



Chapter 16

Cardiovascular and Respiratory Systems

Lesson 1

The Cardiovascular System

Lesson 2

Care and Problems of the Cardiovascular System

Lesson 3

The Respiratory System

Lesson 4

Care and Problems of the Respiratory System





FOLDABLES™

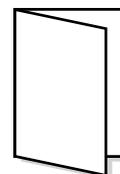
Study Organizer

Before You Read

Use this Foldable to help you organize your notes on the structure and function of the cardiovascular system. Begin with three sheets of 8½" x 11" paper.

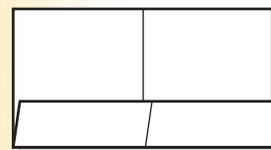
▶ Step 1

Fold a sheet of paper in half along the short axis.



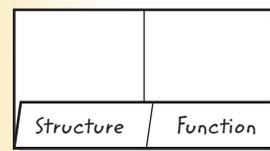
▶ Step 2

Unfold. Fold the bottom 2" of the paper up. Glue along the sides of the fold to form pockets.



▶ Step 3

Label as shown. Place 3" x 5" index cards or pieces of paper in the pockets.



As You Read

As you read and discuss the material in the chapter, record and define terms, draw diagrams, and list main ideas and supporting facts on the index cards in the appropriate pockets of your Foldable.

Quick Write

Using Visuals. Write a short paragraph describing how the cardiovascular and respiratory systems are important for participation in active sports. How might a respiratory condition such as asthma affect a person's ability to participate?



Lesson 1

The Cardiovascular System

VOCABULARY

plasma
hemoglobin
arteries
capillaries
veins
platelets
lymph
lymphocytes

YOU'LL LEARN TO

- Identify the functions and structures of the cardiovascular system.
- Describe the circulation of blood throughout the heart and body.
- Identify the structures and functions of the lymphatic system.
- Demonstrate knowledge about personal and family health concerns related to the cardiovascular system.



Use a digital timer or the second hand on a watch to take your pulse for 60 seconds. Use this number to calculate how many times your heart beats in 24 hours. What can cause your heart rate to increase or decrease?



▲ Any physical activity that raises your heart rate will help strengthen your cardiovascular system.

What is the main function of the cardiovascular system?

When you look at a road map, you see a series of interconnected roads—some small, others large—that connect cities and towns. Vital goods are transported into and out of central areas on these roads. Similarly, your cardiovascular system consists of vessels, both large and small, that transport life-supporting materials to cells of your body. Your heart, one of the main organs of your cardiovascular system, is the central point from which these vessels branch.

Functions of the Cardiovascular System

The cardiovascular system is composed of the heart and all the blood vessels of the body. Its function is to circulate blood, thereby maintaining an internal environment in which all the cells of your body are nourished. As your heart pumps blood, blood vessels carry oxygen and nutrients to body cells. At the same time, carbon dioxide is carried, along with waste matter, from your cells. Carbon dioxide is delivered to your lungs and waste products to the kidneys for removal from the body.



Structure of the Cardiovascular System

The cardiovascular system consists of the heart; blood; and blood vessels, including arteries, capillaries, and veins, which transport blood throughout the body.

The Heart

The heart and the brain are perhaps the most important organs in your body. Your heart is the pump that makes the cardiovascular system work. It never rests. Most of the heart is made of muscle tissue called the myocardium, which contracts and relaxes constantly and rhythmically. Your heart rate adjusts automatically in response to an increase or decrease in physical activity. In an average life span, a person's heart beats more than 2.5 billion times.

CHAMBERS OF THE HEART

Inside the heart are four chambers. Each of the two smaller chambers is called an *atrium*. The two lower, larger chambers are called *ventricles*. A wall of tissue called the *septum* separates the right and left atria, as well as the right and left ventricles, from one another.

At the top of the right atrium is an area of muscle that acts as a natural pacemaker for the rest of the heart. Regular electrical impulses generated from this area stimulate the muscles of each atrium to contract, forcing blood into the ventricles. Within milliseconds each electrical impulse travels through the heart to an area between the two ventricles. There it stimulates the muscles of the ventricles to contract, pumping blood out of the heart.

Valves between the atria and ventricles allow blood to flow through the chambers of the heart. These valves are “one-way” valves, opening to allow blood to flow from the atria into the ventricles. When the ventricles contract, the valves close again to keep blood from flowing back into the atria. The sounds heard as the heart beats are produced by the closing of the valves.

CIRCULATION IN THE HEART

The circulation of blood through the heart and lungs is shown in **Figure 16.1** on page 418. Blood that has been depleted of oxygen but contains carbon dioxide and waste matter is carried to the heart by two large blood vessels called the *vena cava*. This deoxygenated blood enters the right atrium and is transferred to the right ventricle. The blood is then pumped to the lungs. In the lungs the blood releases carbon dioxide and picks up oxygen from inhaled air. This newly oxygenated blood is returned from the lungs to the left atrium of the heart. The left atrium pumps the oxygenated blood into the left ventricle, which then pumps the blood out of the heart to the rest of the body by way of a large artery called the aorta.



Get the Most from Your Physical Activity

Aerobic activities can reduce your risk of developing cardiovascular diseases later in life.

Exercising within your target heart range:

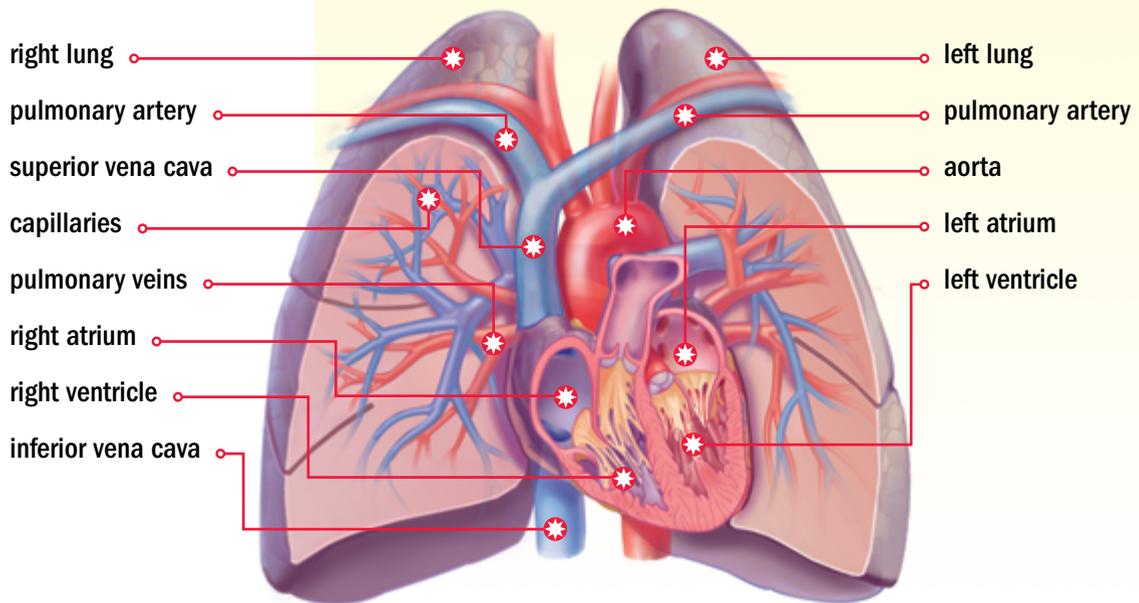
- ▶ Sit quietly for five minutes, and then take your pulse. This is your resting heart rate.
- ▶ Subtract your age from the number 220 to find your maximum heart rate.
- ▶ Subtract your resting heart rate from your maximum heart rate.
- ▶ Multiply the number you arrived at by 60 percent and again by 85 percent. Round off these numbers.
- ▶ Add your resting heart rate to the numbers you just calculated. These two new numbers represent your target heart range.



