Chapter 12

# The health of the body depends on the health of its interdependent systems.

Don't tell Sarah Reinertsen it can't be done, unless you want to be proven wrong. In the world of running, she has just about done it all—100 m, 200 m, 400 m, 5 km, 10 km, marathon, and triathlon. Compared with an athlete with two legs, Sarah must use 40 percent more oxygen and twice as much energy to accomplish the same basic tasks. All her body systems are finely tuned, through training, to work together in the most effective manner. In this regard, however, she is no different from you or anyone else. Body systems provide the cells of the body with the matter and energy the cells need to survive and carry out their life functions.

## What You Will Learn

In this chapter, you will

- **explain** how the needs and functions of cells and organs are related to the needs and functions of the whole body
- **describe** factors that can have a positive effect on various body systems
- **describe** factors that can have a negative effect on various body systems

## Why It Is Important

Understanding how all body systems are dependent on one another can help you appreciate how easy it can be to support and maintain your health.

## Skills You Will Use

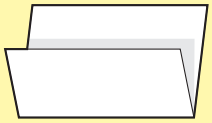
In this chapter, you will

- **investigate** and **communicate** the roles of diet, exercise, and stress on various body systems
- **evaluate** energy drinks for their health benefits
- **examine** and **evaluate** conflicting evidence related to medical support of the body

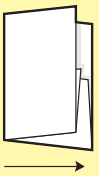
**FOLDABLES™**
Reading & Study Skills

**Make the following Foldable to take notes on what you will learn in Chapter 12.**

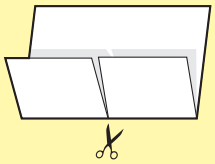
**STEP 1** **Fold** a letter size sheet of paper as shown, so that about one third of its length is folded upwards. This should leave a tab 8-10 cm long exposed at the top of the sheet.



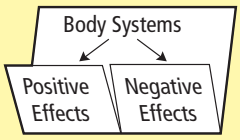
**STEP 2** **Fold** the sheet in half width-wise.



**STEP 3** **Unfold** the sheet and **cut** the bottom tab along the fold line as shown.



**STEP 4** **Label** the Foldable as shown. **Draw** arrows from "Body Systems" to "Positive Effects" and "Negative Effects" to list the effects of various factors on the health of body systems.




**Organize** As you read this chapter, complete the Foldable by recording information, providing examples, and defining terms under the appropriate tabs.

# 12.1 How Body Systems Are Connected

All the cells of the body have the same basic need for energy, nutrients, and oxygen to carry out their functions. All cells also have the same basic needs for removing wastes. Body systems work together to provide cells with what they need. In so doing, body systems support themselves, one another, and the whole human body.

**Key Terms**

nutrients

In Chapter 10 you learned that all cells need energy. This statement applies to unicellular living things as well as multicellular living things. Cells need energy to carry out all their life functions, and the source of energy that cells use is their food. When you eat, your digestive system breaks down food into substances that are commonly called **nutrients**. These nutrient substances include carbohydrates, fats, and proteins. Cells can use any of these nutrient substances for energy, but the main nutrients used for energy in the body are carbohydrates. The main carbohydrate that your body uses for energy is the sugar, glucose.

You also learned in Chapter 10 that cells use a chemical process to release the energy that is stored in glucose. This chemical process is called cellular respiration. Figure 12.1 summarizes this process.

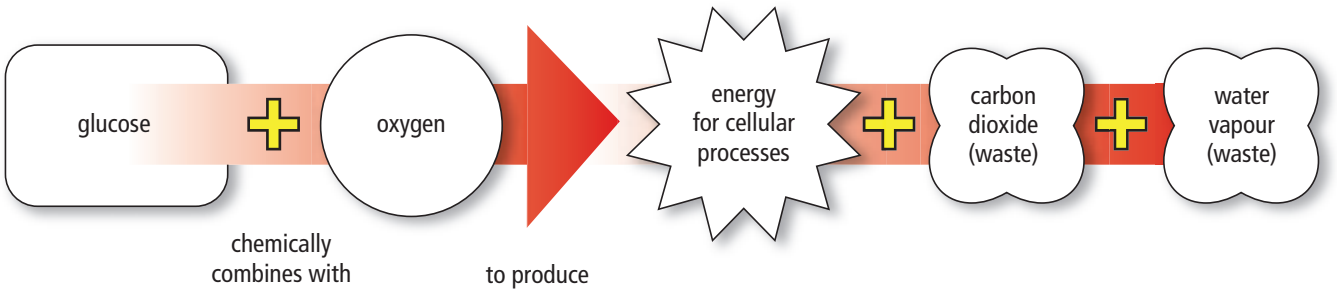


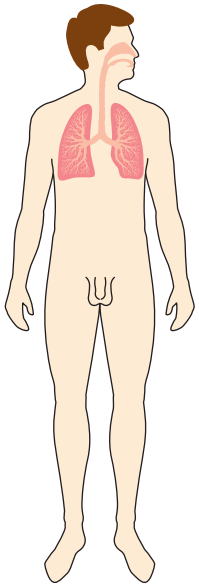

**Figure 12.1** Cellular respiration releases energy that the cell needs for its life functions. Notice that cellular respiration requires two raw substances: oxygen and glucose. Cellular respiration uses these substances to release energy. At the same time, it produces two waste substances: carbon dioxide and water.

Several organ systems are directly involved with cellular respiration. These systems, shown in Figure 12.2, include:

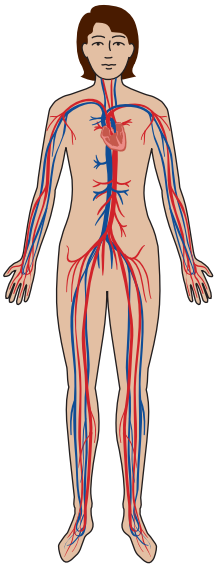
- the respiratory system
- the digestive system
- the circulatory system
- the excretory system

No single system can work by itself to perform this task. Instead, there are connections between these and other organ systems.

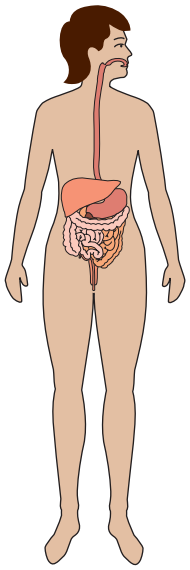
**Figure 12.2** These four systems of the human body play important roles in the process of cellular respiration.



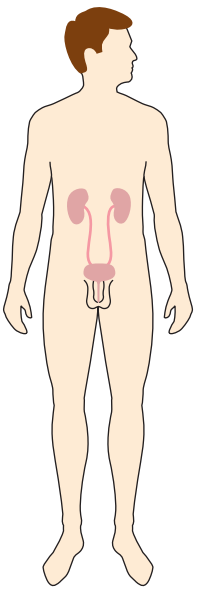
**respiratory system**
nose (takes in oxygen-rich air)
windpipe (directs oxygen-rich air to lungs)
lungs (exchange oxygen and carbon dioxide, and remove carbon dioxide through the nose)



**circulatory system**
heart (pumps blood)
veins (transports blood from body cells)
arteries (transports blood to body cells)



**digestive system**
mouth (grinds up food)
esophagus (moves food to stomach)
stomach (breaks down and churns food)
small intestine (breaks food down into nutrients so they can be absorbed)
large intestine (processes solid waste material)
anus (removes solid waste material)



