



Circulation

section 1 The Circulatory System



LE 1.2f: The circulatory system moves substances to and from cells, where they are needed or produced, responding to changing demands.

Also covered: LE 1.2a, 1.2j

Before You Read

Explain the function of the plumbing system in your home. Describe how it works.

What You'll Learn

- the differences among arteries, veins, and capillaries
- how blood moves through the heart
- the functions of the pulmonary and systemic circulation systems

Read to Learn

How Materials Move Through the Body

The cardiovascular (kar dee oh VAS kyuh lur) system supplies materials to and removes wastes from your body cells. This system includes your heart, blood vessels, and blood.

Movement of materials into and out of your cells occurs by diffusion (dih FYEW zuhn) and active transport. Diffusion occurs when a material moves from an area where there is more of it to an area where there is less of it. Nutrients and oxygen diffuse from your blood into your body's cells. Active transport is the opposite of diffusion. Active transport needs energy from the cell to occur.

The Heart

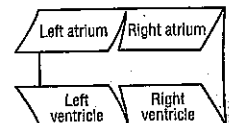
Your heart is an organ made of cardiac muscle tissue. Your heart has four compartments called chambers. The two upper chambers are called the right and left atria (AY tree umz). The two lower chambers are called the right and left ventricles (VEN trih kulz). During one heartbeat, both atriums contract at the same time. Then, both ventricles contract at the same time. A one-way valve separates each atrium from the ventricle below it.



Identify Main Ideas After you have read the material under each question head, highlight the answer to the question.



A Describe Make a shutterfold book, as shown below. Identify the four chambers of the heart. Include a sketch of the heart and the four chambers.



✓ Reading Check

1. **Identify** What controls the blood flow through the three sections of the circulatory system?

Picture This

2. **Explain** to a partner the flow of blood in pulmonary circulation.

Three Sections of the Circulatory System Scientists divide the circulatory system into three sections: coronary (KOR uh ner ee) circulation, pulmonary (PUL muh ner ee) circulation, and systemic circulation. The beating of your heart controls blood flow through each section. ✓

What is coronary circulation?

Blood vessels supply the heart with nutrients and oxygen and remove wastes. **Coronary circulation** is the flow of blood to and from the tissues of the heart.

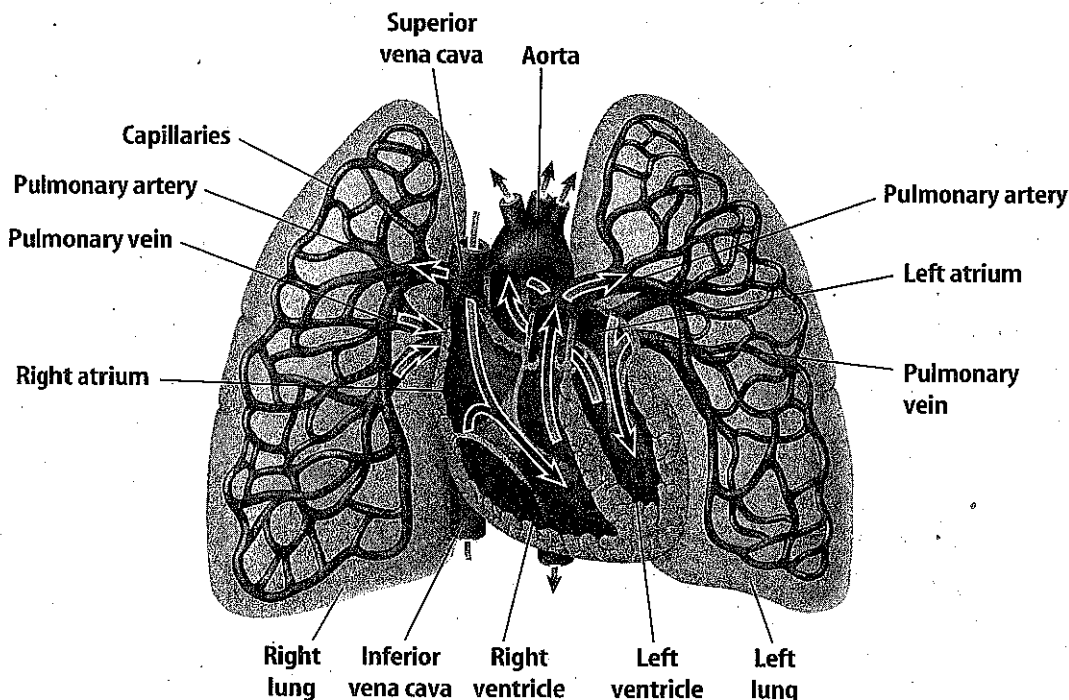
What is pulmonary circulation?

