

The Cardiovascular System

Key Concept The cardiovascular system circulates blood, gases, and nutrients throughout your body.

What You Will Learn

- The cardiovascular system is made up of the heart, three types of blood vessels, and blood.
- Contractions of the heart pump blood throughout the entire body.
- Cardiovascular problems include atherosclerosis, high blood pressure, strokes, heart attacks, and heart failure.

Why It Matters

Learning about the cardiovascular system helps you understand how organ systems in the human body work together.

Vocabulary

- cardiovascular system
- artery
- capillary
- vein
- pulmonary circulation
- systemic circulation

READING STRATEGY

Graphic Organizer In your **Science Journal**, create a Venn Diagram that compares systemic circulation and pulmonary circulation.

cardiovascular system

(KAR dee OH VAS kyoo luhr SIS tuhm)
a collection of organs that transport blood throughout the body



7.5.a Students know plants and animals have levels of organization for structure and function, including cells, tissues, organs, organ systems, and the whole organism.

7.5.b Students know organ systems function because of the contributions of individual organs, tissues, and cells. The failure of any part can affect the entire system.

7.6.j Students know that contractions of the heart generate blood pressure and that heart valves prevent backflow of blood in the circulatory system.


▶ When you hear the word *heart*, what do you think of first? Many people think of love. But the heart is much more than a symbol of love. Your heart is an amazing pump.

The heart is an organ that is part of your cardiovascular system. The word *cardio* means “heart,” and the word *vascular* means “blood vessel.” The blood vessels—arteries, capillaries, and veins—carry blood pumped by the heart. The cardiovascular system is sometimes called the *circulatory system* because it circulates materials around the body.

Your Cardiovascular System

Your heart, blood, and blood vessels make up your **cardiovascular system**. Your *heart* is an organ made mostly of cardiac muscle tissue. When the heart *contracts*, or squeezes, pressure is created. This pressure moves blood throughout your body. **Figure 1** shows your heart, major arteries, and major veins.

The cardiovascular system helps maintain *homeostasis*, a state of stable internal conditions. The cardiovascular system supplies oxygen and nutrients to cells and removes wastes from cells. It also carries heat and chemical signals called *hormones* throughout the body.

Standards Check What are the main parts of the cardiovascular system?  **7.5.a**

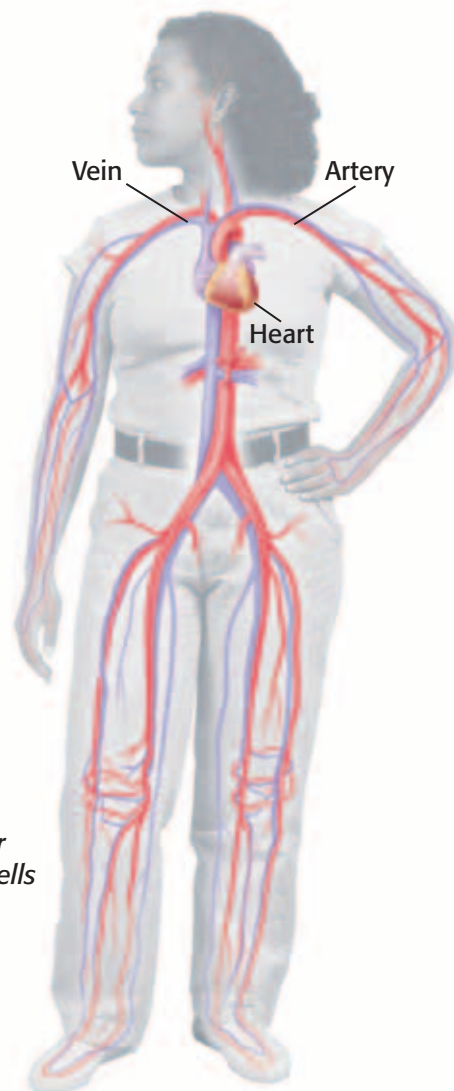


Figure 1 The cardiovascular system carries blood to the cells in your body.

The Heart

Your heart is a muscular organ that is about the size of your fist. It is almost in the center of your chest. Like hearts of all mammals, your heart has a left side and a right side that are separated by a thick wall. The right side of the heart pumps oxygen-poor blood to the lungs. The left side pumps oxygen-rich blood to the body. As you can see in **Figure 2**, each side has an upper chamber and a lower chamber. Each upper chamber is called an *atrium* (plural, *atria*). Each lower chamber is called a *ventricle*.

