CHAPTER 9

Life Functions

Getting Ready...

- What life functions are common to all living things?
- How are cells adapted for specific life functions?
- Which organs form the digestive and circulatory systems?
- What technologies are used to monitor life functions?

Science Log

List at least 10 living things you see in the photograph shown here. Identify some life functions that these living things share in common. Share your findings with a neighbour.

You know that plants and animals are living things. How do you know that?

In Chapter 8, you learned that living things are made up of cells. Cells have structures that carry out necessary life processes. All living organisms have special structures that also carry out life processes or life functions.

Remember the Starting Point activity at the beginning of Chapter 8 (p. 157)? During that activity, you tried to decide whether something was living or non-living. As part of that activity, did you list some processes that show that something is living?

If you did, review that list now. If you did not, consider the processes that show something is alive. The picture of people at a picnic may help you. How many life processes can you identify in this picture?

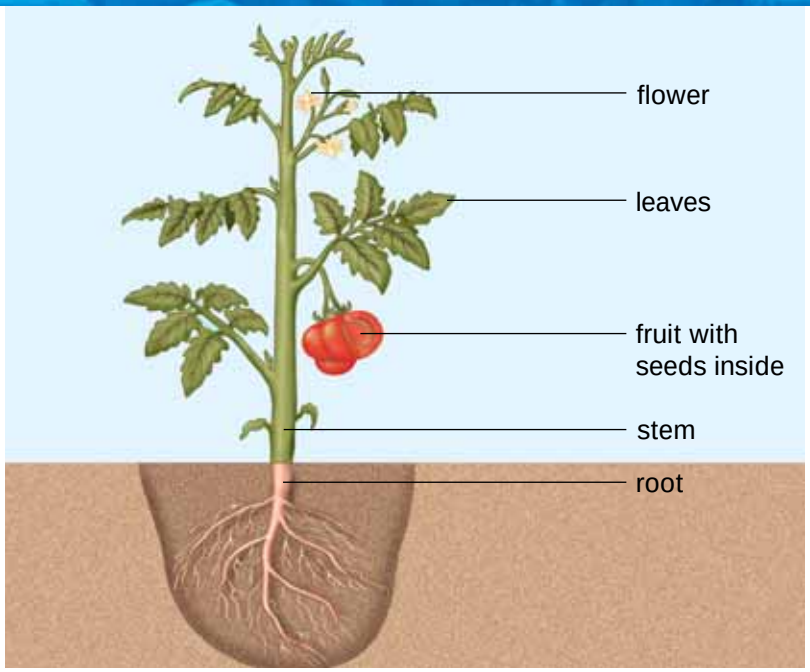
What life processes are suggested by the picture but not actually present? For example, there are young children, teenagers, and adults in this picture. What life process might the existence of people of different ages suggest?

In this chapter, you will investigate the structures that provide the life processes for living organisms. As part of this, you will discover more about the systems in the human body, including:

- how they work together, and
- what is necessary to maintain them.

You will also find out how modern technology is used to monitor life functions.

Common to Living Things



What You Will Learn

In this chapter you will learn:

- about life functions common to all living things
- about the differences and similarities between photosynthesis and cellular respiration
- about some major human organ systems
- about some of the technology used to monitor life functions

Why It Is Important

- What a complex system the human body is! Each part works with many other parts to keep you in balance. The lifestyle choices you make — choices about what you eat, think, and do — help to maintain that balance.

Skills You Will Use

In this chapter you will:

- identify life functions of living cells and organisms
- compare photosynthesis and cellular respiration
- investigate organ systems in the human body
- identify functions of the digestive and circulatory systems

Starting Point ACTIVITY

What Do We Have in Common?

What do plants and animals have in common? What do *you* have in common with a plant?

"How am I like a plant?"

What to Do

1. Sketch a large outline of the human body.
2. Fill in as many body systems as you can.
   - **(a)** Draw and label as many organs as you can.
   - **(b)** Identify the system to which each organ belongs.
   - **(c)** Try to identify any life functions the systems help the body perform.
3. Sketch a plant.
   - **(a)** Identify plant organs.
   - **(b)** Try to identify any life function these organs help the plant to perform.

9.1 Life Functions Common to All Living Things

READING Check

How are you like a dandelion?

All plants and animals share many of the same **life functions**. Did you list them all during the opening activity? To check, study each of the photographs in Figure 9.1. See if you can identify which life function each one represents. Identify any plant or animal structures you think are involved in each life function.