FIGURE 16.1

PULMONARY CIRCULATION

The circulation of the blood between the heart and lungs is called pulmonary circulation.



Blood

Blood delivers oxygen, hormones, and nutrients to the cells and carries away wastes that the cells produce. About 55 percent of total blood volume consists of **plasma**, the fluid in which other parts of the blood are suspended. Plasma, which is mostly water, contains nutrients, proteins, salts, and hormones. Red blood cells make up about 40 percent of blood. White blood cells and platelets together make up the remaining 5 percent of blood. One milliliter of blood contains millions of each of these types of cells.

RED BLOOD CELLS AND WHITE BLOOD CELLS

Red blood cells transport oxygen to the cells and tissues of the body. Formed in bone marrow, red blood cells contain hemoglobin. **Hemoglobin** is the oxygen-carrying protein in blood. Hemoglobin contains iron that binds with oxygen in the lungs and releases the oxygen in the tissues. Hemoglobin also combines with carbon dioxide, which is carried from the cells to the lungs.

The main role of white blood cells is to protect the body against infection and fight infection when it occurs. White blood cells, which are part of the body's immune system, are also produced in bone marrow. Production of these cells increases when an infection is present. Some white blood cells surround and ingest disease-causing microbes. Others are involved in allergic reactions. Still another type of white blood cell forms antibodies that provide immunity.

Q&A

What is blood type?

There are four blood types: A, B, AB, and O. Blood type is determined by the presence or absence of certain substances, called antigens, that stimulate an immune response. Type A has antigen A, type B has antigen B, type AB has both those antigens, and type O has neither. Most blood also carries another substance called the Rh factor. Blood that doesn't have the Rh factor is called *Rh negative*.



Blood Vessels

The network of more than 60,000 miles of blood vessels that transports blood is shown in **Figure 16.2** on page 420. There are three main types of blood vessels: arteries, capillaries, and veins.

ARTERIES

The *blood vessels that carry blood away from the heart* are called **arteries**. Arteries have thick elastic walls that contain smooth muscle fibers. The elastic fibers in the walls of arteries allow them to withstand the pressure exerted by the blood as the heart beats.

Pulmonary arteries carry deoxygenated blood from the right ventricle to the lungs. Systemic arteries, such as the aorta, carry oxygenated blood from the left ventricle to all areas of the body. As arteries move away from the heart, they branch into progressively smaller vessels called *arterioles*. Arterioles deliver blood to capillaries.

CAPILLARIES

Capillaries are *small vessels that carry blood between arterioles and vessels called venules*. Capillaries form an extensive network throughout tissues and organs in the body, reaching almost all body cells. The exchange of gases, nutrients, and wastes between blood and cells takes place through the ultra-thin walls of capillaries. Capillaries also play a role in body temperature regulation. As body temperature rises, capillaries near the skin's surface dilate, allowing heat to escape the body through the skin. If body temperature begins to drop below normal, the capillaries constrict, reducing heat loss.

VEINS

The *blood vessels that return blood to the heart* are called **veins**. Although the walls of veins are thinner and less elastic than those of arteries, veins are still able to withstand the pressure exerted by blood as it flows through them. The large veins called the *vena cava* carry deoxygenated blood from the body to the right atrium of the heart. Pulmonary veins carry oxygenated blood from the lungs to the left atrium. Many veins throughout the body, especially those in the legs, have valves that help prevent the backflow of blood as it is pumped under lower pressure back to the heart. Pressure on the vessel walls from the contraction of surrounding muscles helps move blood through the veins. The venules collect blood from capillaries and empty it into larger veins.

 The blood regulates body temperature. **Explain how these swimmers' bodies adjust to cold water temperature.**





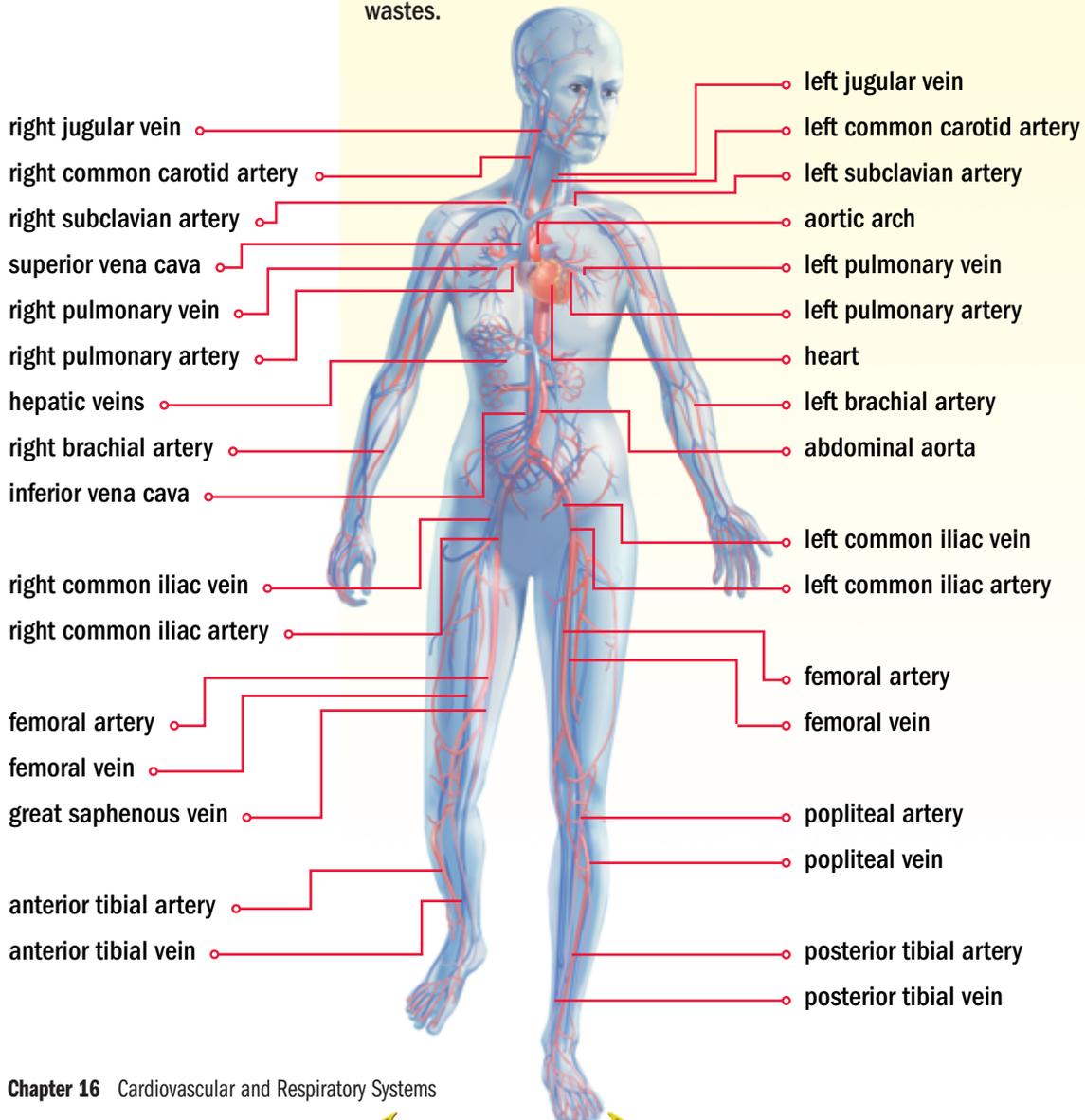
PLATELETS

Platelets are cells that prevent the body's loss of blood. Platelets gather at the site of an injury and release chemicals that make them sticky, causing them to clump together with other cells. The chemicals released by platelets also stimulate the blood to produce small thread-like fibers called *fibrin*. Fibrin threads trap platelets along with red and white blood cells. A mass of fibrin, platelets, and red and white blood cells continues to clump together until a clot is formed. This stops the loss of blood from the injury site. A scab is formed on a healing wound as the surface of the clot dries.

