—when changes in biology can be seen generations beyond a specific adverse experience.

Epigenetics is the process of our genes responding to environmental cues. While our genetic code does not change, the epigenetic ("epi" refers to "above" or "beyond" the gene) responses can change, based on stress or nutritional scarcity in the womb. These changes in genetic responses can be passed from mother to child, making children from disadvantaged nutritional environments more vulnerable to diseases.

epigenetics The process by which our genes respond to environmental cues; and while the genetic code does not change, the epigenetic biological responses, or "switches," can change as a result of nutritional scarcity or abundance in the womb.

This new research is important to help us reduce health disparities among people of different income levels and among different races and ethnicities.

Health advocates all over the world are increasingly recognizing the importance of supporting nutrition for the first thousand days—from pregnancy through the second year of life.

Secretary of Agriculture Earl Butz, foreground, takes questions from reporters in 1973.

GOING UPSTREAM

The Low Price of Soda and Fast Food

Why are spinach and blueberries more expensive than candy, chips, and soda? Finding the answer to this question can help us better understand how the United States can reduce its rates of obesity, diabetes, heart disease, and cancer.

The price differences between healthy and unhealthy foods did not happen by accident. They are the result of policy decisions made by the U.S. government over many years, some still in place today. The U.S. government passed the Agricultural Adjustment Act of 1933 to stabilize crop prices by controlling food overproduction. One way the government did this was by making subsidy payments to farmers. In 1974, the USDA introduced a new policy to encourage producers of corn, wheat, and soy to harvest as much as possible. Then Secretary of Agriculture, Earl Butz, orchestrated a complex system of payments that provided financial support for the overproduction of these commodities. It was the beginning of a long series of multibillion-dollar price supports for the food industry that coincided with a decrease in the number of small farms that produced diverse varieties of vegetables and other crops.

The subsidy system greatly influences our current food supply (**FIGURE 2-6**). One result is a consistent oversupply of cheap corn in the United States, which has led to massive production of high-fructose corn syrup as a sweetener of

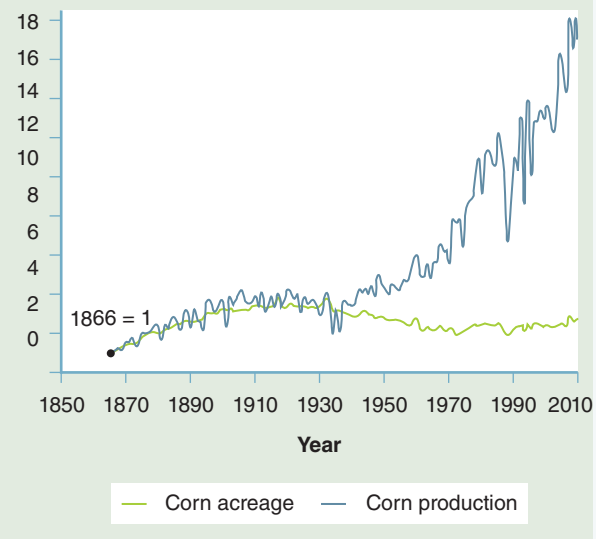


FIGURE 2-6 Corn acreage and production, 1870–2010. U.S. corn production and area farmed.

The Return of Nature: How Technology Liberates the Environment, U.S. Census Bureau (1975, 2012). http://thebreakthrough.org/index.php/journal/past-issues/issue-5/the-return-of-nature

beverages and other foods. Corn also became a cheaper source of feed for cows, which used to be fed mostly on grass. While the stomach of the cow doesn't naturally digest corn, animal pharmaceuticals combined with cheap corn proved to be a more economical alternative for livestock farmers than the traditional grass feeding process. Cows raised on corn yield meat that is higher in calories and contains more harmful omega-6 fatty acids and fewer omega-3 fatty acids than cows raised on grass.[49]

In the 1980s, the United States became more restrictive over raw sugar imports, driving up the price of sugar and contributing to the widespread substitution of corn sweetener. This has resulted in lower prices for corn chips, corn-fed beef, and even fast-food items such as buns (sweetened with corn syrup) and shakes (often made with corn and soy). Cheap corn is now a key ingredient in numerous processed foods, from candy to breakfast cereals and soft drinks, all of which contribute to the type 2 diabetes plaguing the United States. Between 1985 and 2010 the price of beverages sweetened with high-fructose corn syrup dropped by 24%, while the price of fresh fruits and vegetables rose 39%.[50]