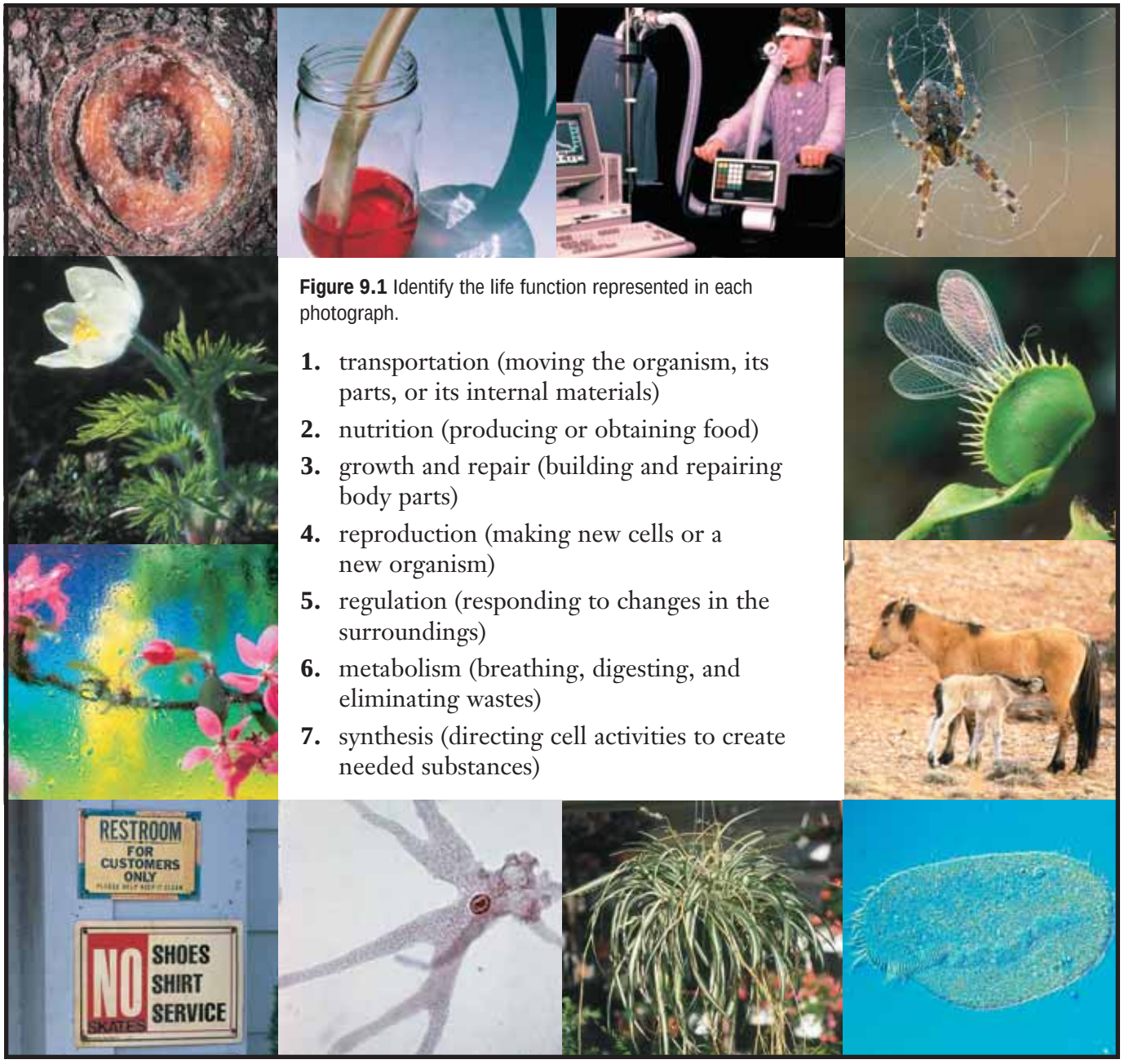


Figure 9.1 Identify the life function represented in each photograph.

1. transportation (moving the organism, its parts, or its internal materials)
2. nutrition (producing or obtaining food)
3. growth and repair (building and repairing body parts)
4. reproduction (making new cells or a new organism)
5. regulation (responding to changes in the surroundings)
6. metabolism (breathing, digesting, and eliminating wastes)
7. synthesis (directing cell activities to create needed substances)

Find Out ACTIVITY

Survivors

SKILL CHECK

- Initiating and Planning
- Performing and Recording
- Analyzing and Interpreting
- Communication and Teamwork

All plants and animals have to respond to changing conditions in their environment. For example, a dog pants when it is hot.

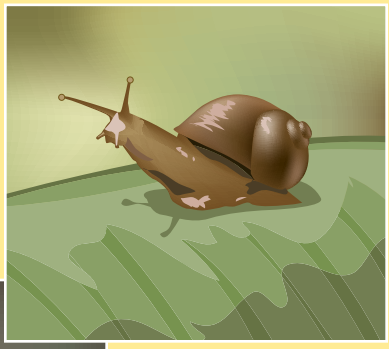
In this activity, you will research some other ways that plants and animals adapt to survive.

What to Do

1. Research at least 10 other unique ways that plants and animals respond to changes in their environment.
2. Do some research in the library or on the Internet to describe these special functions in more detail. See if you can identify any organs or systems that carry out these special functions.
3. Decide on a way to share the information you find. You might make an oral presentation or build a diorama.

What Did You Find Out?

1. How do plant and animal organ systems respond to survive in the conditions that they experience?



Snails become inactive during the hottest, driest parts of the summer when food and moisture are scarce. This is called **torpor**.

During the winter, a bear becomes inactive to avoid winter food shortages. Its heartbeat and breathing slow. Its body temperature is lower than normal. This is called **hibernation**.

Cells and Tissues Are Specialized

In Chapter 8, you learned that cells, tissues, organs, and systems work together to keep an organism alive. Each cell, tissue, organ, and system is built in a special way to help it perform its function.

Cells, tissues, organs, and systems are all designed for their special jobs. They are **specialized**. For example, nerve cells have arm-like parts. These allow the cell to connect to many cells nearby.

For example, each system in an animal or a plant works to keep the plant or animal alive by performing certain functions.

- An animal's digestive system contains all of the organs necessary to take food and change it into a form the animal's body can use.
- A plant's root system includes a primary root, secondary roots, and root hairs. The root system brings water and nutrients into the plant from its environment.

READING Check

Describe one way that plant or animal cells are specialized.