Flaplike structures called *valves* are found between the atria and ventricles. Valves are also found where some large blood vessels attach to the heart. As blood moves through the heart, the valves close and produce the “lub-dub, lub-dub” sound of a beating heart. Valves prevent blood from going backward. **Figure 3** shows the flow of blood through the heart.

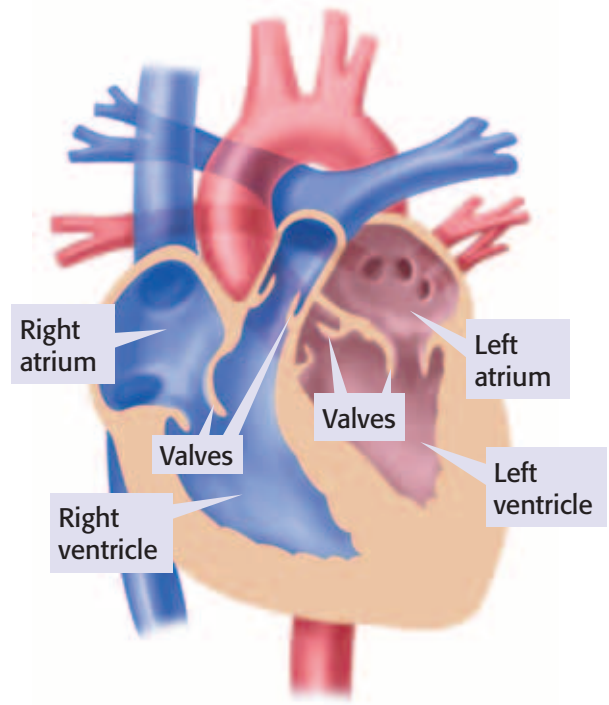
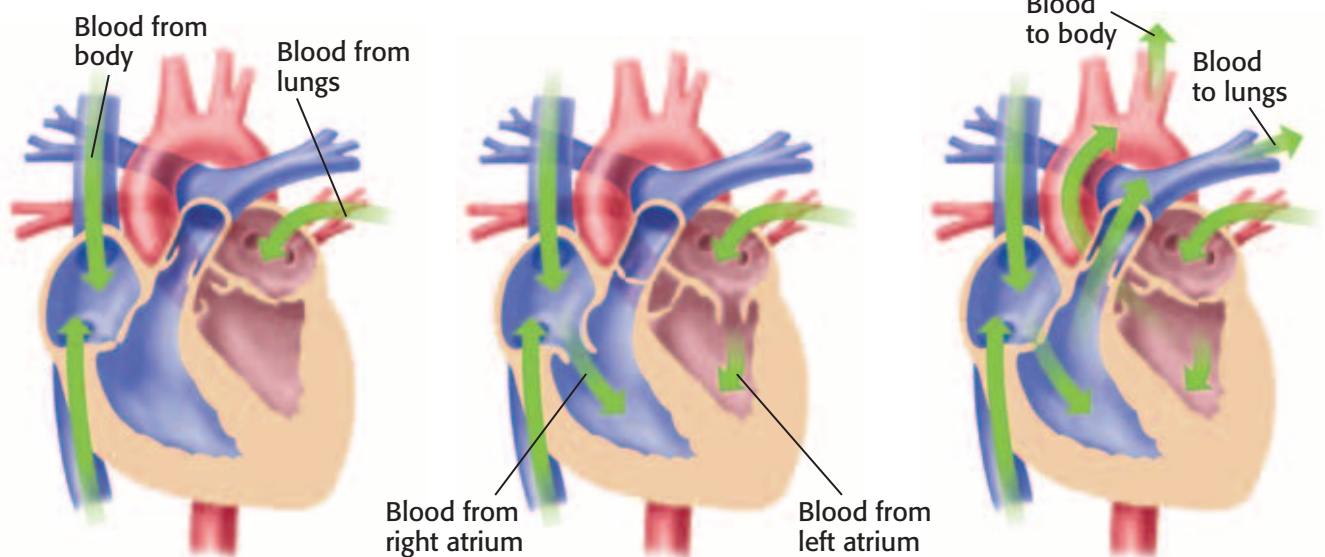


Figure 2 The heart pumps blood through blood vessels. The vessels carrying oxygen-rich blood are shown in red. The vessels carrying oxygen-poor blood are shown in blue.

