

Nutrition

YOUR BODY must consume, absorb, and use nutrients to grow, develop, and maintain life. Carbohydrates, proteins, lipids, vitamins, minerals, and water are the six classes of nutrients your body needs.



Carbohydrates and lipids (fats) provide energy. Proteins build the structural parts of cells and provide energy. Vitamins and minerals ensure healthy functioning. Water is in most body parts and can be as much as two-thirds of your body weight.

Objective:



Describe the importance of eating and drinking a diet rich with nutrients to live healthfully and prolong life.

Key Terms:



amino acids
carbohydrates
disaccharides
fat-soluble
lipids

minerals
monosaccharides
monounsaturated
polysaccharides
polyunsaturated

proteins
saturated
vitamins
water-soluble

Six Nutrients: The Substance of Good Nutrition

The nutrients you need each day are supplied by a healthy diet. Carbohydrates, proteins, and lipids supply all your energy, and water accounts for about one-half to two-thirds of the average person's weight. Food energy is measured in calories. One thousand calories equals 1 kilocalorie (kcal). The energy content of 1 gram of carbohydrate or protein is 4 kcal, and the energy content of 1 gram of fat is 9 kcal.

Carbohydrates, proteins, and lipids, the body's fuels for energy, are digested in the intestine, where they are broken down to their basic units: carbohydrates become sugars, proteins

become amino acids, and lipids become fatty acids and glycerol. These are the basic materials the body needs for energy, growth, repair, and maintenance.

Your daily nutritional requirements, which include essential nutrients, depend on your age, sex, height, weight, metabolism, and physical activity. Depending on energy needs, recommended daily calories per day range from 1,600 to 2,400.

CARBOHYDRATES

Carbohydrates are the class of nutrients providing the major source of energy in the average diet. It is recommended that 50 to 55 percent of your daily calories come from carbohydrates. Carbohydrates break down quickly and are the body's fastest source of energy. Sugars from carbohydrates are absorbed into your bloodstream to provide cells with energy. Foods that supply the sugars in fast-energizing carbohydrates are fiber-rich fruits, dairy products, honey, and maple syrup. Slightly slower carbohydrate sources of energy are the complex carbohydrates found in whole-wheat products (such as bread and pasta), other grains (such as rye and corn), beans, lentils, peanuts, potatoes, and apples.

Carbohydrates are organic compounds, composed of carbon, hydrogen, and oxygen. In their simplest form, they are known as **monosaccharides**. The fructose and glucose in fruit and honey are monosaccharides, or simple sugars. Monosaccharides are colorless, dissolve in water, and taste sweet.

Disaccharides are pairs of monosaccharides. The sugars in disaccharides are sucrose, lactose, and maltose. Before your body can convert disaccharides into energy, the disaccharides must divide into two monosaccharides.

Polysaccharides are complex carbohydrates composed of many units of monosaccharides bonded together. The starch found in many grains and vegetables is composed of long chains of glucose and fibers.

Besides providing energy, carbohydrates provide fiber for bowel elimination. Dietary fiber is not digestible. Fiber is derived from fruits, vegetables, and grains. Fiber helps move food through your body by stimulating contractions of the smooth muscles that form the walls of digestive organs.

