9.2 What and How Much We Need to Eat

Your body needs six essential nutrients in order to stay healthy: carbohydrates, proteins, lipids, water, vitamins, and minerals. These are the building blocks of life. If any of these nutrients are absent from your diet for too long, your cells will stop working properly.

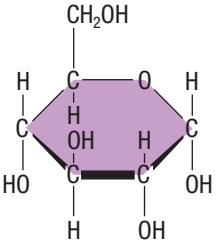


Figure 1 Monosaccharides, such as glucose, consist of a single sugar molecule.

Carbohydrates

Carbohydrates are the main source of energy for the human body. Carbohydrate molecules are made up of carbon, hydrogen, and oxygen. There are three main types of carbohydrates: monosaccharides, disaccharides, and polysaccharides. The most basic carbohydrates are monosaccharides, or simple sugars, which are ring-shaped structures consisting of a single sugar molecule. Glucose and fructose are examples of monosaccharides. Glucose is used during cellular respiration to provide the energy needed for cellular processes and physical activity (**Figure 1**). Disaccharides, as the name suggests, are made up of two simple sugars joined together. Sugars such as lactose (milk sugar) and sucrose (table sugar) are examples of disaccharides.

Many simple sugar molecules can join together to form large carbohydrates called polysaccharides. Polysaccharides are also referred to as complex carbohydrates; a single polysaccharide molecule may consist of hundreds of joined simple sugars. Starches and cellulose are polysaccharides made and stored in plants. Most starches are branched chains of glucose molecules. Unlike starches and most other polysaccharides, cellulose has a straight rigid structure (**Figure 2(a)**). Glycogen is a polysaccharide that is made and stored in animals. Glycogen is more highly branched than plant starches (**Figure 2(b)**).

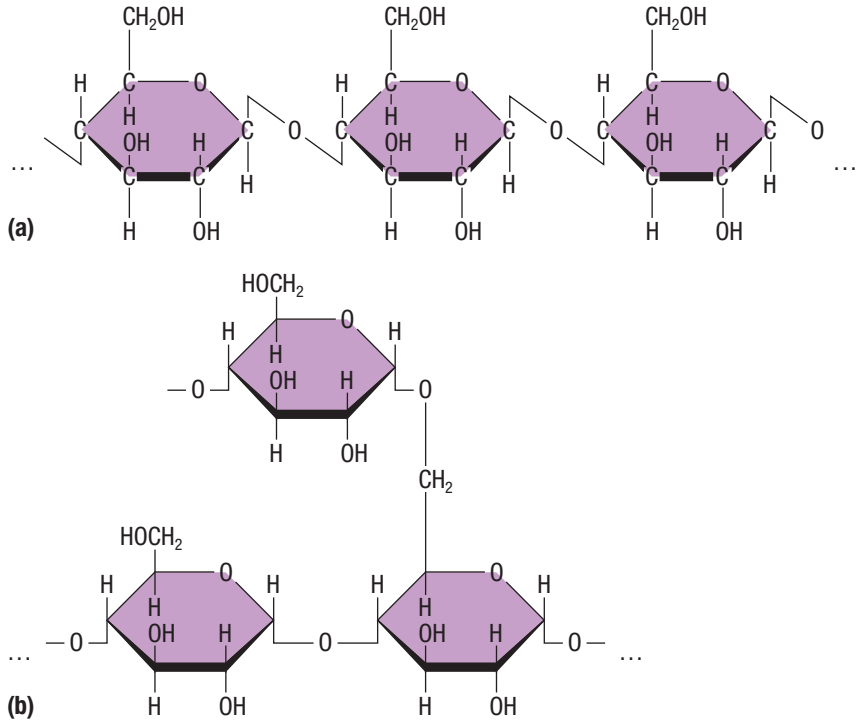


Figure 2 (a) Cellulose, the polysaccharide that provides the structure for plant cell walls, consists of many glucose units. (b) Glycogen, an energy-storing carbohydrate in animals, is a long branching chain of glucose units. The above diagrams represent small portions of much larger molecules.