The flow of blood through the heart to the lungs and back to the heart is **pulmonary circulation**. Use the figure below to trace the path blood takes through this part of the circulatory system.

The blood returning from the body through the right side of the heart and to the lungs contains wastes from the body's cells. Carbon dioxide is one of these wastes.

In the lungs, carbon dioxide and other gaseous wastes diffuse out of the blood, and oxygen diffuses into the blood. Then the blood returns to the left side of the heart.

In the final step of pulmonary circulation, the oxygen-rich blood is pumped from the left ventricle into the aorta (ay OR tuh). The aorta is the largest artery in your body. Next, the oxygen-rich blood flows to all parts of your body.



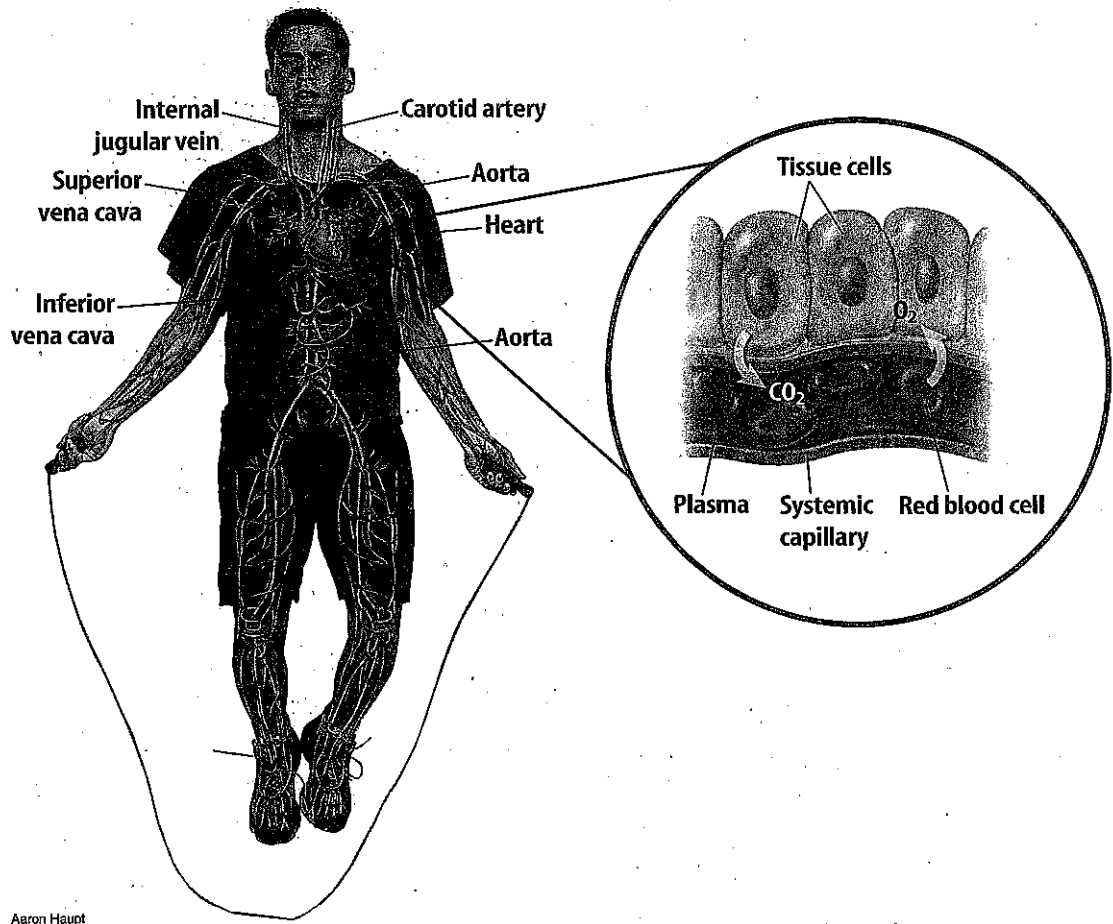
What is systemic circulation?