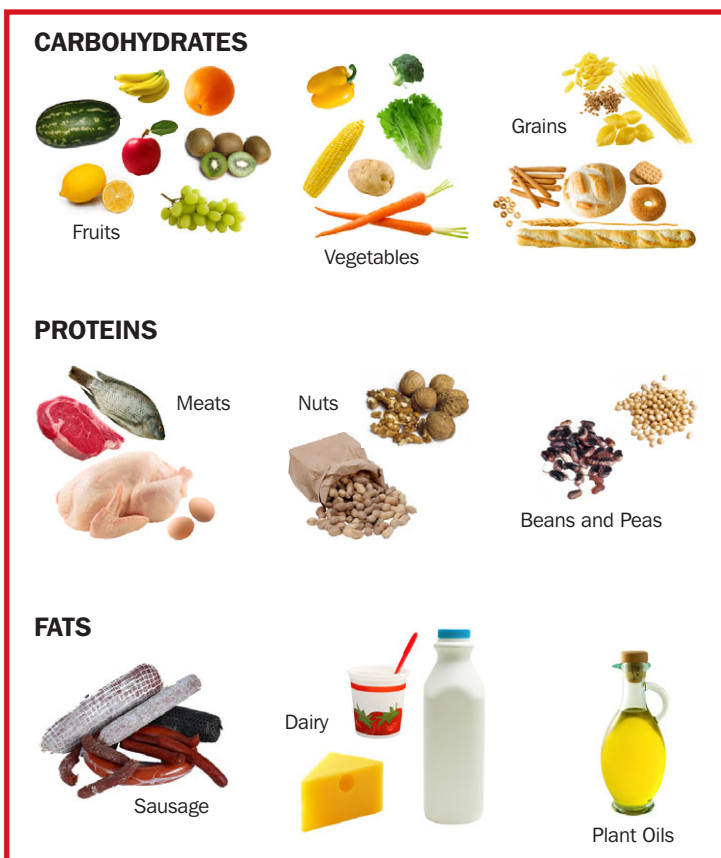


FIGURE 1. Some foods, such as fruits and vegetables, furnish multiple nutrients. A well-rounded diet that includes all the food groups, fats in moderation, and plenty of water will supply your needs for good health and longevity.

PROTEINS

Your body contains large amounts of protein. Protein is the main building unit in your body and is the principal component of most body cells. **Proteins** are the only class of nutrients necessary for the growth and repair of tissue. Muscle, connective tissues, and skin are all built and repaired with protein.

Amino acids (the building blocks of protein) are strung together in complex formations. Complex protein molecules take longer than carbohydrates to break down. As a result, proteins are a slower but longer-lasting source of energy. Healthy adult women need to eat 45 grams of protein every day. Healthy adult men need to eat 52 grams of protein every day. This equals 10 to 15 percent of the total calories you consume. If you consume more protein than you need, your body breaks the protein down and stores its components as fat, which can be broken down and used for energy later.

Proteins are composed of 20 amino acids. Eleven of these are synthesized, or combined with other elements in your body; nine of the amino acids, considered essential amino acids, are supplied only by your diet. A complete protein contains all the essential amino acids; an incomplete protein does not. The incomplete protein is often called a limiting protein because it can build less tissue. Plant foods are incomplete proteins because they lack one or more amino acids needed to build cells.

Foods highest in protein and absorbed most efficiently by your body include beef, fish, poultry, eggs, milk products, and soybeans. Other important sources of protein are grains, fruit, vegetables, beans, peas, cereals, nuts, and seeds.

LIPIDS

Lipids (fats) are the slowest source of energy but the most energy-efficient form of food. Each gram of lipids supplies the body with more than twice the amount supplied by carbohydrates and proteins. Your body stores excess energy as lipids because they are such an efficient form of energy. Lipids are organic compounds, insoluble in water. They include fat, oils, and waxes. Lipids are used to make cell membranes and steroid hormones and to store energy.

Excess carbohydrates and proteins can be converted to fat for storage. Excess fat is stored in the abdomen and under the skin. Fat is also stored in blood vessels and within organs. In cold weather, a light layer of fat under the skin provides insulation. Fat that surrounds vulnerable organs, such as your liver and kidneys, provides protective padding. Stored fats are beneficial unless they are excessive and lead to obesity.

Fat helps your body use some vitamins. Protein amino acids hook up with fats to form lipoproteins, the molecules that transport cholesterol around and out of your body.

Fatty acids and glycerol are the building blocks of fats. Different kinds of fats are classified as saturated, monounsaturated, and polyunsaturated. The classification of a fatty acid is determined by the number of hydrogen atoms attached to the carbon atoms in the fatty-acid chain. The more hydrogen atoms, the more saturated the fatty acid.

Three Kinds of Fatty Acids

The saturated fatty acid has a hydrogen atom at every available carbon link in the fatty-acid chain.

The monosaturated fatty acid drops two hydrogen atoms from the chain and forms one double bond with two lines, instead of one, between two carbon atoms.

The polyunsaturated fatty acid drops more hydrogen atoms from the chain and forms several (poly) double bonds between several carbon atoms.

A **saturated** fat, such as butter, lard, shortening from meat, dairy products, meat, egg yolks, or ice cream, has all the hydrogen atoms possible. Thus, it is mostly fatty acids.

An unsaturated or **monounsaturated** fat, such as olive oil, nuts, canola oil, or avocado, has fatty acid containing one double bond of carbon atoms and fewer hydrogen atoms. It is mostly monounsaturated fatty acid.

A **polyunsaturated** fat, such as corn oil, sunflower oil, tofu, or soybeans, has fatty acid containing two or more double bonds of carbon atoms, letting few hydrogen atoms attach to the fatty-acid chain. It is mostly polyunsaturated fatty acids.

Saturated lipids and trans fatty acids are more likely to increase cholesterol and the risk of atherosclerosis, which is hardening of the arteries caused by a build-up of cholesterol within vessels. Trans fatty acids have extra hydrogen atoms, making them saturated fats.

