CHAPTER 23
Circulation and Respiration

SECTION 1
The Cardiovascular System

BEFORE YOU READ

After you read this section, you should be able to answer these questions:
• What is the cardiovascular system?
• What are some cardiovascular problems?

What Is the Cardiovascular System?

Your heart, blood, and blood vessels make up your cardiovascular system. The word cardio means heart. The word vascular means blood vessels. Blood vessels are hollow tubes that your blood flows through. The cardiovascular system is also sometimes called the circulatory system. This is because it circulates, or moves, blood through your body.

The cardiovascular system helps your body maintain homeostasis. Homeostasis is the state your body is in when its internal conditions are stable. The cardiovascular system helps maintain homeostasis in many ways:
• it carries oxygen and nutrients to your cells
• it carries wastes away from your cells
• it carries heat throughout your body
• it carries chemical signals called hormones throughout your body

THE HEART

Your heart is an organ about the same size as your fist. It is near the center of your chest. There is a thick wall in the middle of your heart that divides it into two halves. The right half pumps oxygen-poor blood to your lungs. The left half pumps oxygen-rich blood to your body.

Each side of your heart has two chambers. Each upper chamber is called an atrium (plural, atria). Each lower chamber is called a ventricle. These chambers are separated by flap-like structures called valves. Valves keep blood from flowing in the wrong direction. The closing of valves is what makes the “lub-dub” sound when your heart beats. The figure at the top of the next page shows how blood moves through your heart.

National Science Education Standards
LS 3b

STUDY TIP
Summarize As you read, underline the main ideas in each paragraph. When you finish reading, write a short summary of the section using the ideas you underlined.

READING CHECK
1. Identify What are two functions of the cardiovascular system?
Math Focus
2. Calculate A person’s heart beats about 70 times per minute. How many times does a person’s heart beat in one day? How many times does it beat in one year?

TAKE A LOOK
3. Identify Where does the left ventricle receive blood from? Where does the right atrium receive blood from?

BLOOD VESSELS
Blood travels throughout your body in your blood vessels. There are three types of blood vessels: arteries, capillaries, and veins.

An artery is a blood vessel that carries blood away from the heart. Arteries have thick walls that contain a layer of muscle. Each heartbeat pumps blood into your arteries. The blood is under high pressure. Artery walls are strong and can stretch to handle this pressure. Your pulse is caused by the pumping of blood into your arteries.

A capillary is a tiny blood vessel. Capillary walls are very thin. Therefore, substances can move across them easily. Capillaries are also very narrow. They are so narrow that blood cells have to pass through them in single file. Nutrients and oxygen move from the blood in your capillaries into your body’s cells. Carbon dioxide and other wastes move from your body’s cells into the blood.

A vein is a blood vessel that carries blood toward the heart. Veins have valves to keep the blood from flowing backward. When skeletal muscles contract, they squeeze nearby veins and help push blood toward the heart.
How Does Blood Flow Through Your Body?

Where does blood get the oxygen to deliver to your body?

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

The oxygen-rich blood returning to your heart from your lungs is then pumped to the rest of your body. The circulation of blood between your heart and the rest of your body is called **systemic circulation**. The figure below shows how blood moves through your body.

**TAKE A LOOK**

5. **Compare** What is one main difference between arteries and veins?

6. **Define** What is pulmonary circulation?

**TAKE A LOOK**

7. **Color** Use a blue pen or colored pencil to color the vessels carrying oxygen-poor blood. Use a red pen or colored pencil to color the vessels carrying oxygen-rich blood.
What Are Some Problems of the Cardiovascular System?

Problems in the cardiovascular system can affect other parts of your body. Cardiovascular problems can be caused by smoking, too much cholesterol, stress, physical inactivity, or heredity. Eating a healthy diet and getting plenty of exercise can help to keep your cardiovascular system, and the rest of your body, healthy.

ATHEROSCLEROSIS

Heart disease is the most common cause of death in the United States. One major cause of heart disease is atherosclerosis. Atherosclerosis happens when cholesterol and other fats build up inside blood vessels. This buildup causes the blood vessels to become narrower and less stretchy. When the pathway through a blood vessel is blocked, blood cannot flow through.