Carbohydrates are a major part of plant cell structure. Plants use the carbohydrates they produce for energy and to create complex molecules, such as cellulose. Cellulose is used in plant cell walls to give the plant structure. Excess sugars produced during photosynthesis are stored by plants as starch in their roots, stems, leaves, and seeds.

A healthy diet is generally considered to be one in which carbohydrates provide at least 55 % of a person's energy needs. Foods high in carbohydrates include vegetables, potatoes, and grains (**Figure 3**). Many grains, fruits, and vegetables contain cellulose. Humans cannot digest cellulose, but it provides fibre, which is an important part of a healthy diet. Plant starches are the main source of chemical energy for humans and are an important component of the diet. Complex carbohydrates, such as starches, must be broken down into simple sugars, such as glucose, before the body can use them. In humans, carbohydrates are stored in the liver and muscle tissues in the form of glycogen. If the maximum amount of glycogen is stored, excess carbohydrates can be converted to lipids and stored as body fat. When energy is needed, glycogen is converted back into usable glucose.

Figure 3 Plants and plant products are a source of dietary carbohydrates.

Proteins

Proteins are one of the key building blocks of cells and perform a wide range of functions. They are important structural molecules, are involved in all metabolic activities, and are used to generate motion. Some proteins serve as **hormones**—chemical messengers released by cells in the body that influence cellular activity in another part of the body. Main protein functions and examples are listed in **Table 1**.

hormone a chemical signal or messenger molecule, circulated through the body and used to coordinate cellular functions

Proteins are the most complex of all nutrients. Proteins are made up of long chains of smaller molecules called amino acids and are highly variable in size and shape (**Figure 4**). There are 20 different amino acids that organisms use to build proteins. The human body can make 12 of these amino acids, but must obtain the other 8 amino acids from food sources. The 8 that must be obtained from food sources are called essential amino acids.

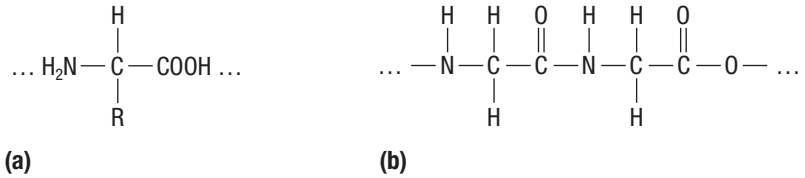


Figure 4 (a) Amino acids consist of a central carbon atom attached to a single hydrogen atom; an amino group (H_2N), a carboxyl group (COOH), and a side chain (represented by R) that varies among the 20 different amino acids. (b) Proteins are formed when many amino acids are joined together. The above diagrams represent only small portions of much larger molecules.

Table 1 Functions of Proteins

Function	Example
control of chemical reactions	digestive chemicals
movement	myosin in muscle cells
transporting oxygen	hemoglobin in red blood cells
structure	collagen in muscles and connective tissue; keratin in hair and nails
hormones (chemical messengers)	human growth hormone
defence	antibodies produced by the immune system
source of energy	excess proteins from diet

There are many animal and plant sources of protein. Animal sources that are high in protein include meat, eggs, fish, and cheese. Plant sources high in protein include beans, lentils, seeds, and nuts. Animal proteins contain all eight essential amino acids. However, most plant proteins lack at least one essential amino acid. Therefore, people who do not eat animal products must eat plant foods in combination to obtain all the amino acids they need. Furthermore, animal muscle has a higher concentration of protein than plant material, so you have to eat a greater mass of plant material to obtain an equivalent amount of protein. For example, a 225 g steak provides approximately 48 g of protein, which is almost enough protein to meet the daily requirements (about 60 g) for an adult. To get 60 g of protein, you would need to eat 15 cups of raw vegetables. When you eat proteins, your body separates the proteins into individual amino acids so they can be rearranged and used as building blocks for human proteins. Regardless of the source, the recommended daily diet for youths 14 to 18 years old should provide 0.85 g of protein for each kilogram of body mass.