FIGURE 16.2

THE CARDIOVASCULAR SYSTEM

A network of arteries, veins, and capillaries moves blood throughout the body, providing cells with oxygen and nutrients and removing wastes.





The Lymphatic System

The lymphatic system helps fight infection and plays an important role in the body's immunity to disease. This system, shown in **Figure 16.3**, is a network of vessels that helps maintain the balance of fluids in the spaces between the cells. The lymphatic system supports the cardiovascular system. All body tissues are bathed in a watery fluid that comes from the blood. Although much of this fluid returns to the blood through capillary walls, some excess remains and is carried to the heart through the lymphatic system.

Lymph

Lymph is the clear fluid that fills the spaces around body cells. It is transported by the lymphatic system to the heart and eventually returns to the blood. Lymph is similar to plasma in content, consisting of water and proteins along with fats and lymphocytes.

Lymphocytes are specialized white blood cells that provide the body with immunity and protect the body against pathogens. A pathogen is an organism that causes disease. There are two types of lymphocytes, **B cells** and **T cells**.

B CELLS

B cells are lymphocytes that are stimulated to multiply when they come in contact with a pathogen. Some of the new B cells form plasma cells, which produce antibodies that attack the pathogen. Other B cells form memory cells that are activated if the body is exposed to the same pathogen a second time, creating immunity.

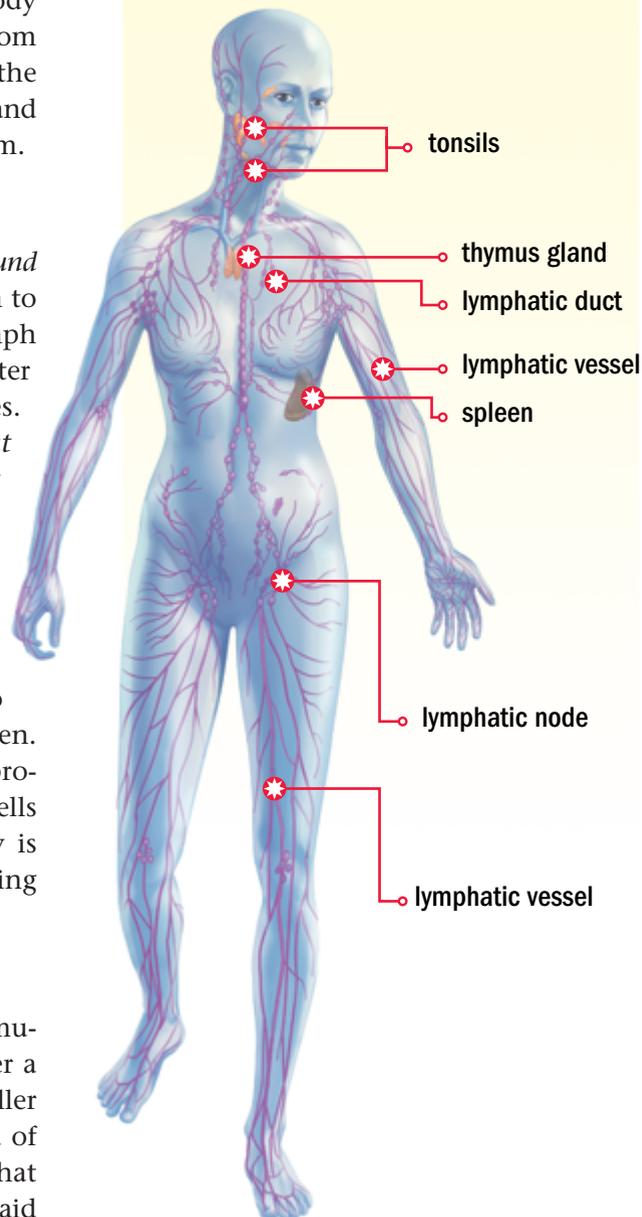
T CELLS

Like B cells, T cells are lymphocytes that are stimulated to enlarge and multiply when they encounter a pathogen. There are two main types of T cells, killer cells and helper cells. Killer T cells stop the spread of disease within the body by releasing toxins that destroy abnormal and infected cells. Helper T cells aid in the activation of B cells and killer T cells and control the body's immune system.

FIGURE 16.3

THE LYMPHATIC SYSTEM

The lymphatic system is a network of vessels, much like the cardiovascular system, that helps protect against pathogens.



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B cells and **T cells** For more information about how the immune system works, see Chapter 24, page 630.



Lymph is moved through the body by the contraction of skeletal muscles during physical activity.

Name the structures of the lymphatic system.



Structure of the Lymphatic System

The lymphatic system consists of a network of vessels and tissues that are involved in the movement and filtering of lymph. Much like the capillaries and arterioles in the cardiovascular system, small lymph vessels collect lymph and combine to form larger vessels. Lymph is moved toward the heart both by the contraction of smooth muscles that line the walls of lymph vessels and by the contraction of surrounding skeletal muscles.

Two large lymphatic ducts empty lymph into veins close to the heart, where it is returned to the blood. As it is moved through the body, lymph is filtered by lymph nodes, small, bean-shaped organs that are found in lymph vessels. White blood cells within lymph nodes trap and destroy foreign organisms such as bacteria and viruses to keep them from spreading throughout the body. Other structures of the lymphatic system include the spleen, thymus gland, and tonsils, all of which play a role in immunity, protecting the body from infection.



Lesson 1 Review

Reviewing Facts and Vocabulary

1. What are the functions of the cardiovascular system?
2. Describe the functions of arteries, capillaries, and veins.
3. Define *lymph* and *lymphocytes*.

Thinking Critically

4. **Comparing and Contrasting.** Compare and contrast the cardiovascular and lymphatic systems.
5. **Evaluating.** What might swollen lymph nodes indicate?

Applying Health Skills

Advocacy. Research and demonstrate knowledge about personal and family health related to the cardiovascular system. Examine the effects of sedentary behavior on cardiovascular health. Create an informative brochure about the relationship between an active lifestyle and a healthy heart. Share the brochure with your family.



INTERNET RESOURCES Use information and links found at health.glencoe.com to help with your research.





Lesson 2

Care and Problems of the Cardiovascular System

VOCABULARY

blood pressure
congenital
anemia
leukemia
Hodgkin's disease

YOU'LL LEARN TO

- Analyze the relationship between health promotion and prevention of cardiovascular disease.
- Examine the effects of health behaviors on the cardiovascular and lymphatic systems.
- Relate the importance of early detection and warning signs that prompt individuals of all ages to seek health care.



Think about the last time you were examined by a medical professional. Which parts of the examination focused on the health of your cardiovascular and lymphatic systems?

Most problems of the cardiovascular and lymphatic systems can be prevented with proper care and by decisions you make during your teen years that can promote health. These involve physical activity, adequate rest, proper diet, and regular medical checkups. Some problems may be hereditary. If you know that heart disease runs in your family or if you have other traits that may lead to heart disease, you need to make careful choices now to promote a lifetime of cardiovascular health.