Health authorities recommend that lipids be limited to less than 30 percent of your daily calories or fewer than 90 grams per day and that saturated fats, trans fatty acids, and cholesterol in the diet be reduced as much as possible. Trans fats are found in shortening and commercially produced baked goods, snack foods, fried foods, margarine, dairy products, beef, and lamb.

The best fat comes from fish, nuts, and vegetable oils and from dried beans. Meat and poultry should be lean. Milk and milk products should be low fat or fat free.

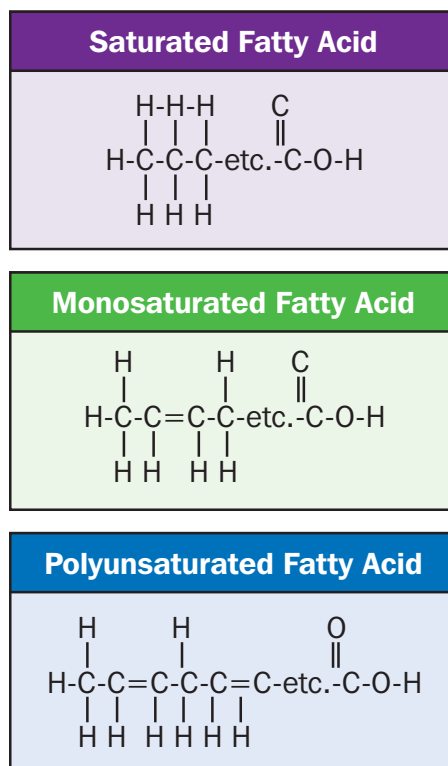


FIGURE 2. Fatty acids have unique chemical structures.

VITAMINS

Vitamins are organic substances necessary for body function and life. They don't provide energy, and they don't provide calories. Vitamins are small organic molecules that act as coenzymes to activate enzymes that are catalysts in all body tissues. Enzymes help in metabolizing (digesting) proteins, fats, and carbohydrates to release energy from food. They help build body tissues, such as bones, skin, glands, nerves, and blood. Vitamins prevent nutritional-deficiency diseases, promote healing, and encourage good health. Most vitamins are essential nutrients that cannot be synthesized by the body and must be consumed through diet.

Vitamins are classified as fat soluble or water soluble. **Fat-soluble** vitamins are vitamins that can be dissolved in fat. **Water-soluble** vitamins are vitamins that can be dissolved in water.

Fat-soluble vitamins are A, D, E, and K. Your body stores these vitamins.

Water-soluble vitamins are C and the eight members of the B complex. These are not stored and must be consumed daily. They are absorbed faster than fat-soluble vitamins.

Vitamins C and E, found in fruits and vegetables, are antioxidants. Eaten in adequate amounts, these antioxidants protect against heart disease and some cancers.

Vitamin enzymes and coenzymes can be reused repeatedly; thus, only small quantities of vitamins are needed in your diet.

Fat-Soluble Vitamins

Vitamin A is the moisturizing nutrient that keeps your skin and mucous membranes smooth and supple. Vitamin A affects vision, hair, growth of bones and teeth, and the reproductive system. It helps build resistance to infection. Sources of vitamin A are liver, spinach and other green leafy vegetables, yellow vegetables, fruits, fish liver oils, egg yolks, butter, cream, and whole milk.

Vitamin D enables absorption and metabolism of calcium and phosphorus and promotes healthy teeth and bones. Sources of vitamin D are fish liver oils, milk, butter, liver, and exposure to sunlight.

Vitamin E aids in normal reproduction, formation of red blood cells, and muscle function. Sources of vitamin E are vegetable oils, milk, eggs, meats, cereals, nuts, and green leafy vegetables.

Vitamin K is responsible for blood clotting. Its sources are liver, dark green leafy vegetables, egg yolk, cereals, fruits, and cheese.



FIGURE 3. Vitamin D is plentiful in a glass of milk.

Water-Soluble Vitamins

Vitamin C aids in forming connective tissue; maintaining healthy blood vessels, skin, gums, bones, and teeth; healing wounds; and resisting infection. Food sources of vitamin C are citrus fruits, tomatoes, potatoes, cabbage, strawberries, green vegetables, and melons.

The vitamin B complex plays roles in muscle tone; functions of the nervous system; digestion; appetite; normal elimination; protein, fat, and carbohydrate metabolism; growth; healthy eyes, skin, and mucous membranes; and formation of red blood cells. Food sources of vitamin B are poultry, fish, lean pork, eggs, liver, breads, pastas, cereals, oatmeal, potatoes, peas, beans, soybeans, peanuts, milk and milk products, nuts, seeds, and green leafy vegetables.