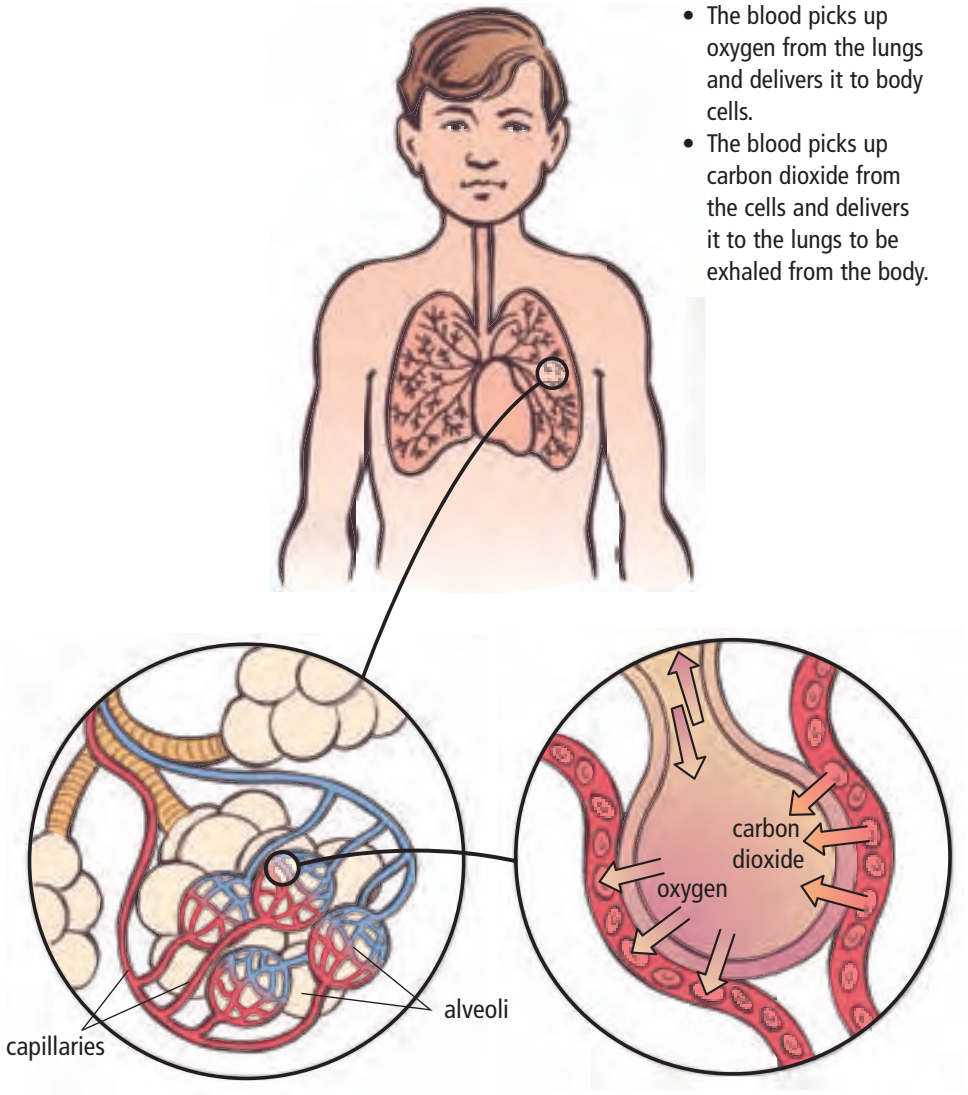
**excretory system**
kidneys (filter blood to produce urine)
ureters (transport urine)
bladder (stores urine)
urethra (excretes urine)

## Connections between the Circulatory and Respiratory System

Your heart is always beating, and your lungs are always expanding and contracting. Figure 12.3 shows what happens inside your cells as your circulatory and respiratory systems work together.

**Suggested Activity**

Conduct an Investigation 12-1B (Core Lab) on page 442




- The blood picks up oxygen from the lungs and delivers it to body cells.
- The blood picks up carbon dioxide from the cells and delivers it to the lungs to be exhaled from the body.

- Inside each lung, there are many tiny sacs called alveoli. The alveoli are surrounded by a mesh-like network of small blood vessels called capillaries.

- The alveoli and capillaries have very thin cell membranes.
- The oxygen passes through (diffuses through) the membrane of the alveolus and the membrane of the capillary into the blood.
- Carbon dioxide diffuses in the opposite direction. The gas moves from the blood into the alveolus.

**Figure 12.3** How the respiratory system and the circulatory system work together during cellular respiration

## Connections between the Circulatory and Digestive Systems

When you eat, your digestive system breaks down food into glucose and other nutrients. Your body uses these nutrients for energy and to repair or make new cells. Figure 12.4 shows what happens inside your cells as your digestive and circulatory systems work together.

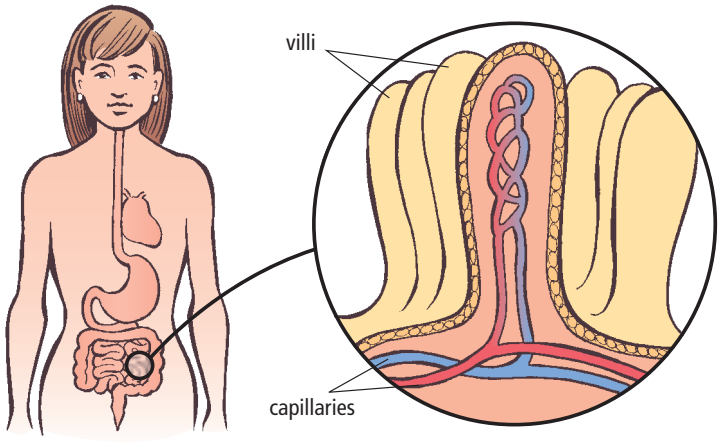



**Figure 12.4** How the digestive system and the circulatory system work together during cellular respiration

- Nutrients enter the blood from the small intestine. The blood carries nutrients to the body cells.
- On the inside wall of the small intestine, there are many structures called villi. They look like very tiny fingers.
- Inside the villi there are many capillaries. The villi and capillaries have very thin cell membranes.
- The nutrients pass through the villi into the capillaries.
- Carbon dioxide wastes from the body cells pass into the capillaries. Some of these wastes are carried to the lungs so they can leave the body.

## Connections between the Circulatory and Excretory Systems

What is urine? Would it surprise you to find out that urine is what remains after your blood has been filtered by the kidneys? Recall that the kidneys, shown in Figure 12.5, are part of the excretory system. It is their job to extract substances from the blood that your body can use again and to remove waste substances such as excess sodium, dissolved carbon dioxide, and nitrogen-containing compounds called urea and uric acid. If these substances are allowed to build up, they can overwhelm and poison other body systems.

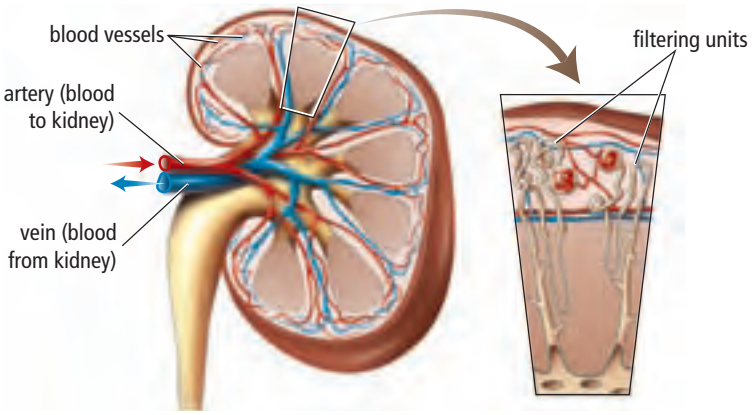



**Figure 12.5** Notice that there are blood vessels in the kidneys. The red-coloured vessels carry blood into the kidneys. The blue-coloured vessels carry blood from the kidneys. Each kidney has more than one million filtering units. These filters remove some substances from the blood that your body can reuse, such as glucose and calcium particles. Undesired wastes are removed from the body when you urinate.

**Explore More**

In Chapter 11, Find Out Activity 11-2A, you studied one organ system. Return to your team and work together with another team that studied a different system to discover ways that your two systems work together. Decide how to present your findings to the class.

## Did You Know?

People have studied the muscular system for thousands of years. It is one of the best-studied systems of the body. In 1996, two American dentists surprised themselves and the rest of the scientific community when, during a dissection to study the muscles involved in chewing, they discovered a muscle that nobody had ever described before.

## Connections between the Nervous and Muscular Systems

The cells of your body need a stable temperature to function best. This temperature is 37°C. Connections between your nervous system and muscular system help to keep your body temperature stable. The nervous system monitors conditions outside of the body through special temperature-sensing cells in the skin. Information from these cells is sent to the brain. In response, the brain sends nerve signals to different parts of your body, including your muscles.

For instance, if your body temperature is too low, the nervous system might stimulate muscles to contract and relax repeatedly. You know this feeling as shivering. When you shiver, the cells in your muscles are rapidly carrying out cellular respiration. The energy that results from this helps warm your body quickly.