Oxygen-rich blood moves to all of your organs and body tissues, except the heart and lungs, by **systemic circulation**. Oxygen-poor blood returns to the heart by systemic circulation. The figure below shows the major arteries and veins (VAYNZ) of the systemic circulation system. Oxygen-rich blood flows from your heart in the arteries. Then nutrients and oxygen are delivered by blood to your body cells and exchanged for carbon dioxide and wastes, as shown below. The blood then returns to your heart in the veins.



Think it Over

3. **Infer** Why is systemic circulation important to your muscles?



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Blood Vessels

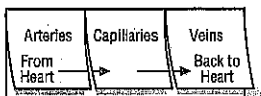
In the middle 1600s, scientists proved that blood moves in one direction in a blood vessel, like traffic on a one-way street. They discovered that blood moves by the pumping of the heart and flows from arteries to veins. They couldn't explain how blood got from arteries to veins. With the invention of the microscope, scientists discovered that capillaries (KAP uh ler eez) connect the arteries and veins.

Picture This

4. **Identify** Circle the name of the blood vessel in which oxygen and carbon dioxide are exchanged.

FOLDABLES

B Explain Make a three-tab Foldable, as shown below. Label the outside of the Foldable *Circulation*. Inside take notes on arteries, capillaries, and veins.



What is the function of arteries?

The blood vessels that carry blood away from the heart are called **arteries**. Arteries have thick, elastic walls made of connective tissue and smooth muscle tissue.

Each ventricle of the heart is connected to an artery. The right ventricle of the heart is connected to the pulmonary artery. The left ventricle of the heart is connected to the aorta. Every time your heart contracts, blood moves from your heart into your arteries.

How does blood flow in the veins?

A blood vessel that carries blood back to the heart is called a **vein**. Veins have one-way valves that keep blood moving toward the heart. If blood flows backward, the pressure of the blood against the valve causes it to close. Two major veins return blood from your body to your heart. The superior vena cava returns blood from your head and neck. The inferior vena cava returns blood from your abdomen and lower body.

What is the function of capillaries?

Very small blood vessels called **capillaries** connect arteries and veins. Nutrients and oxygen diffuse into body cells through the thin capillary walls. Waste and carbon dioxide diffuse from body cells into the capillaries.

Blood Pressure

When your heart pumps, the pressure of the push moves through the blood. The force of the blood on the walls of the blood vessels is called blood pressure. Blood pressure is highest in arteries and lowest in veins. When you take your pulse, you can feel the waves of pressure. This rise and fall in pressure occurs with each heartbeat. Normal resting pulse rates are 60 to 100 heartbeats per minute for adults, and 80 to 100 beats per minute for children.

How is blood pressure measured?

Blood pressure is measured in large arteries. Two numbers describe blood pressure, such as 120 over 80. The first number is a measure of the pressure caused when the ventricles contract and blood is pushed out of the heart. The second number is a measure of the pressure that occurs as the ventricles fill with blood just before they contract again. ✓

✓ Reading Check

5. **Describe** What does the first number in your blood pressure measure?

Blood Pressure and Heart Rate When blood pressure is higher or lower than normal, messages are sent to the brain by nerve cells in the arteries. One way the brain lowers or raises blood pressure is by speeding up or slowing down the heart rate. When blood pressure stays constant, enough blood reaches all organs and tissues in the body.

Cardiovascular Disease

There are many diseases that affect the cardiovascular system—the heart, blood vessels, and blood. Heart disease is the leading cause of death in the United States.

What is atherosclerosis?

Atherosclerosis (ah thuh roh skluh ROH sus) is a leading cause of heart disease. In this condition, deposits of fat build up on the walls of the arteries. These fat deposits can block an artery. If a coronary artery is blocked, a heart attack can occur.

What happens with hypertension?

Hypertension (HI pur TEN chun) is high blood pressure. When blood pressure is higher than normal most of the time, the heart must work harder to keep blood flowing. Atherosclerosis is one cause of hypertension. ✓

How does heart failure occur?

Heart failure occurs when the heart cannot pump blood efficiently. When the heart does not pump properly, fluid collects in the arms, legs, and lungs. A person with heart failure is usually short of breath and tired.