Figure 3 The Flow of Blood Through the Heart

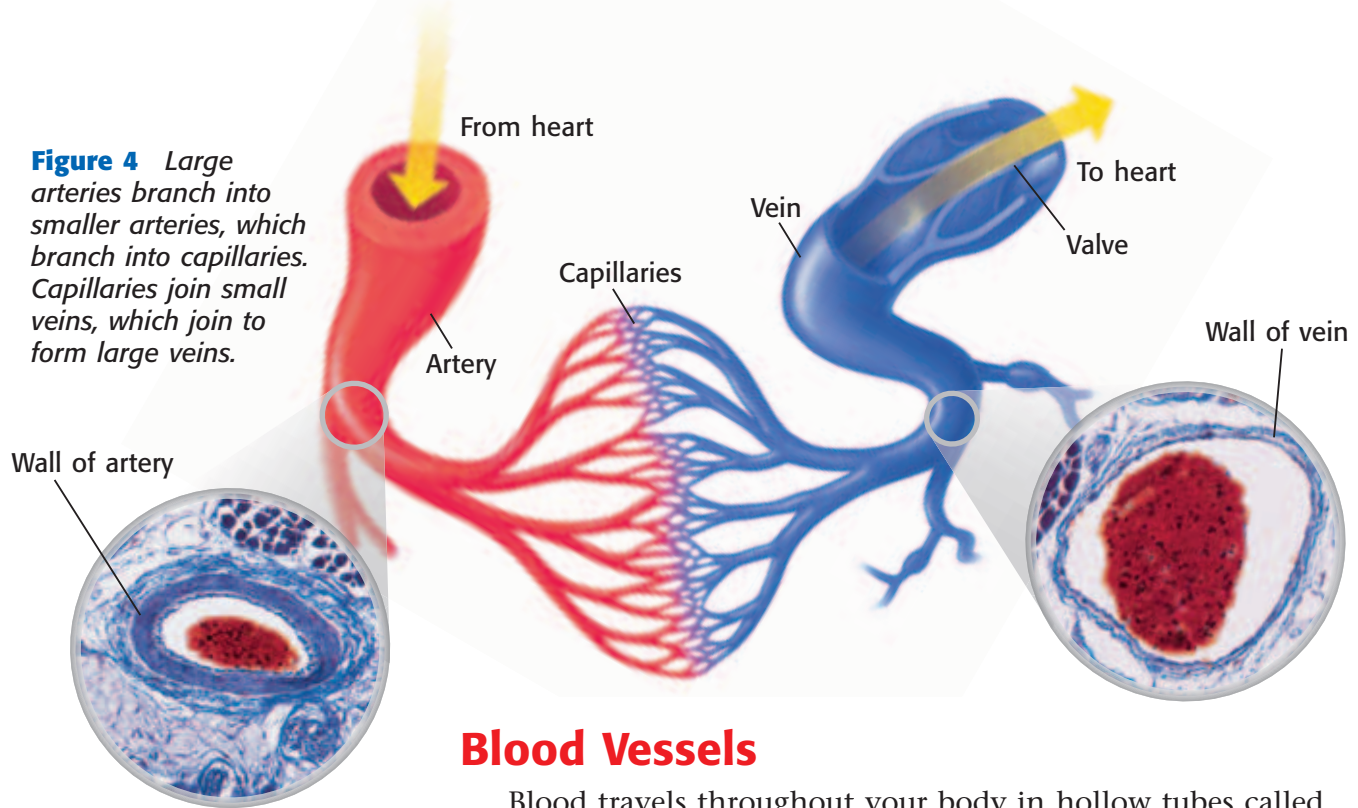


1 Blood enters the atria first. The left atrium receives oxygen-rich blood from the lungs. The right atrium receives oxygen-poor blood from the body.

2 When the atria contract, blood moves into the ventricles.

3 While the atria relax, the ventricles contract and push blood out of the heart. Blood from the right ventricle goes to the lungs. Blood from the left ventricle goes to the rest of the body.

Figure 4 Large arteries branch into smaller arteries, which branch into capillaries. Capillaries join small veins, which join to form large veins.



Blood Vessels

Blood travels throughout your body in hollow tubes called *blood vessels*. The three types of blood vessels—arteries, capillaries, and veins—are shown in **Figure 4**.

Arteries

A blood vessel that carries blood away from the heart is an **artery**. Arteries have thick walls, which contain a layer of smooth muscle. Each heartbeat pumps blood into your arteries at high pressure. Artery walls stretch and are usually strong enough to stand the pressure. Your *pulse* is caused by the rhythmic contractions of the heart pumping blood into arteries.