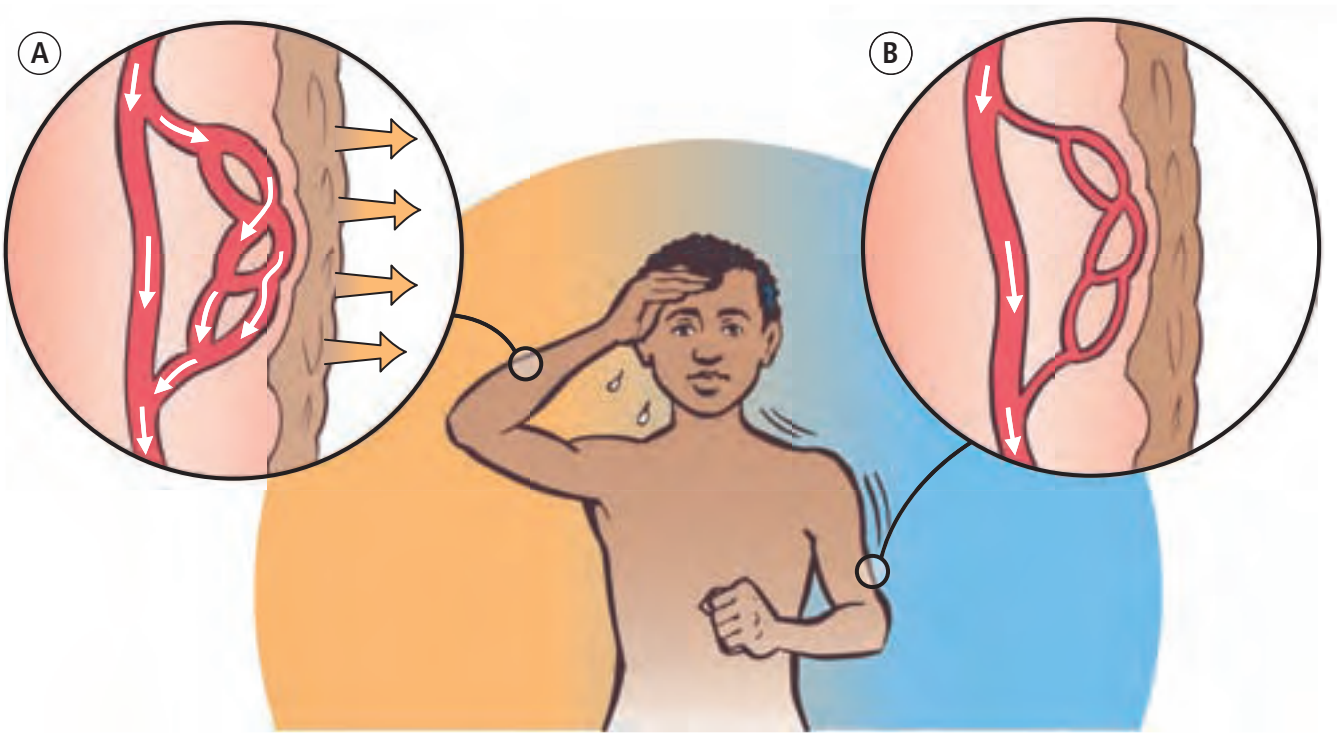



**Figure 12.6** The nervous system controls blood flow to the skin to help remove or conserve body heat.
(a) When the body's inside environment is too warm, blood vessels near the surface of the skin expand. This increases blood flow near the body surface so that heat can be lost to the outside. One way this happens is by sweating. Sweating helps cool your body as the moisture evaporates from your skin surface.
(b) When the outside environment is too cold, blood vessels near the surface of the skin contract. This reduces blood flow near the body surface so that less heat is lost through the skin to the outside. The body might also shiver to produce more heat in muscle cells. The heat is spread through the body by the blood.

Other body systems also work together to keep a stable body temperature. Figure 12.6 shows roles played by the skin (integumentary system) and blood vessels (circulatory system). In fact, these and other body systems are always making adjustments to keep a stable internal environment for your cells.

## 12-1A Muscle Activity and Heat

**Find Out ACTIVITY**

In this activity, you will use a computer interface and temperature probe, if available, to discover a link between muscle activity and heat production.

### Materials

- dumbbell
- computer
- data collection interface
- temperature probe
- digital thermometer
- liquid (alcohol) thermometer

### What to Do

1. Select a dumbbell that is light enough for you to do 10 biceps curls with one arm. If computer and temperature probe equipment is available, continue with step 2. If not, move to step 4.
2. Connect and activate the computer interface and temperature probe. Obtain a base temperature reading for your muscle by holding the probe firmly against your rested biceps (no dumbbell) for 60 s.
3. With the probe still firmly pressed against your biceps, do 10 curls with the dumbbell. Record the temperature.
4. Repeat step 3 using the digital thermometer. Obtain and record a base temperature reading for your muscle first.
5. Repeat steps 3 and 4 using the liquid thermometer. Obtain and record a base temperature reading for your muscle first.

### What Did You Find Out?

1. What evidence did you collect that shows a link between muscle activity and heat production?
2. What can you conclude about the effectiveness of different temperature-measuring technologies from your observations?

## Reading Check

1. What is cellular respiration?
2. What key substances does the circulatory system move through the body?
3. What key substances does the digestive system move through the body?
4. What key substances does the respiratory system move through the body?

# 12-1B The Effect of Activity on Heart Rate and Breathing Rate

**SkillCheck**

- Observing
- Recording
- Communicating
- Explaining systems

## Safety

- Always take a pulse at the wrist, never at the neck.
- Make sure you do not over-exert yourself.
- Let your teacher know if you have any health conditions that prevent you from participating in physical exercise.

## Materials

- electronic heart monitor (if available)
- various pieces of sports equipment supplied by your teacher or brought from home
- graph paper
- data tables supplied by your teacher

The circulatory system and the respiratory system are strongly connected, since they work together to supply your body with the oxygen all your cells need. In this investigation, you will look for evidence of the connection between these two systems. In Part 1, you will learn how to take a pulse safely. Taking a person's pulse lets you determine heart rate—the number of times the heart beats in one minute. You will compare pulse (heart) rate to breathing rate—the number of times a person inhales and exhales in one minute. Then, in Part 2, you will design your own investigation to determine the effect of activity on heart rate and breathing rate.

## Question

What affect does activity have on heart rate and breathing rate?

## Procedure

### Part 1 Measuring Resting Heart Rate and Breathing Rate

1. Your teacher will provide you with a data table to record your measurements and calculations.
2. The resting heart rate is the number of times a person's heart beats per minute while that person is completely at rest. You will find your partner's resting heart rate by taking your partner's pulse. To take a pulse, locate the artery in your partner's wrist. (An artery is a blood vessel that carries oxygen-rich blood throughout the body.) Press your index finger and one or two other fingers against the artery. (Don't use your thumb. It has its own pulse.) Count the number of pulses in 15 s. Then multiply that number by 4. This will give you the number of times the heart beats in 1 min, which is the heart rate (number of beats per minute). Record your partner's resting heart rate in the data table.

3. Repeat step 2 two more times. Add the three values for heart rate together, and divide by three. This will give you your partner's average resting heart rate.
4. The resting breathing rate is the number of times a person breathes per minute while that person is completely at rest. To determine your partner's resting breathing rate, count the number of times your partner breathes (one inhale and one exhale) in 15 s. Then multiply that number by 4. This will give you the number of times your partner breathed in 1 min, which is the breathing rate (breaths per minute). Record your partner's resting breathing rate in the data table.

5. Repeat step 4 two more times. Add the three values for breathing rate together, and divide by three. This will give you your partner's average resting breathing rate.
6. Switch roles with your partner and repeat steps 2 to 5.

**Part 2 Recovery Time**

1. With a partner, state a hypothesis about the time it takes for heart rate and breathing rate to return to their resting rate after light exercise, medium exercise, and intense exercise.
2. Design a procedure to test your hypothesis. As part of your procedure, make decisions about the following:
   - activities to represent light, moderate, and intense exercise (for example: walking, jogging, and running)
   - how long to carry out each activity
   - the time interval between measuring heart rate and breathing rate (for example, taking measurements every 30 s or every 60 s)
3. Write down the procedure you plan to follow. Include the data table you intend to use to record your measurements. Show the procedure to your teacher for approval.
4. Carry out your procedure.
5. Use your completed table to plot recovery rate data on a graph. Title and label the axes of your graph.

## Analyze

1. Interpret your graph. Are the patterns that you observe what you would have expected? Explain why or why not.
2. Identify all the variables that you controlled in your investigation.
3. In step 5, you determined an average breathing rate. In step 3, you determined an average heart rate.

   (a) How did the average breathing rate and average heart rate compare with the individual values for breathing rate and heart rate that you counted?

   (b) Explain why using an average breathing rate and an average heart rate improves the accuracy of your overall results.

## Conclude and Apply

1. Did your results support your hypothesis? If not, explain why that might be the case.
2. Is it possible that there were variables that were not controlled in your investigation? Identify at least one other variable that you might not have controlled, and explain how you think this might have affected your results.

# Science Watch

## Too Much Sugar—Not So Sweet

Can your body get too much of a good thing? The trillions of cells in your body need energy to work, and that energy comes from the sugar, glucose. So how can too much glucose be bad for the body?

Glucose can only enter cells through specialized channels in the cell membrane. These channels are like doors to let glucose pass from the blood through the cell membrane and into cells. A chemical called insulin unlocks the doors to allow glucose to enter the cells. Special cells in the pancreas make insulin. If the pancreas cannot make insulin properly, glucose cannot enter cells and remains, instead, in the blood. This condition is known as type 1 diabetes. If there are not enough channels, glucose also remains outside the cells and in the blood. This condition is called type 2 diabetes.

If glucose stays in the blood, a person feels tired, because the cells are not getting the energy they need to function. The kidneys have to work harder to filter the extra glucose out of the blood. This can result in higher blood pressure and, eventually, kidney failure. Nerve cells do not get enough energy from glucose to pass information to the heart, so the heart does not pump efficiently. This could lead to a heart attack. Blood flow drops, because nerve cells in the blood vessels are affected. This could lead to blindness, prevent sores from healing, and cause confusion or even a coma.