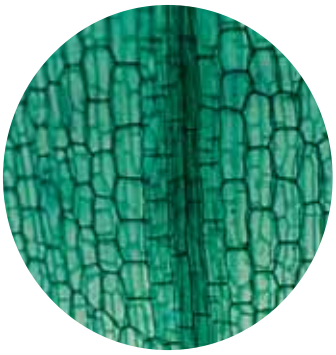
THINK & LINK

INVESTIGATION 9–A

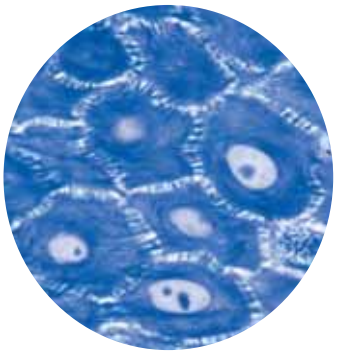
SKILL CHECK

- Initiating and Planning
- Performing and Recording
- Analyzing and Interpreting
- Communication and Teamwork

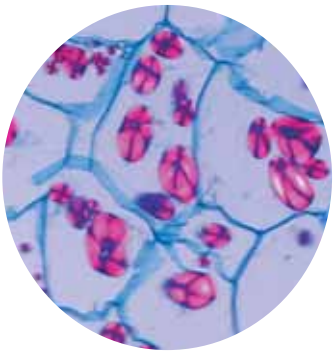
What Is My Role?



plant epidermal cells



human epidermal (skin) cells



root cells

Think About It

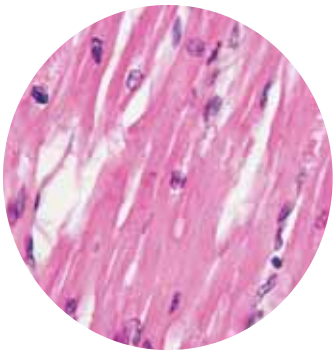
A cell's structure is adapted to the job that the cell does within a plant or an animal. For example, long thin muscle cells can contract to do work.

What to Do

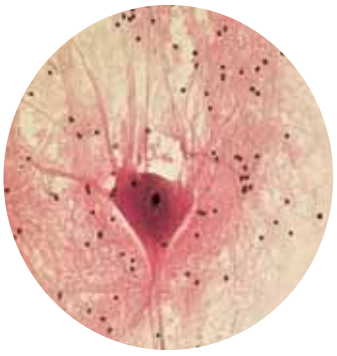
1. Study and record the shape, size, and number of cells in each of the photographs shown here.
2. Use reference books or the Internet to describe the function of the cell.

Analyze

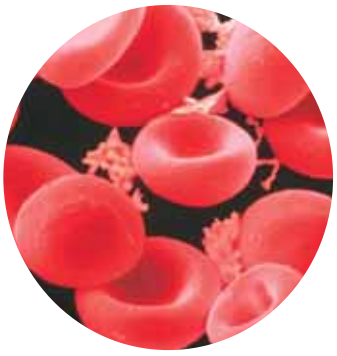
1. Describe how the structure of cells is related to their function.
2. Look at the photographs on page 167 in Chapter 8.
   - The photograph on the left shows stomata, which are tiny openings on the surface of a leaf. These allow water vapour and other gases to pass in and out. How are these cells adapted for the job they do?
   - The photograph on the right shows muscle cells. How do you think muscle cells are adapted for the job they do?



cardiac (heart) muscle cells



human nerve cells



red blood cells

Check Your Understanding

1. How can you prove that you are living?
2. Do plants and animals share the same life functions? Give a reason for your answer.
3. Describe two ways in which plants or animals can respond to changes in their surroundings.
4. Describe how one type of plant or animal cell has been adapted for its function.

Key Terms

life function
torpor
hibernation
specialized

9.2 Photosynthesis and Cellular Respiration

All plants and animals need a continual supply of energy in order to grow and function. Where do plants and animals get this energy?

READING Check

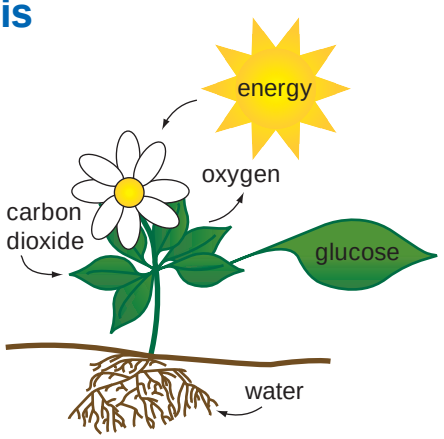
What does photosynthesis produce?

Animals obtain their energy from the food they eat. Plants need to make their own food in a process called **photosynthesis**. These two life processes are connected.

- During photosynthesis, plants make their own food.
- During **cellular respiration**, the food that is produced undergoes chemical change and releases energy. Both plants and animals use cellular respiration.

Learning about these two processes will show you how plants and animals depend on each other.

Photosynthesis



carbon dioxide +water+ energy ⟶ glucose + oxygen

Figure 9.2 During photosynthesis, chloroplasts in green plants capture energy from the Sun and store it in food molecules. This food is in the form of a simple sugar called **glucose**.

Storing Plant Food

Plants use light energy from the Sun, along with carbon dioxide and water, to make glucose. The byproduct of this process is oxygen. Oxygen is released from the leaves into the air.

Any food that the plant does not immediately use is stored for later use — for times of stress or cloudy days!

carbon dioxide + water + energy ⟶ glucose + oxygen

Where do plants store the extra food? Different plants use different parts. Check out Table 9.1 to identify some of these parts. Think about the parts of different plants that store the food. What do these parts have in common?

Table 9.1 Storage Facilities

Storage Location	Plant
stem	sugar cane, celery
roots	carrots, beets
leaves	lettuce, spinach
flowers	broccoli, cauliflower
fruit	apples, tomatoes
seeds	peas, corn

READING Check

Describe cellular respiration.

Cellular Respiration

During cellular respiration, potential energy stores in food are converted to other forms of energy. All animal and plant cells do this. The process takes place in the cells' mitochondria.

Mitochondria are like a cell's power plant. They convert energy from the food into a form of energy that the cell can use to grow and do its work.