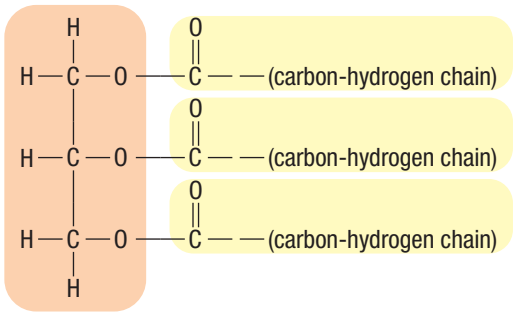
Like carbohydrates, protein can also be used to provide energy, and excess protein can be converted into high-energy storage molecules. However, since proteins have so many important functions, they form a relatively small portion of energy in an individual's diet. Health Canada recommends that 10 % to 30 % of your average energy requirements should come from protein.

Lipids

Lipids provide a concentrated source of chemical energy for the body. They help in the absorption of vitamins, are a main component of cell membranes, and serve as insulation for the body. Certain hormones, including sex hormones, are lipids.

triglyceride a lipid composed of glycerol and three fatty acids that are bonded together

Fats and oils are two familiar types of lipids. Fats and oils are made up of three fatty acids bonded to a glycerol molecule, which make up a **triglyceride**. Triglycerides can be either saturated or unsaturated, depending on the structure of their fatty acid chains. Fatty acids contain long chains of carbon and hydrogen atoms (**Figure 5**). Unsaturated triglycerides (unsaturated fats) are called oils, and they are usually liquid at room temperature. Plant and fish oils are common sources of unsaturated fats. Saturated fats are usually solid at room temperature. Meat and butter are common sources of saturated fats. Unsaturated fats are often thought of as good fats. Studies have shown that people who follow a diet rich in plant oils are often much healthier than people whose diet is rich in animal fats (**Figure 6**).



triglyceride

Figure 5 The fatty acid molecules in triglycerides vary in length, depending on the type of lipid. The above diagram represents only a small portion of a much larger molecule.

Figure 6 Unsaturated fats are generally considered healthier than saturated fats.

WEB **LINK**

For more information on the health benefits of omega-3 fatty acids,

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Some fatty acids are referred to as essential; that is, they cannot be produced in the body and must be obtained from the diet. One of these essential fatty acids is called omega-3 fatty acid. Omega-3 fatty acids are in unsaturated fats and are very important in maintaining good health and preventing health problems such as heart disease and arthritis. They are found in a variety of foods including oily fish (such as salmon, mackerel, herring, and tuna), nuts, seeds, and leafy green vegetables.

A special group of lipids called steroids includes the sex hormones testosterone and estrogen, and cholesterol. Sex hormones control the development of male and female sex characteristics. Cholesterol is a key component of all animal cell membranes. Like saturated and unsaturated fat, cholesterol has good and bad forms. You will learn more about the role and impact of cholesterol in Chapter 11.

Fats usually raise a warning flag when we think about healthy eating, but they are important components of any diet. In a healthy diet, lipids should constitute no more than 30 % of energy intake. Excessive consumption of lipids can cause serious health problems such as heart disease and obesity. Trans fats are a particularly harmful type of lipid. They are a type of unsaturated fat, but they behave like saturated fats. Trans fats pose an even higher risk of heart disease than saturated fats because they raise bad cholesterol levels and lower good cholesterol levels.

Water

Your body is made up of 55 % to 60 % water. In addition to the water required in cell cytoplasm, your body also requires water for chemical reactions, to digest food, and to eliminate waste products. Water is also necessary to maintain your blood volume, to regulate body temperature, and to keep your skin moist. Water is necessary for life. In addition to the water obtained through food intake, humans need to drink about 2 L (8 cups) of water per day. This replaces the water lost through urine, sweat, and respiration.