Type 2 diabetes is the most common form of the condition, and millions of Canadians have it. The number continues to climb, with large increases reported in the number of young Canadians having the condition. Type 2 diabetes can affect anyone, but it is much more common in Aboriginal Canadians as well as Hispanic, Asian, South Asian, and African Canadians.

At present, there is no cure for diabetes. However, medications, healthy eating, and regular exercise can control it. Maintaining a healthy weight is an important factor in controlling diabetes. In the future, scientists hope to find cures if they can transplant healthy pancreas cells into people with type 1 diabetes and help cells produce more channels for people with type 2 diabetes.

### Questions

1. What two things are needed for glucose to enter cells?
2. How does type 1 diabetes differ from type 2 diabetes?
3. If you were a family doctor, what recommendations would you give people who are at risk for developing diabetes?

## Checking Concepts

1. Why do cells of the body need oxygen?
2. Describe one way that the circulatory system and the respiratory system are connected.
3. Describe one way that the circulatory system and the digestive system are connected.
4. Describe one way that the nervous system and the muscular system are connected.

### Pause and Reflect

Describe how carbon dioxide from a cell in your hand leaves your body.

## Understanding Key Ideas

5. (a) How does your circulatory system help you stay cool?
   (b) What other body system(s) work together with the circulatory system to help you stay cool?
6. Explain why it makes sense for there to be blood vessels that enter and leave the kidneys.
7. The table below shows what happens to six substances that are found in the blood when the blood is filtered by the kidneys. (Urea and uric acid are substances that result when proteins are broken down during digestion.)
   (a) Copy the table into your notebook and complete the calculations.
   (b) Which of these substances would you not expect to find in urine? Explain how you know.
   (c) If the substance that you identified in part (b) were to show up in urine, this would be a sign that the kidneys are malfunctioning. Healthy kidneys, on the other hand, filter out this substance so that it may be returned to the circulatory system and reused by the body. Describe one benefit of returning this substance for reuse in the body, rather than excreting it from the body.

| Substance in Blood | Amount in Blood before Reaching Kidneys | Amount Returned to Bloodstream | Amount in Urine |
|---|---|---|---|
| water | 100 L | 99 L | 100 L – 99 L = 1 L |
| chloride | 370 g | 364 g | |
| glucose | 70 g | 70 g | |
| urea | 30 g | 10 g | |
| uric acid | 4 g | 3.5 g | |
| calcium | 10 g | 9.85 g | |

# 12.2 Body Systems and Health

All body systems work together with other body systems. If one system does not function properly, the whole network of systems is disrupted, and the whole body is affected. In the same way, maintaining the health of each body system keeps the network of systems, and the whole body, healthy. Factors such as diet, exercise, and stress affect the health of the body systems.

**Key Terms**

genetic factors
homeostasis
lifestyle factors

A good example of the way body systems work together involves the circulatory system. The heart circulates blood throughout the body. Blood supplies oxygen and nutrients that each cell needs to function. Blood also carries wastes produced by cells to other organ systems that break them down or remove them from the body.

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

**Word Connect**

The name for the device used to measure blood pressure is sphygmomanometer. This word comes from a Greek word that means "pulse" *(sphymos)* and a French word that means "pressure gauge" *(manomètre)*.

## Blood Pressure

Doctors measure blood pressure as a simple first step to assess the health of the circulatory system. A device like the one in Figure 12.7 is used to measure blood pressure. The device has an inflatable cuff that is wrapped around the arm. Air is pumped into the cuff. This squeezes it against the artery in the arm and restricts the blood flow. Air is then slowly let out of the cuff to the point where the blood pressure matches the cuff pressure. When the pressures match, blood can flow once again through the artery. A doctor then listens for the sound of the blood with a stethoscope, as shown in Figure 12.8.

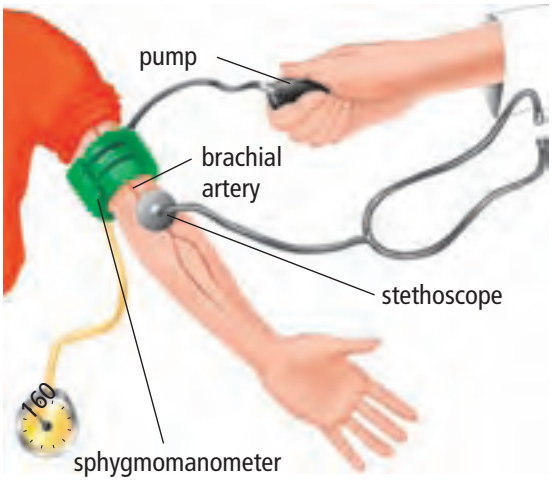



**Figure 12.7** Blood pressure is measured using a device called a sphygmomanometer.

Blood pressure can indicate several things about the health of the circulatory system.

- *Heart rate:* A fast-beating heart pushes blood quickly through the arteries, building up blood pressure.
- *Artery size:* Large, open arteries conduct larger volumes of blood, which produces low blood pressure. Small, narrow, or partly clogged arteries conduct smaller volumes of blood, which produces high blood pressure.
- *Artery elasticity:* Flexible arteries can expand easily, letting more blood flow through. Loss of elasticity results in "hardening of the arteries." This condition produces higher blood pressure.
- *Blood viscosity:* Thick fluids flow less easily than thin fluids. Thus, the heart must work harder if blood viscosity is greater than normal, which can happen if the number of blood cells increases due to illness or injury.
- *Blood volume:* If a person has lost a lot of blood through injury, the blood pressure will be low.

**Figure 12.8** A doctor uses both a stethoscope and a sphygmomanometer to assess a person's blood pressure.

## Factors That Affect Blood Pressure

Factors that can increase blood pressure include smoking, a high-fat diet, and lack of regular exercise. Cigarette smoking is a double threat to the circulatory system. Nicotine in cigarette smoke causes blood vessels to constrict. This increases heart rate and raises blood pressure. Also, carbon dioxide in smoke competes with oxygen in the lungs. This reduces the ability of the blood to carry oxygen to the cells.

Unhealthy diet choices can also lead to disorders of the system. For example, a diet high in salt can raise the blood pressure, putting greater strain on the heart. The heart gradually increases in size, and it pumps less efficiently. High-fat diets can cause fatty deposits to build up inside arteries. (Refer to Figure 12.9.) As the arteries narrow and become blocked, tiny tears in their walls cause blood clots. The clots can travel to the brain, causing a stroke. As well, blood flow through the arteries can become very limited or stop, causing a heart attack.

**Suggested Activitiy**

Find Out Activity 12-2A on page 452

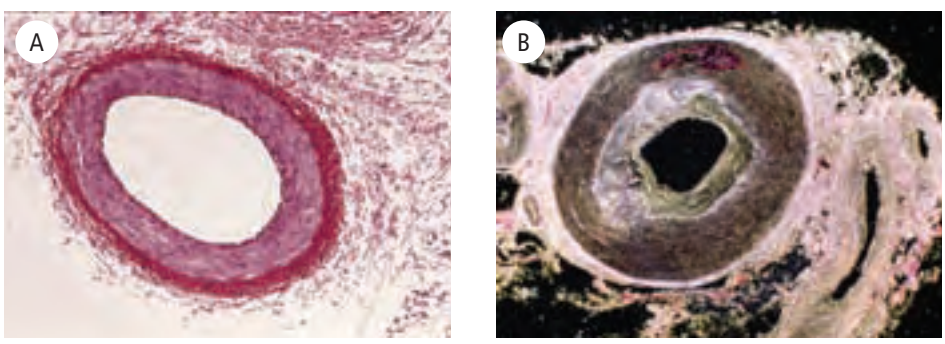



**Figure 12.9** The cross-section view of a healthy artery (A) shows a clear, wide-open pathway through which blood can flow easily. The cross-section view of an unhealthy artery (B) shows a pathway narrowed by the buildup of fatty deposits. Blood does not flow quickly or easily through this artery.

## Body Systems in Balance

The environment around you is always changing. The environment inside your body is always changing as well. For example, during stressful situations, your nervous system causes your heart rate and breathing rate to speed up. This reaction to stress helps you perform well in an emergency, as well as during competitions and tests. When the stressful situation is over, your body systems adjust to return your heart rate and breathing rate to normal.

Your body must maintain the proper internal conditions for all its cells. The ability of your body to maintain an internal balance is called **homeostasis**. All the body systems work together to achieve homeostasis, as illustrated in Figure 12.10.

Waste Product Levels: Each time you exhale, your respiratory system removes waste carbon dioxide. Your body gets rid of toxic substances by filtering the blood through the kidneys.

Blood Sugar Level: After you eat a meal, the concentration of glucose in the blood rises. In response, the pancreas releases a chemical called insulin. Insulin moves glucose from the blood to body tissues. This returns glucose concentrations to normal levels.

Concentration of Substances in Blood: The concentration of substances in your blood is always changing. The organs of different body systems have a role to play in distributing various substances that circulate in the blood throughout the day. These include oxygen, carbon dioxide, glucose, minerals, vitamins, and wastes.