Health Behaviors and the Cardiovascular and Lymphatic Systems

Healthy habits can help reduce many of the risk factors associated with problems of the cardiovascular and lymphatic systems. Here are some healthful behaviors that should become part of your life.



- ▲** These coronary arteries are partially blocked. Blood supply to the heart is reduced if blood cannot flow through arteries. *What health behaviors will help you avoid cardiovascular system problems?*



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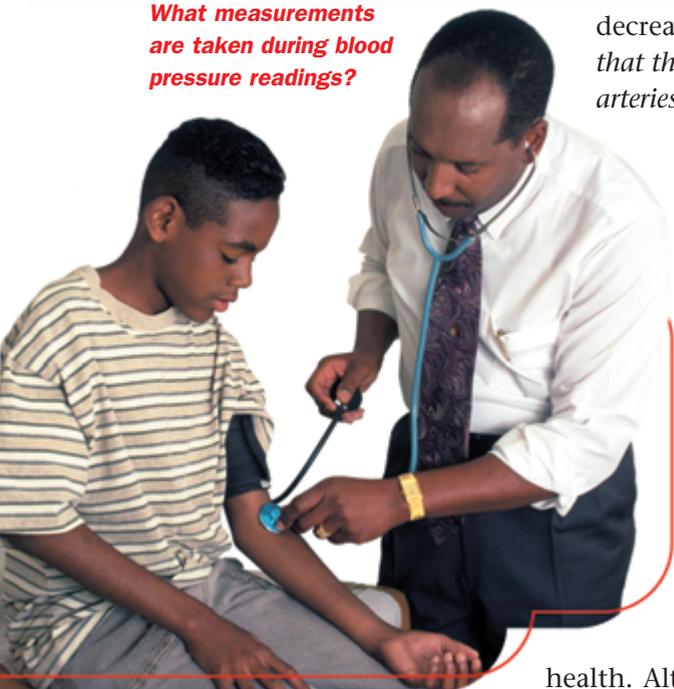
cholesterol For more information on heart disease and cholesterol, see Chapter 26, page 675.

illegal drugs For more information about how illegal drugs can damage the cardiovascular system, see Chapter 23, page 594.



Medical professionals check your heart and blood pressure during regular medical examinations.

What measurements are taken during blood pressure readings?



- ▶ Follow a well-balanced diet that is low in saturated fats, **cholesterol**, and salt.
- ▶ Maintain a healthy weight to reduce stress on the heart, blood vessels, and lymph vessels.
- ▶ Participate in regular aerobic exercise for at least 30 minutes three to four times per week.
- ▶ Avoid the use of tobacco products and exposure to secondhand tobacco smoke.
- ▶ Avoid **illegal drugs**, including stimulants, marijuana, and ecstasy (MDMA).

Blood Pressure

Maintaining pressure in the cardiovascular system is important for proper blood circulation. Pressure in arteries is created as the ventricles contract. As blood is forced into the arteries that exit the heart, arterial walls stretch under the increased pressure. When the ventricles relax and refill with blood, arterial pressure decreases. **Blood pressure** is a measure of the amount of force that the blood places on the walls of blood vessels, particularly large arteries, as it is pumped through the body.

Blood pressure can be measured with an instrument called a sphygmomanometer (sfig-mo-muh-NAH-muh-ter) and a stethoscope. A cuff is placed around the upper arm and inflated until the pressure from the cuff blocks the flow of blood. As the cuff is deflated, the health care professional listens through the stethoscope for blood flow. As your heart contracts to push blood into your arteries, the maximum pressure, called *systolic* pressure, is measured. This is recorded as the upper number of the fraction representing your blood pressure. As the ventricles relax to refill, blood pressure is at its lowest point, called the *diastolic* pressure. This is the lower number of the fraction in a blood pressure reading.

Blood pressure is an indicator of cardiovascular health. Although a healthy person's blood pressure will vary with physical activity or emotional stress, it should remain within a normal range. Blood pressure above 140/90 is considered high, and if chronic, places a strain on the heart as it pumps. Chronic high blood pressure is an early indicator of several cardiovascular system problems and should prompt individuals of all ages to seek health care. Prevention of high blood pressure includes maintaining a healthy weight, staying physically active, managing stress, avoiding tobacco and drugs, and following a **healthful eating plan** that is low in salt.

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healthful eating plan For more information on eating for cardiovascular health, see Chapter 5, page 113.



Cardiovascular System Problems

Disorders of the cardiovascular system can interfere with blood flow through the heart and body, reduce the amount of oxygen that reaches the cells, and keep the blood from clotting properly. Some problems are inherited; others result from illness.

Congenital Heart Defects

A condition that is present at birth is said to be **congenital**. One common type of congenital heart defect is a septal defect, in which a hole in the septum allows oxygenated blood to mix with deoxygenated blood and affects the pumping efficiency of the heart. In other cases of congenital heart defects, valves may not function properly, or the aorta may be abnormally narrow, reducing the amount of blood flowing to the body.

Some congenital heart defects are less serious than others, but most require medication and possibly surgery to repair the affected portion of the heart. In many cases the cause of a congenital defect remains unknown. Use of alcohol and other drugs during pregnancy is associated with heart defects in newborns. Certain infections during pregnancy can also increase the risk of congenital heart defects. Some cases may be hereditary.

Cardiovascular Disease

Cardiovascular disease (CVD) is actually a group of diseases of the cardiovascular system that includes hypertension, heart disease, and stroke. CVD is the number one killer of both men and women among all racial and ethnic groups in the United States. According to the Centers for Disease Control and Prevention, about 95,000 Americans die of CVD each year. Many of these diseases are associated with lifestyle behaviors. Early detection is important for reducing the risk for CVD.

Heart Murmur

Heart murmurs are abnormal sounds that are made as blood flows through the heart. Some heart murmurs may be very slight and disappear without treatment. Other murmurs can be an indication of problems in the heart, such as the valve between the left atrium and ventricle not closing properly, and may require surgery.

Varicose Veins

Varicose veins form if valves in the veins do not close tightly enough to prevent backflow of blood. Varicose veins become enlarged and can be painful. They most commonly occur in veins in the legs. Weakened valves can be the result of a congenital defect or natural aging. Physical activity helps prevent varicose veins. Treatment includes reducing standing time, exercise, elevating legs when sleeping, and in severe cases, surgery to remove the affected vein.

Did You Know?



Substances taken into the body can have serious effects on the heart and cardiovascular system—including consequences that can result in death.

- Ephedra, which is used by some people as a diet aid, stimulates the cardiovascular system. As a result, its use has been linked to heart attacks and strokes.
- Stimulant drugs including cocaine and amphetamines can cause rapid heart rate, high blood pressure, and damage to blood vessels.
- Marijuana use has been linked to heart and lung damage.

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cardiovascular disease

For more information on CVD and lifestyle behaviors, see Chapter 26, page 678.





Individuals in good health who are from 17 to 70 years of age can donate blood. **Name one way donated blood can be used.**



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iron deficiency For more information on nutrition for individual needs, see Chapter 6, page 157.

CHARACTER CHECK

Respect. Making healthful decisions about diet and incorporating physical activity into your daily routine are ways to demonstrate responsibility and respect for your body. **Determine what type of eating plan and physical activity program would be best suited for you. With the advice of a health care provider, make a plan to maintain your cardiovascular health.**

Anemia

Anemia is a condition in which the ability of the blood to carry oxygen is reduced. Anemia can result from low numbers of red blood cells or from low concentrations of hemoglobin in the blood. Both of these conditions interfere with the blood's ability to carry oxygen. The most common cause of anemia is **iron deficiency**, which can be avoided by eating foods high in iron, such as dark green leafy vegetables, red meat, liver, egg yolks, and fortified cereals. Taking an iron supplement also may be recommended by a medical professional.