Critical Thinking

8. Infer How can a problem in your cardiovascular system affect the rest of your body?

READING CHECK

9. Identify What is the most common cause of death in the United States?

TAKE A LOOK

10. Explain How can too much cholesterol cause problems in your cardiovascular system?
HIGH BLOOD PRESSURE

Hypertension is high blood pressure. Hypertension can make it more likely that a person will have cardiovascular problems. For example, atherosclerosis may be caused by hypertension.

High blood pressure can also cause a stroke. A stroke happens when a blood vessel in the brain is blocked or breaks open. Blood cannot flow through the vessel to the brain cells. Without blood, the brain cells cannot get oxygen, so the cells die.

HEART ATTACKS AND HEART FAILURE

Hypertension can also cause heart attacks and heart failure. A heart attack happens when heart muscle cells do not get enough blood. Arteries that deliver oxygen to the heart may be damaged. Without oxygen from the arteries, heart muscle cells can 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 may not receive enough oxygen or nutrients to function correctly. Waste products can build up in the organs and damage them.
Section 1 Review

SECTION VOCABULARY

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>artery</td>
<td>a blood vessel that carries blood away from the heart to the body's organs</td>
</tr>
<tr>
<td>capillary</td>
<td>a tiny blood vessel that allows an exchange between blood and cells in tissue</td>
</tr>
<tr>
<td>cardiovascular system</td>
<td>a collection of organs that transport blood throughout the body; the organs in this system include the heart, the arteries, and the veins</td>
</tr>
<tr>
<td>pulmonary circulation</td>
<td>the flow of blood from the heart to the lungs and back to the heart through the pulmonary arteries, capillaries, and veins</td>
</tr>
<tr>
<td>systemic circulation</td>
<td>the flow of blood from the heart to all parts of the body and back to the heart</td>
</tr>
<tr>
<td>vein</td>
<td>in biology, a vessel that carries blood to the heart</td>
</tr>
</tbody>
</table>

1. Identify What are the three main parts of the cardiovascular system?

2. Describe Beginning and ending in the left atrium, describe the path that blood takes through your body and lungs.

3. Compare How is a heart attack different from heart failure?

4. Explain What is the function of valves in the heart and the veins?

5. Compare How are the arteries that lead from your heart to your lungs different from the other arteries in your body?
3. **Type of joint** | **Example**
--- | ---
Gliding | wrist
Ball-and-socket | shoulder
Hinge | knee

4. Red marrow makes blood cells. Yellow marrow stores fat.

5. Bone replaces most cartilage in your body as you grow up. Only small areas of cartilage will never be replaced by bone.

6. Osteoporosis and arthritis

7. A joint is the place where two bones meet. Ligaments hold the joint together. Cartilage cushions the areas where the bones meet.

8. Too much stress on the bones or joints

**SECTION 3 THE MUSCULAR SYSTEM**

1. Both—we breathe without thinking about it, but we can hold our breath if we want.

2. Signals from the brain

3. Flexor

4. Biceps—flexor, triceps—extensor

5. 50%

6. **Type of exercise** | **Description** | **Example**
--- | --- | ---
Resistance | Muscles work against a weight. | weight lifting, sit-ups
Aerobic | Muscles work steadily for a long time. | running, walking, jogging

**Review**

1. Cardiac muscle, smooth muscle, and skeletal muscle

2. Involuntary—all kinds of muscles act involuntarily at least some of the time.

3. With tendons

4. Muscles contract and pull bones closer together.

5. It becomes larger (or stronger).

6. During aerobic exercise, the muscles work steadily. During resistance exercise, they work against a weight. Aerobic exercise improves strength and endurance. Resistance exercise primarily increases strength.

7. Strains and tendinitis

8. A flexor makes a part of the body bend. An extensor makes a part of the body straighten out.

9. Anabolic steroids can cause high blood pressure, and they can damage the heart, liver, and kidneys. They can also cause bones to stop growing.

**SECTION 4 THE INTEGUMENTARY SYSTEM**

1. The healthy skin is more likely to keep out any harmful particles that are on the surface. The damaged skin may let these particles into your body, causing you to get sick.

2. Epidermis and dermis

3. Muscle fibers, oil glands, nerve fibers

4. Possible answers: They stop a cut from bleeding; they keep bacteria from entering a wound.

5. New hair cells form in the hair follicle and push older cells up. This makes hair get longer.

**Review**

1. Protection, body temperature regulation, sensing the outside world, waste elimination

2. The dermis is made mainly of living cells and is thicker than the epidermis. There are many different structures in the dermis.