Americans now spend a smaller amount of their time preparing food than do people from any other nation in the world, and with each generation, they spend less and less time.[51] Food marketing practices, which invest approximately $2 billion per year on children alone, and disproportionally to minorities, also have a major influence over the consumption of unhealthy foods in the United States.[52]

The U.S. government works to improve health too, through policies such as food assistance and free lunch programs. But, as the editors of *Scientific American* noted, "Public money is working at cross-purposes: backing an overabundance of unhealthful calories that are flooding our supermarkets and restaurants, while also battling obesity and the myriad illnesses that go with it. It is time to align our farm policies with our health policies."[50]

Addressing the simple question of why your spinach is more expensive than your soda turns out to be more complex than it first seems. However it is a question that must be dealt with in order to create a sensible food policy system where the ultimate goal is the healthiest population possible.

Ensuring that every pregnant mother and every newborn baby receives adequate nutrition during the critical gestation and early developmental period may be one of the most effective ways we can use our public resources. Making sure our governments invest in this area may hold the greatest hope for achieving the best overall improved health for everyone, all over the world.[48]

Societal Choices: How Do We Improve Nutritional Options for Everyone?

Eating well is one of the best ways to prevent illness and disease later in life; it is an investment that pays off not only in terms of quality of life, but also financially, because illness and disease are expensive. The benefits of this investment apply to you as an individual, to your family, to your community, and to your country. The financial cost alone of nutrition-related conditions and illnesses such as obesity, diabetes, heart disease, and stroke run in the hundreds of billions of dollars in healthcare costs, increased depression, and reduced numbers of people who can be employed in such areas as public safety, law enforcement, and the military.[53,54]

Ensuring adequate nutrition for pregnant mothers and their children and making healthy choices available to everyone is not a simple process. Lower-income neighborhoods are particularly susceptible to being deprived of affordable healthy food choices. Areas high in fast-food outlets but low in grocery stores are often called **food deserts**, and they are more common in low-income areas of the nation, and the world, than in high-income areas.[55]

food deserts An area high in fast-food outlets but low in grocery stores.

So, what can we do to ensure that healthy food is easier to find and prepare than unhealthy food? What policy decisions can we make to improve nutritional environments for all children? These are the questions facing public health officials, politicians, corporations, public interest groups, and others who influence the nation's food system, and they are not easy.

Wealthier neighborhoods are more likely to have stores like this.

Lower-income neighborhoods tend to have a higher percentage of stores like this.

Addressing Food Subsidies

At the federal level, the policy area influencing the nutritional decisions faced by Americans is the national subsidy program, which determines the foods into which we invest our tax dollars. Currently, the United States channels billions of dollars into subsidizing the corn that makes high-fructose corn syrup cheap and plentiful (see the Going Upstream box). Addressing these subsidies could have a positive impact on the health of our nation. The U.S. government now prohibits its farmers from using subsidies to grow fresh, healthy produce (which it labels "specialty crops"). Even now, our food system is encouraged to produce more soda, sweetened hamburger buns, and corn chips, and less organic produce.[56]

Confronting Food Marketing

The influence of major food producers is another important factor in the dietary habits of Americans. The largest food companies, such as Coca-Cola, Pepsi,

Mars, Kellogg, and Kraft, invest millions of dollars to study the brain's pleasure centers and calibrate products to "optimize" cravings in order to maximize revenues.[57] Marketing is another area that impacts food choices; as of 2015, food companies were estimated to have spent around $2 billion per year on advertising specifically to children.[58]

Menu Labeling

What if you had calorie information right on the menu when you were deciding what to order? As part of the Affordable Care Act, the FDA is implementing regulations that require all chain restaurants with more than 20 locations to provide point-of-sale information about the serving size and calories. Some cities and states have already implemented such policies. While research has yet to show major population-based behavior change, it is still too early to tell how much of an impact these regulations will have on consumer behavior—and health—over the long term.

Taxation

One of the efforts currently being debated to address this issue is excise taxation, or taxing harmful products to discourage their use. For example, in November 2014, Berkeley, California, residents passed the nation's first voter-approved soda tax, arguing that it would reduce diabetes and obesity among the population. States such as Vermont and Illinois have considered such taxes, following the lead of Berkeley, and of Mexico, which passed its own national tax on soda and sports drinks. Supporters feel that these taxes are important to improve the health of the population; however, opponents argue that such taxes are "regressive," meaning they unfairly punish low-income consumers. In 2016, the Philadelphia City Council passed a 1.5 cent-per-ounce tax on soda, energy drinks, and sports drinks. In one of his statements about the tax, Philadelphia Mayor Jim Kenney pointed out that "big soda companies have been marketing to poor neighborhoods for generations."[59]

Health advocates rally in favor of a soda tax at San Francisco City Hall in 2014. That effort was unsuccessful, but Philadelphia passed a similar tax in 2016.