Leukemia

Leukemia is a form of cancer in which any one of the different types of white blood cells is produced excessively and abnormally. The abnormal white blood cells cannot function properly, making the leukemia patient very susceptible to infection. Because all blood cells are produced in the bone marrow, the uncontrolled production of white blood cells can hinder the production of red blood cells and platelets. The result is infection, severe anemia, or uncontrolled bleeding. Childhood leukemia is often curable, and in adults leukemia can go into remission. Chemotherapy and radiation are among the treatment options. Also, some forms of leukemia have been successfully treated with bone marrow transplants.

Hemophilia

Hemophilia is an inherited disorder in which the blood does not clot properly. Certain proteins, called clotting factors, are absent. This may cause uncontrolled bleeding that can occur spontaneously or as a result of injury. Bleeding can take place internally in muscles, tissues of the digestive and urinary tract, and the joints. It may also occur externally as a result of injury or surgery. Treatment for hemophilia includes injections that introduce the missing clotting factors into the blood. These clotting factors can be extracted from blood donated by healthy individuals.





Lymphatic System Problems

Problems in the lymphatic system can be the result of infection or heredity and may range in severity from mild to life-threatening.

- ▶ **Immune Deficiency.** Immune deficiencies occur when the immune system can no longer protect against infection. Some immune deficiencies may be congenital, and others can be caused by **HIV**, the virus that causes AIDS. A weakened immune system may be the result of natural aging or a side effect of chemotherapy.
- ▶ **Hodgkin's Disease.** **Hodgkin's disease**, or Hodgkin's lymphoma, is *a type of cancer that affects the lymph tissue* found in lymph nodes and the spleen. Early detection and treatment, as in all types of **cancer**, is essential for recovery. Treatment may include removal of lymph nodes, radiation, and chemotherapy.
- ▶ **Tonsillitis.** Tonsils are part of the immune system and help reduce the number of pathogens entering the body through the respiratory system. Infected tonsils, or *tonsillitis*, can be common in children. The condition is most often treated with antibiotics. Chronic cases may call for surgical removal of the tonsils.

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HIV For more information on how HIV affects the immune system, see Chapter 25, page 658.

cancer To learn about cancer and how it affects the body, turn to Chapter 26, page 681.

Lesson 2 Review

Reviewing Facts and Vocabulary

1. Analyze the relationship between health behaviors and diseases of the cardiovascular system. List three health promotion behaviors you can practice to help prevent cardiovascular diseases.
2. What is *blood pressure*?
3. Name and describe two problems that can occur in the lymphatic system.

Thinking Critically

4. **Applying.** What symptoms might indicate that a person is suffering from anemia?
5. **Analyzing.** Relate the importance of early detection of cardiovascular disorders in prompting individuals of all ages to seek health care.

Applying Health Skills

Communication Skills. Imagine that you are worried about a close family member who has unhealthy eating and fitness habits. Write a dialogue in which you encourage this person to incorporate positive health behaviors into his or her lifestyle. Examine and include the positive effects such a change would have on his or her cardiovascular and lymphatic systems.



SPREADSHEETS Design a table that can be used to record foods eaten and periods of physical activity. See health.glencoe.com for information on how to use a spreadsheet.



The Respiratory System

VOCABULARY

respiration
diaphragm
pharynx
trachea
bronchi
larynx

YOU'LL LEARN TO

- Identify the functions and structures of the respiratory system.
- Describe the process of breathing.
- Demonstrate knowledge about personal and family health concerns related to the respiratory system.



List situations in which your breathing rate changes. Why does this happen?

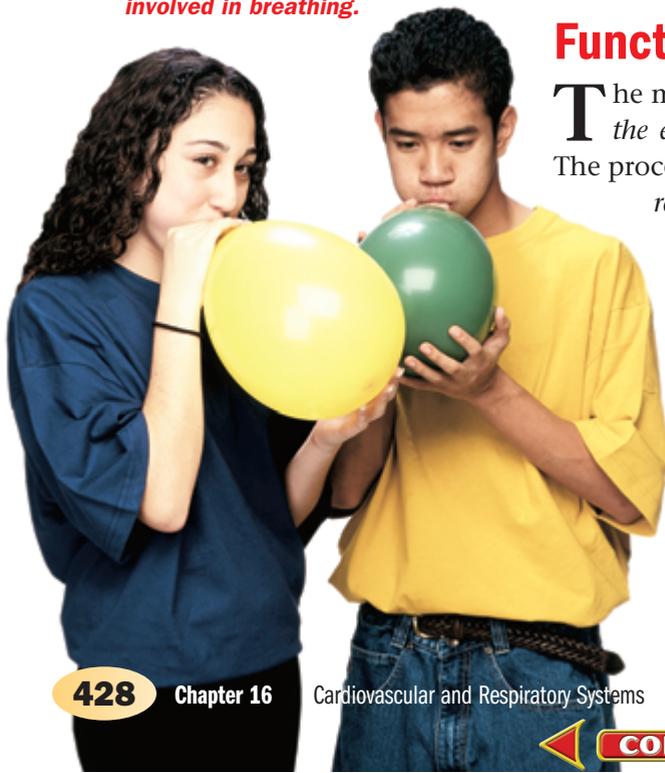
 Your lungs and chest expand like a balloon as you inhale. As you exhale, your lungs deflate slightly.

Name the structures of the respiratory system involved in breathing.

Without your conscious control, your lungs rhythmically fill with air and then empty. This rhythm varies with changes in your level of activity. Breathing is regulated by certain areas of the brain that send impulses to stimulate the automatic contraction of muscles involved in respiration.

Functions of the Respiratory System

The main function of the respiratory system is **respiration**, the exchange of gases between the body and the environment. The process of respiration can be divided into two parts. *External respiration* is the exchange of oxygen and carbon dioxide that takes place between air and blood in the lungs. Oxygen moves from the lungs into the blood, and carbon dioxide moves from the blood into the lungs. *Internal respiration* is the exchange of gases between blood and body cells. Oxygen moves from the blood into the cells, and carbon dioxide moves from the cells into the blood. The continual exchange of gases in both external and internal respiration is essential for survival. Oxygen fuels the brain and allows your body to metabolize food for energy to move muscles.





Structure of the Respiratory System

The respiratory system, shown in **Figure 16.4**, consists of the lungs and a series of passageways through which air travels. The nose and throat make up the upper respiratory system. The lower respiratory system contains the larynx, trachea, bronchi, and lungs.

The Lungs

The lungs are the principle organs of the respiratory system and the site of external respiration. They are found within the chest cavity and are protected by the ribs. The **diaphragm** is the muscle that separates the chest from the abdominal cavity.

The structure of the lungs can be compared to the structure of a branching tree. Air moves into the lungs through the trachea, or the windpipe. The trachea branches out into the bronchi, the main airways that reach into each lung. The airways that lead into the lungs divide and subdivide to form a network of tubes called *bronchioles*. At the end of each bronchiole are groups of microscopic structures called *alveoli*, thin-walled air sacs covered with capillaries. Gas exchange takes place as oxygen and carbon dioxide diffuse across capillary and alveolar walls.

FIGURE 16.4

THE RESPIRATORY SYSTEM

The lungs are the principle organs of the respiratory system.