Capillaries

Nutrients, oxygen, and other substances must leave blood and get to your body's cells. Carbon dioxide and other wastes leave body cells and are carried away by blood. A **capillary** is a tiny blood vessel that allows exchanges between body cells and blood. The exchanges can take place because capillary walls are only one cell thick. Capillaries are so narrow that blood cells must pass through them in single file. Most cells in the body are no more than three or four cells away from a capillary.

Veins

After leaving capillaries, blood enters veins. A **vein** is a blood vessel that carries blood back to the heart. As blood travels through veins, valves found in large veins keep the blood from flowing backward. When skeletal muscles contract, they squeeze nearby veins and help push blood toward the heart.

Standards Check How do the three types of blood vessels work together? 7.5.a

artery (ART uhr ee) a blood vessel that carries blood away from the heart to the body's organs

capillary (CAP uh LEYR ee) a tiny blood vessel that allows an exchange between blood and cells in tissue

vein (VAYN) in biology, a vessel that carries blood to the heart

INTERNET ACTIVITY

William Harvey Biography

Why is William Harvey famous? Write about the life and work of William Harvey in your **Science Journal**. Go to go.hrw.com, and type in the keyword HY7BD2W.

Two Types of Circulation

Where does blood get the oxygen to deliver to your body? From your lungs! Your heart contracts and pumps blood to the lungs. Here, carbon dioxide leaves the blood and oxygen enters the blood. The oxygen-rich blood then flows back to the heart. This circulation of blood between your heart and lungs is called **pulmonary circulation**.

The oxygen-rich blood returning to the heart from the lungs is then pumped to the rest of the body. The circulation of blood between the heart and the rest of the body is called **systemic circulation**. Both types of circulation are shown in **Figure 5**.