Vitamins and Minerals

A **vitamin** is a compound that an organism needs as a nutrient only in small amounts. Vitamins regulate cell functions, growth, and development within our bodies.

Vitamins are classified as either fat soluble (will dissolve in fats) or water soluble (will dissolve in water). Vitamins A, D, E, and K are fat soluble and can be stored in the body's fatty tissues for future use. These vitamins do not dissolve in water and are therefore not easy to eliminate from the body if they are in excess. Taking high doses of these vitamins can lead to toxic levels in the body. Vitamins B and C are examples of water-soluble vitamins. They cannot be stored in the body, and excess quantities are readily excreted in urine. Water-soluble vitamins must be replenished daily through diet.

We obtain most of our vitamins from food, but vitamins A, D, and K can also be produced in our bodies. For example, the body can convert a chemical called beta-carotene into vitamin A. Beta-carotene is found in foods such as green vegetables, carrots, egg yolks, and liver. Vitamin D is often called the "sunshine" vitamin, because it is formed in the skin when the skin is exposed to sunlight. Our bodies can produce enough vitamin D from 10 min to 15 min of sunshine three times a week. Vitamin K is synthesized by special bacteria found in the large intestine.

Our bodies also need minerals to maintain health. **Minerals** are naturally occurring elements that the body uses to carry out metabolic processes and to build or repair tissues. Calcium and phosphorus, for example, are critical in the formation of bone. Sodium is involved in nerve impulse transmission and in muscle contraction. Iron is a key component of the blood protein hemoglobin. Oxygen binds to the iron component of hemoglobin and is transported throughout the body. Calcium, phosphorus, sodium, and iron are prominent in our bodies. Other minerals, such as fluorine, zinc, and copper, are present in our bodies in trace amounts.

vitamin an organic molecule that the body requires in small amounts as an essential nutrient

WEB LINK

There is some concern that an indoor lifestyle and lack of routine exposure to sunlight may be resulting in a vitamin D deficiency for many Canadians. To find out more about this and other vitamin deficiencies,

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mineral an element, such as calcium or phosphorus, required by the body in small amounts; plays a role in cell processes and repair

Healthy Eating

To promote healthy eating habits, Health Canada publishes *Eating Well with Canada's Food Guide*, which recommends how much of which types of foods we should eat each day (**Figure 7**). The recommendations include foods that supply appropriate amounts of carbohydrates, proteins, and lipids, as well as essential vitamins and minerals. A dietitian can provide professional advice on how to maintain a healthy diet or when a health problem requires adjustments to the diet.

CAREER LINK

Dietitian

To learn about becoming a dietitian,

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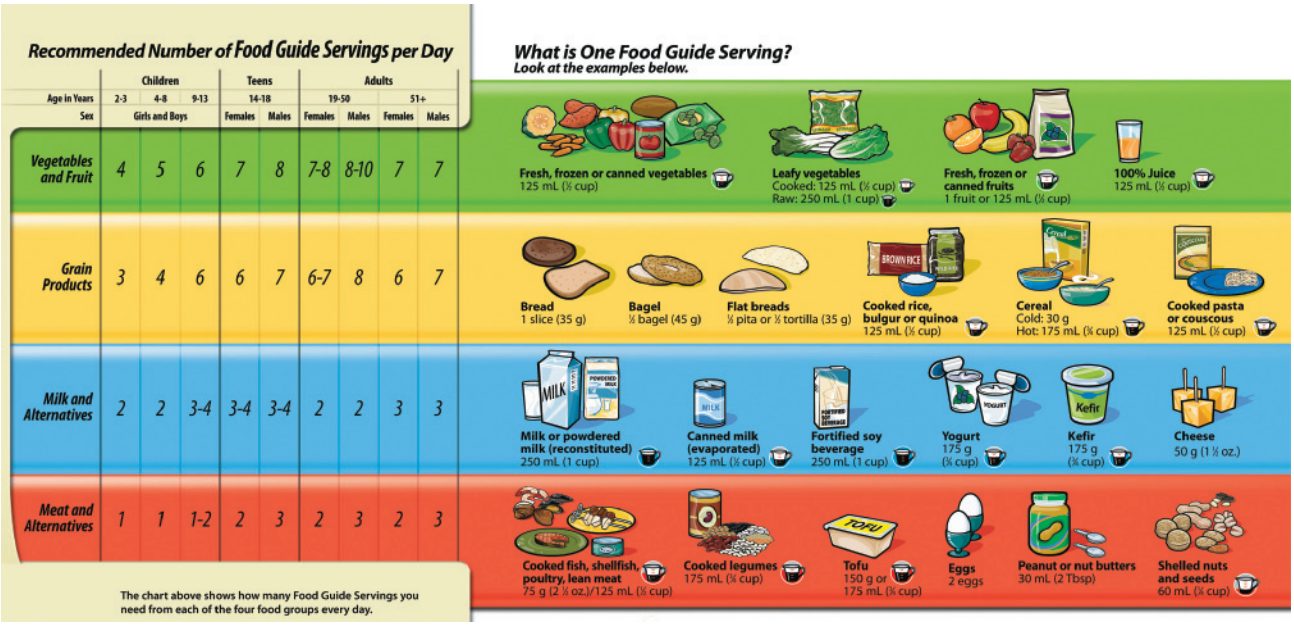