The **epiglottis** (e-puh-GLAH-tis) is a flap of tissue that closes over the trachea when you swallow.

The **larynx** (LA-rings) is the voice box and contains the vocal cords.

The **trachea** (TRAY-kee-uh) is the windpipe.

The **bronchi** (BRAHN-ky) are the passages through which air spreads through the lungs.

The **diaphragm** (DY-uh-fram) is a dome-shaped muscle that causes the chest cavity to expand and contract.

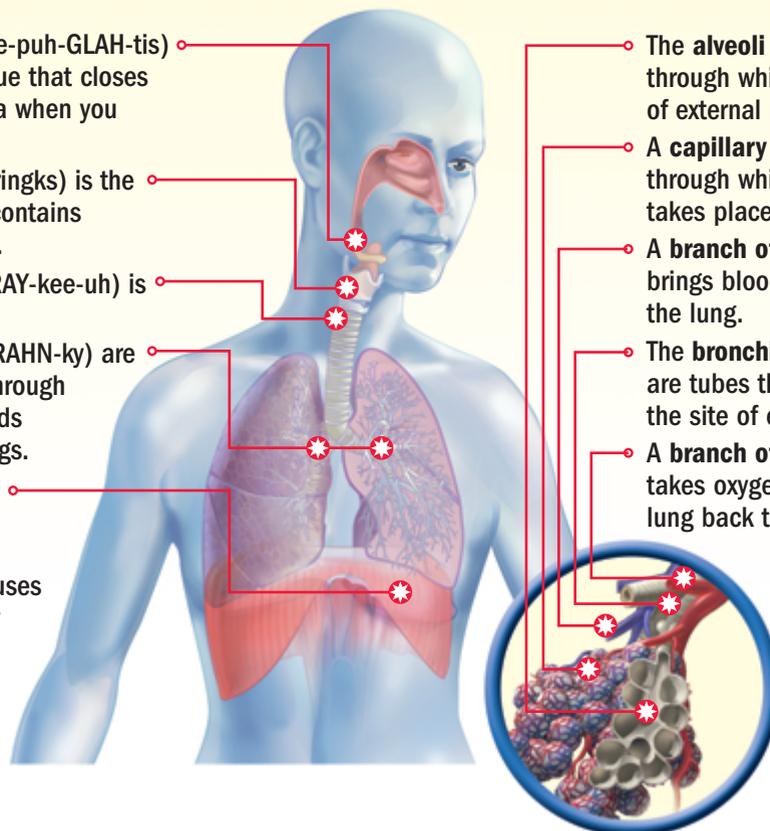
The **alveoli** are tiny air sacs through which the gas exchange of external respiration takes place.

A **capillary** is a tiny blood vessel through which gas exchange takes place.

A **branch of the pulmonary artery** brings blood from the heart into the lung.

The **bronchioles** (BRAHN-kee-ohlz) are tubes that carry air closer to the site of external respiration.

A **branch of the pulmonary vein** takes oxygenated blood from the lung back to the heart.





Did You Know ?

Hiccups occur as a result of the diaphragm contracting in a spasm, quickly followed by the closure of the vocal cords. This sudden closure produces the unmistakable sound of a hiccup.

THE BREATHING PROCESS

The breathing process is made possible by creating a pressure difference between the lungs and the outside of the body. When you inhale, the diaphragm and muscles between your ribs contract, expanding your chest cavity and your lungs. When your lungs expand, the pressure inside them becomes lower than the pressure outside your body. Air naturally flows into your lungs to equalize the pressure. When you exhale, the same muscles relax and the volume of your chest cavity decreases, making the pressure in your lungs higher than the pressure outside your body. Air naturally flows out of your lungs to the area of lower pressure.

Other Respiratory Structures

The upper respiratory system includes structures such as the nose and mouth. Air enters and exits your body through the nose and mouth. The membranes of the nose are lined with hairlike structures called *cilia* and with cells that produce mucus. Together, the cilia and mucus trap and remove foreign particles, such as dust, bacteria, and viruses, that would otherwise move farther into the respiratory system.

Hands-On Health ACTIVITY

Seeing the Effects of Smoking

What You'll Need

- glass jar with a lid
- one cup of dark brown corn syrup
- packaging tape
- poster board and markers

What You'll Do

1. Pour the cup of corn syrup into the jar, put on the lid, and secure it with packaging tape to prevent leaks.
2. Examine the contents of the jar. The liquid represents the amount of tar that gets into a smoker's lungs during a single year of smoking one pack of cigarettes each day.

3. Discuss your response to this activity with the class. Are you surprised by the amount of "tar" in the jar? How do you think this affects a smoker's health?
4. Create a poster that highlights the dangers of tar, a substance that can cause cancer. Write a convincing statement about why teens should avoid tobacco. Present your information in a clear, concise manner.

Apply and Conclude

Present this activity and your poster to a class of younger students. Is it effective in persuading others to avoid tobacco? Why or why not?



In addition to being filtered, air is warmed and moistened as it moves through the nasal passages. Air continues through the respiratory system to the **pharynx**, or *throat*, and into the **trachea**, or *windpipe*, which is located in front of the esophagus. Like the nasal passages, the tissue that lines the trachea is covered with mucus and cilia to trap particles and prevent them from going deeper into the respiratory system. As the trachea reaches the lungs, it branches into two tubes called **bronchi**, *the airways that connect the trachea and the lungs*.

The Larynx and the Epiglottis

Other structures that are not directly involved in respiration but have important functions in the respiratory system are the larynx and the epiglottis. The **larynx**, or *voice box*, connects the throat and the trachea. The larynx contains the vocal cords, two bands of tissue that produce sound when air forced between them causes them to vibrate.

The epiglottis is a flap of cartilage located above the larynx. It folds down to close off the entrance to the larynx and trachea when you swallow, keeping food or drink from entering the respiratory system. If you eat too quickly or laugh while eating, food may go down the “wrong pipe.” The cough reflex is then stimulated in an attempt to expel the material from the respiratory system.



 **Your voice may be affected by health behaviors. For example, smoking irritates structures in the throat and can cause hoarseness. What are some other factors that can affect your voice?**

Lesson 3 Review

Reviewing Facts and Vocabulary

1. What is the function of the respiratory system?
2. Explain the relationships among the trachea, the pharynx, and the larynx.
3. What role does the diaphragm play in respiration?

Thinking Critically

4. **Evaluating.** Explain the relationship between oxygen and carbon dioxide in the respiration process.
5. **Analyzing.** Demonstrate knowledge about personal and family health concerns related to respiratory system functions. Explain why it is important that the lungs are elastic.

Applying Health Skills

Advocacy. Tobacco use is associated with several types of cancer that occur in the upper respiratory system, most notably the throat. Research the effects of tobacco use on the structures of the upper respiratory system. Use what you learn to produce an educational pamphlet.



WORD PROCESSING Word processing can give your pamphlet a professional look. See health.glencoe.com for tips on how to get the most out of your word-processing program.



Lesson 4

Care and Problems of the Respiratory System

VOCABULARY

bronchitis
pneumonia
pleurisy
asthma
sinusitis
tuberculosis
emphysema

YOU'LL LEARN TO

- Analyze the relationship between health promotion and the prevention of respiratory disorders.
- Examine the effects of health behaviors on the respiratory system.
- Relate the importance of early detection and warning signs that prompt individuals to seek care for respiratory problems.



Think about a time when you experienced a problem with your respiratory system. How did it affect your daily activities? What treatment did you receive?



-  Imagine not being able to perform so simple an act as climbing a single flight of stairs without having to stop to catch your breath. *What are some reasons for shortness of breath?*

For your body to function properly, all your body systems must be healthy and working together. Respiratory system problems can affect the functioning of other body systems.