Can cardiovascular disease be prevented?

Cardiovascular disease can be prevented by following a diet that is low in salt, sugar, cholesterol, and saturated fats. Large amounts of body fat force the heart to pump faster. Relaxing and exercising help prevent tension and relieve stress. Exercising strengthens the heart and lungs and helps maintain proper weight. Not smoking also helps prevent heart disease. ✓

✓ Reading Check

6. **Apply** What is another name for high blood pressure?

✓ Reading Check

7. **Explain** What is one thing you can do to prevent cardiovascular disease?

● After You Read

Mini Glossary

artery: a blood vessel that carries blood away from the heart

atria (AY tree umz): the two upper chambers of the heart

capillaries (KAP uh ler eez): very small blood vessels that connect arteries and veins

coronary (KOR uh ner ee) circulation: the flow of blood to and from the tissues of the heart

pulmonary circulation: the flow of blood through the heart to the lungs and back to the heart

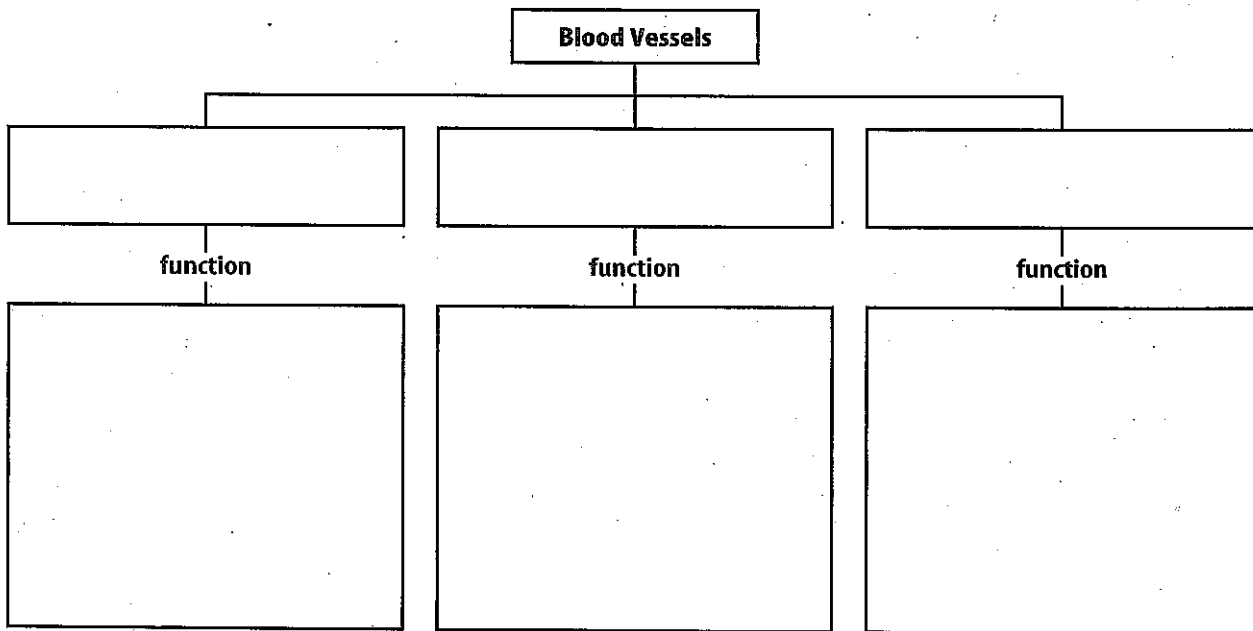
systemic circulation: the system in which oxygen-rich blood moves to all of the organs and body tissues, except the heart and lungs, and oxygen-poor blood returns to the heart

vein: a blood vessel that carries blood back to the heart

ventricles (VEN trih kulz): the two lower chambers of the heart

1. Review the terms and their definitions in the Mini Glossary. Write a sentence that explains the difference between pulmonary circulation and systemic circulation.

2. Complete the concept map below to show the kinds of blood vessels and their functions.



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Visit glencoe.com to access your textbook, interactive games, and projects to help you learn more about the circulatory system.

section 2 Blood



LE 1.2f: The circulatory system moves substances to and from cells, where they are needed or produced, responding to changing demands.