About half of the energy from glucose is released into the body as thermal energy or heat. The other half of the energy is used to carry out life functions. During cellular respiration, food in the form of glucose is broken down to produce energy that the cell can use. Cellular respiration needs oxygen. As glucose is used, it gradually breaks down to produce carbon dioxide and water. The carbon dioxide and some of the water are released into the surrounding air.

glucose + oxygen ⟶ carbon dioxide + water + energy

Figure 9.3 Equation for cellular respiration

Comparing Photosynthesis and Cellular Respiration

Use Figure 9.4 to compare the processes of cellular respiration and photosynthesis. How are they the same? How do they differ?

Remember:

- The process of photosynthesis *stores* energy.
- The process of cellular respiration *releases* energy. This released energy is the only form of energy the cell can use for all cellular activities.

READING Check

Explain the energy changes in photosynthesis and cellular respiration.

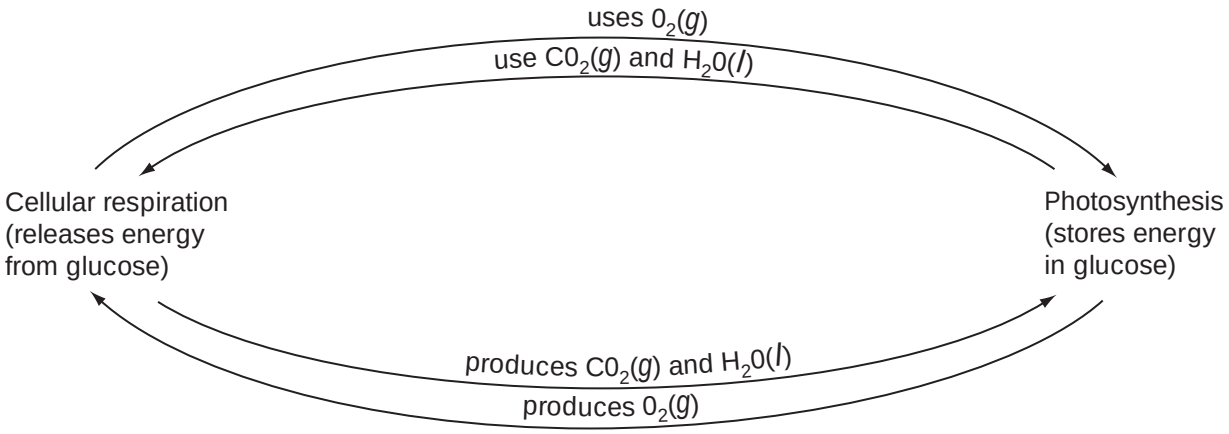


Figure 9.4 Photosynthesis and cellular respiration are closely connected. Look at the arrows in these figures. The processes form a cycle.

DidYouKnow?

Most of the world's photosynthesis happens in marine algae — simple organisms living in water. Some algae are unicellular. Others, such as the kelp shown here, are multicellular.

Figure 9.5

Disc CONNECT

Organisms that carry on photosynthesis provide food for nearly all the other organisms on Earth. Cellular respiration releases the energy from food. What do the processes of photosynthesis and cellular respiration have in common? What are the chemical reactions for these two processes? To answer these and other questions, load the student CD-ROM onto your computer. Launch the **Photosynthesis** applet to learn more about photosynthesis and cellular respiration.

Check Your Understanding

Key Terms

photosynthesis
cellular respiration
glucose

1. What is photosynthesis? Draw and label a sketch explaining the process.
2. What is cellular respiration? Use a labelled sketch to explain the process.
3. Where do the following plants store their excess food?
   - apple trees
   - carrots
   - lettuce

9.3 Human Organ Systems

Imagine a machine that can do the following!

- pump fluids for years and years without stopping
- release energy from food
- eliminate wastes
- send messages
- reproduce itself or parts of itself

Would you like to have such a machine?

Actually, you do. That machine is your body. Your body machine works so well that most of the time you are not even aware of everything that is happening! The figures below show what the systems in your body's machine do for you. And you don't even have to tell them!