Figure 7 Following Health Canada's *Eating Well with Canada's Food Guide* is the first step to a healthy diet. The guide can be customized to suit many types of diets.

Maintaining a Balance

In addition to eating the right kinds of foods, we have to ensure that we eat the right amount of food. The food guide provides guidelines for the number of servings and appropriate serving size of each food category. The challenge is to find the right nutrient balance so that energy intake equals energy output.

Maintaining your body mass requires that the average energy output equals the average energy input. In other words, the amount of energy you use in metabolic processes must equal the amount of energy obtained from the food you eat. A disruption in balance can cause weight loss (energy input is less than energy output) or weight gain (energy input is greater than energy output).

There are three variables in maintaining a balance: level of physical activity, amount of food consumed, and type of food consumed. Increasing physical activity increases the output of energy. Reducing the amount of energy taken in can be achieved by simply reducing the total amount of food consumed. However, it is more effective to simply eat foods that have lower energy content. One gram of carbohydrate or protein provides about 17 kJ of energy in the body. One gram of fat, however, provides about 38 kJ. Thus, a diet that has a low proportion of lipids is generally considered a healthy diet.

How much should you weigh? How much should you eat? What kinds of foods should you eat? These are questions that do not have easy answers. Nonetheless, some physical and psychological problems are directly related to what, how much, or how little we eat.

LEARNING **TIP**

Body Mass Index

Body Mass Index (BMI) is the ratio of a person's height and weight. It is used to estimate whether a person has a healthy body weight for his or her height. BMI is calculated using the following equation:

$$\text{BMI} = \text{weight (kg)} \div \text{height (m)}^2$$

BMI is an estimate of the relative amount of body fat. It is a widely accepted method to screen for potential weight problems because it is inexpensive, convenient, and reliable.

Overeating

Obesity is a condition where an excessive amount of body fat poses potential health risks. In some cases, genetic factors contribute to obesity. In the majority of cases, inappropriate diet and inactivity combine to produce weight gain and obesity.

Despite all we know about the importance of a healthy diet and physical activity, research shows that the percentage of overweight and obese people is increasing in Canada. Access to fast food and other high-fat and sugary foods is a major factor contributing to this rise in obesity rates. Being overweight or obese increases the risk of many medical conditions, including heart disease, respiratory problems, diabetes, cancer, high blood pressure, and joint problems. Because obesity can lead to health problems, it has potential social and economic implications related to productivity and the cost of providing healthcare.