Also covered: LE 1.2a, 1.2b, 1.2j

● Before You Read

Have you ever fallen and scraped your knee? What happens to the wounded area? What happens while the wound is healing?

What You'll Learn

- the parts and function of blood
- why blood types are checked before a transfusion
- kinds of blood diseases

● Read to Learn

Functions of Blood

Blood has four important functions.

1. Blood carries oxygen from your lungs to your body cells. Carbon dioxide diffuses from your body cells to your blood. Your blood carries carbon dioxide to your lungs to be exhaled.
2. Blood carries waste from your cells to your kidneys to be removed.
3. Blood carries nutrients and other materials to your body cells.
4. Cells and molecules in blood fight infections and help heal wounds.

Parts of Blood

Blood is a tissue made of plasma (PLAZ muh), platelets (PLAYT luts), and red and white blood cells. Blood makes up about eight percent of your total body mass. If you weigh 45 kg, you have about 3.6 kg of blood.

What is plasma?

The liquid part of blood is mostly water and is called **plasma**. Nutrients, minerals, and oxygen are dissolved in plasma and carried to cells. Wastes from cells also are carried in plasma.

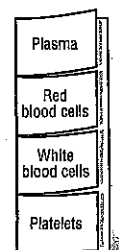
Mark the Text

Identify Main Points

Highlight the main idea of each paragraph. Circle the details that support the main idea.

FOLDABLES

● Explain Make a four-tab foldable, as shown below, to describe the four parts of blood—plasma, red blood cells, white blood cells, and platelets.



✓ Reading Check

1. **Determine** What gives blood its red color?

Picture This

2. **Identify** Highlight the name of the blood part that releases chemicals to help with clotting.

What is the function of red blood cells?

Red blood cells are different from all other human cells because they have no nuclei. They contain **hemoglobin** (HEE muh gloh bun), which is a molecule that carries oxygen and carbon dioxide. Hemoglobin is made of an iron compound that gives blood its red color. Hemoglobin carries oxygen from your lungs to your body cells. Then it carries some of the carbon dioxide from your body cells back to your lungs. ✓

How do white blood cells fight invaders?

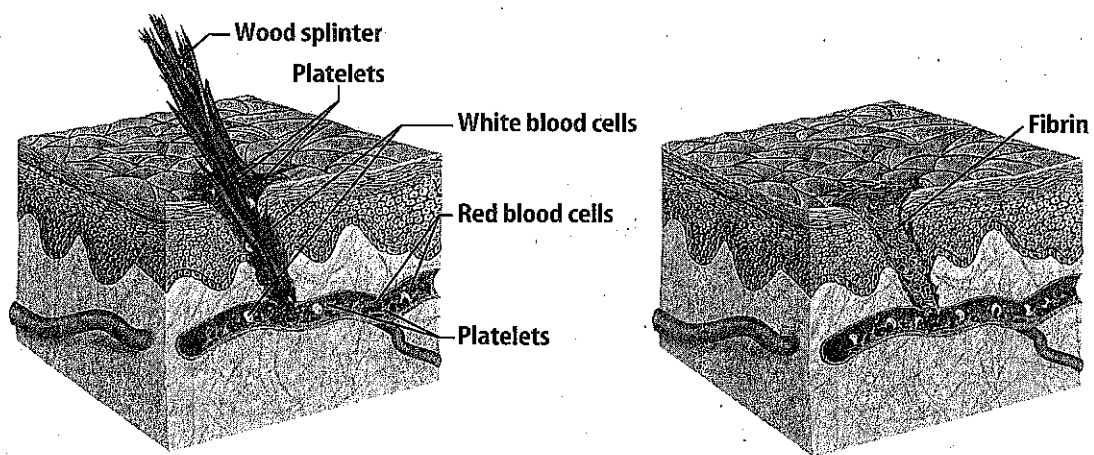
White blood cells fight bacteria, viruses, and other invaders of your body. Your body reacts to these invaders by increasing the number of white blood cells. These cells leave the blood through capillary walls and go into the tissues that have been invaded. Here, they destroy bacteria and viruses and absorb dead cells.

What are platelets?

Platelets circulate with red and white blood cells. **Platelets** are irregularly shaped cell fragments that help clot blood.