Warning labels on sugary drinks are another strategy that has been proposed by public health advocates, who clearly have taken some of their cues from the tobacco control efforts of the past few decades. Establishing schools, hospitals, and community centers as **sugar-sweetened beverage-free zones** is now being employed by more and more local communities. All of these efforts are intended to counterbalance the massive influence food companies have over the landscape of food choices available to Americans.

sugar-sweetened beverage-free zones An initiative to eliminate the sale of sugar-sweetened beverages from school campuses.

Procurement

Another policy area health advocates are looking at is procurement, or the purchasing rules established by public and private entities. Procurement policies address workplace food and beverage sources, including vending machines and cafeterias (for employees as well as students, prisoners, etc.), and can be vital to a policy strategy to improve public nutrition.[60] Private companies can adopt healthy food procurement policies, and so can city, state, and federal governments.

Seeking to improve a nation's nutrition through policy changes can result in major public impacts on health, but policy change can be controversial. Policy decisions, whether they seek to regulate human consumption, exert control over corporate marketing, or add costs through taxation, touch on fundamental tensions of individual freedom of choice, versus protecting the common good. As this chapter has discussed, food and nutrition decisions are not only personal but can also be highly political. Of course that does not mean we should avoid policy change; it simply means that these decisions are not easy. The way we as a society choose to navigate these choices will have effects on population health, now and into the future.

In Summary

Nutrition is one of the most important determinants of our own *personal* health. The nutritional choices available to our communities, towns, cities, and countries have a direct effect on the *public's* health. Just as our bodies require a complex and adequate balance of macronutrients and micronutrients, communities face decisions about how to best ensure that people have access to good nutrition. These decisions include how to ensure that mothers have strong nutrition options before, during, and after pregnancy. They also include figuring out how people, especially children, will not be inundated with highly processed and sweetened food options.

These decisions are not easy. Policies and marketing practices are in place today to encourage unhealthy eating. For example, government subsidies that make corn sweeteners a cheap option. Changing these policies can be difficult, but many people and government agencies are trying.

Developing a thorough understanding of population health nutrition requires learning about the biological functions of eating, drinking, and metabolism, as well as the governmental functions of how policies are established. Working to change nutritional environments requires education and action on both the individual and the societal fronts.

Key Terms

complex carbohydrates
epigenetics
fatty acids
food deserts
food fortification
glycemic index
high-fructose corn syrup
ketosis
macronutrients
metabolism
microbiome
micronutrients
nutritional environments
predigestive process
refined sugar
regional-level eating patterns
saturated fats
simple carbohydrates
sugar-sweetened beverage-free zone
type 2 diabetes mellitus
unsaturated fats
Women, Infants, and Children (WIC)

Student Discussion Questions and Activities

1. Look around at your community. In what contexts do you encounter foods that are processed or contain excess sugars, trans fats, and other unhealthy ingredients? How did they get there? What strategies do you recommend to shift the diets in your community from heavy on simple carbohydrates and processed foods to focused on more complex and nutrition-dense foods that are richer in fiber? What more "upstream" policies are there to improve the dietary patterns of Americans?
2. Who is in charge of the food decisions you make? Is it you alone? Your roommates? Your parents? How does government policy influence your choices? What about food companies' marketing and advertising? Do they give us what we want to buy, or do they determine what we want? Do the production and marketing practices of food companies influence what you eat? How?
3. How much control should be exercised over the marketing practices of food companies? Do individuals need to be responsible for their own choices, or is there a responsibility of food manufacturers to ensure that their products are not too unhealthy?
4. What role should for-profit corporations have over health and nutrition guidelines of the nation? What kinds of partnerships can there be between companies and governments to ensure the best health for Americans?
5. Are there decisions regarding the WIC program that can be made that are more impactful than the inclusion of the white potato? What foods should be included or excluded?