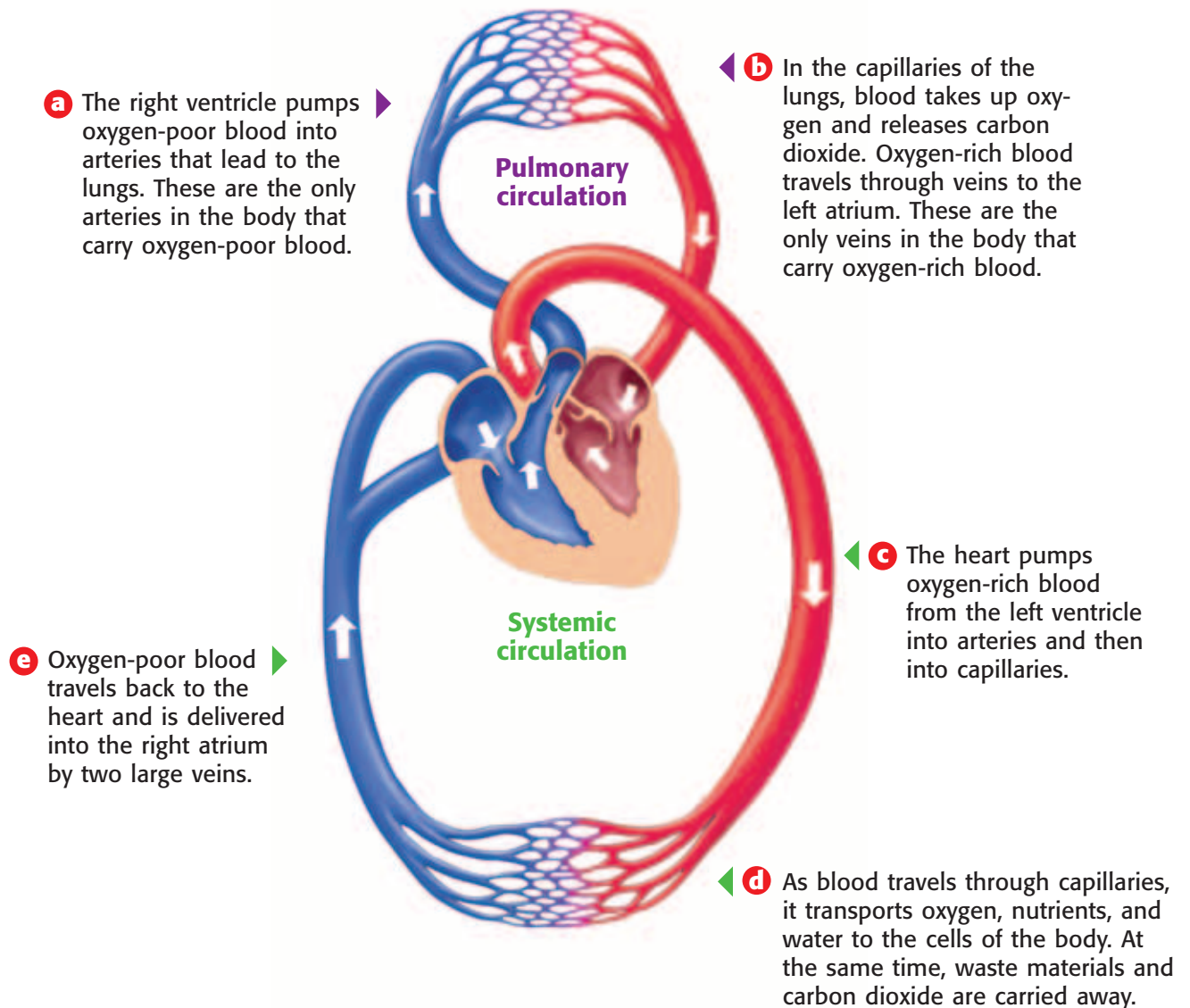
pulmonary circulation

(PUL muh NER ee SUHR kyoo LAY shuhn)
the flow of blood from the heart to the lungs and back to the heart through the pulmonary arteries, capillaries, and veins

systemic circulation

(sis TEM ik SUHR kyoo LAY shuhn)
the flow of blood from the heart to all parts of the body and back to the heart

Figure 5 The Flow of Blood Through the Body



Quick Lab



Vessel Blockage



7.5.b

1. Connect **4 or 5 straws** together by taping them end to end with **clear tape**.
2. Tape a **tissue** to the side of your desk so that the tissue hangs. Blow through your long straw so that the tissue moves.
3. Tightly wrap a **small piece of wire** around one section of your straw. Blow through your straw, and try to make the tissue move. How does this blockage affect the function of the straw?
4. How does this activity relate to atherosclerosis?
5. How might the failure of one blood vessel in the body affect the rest of the organism?



10 min

Cardiovascular Problems

More than just your heart and blood vessels are at risk if you have cardiovascular problems. Your whole body may be harmed. Cardiovascular problems can be caused by smoking, high levels of cholesterol in the blood, stress, physical inactivity, or heredity. Eating a healthy diet and getting plenty of exercise can lower the risk of having cardiovascular problems.

Atherosclerosis

Heart diseases are the leading cause of death in the United States. One major cause of heart diseases is a cardiovascular disease called *atherosclerosis* (ATH uhr OH skluh ROH sis). Atherosclerosis happens when cholesterol (kuh LES tuhr AWL) and other lipids build up inside blood vessels. This buildup causes the blood vessels to become narrower and less elastic. **Figure 6** shows a blocked pathway through an artery. When an artery that supplies blood to the heart becomes blocked, the person may have a heart attack.

High Blood Pressure

Atherosclerosis may be caused in part by hypertension. *Hypertension* is abnormally high blood pressure. The higher the blood pressure is, the greater the risk of cardiovascular problems is. For example, high blood pressure can cause a stroke. A *stroke* happens when a blood vessel in the brain becomes blocked or ruptures. As a result, that part of the brain receives no oxygen. Without oxygen, brain cells die. High blood pressure can also cause other cardiovascular problems, such as heart attacks and heart failure.