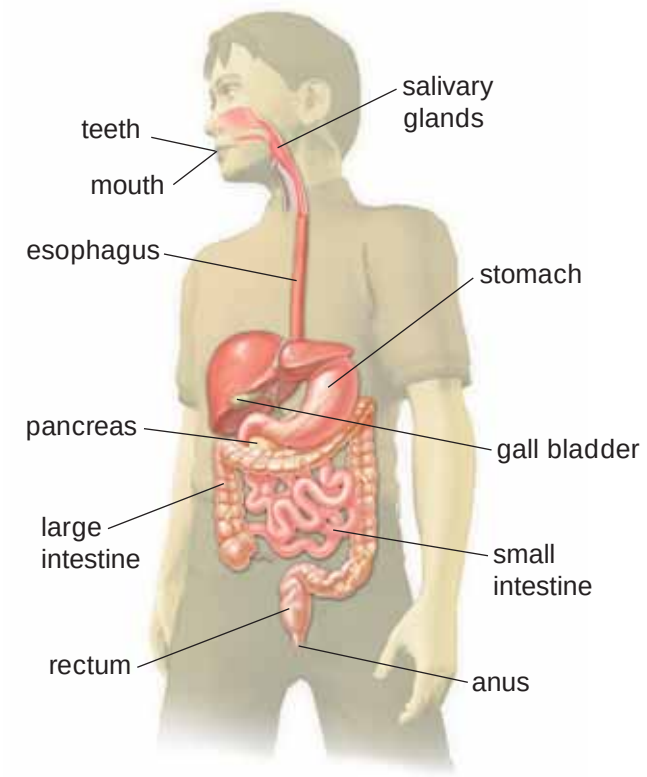


Figure 9.6 Digestive system

- breaks down and digests food
- rids the body of solid wastes

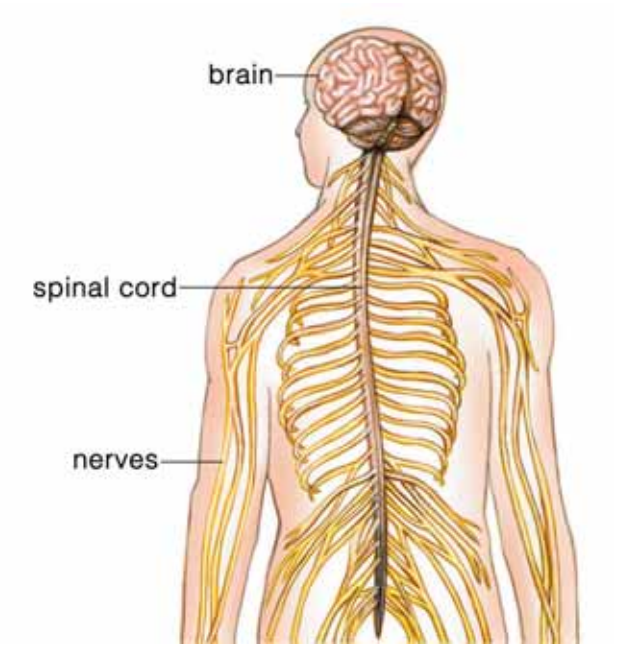
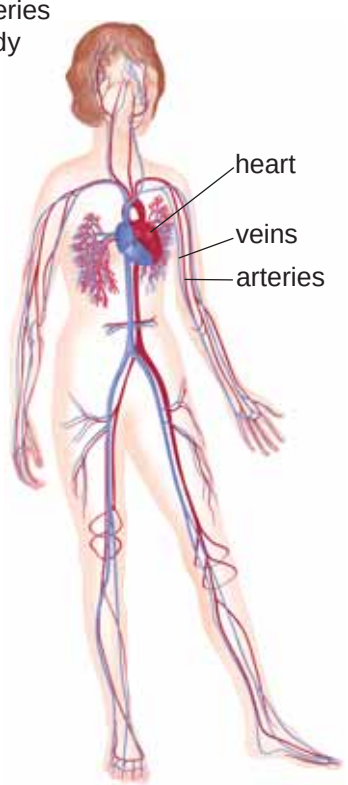


Figure 9.7 Nervous system

- provides a communication network
- regulates life functions

Heart and Major Arteries and Veins of the Body



The human heart has four compartments: the right atrium, the right ventricle, the left atrium, and the left ventricle.

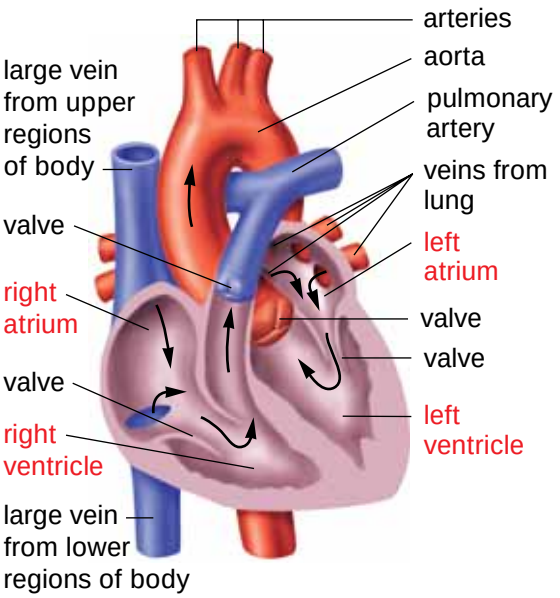
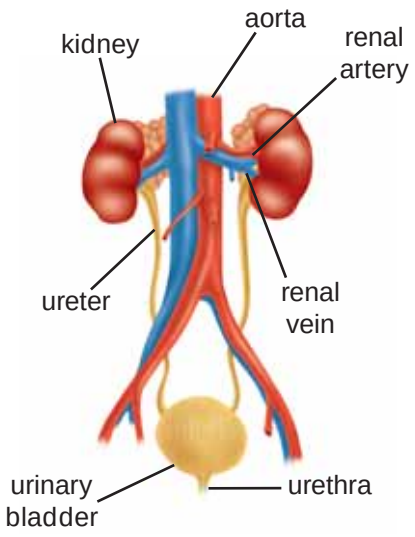
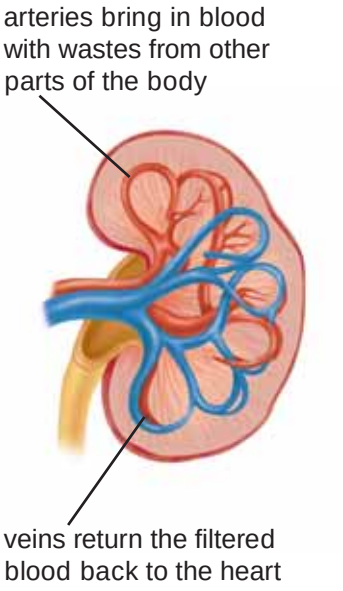


Figure 9.8 Circulatory system

- blood transports the following substances:
  - food molecules
  - oxygen
  - carbon dioxide
  - wastes



Urinary System



Kidney

Figure 9.9 Urinary system

- kidney filters blood that has collected wastes from cells and then transports these wastes to the urinary bladder
- urinary bladder holds wastes until they are excreted through the urethra

The Digestive System — Catch the Wave!

Chemical energy is stored in food. The role of the **digestive system** is to change the food you eat into simple chemical compounds that can enter the cells. The body uses these compounds (called nutrients) for energy, growth, and repair. The major types of nutrients are carbohydrates (sugars and starches), proteins, fats, vitamins, minerals, and water.

READING Check

List the steps in digestion.

Look at Figure 9.6 (on page 186), which shows the digestive tract — the body's food tube. Trace the long curving path to see the route that food takes through your body.