Heart Rate: During times of stress or high activity, your heart rate increases to circulate more blood to deliver the necessary nutrients and oxygen to the cells.

Water Balance: Human bodies are about two-thirds water, and most of a cell's cytoplasm is water. Certain chemicals in the body influence mineral and water balance in the body. If the concentration of minerals is too high, more are excreted from the body. If the concentration is too low, less urine is excreted.

**Figure 12.10** Homeostasis maintains the proper conditions for life.

## What Affects Homeostasis?

Many things can interfere with the balance of body systems. Some of these are **genetic factors**. These are things that you inherit from one or both birth parents. Other factors that can affect the balance of body systems are within your control. These **lifestyle factors** include diet (the types and amounts of food you eat), exercise, and how you respond to stress. Table 12.1 outlines some of the effects that these and other lifestyle factors

can have on body systems. Note: Some of the factors in the table are genetic. This means that, for some people, the factors are determined before birth. For instance, genetics may increase a person's chance of becoming overweight or obese or of abusing alcohol.

**Table 12.1 Effects of Lifestyle Choices on the Health of Body Systems**

| Lifestyle Factors | Effects |
|---|---|
| Diet high in fats and cholesterol (a fat-like substance) | • fats are harder to digest than other nutrients; high-fat diets tax the digestive system<br>• fatty deposits from cholesterol and fats clog blood vessels<br>• fatty deposits in the arteries make the heart work harder<br>• cholesterol can crystallize in the gall bladder to form gallstones |
| Overweight (people whose body weight is more than the maximum desirable weight for their height and bone structure) and obesity (people whose body weight is 20 percent above the maximum desirable weight) | • added weight strains heart functions, adding a risk of heart disease<br>• added weight is a particularly high risk factor when it is associated with high cholesterol levels, high blood pressure, or diabetes |
| Smoking | • causes an increase in blood pressure, which makes the heart work harder<br>• decreases the amount of oxygen available to body cells<br>• doubles the risk of heart attacks and sudden death<br>• can cause indigestion<br>• linked to respiratory problems and lung cancer |
| Drugs and alcohol | Stimulants:<br>• temporarily increases rate of life functions<br>• speed up heart rate<br>• may cause diarrhea, stomach pain, changes in sleep patterns, anxiety, loss of appetite, vomiting<br>• can lead to dehydration, which could lead to constipation<br>Depressants:<br>• decrease the rate of life functions<br>• slow down heart rate<br>• may cause nausea, increased acid production, vomiting, and diarrhea or constipation , depending on other factors such as whether the person is dehydrated or not, or if the person is taking other drugs or has pre-existing medical conditions |
| Lack of exercise | • digested food stays in large intestine too long; coating of feces on walls of large intestine results in poor absorption of water and nutrients<br>• constricts blood vessels<br>• increased risk of heart disease<br>• risk of becoming overweight<br>• increased risk of joint disorders such as arthritis<br>• poor digestion leading to constipation |

## Technology in Support of Homeostasis

Health-care providers use technology to diagnose and treat illnesses and diseases. Technology can also be used to support or, in some cases, replace the function of an organ or a body system. Figure 12.11 shows several examples.

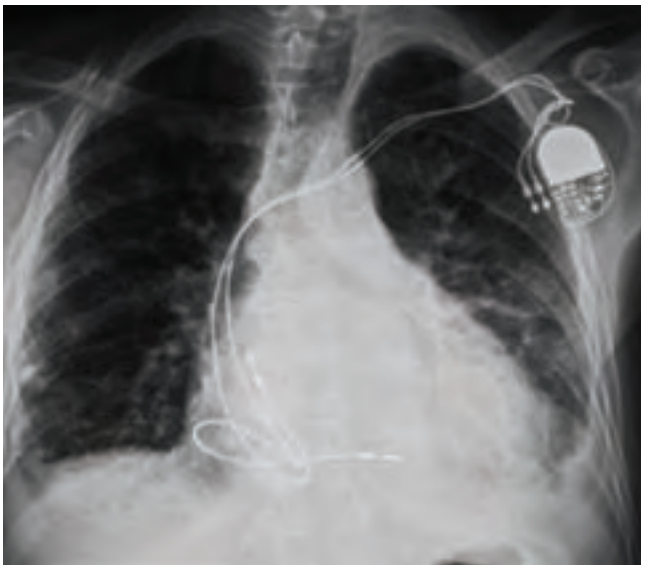


**Figure 12.11A** A healthy heart has cells that create impulses to cause the heart to beat. If these cells become damaged, an artificial pacemaker can be used. An artificial pacemaker is an electrical device that is implanted under the collarbone. It releases electrical charges to stimulate the heart to beat with a steady rhythm.


**Figure 12.11B** People who have diabetes (see Science Watch on page 444) have to monitor their glucose levels all the time and may receive injections of insulin. An insulin pump is a device that some people with diabetes wear all the time. The pump is programmed to deliver a specific dose of insulin at specific times during the day. The person must still continue to monitor glucose levels.

**Figure 12.11 C** The Jarvik-7 is an artificial heart. Artificial hearts are sometimes used because there are not enough donors of human hearts, and it is difficult for humans to stay alive for any length of time using hearts from other species.

**Figure 12.11D** Kidney dialysis is used when the kidneys no longer function. In one type of dialysis, a system of tubing allows blood to flow into a machine that removes waste products from the blood. Filtered blood is then cycled back into the body. In another type, shown here, the filtering is done by the lining of the intestines.

## You and Your Body Systems

What would you think if someone advised you to sit on a couch for at least 8 hours a day in a smoke-filled room, eat plenty of candy, drink lots of pop, and get three or four hours of sleep a night? You would probably think that you would not feel very well after a week or two. You know that your body needs proper care to function properly. However, some people pay less attention to the health of their bodies than they do to maintaining a bicycle or a car.

To support healthy organs and body systems, everyone has the same essential needs: clean air and water, a nutritious, well-balanced diet, exercise, and restful sleep. Clean air means oxygen for your cells. Pollution decreases the ability of oxygen to get into your body. A nutritious, well-balanced diet provides your cells with the materials they need for growth and activities. Lack of essential materials weakens the body. Too much of some substances, such as fats, processed sugars, and salt, places a strain on certain organs and systems.

Exercise helps the body process food and oxygen more efficiently. A healthy heart, lungs, and kidneys help carry materials to the cells and get rid of wastes. Strong muscles help protect the body from injury, and—coupled with a healthy heart and lungs—they use energy more efficiently.

The choices that you make in support of a healthy lifestyle can help to support your body systems for all of their life—and yours.

**internet connect**

The two types of kidney dialysis are called hemodialysis and peritoneal dialysis. Go to **www.discoveringscience8.ca**, and find out how these types of dialysis are similar and different.

***Suggested Activity***

Find Out Activity 12-2B on page 453
Conduct an Investigation 12-2C on page 454

### Reading Check

1. What are genetic factors?
2. What are lifestyle factors?
3. Name two types of technology that support or replace the function of an organ or a body system.

# 12-2A Health Watch

Find Out ACTIVITY

All health-care providers agree that the following factors have a signficant efffect on the health of body systems:

- diet
- exercise
- stress

In Activity 11-2A, you examined one body system in detail. At that time, your focus was on the organs that are a part of it and how they work together in a healthy body. In this activity, you will explore ways that diet, exercise, or stress can affect this body system.

## What to Do

1. Review what you learned about your group's body system from Activity 11-2A.
2. Discuss the meaning of the terms diet, exercise, and stress, and make sure everyone agrees on the meanings that you will use for them.
3. Choose to investigate the effect of either diet, exercise, or stress on the health of this body system. If there are other groups in the class that studied this system, try to investigate a factor that is different from theirs.
4. In step 3, you investigated the effect of one factor--diet, or exercise, or stress--on the health of one body system. Choose two other body systems whose functions are closely related to the function of the body system from step 3, and investigate the effect of diet, exercise, or stress (whichever factor you chose in step 3) on the health of these two systems.
5. Decide how the members of your group will get the information needed. For instance, you could do one or several of the following:
   - do library/Internet research
   - interview a medical specialist
   - interview a person who has worked hard to keep your system healthy or to recover from poor health
   - interview or invite a representative from an organization that specializes in your system or some aspect of its health
6. Decide how your group will coordinate and present its findings.

# 12-2B Evaluating Energy Drinks

Find Out ACTIVITY

Energy drinks are sold in grocery stores, gas stations, and bars. Manufacturers claim that energy drinks improve physical endurance and mental alertness. Energy drinks are not the same as sports drinks. Sports drink such as Gatorade™ are designed to replace glucose and several other nutrients that are lost from the body during exercise. Research energy drinks to learn more about why people use them and how safe they are.