MINERALS

Minerals are inorganic elements necessary for body functions. These naturally occurring substances help regulate nerve and muscle function and acid-base balance in body cells. They

also help the body maintain normal fluid-containing areas: within cells, in space surrounding cells, and in the blood.

Some minerals form enzymes necessary for energy production. Others are required for normal nerve and muscle function. Some are needed for healthy skin, the healing of wounds, growth, and bone and tooth formation. Kidneys filter minerals in the blood and excrete any excess in urine to maintain a balance between daily intake and output.

Calcium, magnesium, and iron, drawn from soil, become part of plants. Animals that feed on these plants absorb the minerals into their bodies.

Some minerals are required in large quantities, some in small quantities. Among the major minerals are calcium, phosphorus, potassium, sodium, chloride, and magnesium. Most of your body's calcium is stored in your bones, but it is also found in muscle cells and in your blood. Calcium is essential for muscle contraction and for the normal functioning of many enzymes. It is necessary for the formation of bones and teeth, for blood clotting, and for normal heart rhythm. Food sources of calcium are milk and milk products, meat, fish, egg yolks, cereal products, dried peas and beans, fruits, and vegetables.

Phosphorus affects formation of bones and teeth; use of proteins, fats, and carbohydrates; and nerve and muscle function. Potassium affects nerve function, muscle contraction, and heart function. Sodium affects fluid balance and nerve and muscle function. Chloride plays an important part in maintaining the acid-base balance of fluids in the body. Magnesium helps make body tissues, especially bone, and transmits genetic code when cells divide and reproduce.

Among the trace minerals are iron, zinc, copper, iodine, selenium, manganese, and molybdenum. All the trace minerals mentioned activate enzymes required in metabolism. Some trace minerals are toxic at high levels (arsenic, chromium, and nickel) and have been identified as causes of cancer.

WATER

Water is needed for all body processes and accounts for more than half your body weight. Fat tissue has a lower percentage of water, and women tend to have more fat than men. Thus, the percentage of water in the average woman is 52 to 55 percent, and the percentage of water in the average man is 60 percent. A man who weighs 150 pounds has about 10 gallons of water in his body: 6 to 7 gallons of water inside his cells, 2 gallons in the space around his cells, and less than 1 gallon in his bloodstream. Water circulates to keep the quantity in each area constant.

Since your body doesn't store water, a new supply must be taken in every day, enough to replace what you lose when you breathe, perspire, urinate, and defecate.

When you perspire, water on your skin evaporates and cools your skin to help regulate your body temperature. Water helps you digest food, as it dissolves nutrients so they can pass through your intestinal walls into your bloodstream. It moves food through your intestinal tract. Water lubricates your moving parts, including your joints.

If you don't get enough water, your first sign is thirst. The next is reduced urination, as your body conserves water rather than eliminating it. You can supply your body with the water

it needs by drinking water, juices, and other beverages. Fruits, vegetables, and most foods also supply water to your body.

Summary:



Nutrients are essential for your body's energy, growth, repair, and maintenance. Carbohydrates are your fastest source of energy. Proteins are necessary for the growth and repair of tissue. Lipids are the slowest source of energy but the most energy-efficient form of food. Vitamins are essential for certain body functions and act as catalysts in all body tissues. Minerals are naturally occurring inorganic substances required for the normal functioning of body cells. Water is needed for all body processes and accounts for more than half your body weight. These are the six nutrients you absorb from a healthy diet.

Checking Your Knowledge:



1. Into what basic units are carbohydrates, proteins, and lipids broken down during digestion?
2. Name four foods that supply the sugars in fast-energizing carbohydrates.
3. Why are proteins a slower but longer-lasting source of energy than carbohydrates?
4. Where is fat stored in your body?
5. How are vitamins valuable to your body?
6. In what parts of your body do minerals maintain fluid levels?
7. Name three body processes controlled by water.

Expanding Your Knowledge:



Strict vegetarians eat no animal or fish products. Design seven vegetarian menus (one for each day of the week) consisting of breakfast, lunch, dinner, and one snack. Carbohydrate, protein, lipid, vitamin, mineral, and water nutrients needs must all be satisfied without any meat or fish choices. Make your menus appetizing.

Web Links:



Nutrients in Foods

<http://www.umass.edu/nibble/infolist.html>

Essential Nutrients in the World's Healthiest Foods

<http://www.whfoods.com/nutrientstoc.php>

USDA's MyPlate—Home page

<http://www.choosemyplate.gov>