Notice that digestion begins when food enters the mouth and ends when food wastes leave through the anus. As you trace the journey, read about what each of the following parts does:

Esophagus — pushes food to stomach through wave-like muscle contractions

Stomach — muscles contract to mix food; releases acids that activate enzymes to digest food; dissolves food into liquid form

Small Intestine — neutralizes stomach acid; absorbs 80 to 90 percent of nutrients; releases digestive juices to digest food

Large Intestine — absorbs vitamins, minerals, and water

Anus — discharges solid mass of undigested food called feces

READING Check

Explain the term "closed transport system" as it refers to the circulatory system.

The Circulatory System — The Beat Goes On

The role of the **circulatory system** is to move blood throughout the body. The systems consists of the **heart** — a hollow muscle that pumps the blood — and blood vessels called **arteries**, **veins**, and **capillaries**. Together, these parts form a closed transport system that moves the blood. This means that the blood that is pumped from the heart eventually returns to the heart.

How does the circulatory system work? Your heart squeezes and relaxes to do the pumping. The blood vessels each have a specialized role.

Figure 9.10 William Harvey (1578–1657) became famous for discovering how blood travels around the body of mammals, including humans.

- The heart receives oxygen-rich blood from the lungs. The arteries take this blood away from the heart to the body tissues.
- The veins return the oxygen-poor blood from the body tissues to the heart. From there it is pumped to the lungs to receive oxygen. The cycle then begins over again.
- The capillaries are extremely small vessels that connect the veins and arteries. Their walls are only one cell thick!

Take a look at Figure 9.8 (on page 187). The red line shows the path blood takes through the arteries as it leaves the heart. The blue line shows the path that blood takes through the veins as it returns to the heart.

Working Together — The Digestive System and the Circulatory System

The circulatory system works with the digestive system in the following ways.

1. Nutrients enter the bloodstream from the digestive system through the thin capillary walls.
2. The circulatory system carries digested food substances to the cells of the body.
3. Then, the nutrients travel around, over, and through each cell in the body.
4. Waste molecules pass from the cells back into the bloodstream through the capillary walls.
5. The circulatory system helps dispose of waste products and toxic materials such as salts. These materials would harm the body if they accumulated.

Figure 9.11 A fluoroscope is a special kind of X-ray device. Doctors use this technology to see a patient's digestive organs actually functioning.

Internet CONNECT

www.mcgrawhill.ca/links/science.connect1

Find out more about the heart and how the circulatory system works. Go to the above web site, then to Internet Connects, Unit C, Chapter 9, and then to The Heart.

Did You Know?

Your heart beats about 72 times a minute, which is 38 000 000 times a year! It pumps over 10 000 litres of blood a day. In one day, your heart pumps more than 10 times as much blood as your house uses water in a day.

Reading Check

How do the digestive and circulatory systems work together?

Try This!

Push a marble into a piece of rubber tubing. Squeeze the tubing behind the marble until it reaches the other end. You have just modelled the contractions that occur in the esophagus, small intestine, and large intestine to move materials through.

Key Terms

digestive system
esophagus
stomach
small intestine
large intestine
anus
circulatory system
heart
vein
artery
capillary

Check Your Understanding

1. Make a flowchart to show the path that food travels through the digestive tract. Identify the organs at each step.
2. List the parts of the circulatory system.
3. Explain how the circulatory system works with the digestive system.
4. What do you think would happen if the circulatory system were no longer able to absorb food?
5. Why do blood vessels under the skin look blue?

9.4 Keeping an Eye on Life Functions

How do doctors and nurses know whether your body is working properly?

They start by asking how you feel. That gives them a certain amount of information. Like auto mechanics, they back up what you say and what they observe with reports from pieces of equipment. All of this information is used to help you recover from injuries or diseases.

Let's take a look at some of the technologies you might see if you had to make an emergency trip to a clinic or hospital.

An Emergency Trip to the Clinic

Looks like the last run of the day! Maybe your friend has a broken leg? He seems to be unconscious. But help is on its way!

Emergency care begins with checking vital signs. A **blood pressure cuff** is used to check blood pressure. A stethoscope is used to check the heart rate.

Your friend is hooked up to a CAT scan machine. A CAT scan is an X-ray picture of the brain to check for swelling or internal bleeding.

X rays will show any damage to the bones in the leg. X rays can penetrate soft tissue like skin and muscles. They do not penetrate dense substances such as bones.

Think of the signatures and attention your friend will get! Now let's see what other technologies are in use today.

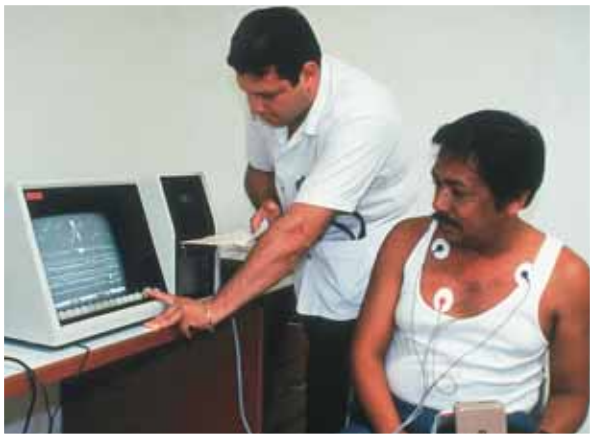


Figure 9.12 An **EKG** diagnoses disorders of the heart. An EKG provides a printed record of the rate and pattern of a patient's heartbeat.

READING Check

Why do medical professionals monitor life functions?