## Materials

- labels from one or more energy drink products
- labels from one or more sports drink products
- library and/or computer with Internet access

## What to Do

1. Work in teams of three or four.
2. Each team will be given an energy drink to investigate. Do research to answer the following questions about your energy drink:
   - What is the name of your energy drink?
   - What are the ingredients in your energy drink?
   - What advertising claims are made about it?
   - What, if any, safety warnings are given on the label or on the drink's web site?
3. Use an approved Internet search engine. Key in the terms "safety issues energy drinks." Go to at least two of the sites that the search engine shows. List four health and safety issues associated with energy drinks.
4. Each team will be given a sports drink to investigate. Repeat steps 2 and 3 for your sports drink.

## What Did You Find Out?

1. Compare what you learned about your energy drink and sports drink with what another group learned. Use a table or a Venn diagram to compare your findings.
2. A PMI chart is a type of tool to help you make a decision about a problem or an issue. In the chart, you list the advantages (plus), disadvantages (minus), and interesting points about a problem or issue. Complete one PMI chart for energy drinks and another PMI chart for sports drinks.

| Plus (P) | Minus (M) | Interesting (I) |
|---|---|---|
| | | |

3. Based on your PMI charts, would you recommend using energy drinks to prepare for an exam? Explain why or why not.
4. Based on your PMI charts, would you recommend using energy drinks to prepare for a sports activity? Explain why or why not.

# 12-2C Debate: Conventional versus Alternative Medicine

**SkillCheck**

- Evaluating information
- Working co-operatively

## Background Information

Conventional medicine is medicine that is based on science as it is understood and practised mostly by Western cultures such as Canada, the United States, and many parts of Europe. Conventional medicine has helped to develop vaccines, antibiotics, and surgical techniques that have improved the lives of many people.

Alternative medicine is medicine that is based on science as it is understood and practised mostly by Eastern cultures, such as those of China, Japan, and India, and by Aboriginal cultures throughout the world. For example, acupuncture was developed in ancient China. It involves inserting needles into certain places in the skin to relieve pain and to help organs to function properly. Other examples of alternative medicine include herbalism, homeopathy, naturopathy, chiropractic, and Aryuvedic medicine.

Some practitioners of conventional medicine are licensed to use selected alternative methods—notably acupuncture. One health-care facility in Quebec and two in Alberta provide both conventional and alternative methods of treatment. This approach is sometimes called integrative medicine. In general, however, practitioners of conventional medicine do not support the use of alternative medicine, because its techniques have not been tested to the same standards used to establish the value of conventional therapies and practices.

This large device is a gamma camera, which is used in nuclear medicine to treat cancer.

Acupuncture needles are placed at points along lines of chi (body energy) called meridians.

Decision Making

## Identify and Analyze Alternatives

Your teacher will provide you with a set of debating procedures to follow. Debate the following resolution: Be it resolved that methods used in alternative medicine are unproven as effective ways of treating illness.

Read the "In Favour" and "Against" points listed here, and start to think about other points that could be made in favour of the resolution and against the resolution. Your class with be divided into groups of six. In each group, two students will speak in favour of the resolution, and two will speak against it. Each of the remaining students will be asked to join a side and work with the speakers to gather the background information needed to put forward a strong case for the point that side is defending. (To help make the research more manageable, each team can choose to find detailed information about one of the alternative therapies mentioned.)

Each group will take turns presenting its debate to the rest of the class. The class will vote to declare which side is the winner.

| In Favour | Against |
|---|---|
| • There is little or no statistical evidence based on controlled clinical trials that demonstrate that alternative therapies produce cures.<br>• Many alternative therapies contradict what Western science teaches about how cells and organs in the body carry out their functions.<br>• The apparent success of some alternative therapies may be the result of a faulty diagnosis. In other words, people seem to recover because they did not have the illness that was diagnosed in the first place. | • Good health is a result of many factors that affect organ systems as a whole, and alternative medicine looks at this complex balance, rather than just single factors.<br>• Many alternative therapies are based on practices that have been used to treat illnesses successfully for hundreds and, in some cases, thousands of years.<br>• Alternative therapies might use some principles that have not yet been discovered by scientific research. |

## Evaluate

1. Did the side that won in each group provide better research or make a better presentation?
2. (a) What was your own opinion about the use of alternative medicine vs. conventional medicine before the debates?

   (b) Did your opinion change as a result of the debates? Explain why it did or did not.

## Career Connect

### Robyn Bagley

Robyn Bagley (far left) is a Certified Athletic Therapist with a Bachelor of Kinesiology degree. Kinesiology is the study of human-body movement.

**Q.** Athletes train to challenge the limits of the human body. What are the most common kinds of injuries you see?

**A.** Injuries vary with the sport, but generally injuries to the joints—ankles, knees, shoulders—are quite common because the joints are a point of weakness. Joints are where two bones come together, held by ligaments and acted upon by muscle tissue.

**Q.** Have advances in technology and equipment changed the stresses on the body? How?

**A.** Definitely. Advances in technology and equipment will always add new dimensions, both positive and negative, to a sport. In some ways, advances have improved a sport so we see fewer injuries than we once did. For example, visors in hockey reduce the incidence of eye injuries. Unforeseen aspects that advances bring include athletes' ability to hit each other harder, which increases the severity of injury and the occurrence of spinal and head injuries; newfound ability to push themselves further in training, which increases the risk of repetitive injuries; the ability to perform tasks they could not do without the new equipment; the creation of a longer season, which also increases the risk of repetitive injuries.

**Q.** How does the work of an athletic therapist differ from that of a physiotherapist?

**A.** Athletic therapists share a similar skill set, but we specialize in musculoskeletal conditions. We traditionally follow the cyclical nature of sport from the field of play, to the clinic, and back to the field of play. Physiotherapists also work with patients with neurological, cardio, and respiratory conditions—usually in a clinical setting.

**Q.** What advice do you have for serious athletes?

**A.** Balance in training and life is always important to help the body keep up with the demands we place on it. For high-level athletes, it is all the more important. Rest and recovery, along with proper training, proper nutrition and hydration, core strengthening, and sport-specific drills, all provide a strong base for all athletic pursuits. Core training—the strengthening of the muscles located mainly in the trunk of the body—is important for all people, regardless of their activity level. The abdominal muscles, for a start, provide the body with a good foundation to perform daily activities, let alone a high level of sport.

### Questions

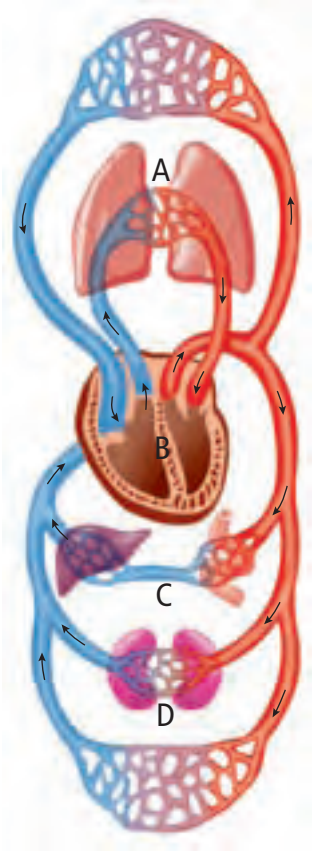
1. How have technology and equipment affected athletes?
2. What advice does Robyn give that applies to everyone, not just athletes?

## Checking Concepts

1. Give two examples of choices people make that can support the health of their body systems and two examples of choices that can harm the health of their body systems.
2. Why must the heart work harder if blood viscosity is greater than normal?
3. (a) How can technology help health-care providers?
   (b) Name two technologies that can support or replace the function of an organ or a body system, and explain how they work.
4. Explain why cigarette smoking is a double threat to the circulatory system.
5. Define the term homeostasis.
6. How are lifestyle factors different from genetic factors in their effect on body systems?

## Understanding Key Ideas

7. How can a high-fat diet affect the flow of blood through the body?
8. What effects can drugs and alcohol have on the nervous system?
9. The diagram summarizes the relationship between the circulatory system and other body systems. The blue colour represents blood vessels through which blood flows to the heart to get more oxygen to be pumped to the rest of the body. The red colour represents blood vessels that carry the high-oxygen blood to other body systems. Name a body system that is represented at each letter on the diagram, and explain the interdependence of each system and the circulatory system.




### Pause and Reflect

Some people who experience a lot of stress in their lives get sick more often than people who experience less stress or people who handle stress better. Explain how this could be possible.

## Prepare Your Own Summary

In this chapter, you explored how the systems of the body depend on one another to support the health of the whole body. Create your own summary using the key ideas from this chapter. You may include graphic organizers or illustrations with your notes. (See Science Skill 10 for help with using graphic organizers.) Use the following headings to organize your notes:

1. How Body Systems are Connected
2. Body Systems in Balance
3. How Technology can Help Body Systems
4. Healthy Choices Support Healthy Body Systems

## Checking Concepts

1. Make a concept map to show how the following terms are related. Link the concepts together using a few key words or descriptions. Add any other terms you need.
   - nutrients
   - external environment
   - oxygen
   - lungs
   - cells
   - circulatory system
   - carbon dioxide
   - cellular respiration
2. The normal breathing rate of an infant is faster than that of a teenager. Why would this be the case?
3. Describe one example of a connection between each of the following pairs of body systems:
   (a) circulatory system and digestive system
   (b) respiratory system and excretory system
   (c) nervous system and circulatory system
   (d) muscular system and digestive system
   (e) digestive system and respiratory system
   (f) muscular system and circulatory system

## Understanding Key Ideas

4. When you exercise on a hot day, you sweat and become thirsty. Explain how sweating and thirst are examples of your body's response to changing conditions.
5. The body's systems work together to maintain homeostasis. Why is homeostasis important?