Food Journal

Make a food and nutrition journal for 1 week. Document both what you ate and its nutritional characteristics (as closely as you can estimate). For each meal or snack, document:

- Calories
- Carbohydrates
- Protein

- Fat
- Sugars (glucose, fructose, and sucrose) and what foods they come from
- Major micronutrients of note (vitamins and minerals)
- Pure water (completely pure or slightly flavored with fruit)

Also document the cost per week of your diet and assess your overall satisfaction with your nutrition choices. Consider the following:

- What does your diet tell you about yourself?
- What does your diet tell you about your community or where you live?
- Are there decisions you would have made differently now that you see what you ate over the course of a week?
- What areas did you feel were deficient or lacking? What areas were plentiful?
- How might you have had a more healthy or unhealthy diet if you could spend more money?
- Based on this experience, is there anything about your diet that you will change?

References

1. de Lorgeril, M., Salen, P., Martin, J. L., Monjaud, I., Delaye, J., & Mamelle, N. (1999). Mediterranean diet, traditional risk factors, and the rate of cardiovascular complications after myocardial infarction. *Heart Failure, 99*(6), 779–785.
2. Liska, D., & Bland, J. S. (2004). *Clinical nutrition: A functional approach* [Audiobook]. Princeton, NJ: Recordings for the Blind and Dyslexic.
3. Balch, P. (2006). *Prescription for nutritional healing*. New York, NY: Penguin.
4. Morgan, X. C., & Huttenhower, C. (2012). Human microbiome analysis. *PLoS Computational Biology, 8*(12), e1002808.
5. Bested, A. C., Logan, A. C., & Selhub, E. M. (2013). Intestinal microbiota, probiotics and mental health: From Metchnikoff to modern advances: Part II—contemporary contextual research. *Gut Pathogens, 5*(1), 1.
6. Smith, P. A. (2015, June 23). Can the bacteria in your gut explain your mood? *New York Times Magazine*. Retrieved from http://www.nytimes.com/2015/06/28/magazine/can-the-bacteria-in-your-gut-explain-your-mood.html?_r=0
7. Pollan, M. (2013, May 15). Some of my best friends are germs. *New York Times Magazine*. Retrieved from http://www.nytimes.com/2013/05/19/magazine/say-hello-to-the-100-trillion-bacteria-that-make-up-your-microbiome.html
8. Coman, M. M., Cecchini, C., Verdenelli, M. C., Silvi, S., Orpianesi, C., & Cresci, A. (2012). Functional foods as carriers for SYNBIO, a probiotic bacteria combination. *International Journal of Food Microbiology, 157*(3), 346–352.
9. Guzman, J. R., Conlin, V. S., & Jobin, C. (2013). Diet, microbiome, and the intestinal epithelium: An essential triumvirate? *BioMed Research International*. doi:10.1155/2013/425146
10. Dash, S., Clarke, G., Berk, M., & Jacka, F. N. (2015). The gut microbiome and diet in psychiatry: Focus on depression. *Current Opinion in Psychiatry, 28*(1), 1–6.
11. Haas, E. M. (2006). *Staying healthy with nutrition: The complete guide to diet and nutritional medicine*. New York, NY: Random House.
12. Garrison, R., Jr., & Somer, E. (1995). *The nutrition desk reference*. New Canaan, CT: Keats Publishing.
13. Livestrong.com. (2017, August 14). How does diabetes occur? Retrieved from https://www.livestrong.com/article/32042-diabetes-occur/
14. Michaud, D. S., Liu, S., Giovannucci, E., Willett, W. C., Colditz, G. A., & Fuchs, C. S. (2002). Dietary sugar, glycemic load, and pancreatic cancer risk in a prospective study. *Journal of the National Cancer Institute, 94*(17), 1293–1300.
15. Anderson, J. W., Baird, P., Davis, R. H., Jr., Ferreri, S., Knudtson, M., Koraym, A., . . . Williams, C. L. (2009). Health benefits of dietary fiber. *Nutrition Reviews, 67*(4), 188–205.
16. Slavin, J. L., & Beate, L. (2012). Health benefits of fruits and vegetables. *Advances in Nutrition, 3*(4), 506–516.
17. Kranz, S., Brauchla, M., Slavin, J. L., & Miller, K. B. (2012). What do we know about dietary fiber intake in children and health? The effects of fiber intake on constipation, obesity, and diabetes in children. *Advances in Nutrition, 3*(1), 47–53.
18. Turner, N. D., & Lupton, J. R. (2011). Dietary fiber. *Advances in Nutrition, 2*(2), 151–152.
19. Whitney, E. N., & Rolfes, S. R. (2007). *Understanding nutrition*. Belmont, CA: Wadsworth, Cengage Learning.
20. Dunford, M. (2006). *Sports nutrition: A practice manual for professionals*. Chicago, IL: American Dietetics Association.
21. Haas, E. M., & Levin, B., (2006). *Staying healthy with nutrition: The complete guide to diet and nutritional medicine* (p. 1168). Berkeley, CA: Celestial Arts.
22. Harvard T. H. Chan School of Public Health. (n.d.). Omega-3 fatty acids: An essential contribution. *The Nutrition Source*. Retrieved from https://www.hsph.harvard.edu/nutritionsource/omega-3-fats/
23. Grogan, S., 2016. *Body image: Understanding body dissatisfaction in men, women and children*. Abingdon, UK: Taylor & Francis.
24. Golden, M. H., Waterlow, J. C. & Picou, D., (1977). Protein turnover, synthesis and breakdown before and after recovery from protein-energy malnutrition. *Clin Sci Mol Med*, *53*(5), 473-477.
25. Consumer Reports. (2010). *Health risks of protein drinks*. Retrieved from https://www.consumerreports.org/cro/2012/04/protein-drinks/index.htm Accessed: 4/18/2018