Health Behaviors and the Respiratory System

Many respiratory system disorders can be prevented by practicing positive health behaviors. The single most important decision you can make for respiratory health is not to smoke. Smoking damages the respiratory system and is the main cause of lung cancer. Tobacco use has also been connected with cancers of the mouth, pharynx, and larynx. It can cause bronchitis, emphysema, and an increase of asthma in children and adults. In teens, smoking reduces the rate of lung growth. Avoiding the use of tobacco and all secondhand smoke, including smoke from cigarettes, cigars, pipes, and marijuana, greatly reduces your risk of all these effects.



Regular physical activity is also important to the health of the respiratory system. Increased respiration during exercise improves the capacity of the lungs to diffuse oxygen into the blood. Exercise also increases the total amount of air moved into and out of the lungs per minute.

Although the mucus and cilia that line the nasal passages and trachea work to keep out foreign particles, the respiratory system is still vulnerable to infection from bacteria and viruses. Pathogens can be transmitted easily to the respiratory system by contaminated hands touching the nose or mouth. Washing your hands regularly helps prevent infection.

Air pollution contributes to lung diseases, including respiratory tract infections, **asthma**, and lung **cancer**. Limiting your exposure to pollutants in the air, including **environmental tobacco smoke**, can also reduce your risk of developing respiratory disorders.

Respiratory System Problems

Problems of the respiratory system range from mild infections to disorders that can damage lung tissue or interfere with respiration. Colds and influenza are common infections of the upper respiratory system. Other infections and disorders affect the lower respiratory tract.

Bronchitis

Bronchitis is an inflammation of the bronchi caused by infection or exposure to irritants such as tobacco smoke and air pollution. In this condition the membranes that line the bronchi produce excessive mucus in the airways. Decreased airway diameter leads to symptoms such as coughing, wheezing, and shortness of breath that worsens with physical activity. Treatment includes medication that dilates the bronchial passages. Chronic bronchitis, a more serious form of the disease, is often caused by smoking. Early detection and treatment is important because the disease can cause irreversible tissue damage. Treatment includes eliminating exposure to the irritant.

Pneumonia

Pneumonia, an inflammation of the lungs commonly caused by a bacterial or viral infection, actually includes several types of lung infections. In a common type of pneumonia, the alveoli swell and become clogged with mucus, decreasing the amount of gas exchange. Symptoms of pneumonia include cough, fever, chills, and chest pain. Bacterial pneumonia is treated with antibiotics.

Pleurisy (PLUR-uh-see), an inflammation of the lining of the lungs and chest cavity, causes chest pain when breathing and coughing.

hot link

asthma and **cancer** More information about asthma, cancer, and other noncommunicable diseases can be found in Chapter 26, page 674.

environmental tobacco smoke For more information on the effects of tobacco use on the respiratory system, see Chapter 21, page 540.



Know the dangers:

- ▶ The Air Quality Index (AQI) is a daily measure of the air quality in an area. Information about the levels of pollutants such as carbon monoxide, fine particles, and ozone is usually included in the report.
- ▶ Check the AQI for your area in the newspaper, television or radio weather forecasts, or on the Internet.

Respond to alerts:

- ▶ If the AQI measurement for the day is very high or if you are sensitive to certain air pollutants, avoid participating in strenuous outdoor activities.





Health Skills Activity

Communication: Asthma and Physical Activity

Todd and Rohan are friends and are happy to be in the same gym class this semester. Todd is a captain and has to choose teammates for the next few weeks. He is aware that Rohan has recently been suffering from asthma attacks. Todd decides not to choose Rohan to be on his team, but he does not explain why.

Rohan is disappointed and a little hurt. He suspects that his asthma is Todd's reason for not choosing him. Rohan has talked to his doctor and knows that it's perfectly okay to participate in physical activity as long as he uses his medication. His performance should not be affected by his asthma.

Rohan sees Todd at lunch. He wants to explain how he feels and let his friend know what the doctor said.

"Hey, Todd," Rohan calls out. "Can we talk about gym class?" Todd looks a little embarrassed, but he comes over to sit with his friend.



What Would You Do?

Finish the dialogue showing how Rohan can let Todd know how he feels.

1. Use "I" messages.
2. Use appropriate body language.
3. Maintain a respectful tone of voice.
4. Use clear, simple statements.

Asthma

Asthma (AZ-muh) is an inflammatory condition in which the trachea, bronchi, and bronchioles become narrowed, causing difficulty in breathing. An asthma attack is characterized by the involuntary contraction of smooth airway muscles that leads to wheezing, chest tightness, and difficulty in breathing. Acute asthma attacks can be relieved by the use of an inhaler that contains a bronchodilator, a medicine that dilates, or widens, the airways. Long-term treatment of asthma includes using medication that reduces inflammation and avoiding substances that can trigger an attack, such as pollen, dust, animal dander, and tobacco smoke. Certain food preservatives, aspirin, and inhalation of cold air can also trigger asthma attacks.



Sinusitis

An inflammation of the tissues that line the sinuses, air-filled cavities above the nasal passages and throat, is called **sinusitis**. Symptoms include nasal congestion, headache, and fever. Treatment includes nasal decongestant drops or sprays and antibiotics.

Tuberculosis

Tuberculosis is a contagious bacterial infection that usually affects the lungs. When a person is infected with tuberculosis, the immune system surrounds the infected area and isolates it. In this inactive stage, symptoms do not appear. This stage can last for many years. If the immune system is weakened by illness or advancing age, the infection can become active. Symptoms of active tuberculosis include cough, fever, fatigue, and weight loss. Treatment involves antibiotics and hospitalization. Numbers of reported cases of tuberculosis have increased in the United States in recent years.

Emphysema

Emphysema is a disease that progressively destroys the walls of the alveoli. Symptoms include difficulty breathing and chronic cough. Although the symptoms of emphysema can be treated, tissue damage is irreversible. Eventually the lungs cease to function. Emphysema is almost always caused by smoking.

 **Anti-inflammatory medications keep bronchial tubes open and reduce swelling to help control asthma before an attack. What other treatment can be used to relieve symptoms during an asthma attack?**



Lesson 4 Review

Reviewing Facts and Vocabulary

1. Explain the effects of smoking on the health of the respiratory system.
2. Define *bronchitis* and describe its symptoms.
3. List three things you can do to help keep your respiratory system healthy.

Thinking Critically

4. **Applying.** Your friend is having trouble with shortness of breath during everyday activities. How can you encourage him or her to be examined by a health care professional?
5. **Analyzing.** Why is early detection important in prompting individuals of all ages to seek health care for respiratory disorders?

Applying Health Skills

Accessing Information. Analyze the relationship between health promotion and the prevention of respiratory system disorders. Draw a diagram of the respiratory system, and label each part with health behaviors that will help teens avoid respiratory problems.



INTERNET RESOURCES Find information on the Internet about smoking and its effects by visiting Web links at health.glencoe.com.



health.glencoe.com





A Heart to Last a Lifetime

Looking to avoid heart disease down the road? Check out these tips that will keep your heart healthy and strong far into the future.

1. Don't Smoke!

Smoking can more than triple a person's chances of having a heart attack. When a smoker quits, that risk is cut in half within 2 years. It takes more than 10 years for the odds to return to nearly normal—so unless you want to waste a decade of your life getting back your health, don't start smoking in the first place.