**Vegetarian diets:** Some people choose to eat foods that do not include animal products. This choice might be based on spiritual beliefs as well as for personal or ethical reasons. Strict vegetarian diets (called vegan diets) contain no animal products at all. Other vegetarian diets may include dairy and eggs, and sometimes small amounts of fish. Vegetarian diets are high in whole grains and fibre, high in good fats, and low in bad fats. One drawback, however, is that such diets can be too low in some vitamins and minerals, so many vegetarians take supplements.

**Fad diets:** This term refers to a specialized diet that becomes very popular for a short period of time. Fad diets usually promise speedy weight loss. They often feature an emphasis on a specific food (for example, the grapefruit diet) or a specific nutrient (for example, the Atkins diet, which stressed high amounts of protein and low amounts of carbohydrates). Most people do not stay on a fad diet for lengthy periods of time.

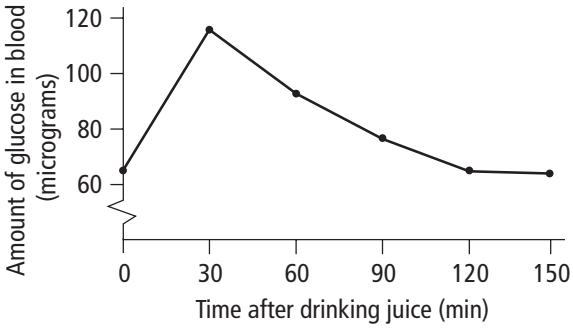
**6.** Statistics Canada collected data on the obesity rates of Canadians in 1978 and 2004. The obesity rates were calculated using something called a body mass index (BMI). The table below shows representative data from these two studies.

| Age Group | Obesity Rate, 1978 | Obesity Rate, 2004 |
|---|---|---|
| 12–17 | 3% | 9% |
| 25–34 | 9% | 21% |
| 75+ | 11% | 24% |

(a) Interpret what is happening to the obesity rate for each age group. (You might find it helpful to make a bar graph of the data first.)

(b) Infer three reasons for the changing obesity rates for each age group.

**7.** The graph below shows how the amount of glucose in a person's blood changed after she drank some fruit juice. Before she drank the fruit juice, the amount of glucose in her blood was about 65 micrograms. Does this graph provide an example of homeostasis? Explain your answer.




**8.** Read the information at the top of this page comparing vegetarian diets and fad diets. Which of these types of diets is more likely to provide long-term health and support of the body? Explain your answer.

## Pause and Reflect

Name three things that you are doing, or could be doing, to support the healthy functioning of your body. Explain why these things are important, based on what you have learned about cells, tissues, organs, and systems.

UNIT 4

# Unit Summary

## 10 The cell is the basic unit of life.

- All living things have characteristics that demonstrate they are alive. These include the ability to grow, to move, to reproduce, and to respond to stimuli. (10.1)
- Some living things are very small and can be observed only with a microscope. (10.1)
- A compound light microscope is an important tool in the study of cells and microscopic living things. (10.1)
- All cells have similar structures and organelles. Each structure and organelle carries out a specific task to help support the life functions of a cell. (10.2)
- Cellular respiration is the process that produces energy for the cell. (10.2)
- Cell theory states that the cell is the basic unit of life; all living things are composed of one or more cells; all cells come from other living cells. (10.2)

## 11 Human body cells are organized as tissues, organs, and systems.

- A system is made up of parts that work together as a whole. (11.1)
- Each system of the human body consists of organs that are made up of different kinds of tissue. (11.1)
- Tissues are made up of many similar cells working together to carry out a specific function. (11.1)
- The human body is made up of eleven systems that, working independently and together, support and maintain the function of the whole body. (11.2)

## 12 The health of the body depends on the health of its interdependent systems.

- All the cells of the body have the same basic need for energy, nutrients, and oxygen to carry out their functions. All cells also have the same basic needs for removing wastes. (12.1)
- Body systems work together to provide cells with what they need. Thus, they support themselves, one another, and the whole human body. (12.1)
- All body systems work together with other body systems. (12.2)
- If one system does not function properly, the whole network of systems is disrupted, and the whole body is affected. In the same way, maintaining the health of each body system keeps the network of systems, and the whole body, healthy. (12.2)
- Factors such as diet, exercise, and stress affect the health of the body systems. (12.2)

## Key Terms

- arm
- base
- cell
- cell membrane
- cell theory
- cell wall
- chloroplast
- coarse adjustment knob
- compound light microscope
- cytoplasm
- eyepiece
- fine adjustment knob
- iris diaphragm
- light source
- magnification power
- mitochondria
- mitosis
- nucleus
- objective lenses
- organelle
- resolving power
- revolving nosepiece
- stage
- total magnification
- tube
- vacuole

## Key Terms

- circulatory system
- digestive system
- endocrine system
- excretory system
- immune system
- integumentary system
- muscular system
- nervous system
- organ
- organ system
- reproductive system
- respiratory system
- skeletal system
- system
- tissue

## Key Terms

- genetic factors
- homeostasis
- lifestyle factors
- nutrients

Project

# Building a 3-D Model of Human Body Systems

In this project, you will work in groups to create a life-sized, three-dimensional model of four organ systems using a variety of everyday materials.

## Problem

How can you use everyday materials, such as those you find at home and at school, to build a three-dimensional model of the digestive, excretory, circulatory, and respiratory systems?

## Criteria

You must complete three drawings.

- The different structures of each organ system are made from everyday materials.
- Each structure in each organ system is correctly labelled.
- The model demonstrates at least one example of the interaction between two organ systems.
- The way the model is presented to your class follows your teacher's instructions.

## Procedure

### Part 1 Brainstorming Ideas

1. With your group, brainstorm various materials you could use to create your model of the digestive, excretory, circulatory, and respiratory systems. Write down any materials and the body parts they represent in a particular organ system on a large sheet of chart paper. An example is shown below.

| | |
|---|---|
| Digestive System<br>vacuum hose—small or large intestine | Excretory System<br>bean bag—kidney |
| Circulatory System<br>rubber tubing—blood vessels | Respiratory System<br>sponge—lung |

2. Decide on a final list of materials you will use for each organ system. Assign different group members to collect the materials. (Use any material that is available and safe. If you are unsure, check with your teacher.)
3. Ask your teacher to review this list before you collect your materials.

### Part 2 Building Your Model

4. Outline the body of one member of your group on a large piece of chart paper.
5. Using the materials your group collected, build your three-dimensional model. Your materials should fit within the body outline you have drawn and clearly show the four organ systems.
6. When you have completed your model, review the criteria at the beginning of this project and make sure you have correctly labelled each system. Be sure to include an example of where two systems interact.

## Report Out

1. After building your model, follow the directions provided by your teacher for presenting your work to the class. In your presentation, be sure to explain your choice of materials to build each organ system and describe where two organ systems interact.

# Advances in Biotechnology

As our understanding of cells, tissues, and organ systems has grown, so too have the ways in which we use this knowledge. Biotechnology is an example of an area of research that has expanded because of our ability to apply new knowledge to the development of new products for human use. In this integrated research investigation, you will use print and electronic resources to study the role of biotechnology in our society.

## Background

The United Nations, an international organization that promotes world peace, security, and human improvement, defines biotechnology as "any technological application that uses biological systems, living organisms, or derivatives thereof, to make or modify products or processes for specific use."

Biotechnology has expanded to include many different areas of research. Many, but not all, of these areas investigate what happens when changes are made to the DNA of living things such as bacteria, plants, and some animals. The table below describes some of these areas.

## Find Out More

Choose one area of biotechnology from the table and conduct research on a topic in this area. If you would rather select a different area to study check with your teacher. Start at **www.discoveringscience8.ca** and use magazines and newspapers to find out information on your topic. You may also wish to contact universities that are conducting research in your chosen area.