26. Kleiner, S. M. (1999). Water: An essential but overlooked nutrient. *Journal of the American Dietetic Association, 99*(2), 200–206.
27. Popkin, B., D'Anci, K. E., & Rosenberg, I. H. (2010). Water, hydration, and health. *Nutrition Reviews, 68*(8), 439–458.
28. Batmanghelidj, F., & Page, M. (2012). *Your body's many cries for water*. Old Saybrook, CT: Tantor.
29. Fowler, S. P., Williams, K., Resendez, R. G., Hunt, K. J., Hazuda, H. P., & Stern, M. P. Fueling the obesity epidemic? Artificially sweetened beverage use and long-term weight gain. *Obesity, 16*(8), 1894–1900.
30. Steinberger, J., Daniels, S. R., Eckel, R. H., Hayman, L., Lustig, R. H., McCrindle, B., . . . Council on Nutrition, Physical Activity, and Metabolism. (2009). Progress and challenges in metabolic syndrome in children and adolescents: A scientific statement from the American Heart Association Atherosclerosis, Hypertension, and Obesity in the Young Committee of the Council on Cardiovascular Disease in the Young; Council on Cardiovascular Nursing; and Council on Nutrition, Physical Activity, and Metabolism. *Circulation, 119*(4), 628–647.
31. Rosenberg, I. H. (2007). Further evidence that food fortification improves micronutrient status. *British Journal of Nutrition, 97*(6), 1051–1052.
32. Parker-Pope, T. (2008, November 20). News keeps getting worse for vitamins. *NYTimes.com*. Retrieved from http://well.blogs.nytimes.com/2008/11/20/news-keeps-getting-worse-for-vitamins/
33. Hemilä, H., & Chalker, E. (2013). Vitamin C for preventing and treating the common cold. *The Cochrane Library*. doi:10.1002/14651858.CD000980.pub4
34. Kaefer, C. M., & Milner, J. A. (2008). The role of herbs and spices in cancer prevention. *Journal of Nutritional Biochemistry, 19*(6), 347–361.
35. Simopoulos, A. P. (2013). Dietary omega-3 fatty acid deficiency and high fructose intake in the development of metabolic syndrome, brain metabolic abnormalities, and non-alcoholic fatty liver disease. *Nutrients, 5*(8), 2901–2923.
36. Centers for Disease Control and Prevention. (2015). *2014 national diabetes statistics report*. Retrieved from http://www.cdc.gov/diabetes/data/statistics/2014statisticsreport.html
37. Lustig, R. H. (2013). *Fat chance: The bitter truth about sugar*. London, UK: Fourth Estate.
38. Lustig, R. H. (2009). Sugar: The bitter truth. YouTube. Retrieved from https://www.youtube.com/watch?v=dBnniua6-oM
39. Boyles, S. (2010, April 10). High-sugar diet linked to cholesterol. WebMD. Retrieved from http://www.webmd.com/heart-disease/news/20100420/high-sugar-diet-linked-lower-good-cholesterol#1
40. Welsh, J., Sharma, A., Abramson, J. L., Vaccarino, V., Gillespie, C., & Vos, M. B. (2010). Caloric sweetener consumption and dyslipidemia among U.S. adults. *JAMA, 303*(15), 1490–1497.
41. Daily Mail Reporter. (2013, September 16). Diet starts today . . . and ends on Friday: How we quickly slip back into bad eating habits within a few days. Dailymail.uk. Retrieved from http://www.dailymail.co.uk/news/article-2421737/Diet-starts-today—ends-Friday-How-quickly-slip-bad-eating-habits-days.html
42. U.S. Department of Agriculture. (n.d.). WIC fact sheet. Retrieved from http://www.fns.usda.gov/sites/default/files/wic/WIC-Fact-Sheet.pdf
43. American Academy of Pediatrics. (n.d.). Statement opposing Congressional intervention in the WIC food packages. Retrieved from https://www.aap.org/en-us/advocacy-and-policy/federal-advocacy/Documents/AAPJointStatementOpposingCongressionalInterventioninWIC.pdf