Anorexia Nervosa

Some individuals become obsessed with losing weight to the point of severe malnutrition. Anorexia nervosa, or simply anorexia, is a psychological disorder that usually begins with dieting and progresses to extremes such as severe dieting, excessive exercising, and use of laxatives, diet pills, and even enemas in order to lose weight. Laxatives are medications that cause food to pass through the intestines more quickly than normal. An enema involves flushing the bowels with liquids. Even when severely underweight and close to starvation, people suffering from anorexia perceive themselves as overweight and do not recognize that they have a problem. The health complications resulting from anorexia can become life-threatening. Estimates are that 10 % of anorexia cases end in death.

Bulimia

Bulimia is another common psychological eating disorder. Bulimia usually involves excessive eating followed by self-induced vomiting or laxative use to prevent weight gain. This pattern is referred to as binge–purge behaviour. Many individuals with bulimia also suffer from anorexia. Unlike people with anorexia, a person who suffers from bulimia recognizes that his or her behaviour is abnormal and may feel guilty about it.

Like anorexia, there are many risk factors associated with bulimia that usually include a psychological component. Depending on the severity of the symptoms and related health problems, treatment of eating disorders usually involves behavioural and nutritional therapy. Treatment for eating disorders is always challenging and requires a strong commitment from the individual and continuous support from family and friends to prevent a relapse.

9.2 Summary

- The nutrients that we obtain from our food are carbohydrates, proteins, and lipids. Generally, carbohydrates and lipids are energy nutrients. Amino acids from food are used to construct a variety of proteins that have numerous functions in the body.
- Vitamins and minerals are important to maintaining good health, and water is an essential substance for survival.
- The key to maintaining a healthy weight is to ensure that the energy intake is balanced by the energy output. This can be achieved by a combination of a healthy diet and an appropriate level of physical activity.
- In a large majority of cases, obesity is the result of overeating, an unhealthy diet, and inactivity.
- Eating disorders such as anorexia and bulimia are psychological disorders that can lead to serious physical health risks.

UNIT TASK **BOOKMARK**

Consider what you have read about nutrients and healthy eating. How can this information help you create a health and fitness plan in the Unit Task?

9.2 Questions

1. (a) Create a table to compare carbohydrates, proteins, and lipids. Your comparison should include the functions of each group of nutrients, examples of foods that contain each type of nutrient, and any other criteria that you think are important.
   (b) What other nutrients are necessary for good health? K/U T/I C A
2. (a) Estimate and record the type and amount of food you eat in one day. How does your food intake compare with the recommendations of Health Canada's food guide?
   (b) Do you think that this sample is representative of your overall diet? Explain. T/I C A
3. Obesity is a growing problem in Canada, especially among children and youth. Use the Internet and other sources to research the current statistics on the incidence of obesity in Canada, and prepare a brief report of your findings. In addition to summarizing your findings, answer the following questions in your report. T/I C A
   (a) Do you think there are childhood and youth obesity issues in your community? What evidence do you have?
   (b) What do you think are the main factors that contribute to this problem in Canada and/or your community?
   (c) What measures do you think should be taken to address the problem in Canada and/or your community?
4. The dietary goal of a sumo wrestler is to gain weight. Use the Internet and other sources to research the strategies used by sumo wrestlers to gain weight. T/I C A
   (a) In addition to eating a lot of food, what strategies do sumo wrestlers use to gain weight?
   (b) What health risks do sumo wrestlers face?
   (c) What lessons can be learned from a sumo wrestler's approach that might help with weight loss?
   (d) Do you think a sumo wrestler represents a healthy individual? Explain your answer.
5. (a) How are anorexia and bulimia similar? How are they different?
   (b) Why are these disorders difficult to treat?
   (c) What do you think would be an appropriate response if you suspect that a friend has an eating disorder? K/U A
6. Use the Internet and other sources to research anorexia and bulimia. Are these disorders more common among males or females? What age group is most affected? K/U T/I
7. (a) The discipline of molecular gastronomy is a recent area of study related to food and nutrition. Use the Internet and other sources to research molecular gastronomy. Write a brief report of your findings.
   (b) Do you think molecular gastronomy is a scientific discipline? Why or why not? T/I

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