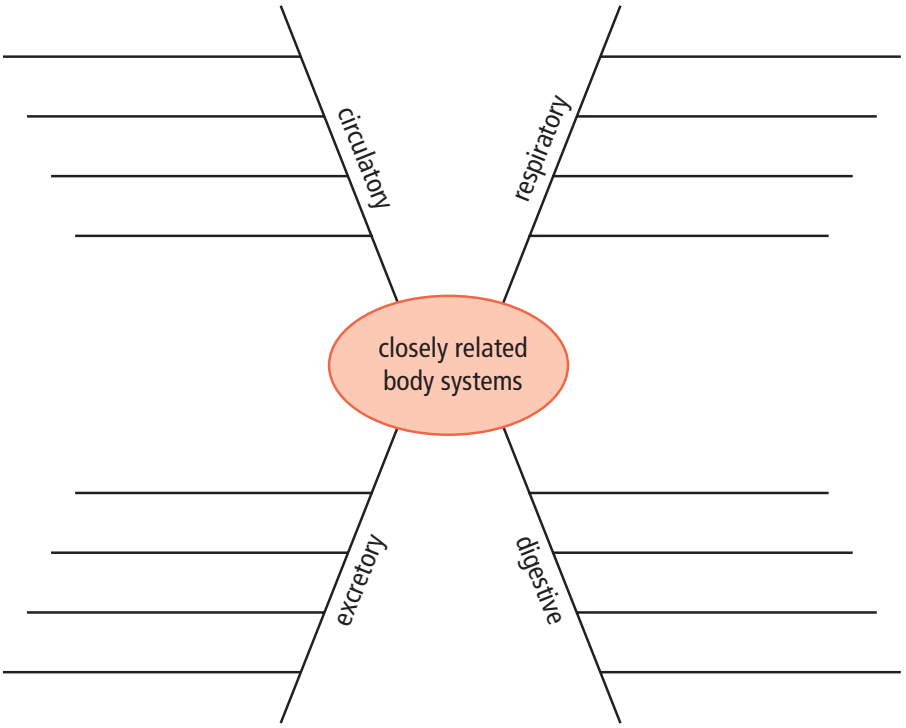
## Report Out

Create an information pamphlet, brochure, or electronic presentation that could be used to inform people about recent advances in the biotechnology topic you selected. Include an overview of your topic area, what new discoveries have occurred in this area, what potential applications could come from this research, and a description of any ethical issues resulting from this type of research.

| Biotechnology Area | Example |
|---|---|
| Bioethics | Changing the DNA (genetic material) of living things has raised questions about the safety and ownership of newly created living things. |
| Biomedicine | Scientists are modifying bacteria in such a way that the bacteria make products useful to humans. For example, insulin that is used by people with diabetes can be made from modified bacteria. |
| Bioengineering | The production of foods such as cheese and yogurt requires bacteria. Bioengineering finds ways to modify the bacteria to produce new and tastier foods. |
| Bioremediation | Certain bacteria can be used to clean up toxic wastes and other types of pollution. |
| Molecular biology | Police use DNA fingerprinting to discover who may be responsible for committing a crime. |

## Visualizing Key Ideas

**1.** Copy the following spider map into your notebook. Beside each topic, fill in as many words as you can that are related to their topic. Do not look at your textbook. When you have completed the map, go back and look for other words you could include. Add these words to the map using a different colour of pen.




## Using Key Terms

**2.** (a) Use the key terms below to create your own fill-in-the-blank quiz. For example, for the key term "cell," an acceptable quiz statement might be:
The basic unit of life is called a _____.

- arm
- base
- cell
- cell membrane
- cell theory
- cell wall
- chloroplast
- coarse adjustment knob
- compound light microscope
- cytoplasm
- diaphragm
- eyepiece
- fine adjustment knob
- light source
- magnification power
- mitochondria
- nucleus
- objective lenses
- organ
- organ system
- organelle
- resolving power
- revolving nosepiece
- stage
- system
- tissue
- tube
- vacuole

## Checking Concepts

### 10

3. You have found something that you think is living. What characteristics would your discovery have to demonstrate to be considered living?
4. (a) What are two differences between unicellular living things and multicellular living things?
   (b) What are two similarities between unicellular living things and multicellular living things?
5. State the function of each of the following parts of a compound microscope.
   (a) eyepiece
   (b) revolving nosepiece
   (c) coarse adjustment knob
   (d) light source
   (e) stage
   (f) diaphragm
   (g) objective lenses
6. Name the part of the microscope that does each of the following:
   (a) holds the slide in place
   (b) brings objects into clearer focus
   (c) controls the amount of light
   (d) supports the microscope
7. Describe how an object appears when it is viewed through a compound light microscope.
8. What is the difference between a micron and a millimetre?
9. Which organelle produces energy for cellular activities?
10. What function does the vacuole perform in a cell?
11. (a) Which organelles are found only in a plant cell?
    (b) What is the function of each of these organelles, and why is each one necessary for a plant's survival?
12. Which organelle directs the process of mitosis?
13. Summarize the cell theory.
14. Under low power, an eyelash has a total magnification of 40×.
    (a) Explain how this magnification is calculated.
    (b) What is the total magnification of an eyelash when it is viewed under medium power?
    (c) What is the total magnification of an eyelash when it is viewed under high power?
    (d) Make a sketch to compare the difference in size of an eyelash viewed under low and then medium power.

### 11

15. Explain the characteristics of a system, using the circulatory system as an example.
16. List the four types of human tissue, and give an example of each.
17. Which of the following terms defines a group of similar cells working together: cells, tissue, organ, or organ system?
18. Use a diagram to explain how the terms in the previous question are related.
19. The arteries of the circulatory system carry oxygen to the cells of the body. How do the arteries get the oxygen?
20. Three things that you cannot live without are water, food, and air. Why does a lack of air lead to death much faster than a lack of the other two?

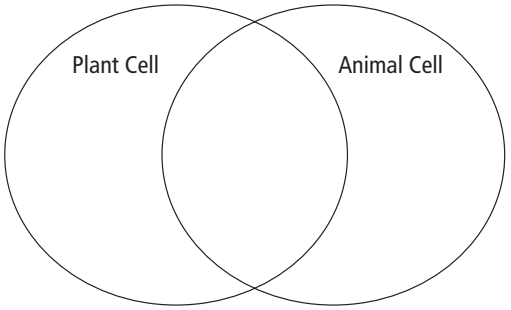
12

21. Several body systems that you have studied in this unit are:
    - circulatory system
    - digestive system
    - excretory system
    - muscular system
    - nervous system

    (a) Briefly describe the main function of each of these systems.
    (b) Choose two of these systems, and give an example to show how they are connected.
    (c) Repeat part (b) with a different pair of systems.
    (d) Repeat part (b) again with another different pair of systems.
22. Explain why cellular respiration is so important to the health of the human body.
23. The blood vessels in the kidneys are very sensitive to changes in blood pressure. What could happen if high blood pressure damages these blood vessels?
24. (a) Define the term homeostasis.
    (b) Use your answers to question 21 to write a brief paragraph about the role of homeostasis in the body.

## Understanding Key Ideas

25. Draw a cell that would take up half the field of view under a compound light microscope at low power. (You can use your imagination in your drawing.) Now draw what this organism would look like under medium power.
26. Would you expect to find chloroplasts in the root tip of a growing plant? Why or why not?
27. Use a Venn diagram like the one below to compare the structure and organelles of plant and animal cells.




## Thinking Critically

28. Your body releases carbon dioxide when you exhale. Where in the body does this carbon dioxide originally come from?
29. Describe the difference in blood pressure of blood flowing through a healthy artery and blood flowing through an artery with a buildup of fatty deposits.
30. Your teacher announces a surprise quiz. This sudden surprise may cause your heart to beat faster and your rate of breathing to increase. After a short time, your heart rate and breathing rate would return to normal.
    (a) Which two body systems are interacting in this example?
    (b) Which system controls and coordinates their interaction?
    (c) What word is used to describe the return to normal functioning of these systems?

**31.** Sometimes the living cell is compared with a factory. Write a paragraph or design a table to compare the parts and functions of a cell with what happens in a factory? Use the illustration to guide your answer.


## Developing Skills

**32.** How do you prepare a wet mount slide? Use labelled diagrams to describe the steps.

**33.** Explain the steps involved in safely moving a microscope from its storage area to your work area and setting it up to view a specimen.

**34.** The average human heart beats about 70 times per minute. How many heart beats would occur in one day, one month (30 days), one year, and a lifetime of 80 years?

**35.** In a study comparing heart rates of athletes and non-athletes, 30 individuals were given 10 min of intense physical exercise. Half the individuals were athletes and the other half were not. The following table summarizes the data collected for the athletes. Follow this model to make a similar table for the non-athletes. Compare the data in the two tables. What can you conclude about the effect of physical training on heart rate? How could you display the data to make it easier to analyze?

Heart rates of 15 trained athletes after physical activity: 128, 131, 120, 127, 132, 125, 129, 122, 127, 133, 135, 130, 123, 128, 124

Heart rates of 15 non-athletes after physical activity: 143, 139, 144, 132, 138, 135, 141, 137, 128, 139, 140, 136, 133, 143, 135

| Range of Heart Rates | Total Number of Athletes in theRange |
|---|---|
| 119–122 | 2 |
| 123–126 | 3 |
| 127–130 | 6 |
| 131–134 | 3 |
| 135–138 | 1 |

### Pause and Reflect

Review the titles of the three chapters in this unit. Explain how the relationship of these three titles outlines what people should know about how cells and body systems function.