2. Watch Your Weight

Carrying excess fat, especially around the middle, increases the risk of a heart attack or stroke later on in life. Obesity can also lead to diabetes, a major risk factor in heart disease. Doctors recommend a reduced-calorie diet with lots of vegetables and whole grains, plus at least 30 minutes of moderate aerobic exercise a day.

3. Lower Your Bad Cholesterol

High levels of LDL (bad cholesterol) can tell doctors that heart problems are on the way. Although doctors have focused on levels of LDL, HDL (good cholesterol) may be a better predictor of heart-disease risk. Low levels of HDL might indicate that heart trouble is in the future.

4. Control Blood Pressure

Hypertension makes the heart work harder to move blood through the body and puts those

who suffer from it at higher risk of both heart disease and stroke. Teens don't usually have to worry about hypertension. However, if you get short of breath when you exercise, tell a doctor. High blood pressure can be treated with proper diet, exercise, and medication if needed.

5. Reduce Stress

Stress can increase the risk of heart disease and lead to unhealthy habits such as drinking alcohol and eating junk food. Exercise and meditation can reduce stress; so can getting enough sleep every night. If you are feeling stressed out for an extended period of time, talk about it with your parents, teachers, or counselor. ■

TIME
to THINK...

About
Cholesterol

The article mentions LDL and HDL. Research these two kinds of cholesterol and answer the following questions:

1. What do the letters LDL and HDL stand for?
2. What is the difference between LDL and HDL?
3. What are two examples of foods that contain high levels of each?



Health Skills Application



1. Analyzing Influences. Explain how technology has impacted the cardiovascular health of individuals. Evaluate both the positive and negative effects of technologies such as the automobile, elevators, and medical equipment. (LESSON 1)



2. Decision Making. You are sick with tonsillitis and your friends want you to go hiking. Your doctor has advised you to avoid physical activity and get plenty of rest. Using the steps in the decision-making process, role-play with a friend how you will make your decision. (LESSON 2)



3. Accessing Information. Find information about abdominal thrusts. Why is it important to properly perform this maneuver? What agencies in your community offer training in first aid for choking? (LESSON 3)



4. Advocacy. An antibiotic-resistant strain of tuberculosis is increasing in frequency in the United States. Find out how often testing for tuberculosis is offered in your community. For which age groups does it apply? Is there a cost? Raise community awareness by making a poster that encourages individuals to get tested. (LESSON 4)

CAREER Corner

Medical Laboratory Technician

If you are interested in biology, chemistry, math, and computer science, and if you enjoy working in the laboratory, consider a career as a medical laboratory technician (MLT). MLTs discover information about



a patient's health by analyzing tissue samples and using the latest laboratory technology and techniques.

To become an MLT, you need a high school diploma or its equivalent to enter a college-level course of study. Successful completion of an associate's degree program and a national certification exam are required for employment. You can find out more about this and other health careers by clicking on Career Corner at health.glencoe.com.

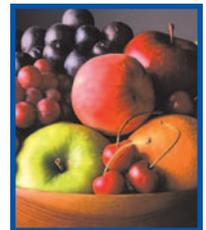


BEYOND the Classroom

Parent Involvement

Practicing Healthful Behaviors.

Brainstorm with parents or guardians ways your family can practice healthful behaviors to maintain the health of your cardiovascular and respiratory systems. Find ways to incorporate low-fat, low-cholesterol foods, including fresh fruits, into your family's daily eating plan.



School and Community

A Smoke-Free Community. Find information about the Great American Smoke Out. What does your community do to participate in this event? Share the information you learn with your classmates, and brainstorm ideas about how your school can become involved with this event.





Chapter 16 Review

After You Read

Use your Foldable to review what you have learned about the structure and function of the cardiovascular system. Make a similar Foldable to note what you have learned about the respiratory and lymphatic systems.



▶ EXPLORING HEALTH TERMS *Answer the following questions on a sheet of paper.*

Lesson 1 *Match each definition with the correct term.*

arteries	lymphocytes
capillaries	plasma
hemoglobin	platelets
lymph	veins

- The fluid in which other parts of the blood are suspended.
- The oxygen-carrying protein in blood.
- Cells that prevent the body's loss of blood.
- Blood vessels that carry blood to the heart.

Lesson 2 *Identify each statement as True or False. If false, replace the underlined term with the correct term.*

anemia	Hodgkin's disease
blood pressure	leukemia
congenital	

- Leukemia is a condition in which the ability of the blood to carry oxygen is reduced.
- A congenital condition is present at birth.
- Anemia is a type of cancer that affects the lymphatic system.

Lesson 3 *Replace the underlined words with the correct term.*

bronchi	pharynx
diaphragm	respiration
larynx	trachea

- The exchange of gases between the body and the environment is known as bronchi.
- The pharynx is a muscle that separates the chest from the abdominal cavity.
- The diaphragm are airways that connect the trachea and the lungs.
- The windpipe is also referred to as the pharynx.
- The voice box is the trachea.

Lesson 4 *Match each definition with the correct term.*

asthma	pneumonia
bronchitis	sinusitis
emphysema	tuberculosis
pleurisy	

- An inflammation of the lungs commonly caused by a bacterial or viral infection.
- An inflammatory condition in which the trachea, bronchi, and bronchioles become narrowed, causing difficulty breathing.
- An inflammation of the lining of the lungs and chest cavity.

▶ RECALLING THE FACTS *Use complete sentences to answer the following questions.*

- Compare and contrast red blood cells, white blood cells, and platelets.
- Differentiate between B cells and T cells.
- What is the purpose of the lymphatic system?



4. What are some possible causes of congenital heart disease?
5. What causes anemia, and how can it be avoided?
6. What can cause a deficiency of the immune system?
7. What is the difference between external and internal respiration?
8. Explain how the process of breathing occurs.
9. What is the function of the epiglottis?
10. How is physical activity related to the health of your respiratory system?
11. What is pneumonia? What causes it?
12. What effects does emphysema have on the respiratory system?

▶ THINKING CRITICALLY

1. **Analyzing.** How would the improper functioning of the valve between the left atrium and ventricle affect the movement of blood through this area of the heart?
2. **Analyzing.** How could having hemophilia affect a person's everyday activities?
3. **Synthesizing.** Describe the process of respiration, including both internal and external respiration. Identify each body structure involved, and explain how these work together in respiration.
4. **Evaluating.** Review the information provided for each respiratory disease. How many of the diseases are linked to smoking? How can you use this information to persuade a family member not to smoke?

Standardized Test Practice

ELA

Read the paragraphs below and then answer the questions.

Consider Chicken Soup

You have a cold. Your nose is running, your eyes are watery, and you ache all over. A cold virus has invaded your upper respiratory tract, and you feel miserable. For centuries chicken soup has been offered as a remedy for these symptoms. People swear that it works, but no one knows why. So scientists decided to do some testing. They found that in most, but not all, cases, chicken soup came to the rescue.

These results left the door open for other theories. Consuming a bowl of soup lessens dehydration in cold victims, which might alleviate symptoms. Then there is the comfort factor of a warm, soothing bowl of soup when you are miserable with a cold. And there's always the placebo effect, leaving a cold victim improved because he or she believes that the remedy works. So the jury is still out on chicken soup.

1. The author opens the passage by
 - A comparing the possible effects of chicken soup.
 - B describing cold symptoms.
 - C analyzing the effects of chicken soup.
 - D describing how a virus causes colds.
2. Which phrase from paragraph 2 helps the reader understand the meaning of the word **placebo**?
 - A connection to a calming of the symptoms
 - B leaving a cold victim improved
 - C because he or she believes that the remedy works
 - D other theories
3. Write a paragraph describing how you feel when you have a cold and what remedies have worked to make you feel better.