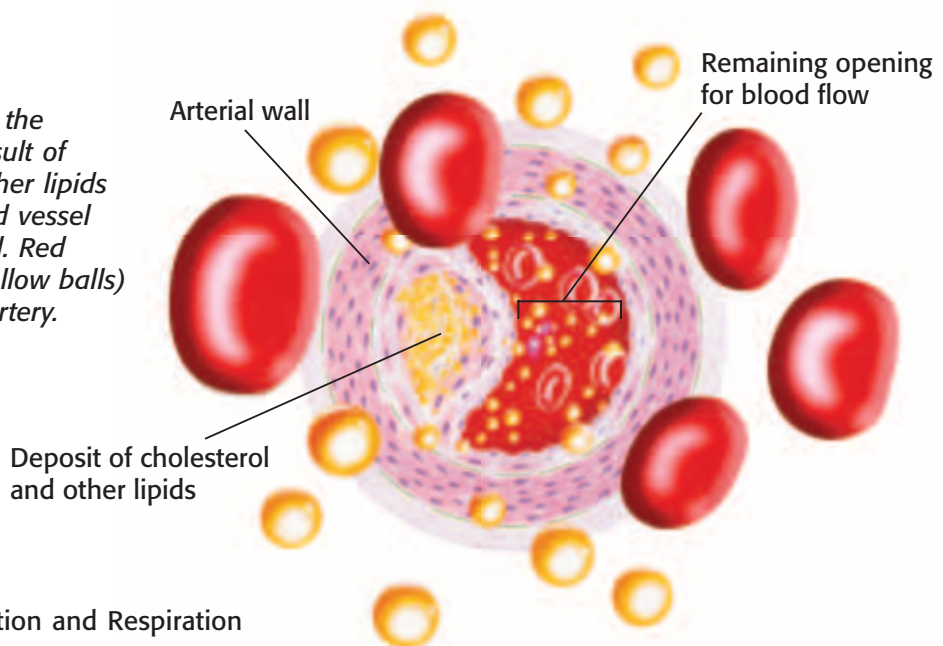
Standards Check



7.5.b, 7.6.j

How can high blood pressure lead to a stroke?

Figure 6 This illustration shows the narrowing of an artery as the result of lipid deposits. Cholesterol and other lipids (yellow) build up inside the blood vessel walls and block the flow of blood. Red blood cells and lipid particles (yellow balls) are shown moving through the artery.



Heart Attacks and Heart Failure

A *heart attack* happens when heart muscle cells do not get enough blood. The heart muscle is damaged. As shown in **Figure 7**, arteries that deliver oxygen to the heart may be blocked. Without oxygen, heart muscle cells may be damaged. If enough heart muscle cells are damaged, the heart may stop.

Heart failure happens when the heart is too weak to pump enough blood to meet the body's needs. Organs, such as the brain, lungs, and kidneys, may be damaged by lack of oxygen and nutrients or by the buildup of fluids or wastes.

Standards Check What is heart failure?  **7.5.b**

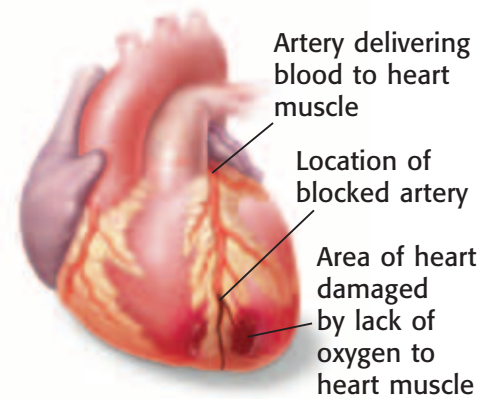


Figure 7 A heart attack happens when an artery to the heart is blocked.

SECTION Review



7.5.a, 7.5.b,
7.6.j

Summary

- Parts of the cardiovascular system include the heart, three types of blood vessels, and blood.
- Contractions of the heart pump blood throughout the body. Valves ensure that blood flows in only one direction.
- The three types of blood vessels are arteries, veins, and capillaries.
- Oxygen-poor blood flows from the heart through the lungs, where it picks up oxygen. Oxygen-rich blood flows from the heart to the rest of the body.
- Cardiovascular problems include atherosclerosis, hypertension, strokes, heart attacks, and heart failure.

Understanding Concepts

- 1 **Modeling** Describe the pathway of blood flow. Begin and end in the left atrium.
- 2 **Describing** Describe the functions of the five parts of the cardiovascular system.
- 3 **Comparing** Compare a heart attack and heart failure.
- 4 **Analyzing** What is the function of valves?

Critical Thinking

- 5 **Identifying Relationships** How is the structure of capillaries related to their function?
- 6 **Making Inferences** One of aspirin's effects is that it prevents substances in blood from being too "sticky." Why might doctors prescribe aspirin for patients who have had a heart attack?
- 7 **Analyzing Ideas** Veins and arteries are everywhere in your body. When a pulse is taken, it is usually taken at an artery in the neck or wrist. Explain why.

8 Identifying Relationships

How are heart contractions and blood pressure related?

Math Skills

- 9 **Making Conversions** An adult male's heart pumps about 2.8 million liters of blood per year. If his heart beats 70 times per minute, how much blood does his heart pump with each beat?

Challenge

- 10 **Predicting Consequences** Cardiac bypass surgery allows surgeons to remove unhealthy blood vessels near the heart. They are replaced with healthy blood vessels from other places in the patient's body. Why might a patient need this type of surgery?

Internet Resources

For a variety of links related to this chapter, go to www.scilinks.org

Topic: **The Cardiovascular System;**
Cardiovascular Problems

SciLinks code: **HY70221; HY70220**