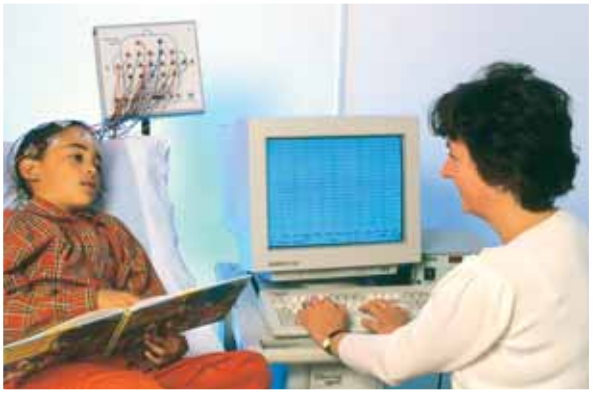


Figure 9.13 Doctors use the **EEG** to study brain actvity. The instrument records changes in brain activity on a moving chart. Pens that move back and forth record the readings.

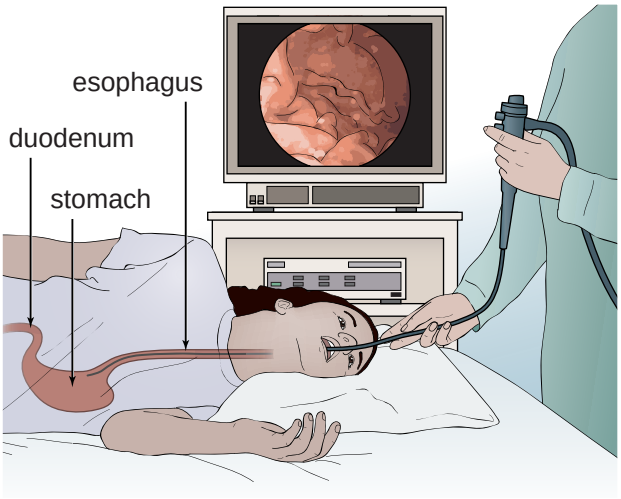


Figure 9.14 A lighted instrument called an endoscope allows doctors to see the inside of hollow organs such as the stomach to check for abnormalities.

Check Your Blood Pressure

Your heart is a pump. As it contracts, it pushes blood through your arteries. When blood is pumped out of the heart it is forced out under pressure. You can feel this wave of blood when you check your pulse with your fingers. Your pulse tells you how fast your heart is beating. It is also an indication of how hard your heart is working.

In order for blood to reach your hands and feet, it must be pumped out of the heart under great pressure. You can measure that pressure using a blood pressure cuff or *sphygmomanometer* [sfig-mo-ma-NOM-et-er].

When you give a blood pressure reading, you use two numbers, such as 120 over 80. The two numbers show the blood pressure at two different stages of your heart's pumping cycle.

Blood pressure rises and falls as the heart contracts to pump blood and then relaxes. When the heart pumps, blood pressure rises sharply. This provides a high blood pressure reading known as systolic pressure.

When the heart is relaxed, and just before it contracts to pump again, the blood pressure is at its lowest. This is referred to as the diastolic pressure.

Look at Figure 9.16 to find the average systolic and diastolic readings for a person your age. How would you report such a blood pressure?

Figure 9.15 Take your own pulse

Try This!

Take your pulse either in your wrist or by finding the artery in your neck. Once you have found your pulse, count the number of beats in one minute. Is your heart rate the same as others in your class?

READING Check

What technology is used to monitor your systolic and diastolic blood pressure readings?

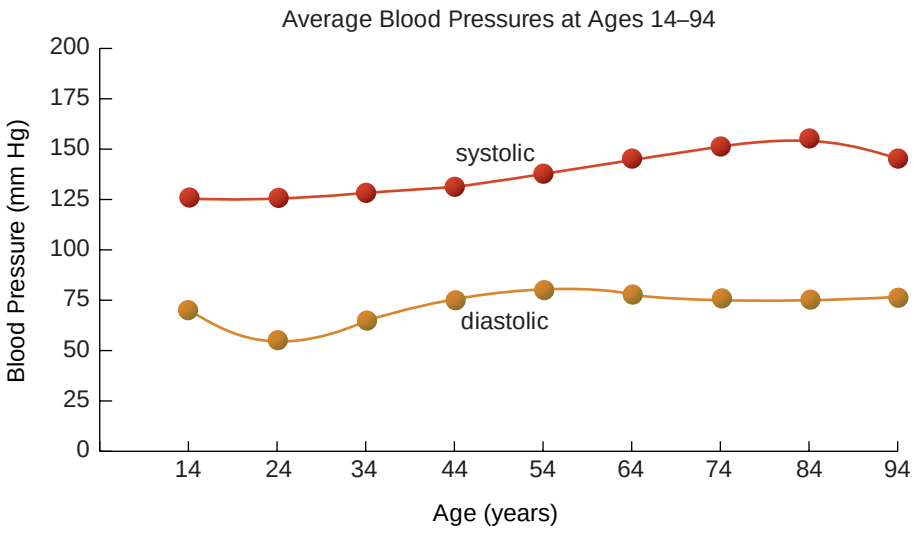


Figure 9.16 What is the average blood pressure for someone your age? How would you report it?

Find Out ACTIVITY

SKILL CHECK
- Initiating and Planning
- Performing and Recording
- Analyzing and Interpreting
- Communication and Teamwork

How Does Exercise Affect Blood Pressure?

Read blood pressure before and after exercise to find out how exercise affects blood pressure.

Safety Precautions

- Make sure you do not overexert yourself.
- Let your teacher know if you have health concerns that prevent you from participating in physical exercise.

Digital blood pressure cuff or sphygmomanometer

What You Need

digital blood pressure cuff
skipping rope (optional)

What to Do

1. Work with a partner.
2. Read and follow the instructions that are supplied with the digital blood pressure monitor. Use them to take and record each other's pulse and blood pressure while at rest. Record this information.
3. Do five minutes of exercise such as running on the spot, stride jumps, stair climbing, or jumping rope.
4. Take and record each other's pulse and blood pressure after exercise.
5. Rest for five minutes. Take and record each other's blood pressure and pulse.