3. The palms of the hands and soles of the feet are most likely to come into contact with other objects. They are therefore more likely to be damaged than skin on other parts of the body. Therefore, the epidermis is thicker to protect the skin better.

4. The skin cells make more melanin to protect themselves from damage.

5. It prevents foreign particles from entering the body and helps to keep the body warm.

6. Bacteria may have already entered the body before the clot formed.

**Chapter 23 Circulation and Respiration**

**SECTION 1 THE CARDIOVASCULAR SYSTEM**

1. It carries oxygen and nutrients to the cells and removes wastes from the cells.

2. About 100,000 times per day; about 37 million times per year

3. The left ventricle receives blood from the left atrium. The right atrium receives blood from the body.

4. The pressure of blood inside your arteries when your heart contracts

5. Veins have valves, but arteries do not.

6. Circulation of blood between the heart and lungs

7. Blue should be on the left, red on the right.

8. Your cells would not be able to get the oxygen and nutrients that they need, and your tissues and organs would not be able to work properly.
9. heart disease
10. The cholesterol can build up on artery walls and block them.
11. a blockage or rupture in a blood vessel in the brain
12. If the artery is blocked, the cells cannot get oxygen. If the cells don’t get oxygen, they die.

Review
1. heart, blood, and blood vessels
2. From the left atrium, blood moves into the left ventricle. The left ventricle pumps the blood to the body. After it moves through the body, the blood enters the right atrium. The right atrium pumps the blood into the right ventricle. The right ventricle pumps the blood to the lungs. The blood moves from the lungs back into the left atrium.
3. During a heart attack, part of the heart muscle is damaged due to lack of oxygen. Heart failure means that the heart is not strong enough to pump enough blood to meet the body’s needs.
4. Valves prevent blood from flowing in the wrong direction.
5. The arteries that lead to the lungs carry oxygen-poor blood. The other arteries in the body carry oxygen-rich blood.

SECTION 2 BLOOD
1. a connective tissue made up of plasma, red blood cells, platelets, and white blood cells
2. The cut will bleed for longer than usual because there are not enough platelets to help form a clot.
3. 500 times more
4. in bone marrow
5. They control how much heat is lost through your skin.
6. antigens on your RBCs
7. A and B antigens
8. AB can receive the most, O can donate the most.

Review
1. They fight pathogens and clean up wounds.

SECTION 3 THE LYMPHATIC SYSTEM
1. Plasma pushed out of the circulatory system is collected and returned by the lymphatic system.
2. into neck veins
3. Tonsil: trap pathogens
   - Thymus: produce mature T cells to fight infections
   - Spleen: store lymphocytes
   - Lymph nodes: remove pathogens and dead cells from lymph
   - Lymphatic vessels: return fluid to the cardiovascular system
4. to produce red and white blood cells
5. You may have an infection.
6. Answers may include: It monitors, stores, and destroys old blood cells; it releases lymphocytes into the bloodstream when there is an infection; it attacks or marks pathogens in blood.

Review
1. Lymph collects pathogens and dead cells from body tissues. Lymphocytes in the lymph nodes, tonsils, and spleen attack and mark pathogens for destruction.
2. Plasma is pushed out of capillaries.
   - Lymph capillaries absorb lymph.
   - Lymph capillaries carry lymph to lymphatic vessels.
   - Lymphatic vessels deliver lymph to veins in the neck.

<table>
<thead>
<tr>
<th>Type of pressure</th>
<th>Description</th>
<th>Where it is found in a blood pressure measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Systolic</td>
<td>pressure in the arteries when ventricles contract</td>
<td>top number</td>
</tr>
<tr>
<td>Diastolic</td>
<td>pressure in the arteries when ventricles relax</td>
<td>bottom number</td>
</tr>
</tbody>
</table>

3. carry oxygen, fight pathogens, regulate body temperature
4. More blood moves toward the skin to help your body cool off. Since blood is red, a lot of it near the skin makes the skin look redder.
5. A person with type O blood has antibodies to A and B antigens. If a transfusion of A, B, or AB blood is given to someone with type O, the antibodies will react with the transfused blood and cause it to clot. This can cause death.
6. The RBCs will not be able to carry oxygen to the body.