44. Nestle, M. (2016, February 26). Potatoes. Food Politics Blog. Retrieved from http://www.foodpolitics.com/tag/potatoes/
45. Delisle, H. (2002). *Programming of chronic disease by impaired fetal nutrition: Evidence and implications for policy and intervention strategies*. World Health Organization. Retrieved from http://apps.who.int/iris/bitstream/10665/67126/1/WHO_NHD_02.3.pdf
46. Barker, D. J. (1990). The fetal and infant origins of adult disease. *BMJ, 301*(6761), 1111.
47. Negrato, C. A., & Gomes, M. B. (2013). Low birth weight: Causes and consequences. *Diabetology and Metabolic Syndrome, 5*(1), 1.
48. Braveman, P., & Barclay, C. Health disparities beginning in childhood: A life-course perspective. *Pediatrics, 124*(Suppl 3), S163–S175.
49. Hebeisen, D. F., Hoeflin, F., Reusch, H. P., Junker, E., & Lauterburg, B. H. (1992). Increased concentrations of omega-3 fatty acids in milk and platelet rich plasma of grass-fed cows. *International Journal for Vitamin and Nutrition Research, 63*(3), 229–233.
50. *Scientific American*. (2012, May 1). For a healthier country, overhaul farm subsidies. Retrieved from http://www.scientificamerican.com/article/fresh-fruit-hold-the-insulin/
51. Pollan, M. (2010, June 10). The food movement, rising. *The New York Review of Books*. Retrieved from http://www.nybooks.com/articles/archives/2010/jun/10/food-movement-rising/
52. Kovacic, W. E. (2008). *Marketing food to children and adolescents: A review of industry expenditures, activities, and self-regulation*. Federal Trade Commission. Retrieved from https://www.ftc.gov/sites/default/files/documents/reports/marketing-food-children-and-adolescents-review-industry-expenditures-activities-and-self-regulation/p064504foodmktingreport.pdf
53. Bauer, U. E., Briss, P. A., Goodman, R. A., & Bowman, B. A. (2014). Prevention of chronic disease in the 21st century: Elimination of the leading preventable causes of premature death and disability in the USA. *The Lancet, 384*(9937), 45–52.
54. Cawley, J., & Maclean, J. C. Unfit for service: The implications of rising obesity for U.S. military recruitment. *Health Economics, 21*(11), 1348–1366.
55. McGraw, T. (2013). Combating food deserts through incentivizing local businesses. *The Cornell Roosevelt Institute Policy Journal Center for Healthcare Policy, 15*.
56. Pollan, M. (2008, October 12). Farmer in chief. *New York Times Magazine*. Retrieved from http://michaelpollan.com/articles-archive/farmer-in-chief/
57. Freudenberg, N. (2014). *Lethal but legal*. New York, NY: Oxford Press.
58. Corbett, A. (2015). Blurred lines: The food marketing landscape and its effect on children's health. *2015 APHA Annual Meeting and Expo*. Chicago, IL. October 31–November 4, 2015.
59. Philadelphia first major city in U.S. to pass sugary drink tax. (2016, June 16). *NBC News*. Retrieved from http://www.nbcnews.com/nightly-news/video/philadelphia-first-major-city-in-u-s-to-pass-sugary-drink-tax-707171395512
60. Anderson, L. M., Quinn, T. A., Glanz, K., Ramirez, G., Kahwati, L. C., Johnson, D. B., . . . Task Force on Community Preventive Services. (2009). The effectiveness of worksite nutrition and physical activity interventions for controlling employee overweight and obesity: A systematic review. *American Journal of Preventive Medicine, 37*(4), 340–357.