What Did You Find Out?

1. How did exercise affect your heart rate (pulse) and blood pressure?
2. What happened to your heart rate and blood pressure when you rested after the five minutes of exercise?

Conclude and Apply

3. During exercise, people's heart rates go up. Regular exercise increases circulation and increases the health of the heart. As a result, the heart muscle works more efficiently. Over time, as people exercise regularly, their heart rates can drop. Predict how you think regular exercise will affect blood pressure.

To take your own blood pressure, sit relaxed with your arm on a flat surface. Place the blood pressure cuff around your upper arm. The blood pressure reading will show digitally on the pressure gauge.

Check Your Understanding

1. **(a)** Name three technologies used to diagnose injury and disease.

   (b) Explain the purpose of each technology.

2. Why do you think a doctor might give a patient a CAT scan before a leg X ray?

Key Terms

blood pressure cuff
X ray
EKG
EEG

CHAPTER

9 Review

Key Terms

life function
torpor
hibernation
specialized
photosynthesis
cellular respiration
glucose
digestive system
esophagus
stomach
small intestine
large intestine
anus
circulatory system
heart
artery
vein
capillary
blood pressure cuff
X ray
EKG
EEG

Reviewing Key Terms

If you need to review, the section numbers show you where these terms were introduced.

1. (a) List the major organs in the order that your lunch meets them on its journey through the digestive tract. (9.3)
(b) Identify a role for each organ. (9.3)

2. List the reactants and products of cellular respiration and photosynthesis. (9.2)

3. In your notebook, match each description in column A with a term in Column B.

A	B
(a) are necessary for life	i. life functions (9.1)
(b) measures brain wave activity	ii. EKG (9.4)
(c) carries oxygen-rich blood from the heart	iii. blood pressure cuff (9.4)
(d) printed record of the heart rate	iv. EEG (9.4)
(e) major organ of circulatory system	v. heart (9.3)
(f) returns oxygen-poor blood to heart	vi. artery (9.3)
(g) absorbs nutrients and removes wastes	vii. vein (9.3)
(h) measures force of blood	viii. capillary (9.3)

Understanding Key Ideas

Section numbers are provided if you need to review.

4. (a) Which photograph shows a life function?
(b) Name the life function. (9.1)

5. Explain how a plant makes its own food. Use a diagram to help you. (9.2)

6. What does the process of photosynthesis depend on? (9.2)

7. Systems work together. Use an example to explain this statement. (9.3)

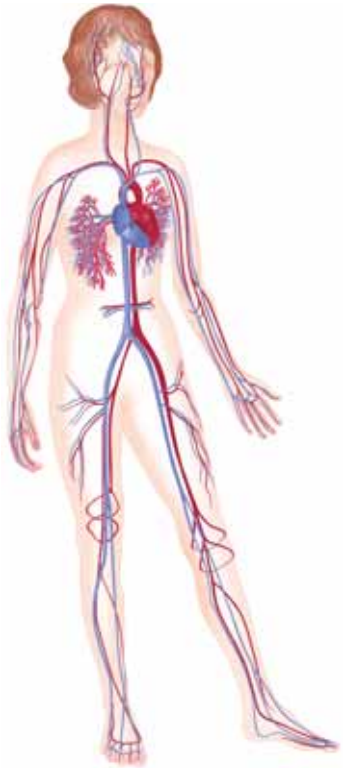
8. Why do health-care providers check out a patient's life functions? (9.4)

Developing Skills

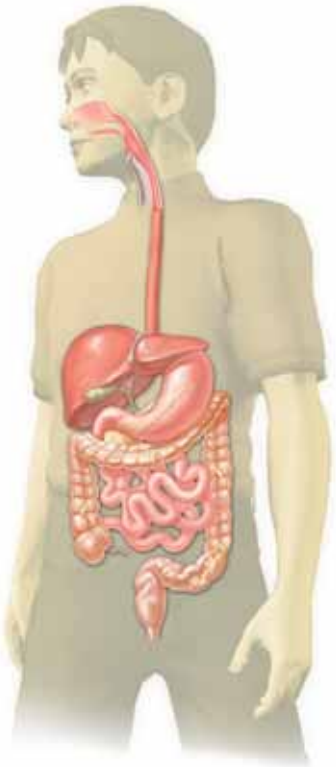
9. (a) Name the systems shown in illustrations A and B.
(b) Use a chart to classify each of the following body parts according to the system with which it is associated. (9.3)

stomach, large intestine, heart, mouth, artery, nerve, vein, gall bladder, small intestine, liver, spinal cord, brain, pancreas, rectum, blood, capillary, salivary gland

A.



B.



10. Over a two-week period, collect newspaper articles about blood pressure and health. Read each article and identify the main point. Present your findings in the form of a brief report. (9.4)

Problem Solving/Applying

11. Many mammals that hibernate become extremely fat before they go into hibernation. (9.1)

(a) Explain why.

(b) Identify two ways that hibernation affects life functions.

12. Imagine there were no more plants to carry out photosynthesis. What would be a direct result for other living organisms? (9.2)

13. Blood tests are commonly done by health-care providers. What information might such a test give about the state of your health? (9.3)

Critical Thinking

14. Some people eat a delicacy called tripe. Tripe is the stomach of an animal such as a beef cow. If your stomach can digest tripe, why does your stomach not digest itself? (9.3)

Pause & Reflect

1. Go back to the beginning of this chapter on page 178 and check your original answers to the Getting Ready questions. How has your thinking changed? How would you answer these questions now that you have investigated the topics in this chapter?
2. A student falls suddenly to the floor while playing basketball. He appears to be unconscious. List the technologies that a doctor might use to check the student's life functions.