Blood Clotting

When you cut yourself, platelets stick to the wound and release chemicals. Then materials called clotting factors carry out a series of chemical reactions. These reactions cause threadlike fibers called **fibrin** (FI brun) to form a sticky net, as shown in the figure below. This net traps escaping blood cells and plasma and forms a clot. The clot becomes hard and skin cells begin the repair process under the scab. After a few days, the scab falls off.



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Blood Types

Blood clots stop blood loss quickly in a minor wound. However, a person with a serious wound might lose a lot of blood and need a blood transfusion. During a blood transfusion, a person receives donated blood or parts of blood. The person must get the right type of blood, or the red blood cells will clump together. This causes clots to form in the blood vessels and the person could die.

How are blood types identified?

People can inherit one of four types of blood: A, B, AB, or O. Types A, B, and AB have chemical identification tags called antigens (AN tih junz) on their red blood cells. Type O red blood cells have no antigens, as shown in the table below.

Blood Type	Antigen	Antibody
A	A	Anti-B
B	B	Anti-A
AB	A, B	None
O	None	Anti-A Anti-B

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Antibodies and Transfusions Each blood type, except AB, also has specific antibodies in its plasma. Antibodies are proteins that destroy materials that do not belong in or are not part of your body. For example, if type A blood is mixed with type B blood, the type A antibodies cause the type B red blood cells to clump.

Because of these antibodies, certain blood types cannot be mixed. Type AB blood has no antibodies, so people with this blood type can receive blood from A, B, AB, and O types. Type O blood has both A and B antibodies. People with type O blood are sometimes called universal donors because their blood can be transfused into a person with any blood type.

Think it Over

3. **Analyze** Why would it be important for doctors to check your blood type if you were in a serious accident?

Picture This

4. **Identify** Highlight the blood type that produces no antibodies. Circle the blood type that has no antigens.

✓ Reading Check

5. Define What is the Rh factor?

✓ Reading Check

6. Identify the blood disease that affects red blood cells.

What is the Rh factor in blood?

The Rh factor is another chemical identification tag in blood. The Rh factor is inherited. If the Rh factor is on red blood cells, the person has Rh-positive (Rh+) blood. If it is not present, the person's blood is Rh-negative (Rh-). If an Rh- person receives a blood transfusion from an Rh+ person, he or she will produce antibodies against the Rh factor. These antibodies can cause Rh+ cells to clump. Clots then form in the blood vessels and the person could die. ✓

When an Rh- mother is pregnant with an Rh+ baby, the mother might make antibodies to the child's Rh factor. Close to the time of birth, Rh antibodies from the mother can pass from her blood into the baby's blood. These antibodies can destroy the baby's red blood cells. If this happens, the baby must receive a blood transfusion before or right after birth.

At 28 weeks of pregnancy and immediately after the birth, an Rh- mother can be given an injection that stops the production of antibodies to the Rh+ factor. This keeps the baby from needing a blood transfusion.

Diseases of Blood

Any disease of the blood is a cause for concern, because blood circulates to all parts of your body and performs many important functions. Anemia (uh NEE mee uh) is a common disease of red blood cells. Body tissues cannot get enough oxygen and are not able to carry out their usual activities. Anemia can be caused by the loss of large amounts of blood. It also can be caused by the lack of iron or certain vitamins in the diet. Anemia can be the result of other diseases. Some types of anemia, such as sickle-cell anemia, are inherited. ✓

Leukemia (lew KEE mee uh) is a disease in which one or more types of white blood cells are made in large numbers. These cells are not able to fight infections well. They crowd out the normal cells. Then not enough red blood cells, normal white blood cells, and platelets can be made. Types of leukemia can affect children or adults. Medicines, blood transfusions, and bone marrow transplants are used to treat this disease. If the treatments are not successful, the person will eventually die from complications related to the disease.

● After You Read

Mini Glossary

hemoglobin (HEE muh gloh bun): a molecule that carries oxygen and carbon dioxide

plasma (PLAZ muh): the liquid part of blood that carries nutrients, minerals, and oxygen to cells

platelet (PLAYT lut): an irregularly shaped fragment of a cell that helps clot blood

1. Review the terms and their definitions in the Mini Glossary. Choose one term that describes a part of the blood. Write a sentence that explains the function of this part of the blood.

2. Using the phrases below, fill in the boxes in the correct order to explain how a wound heals.

Clot forms.

Clot hardens.

Clotting factors carry out chemical reaction.

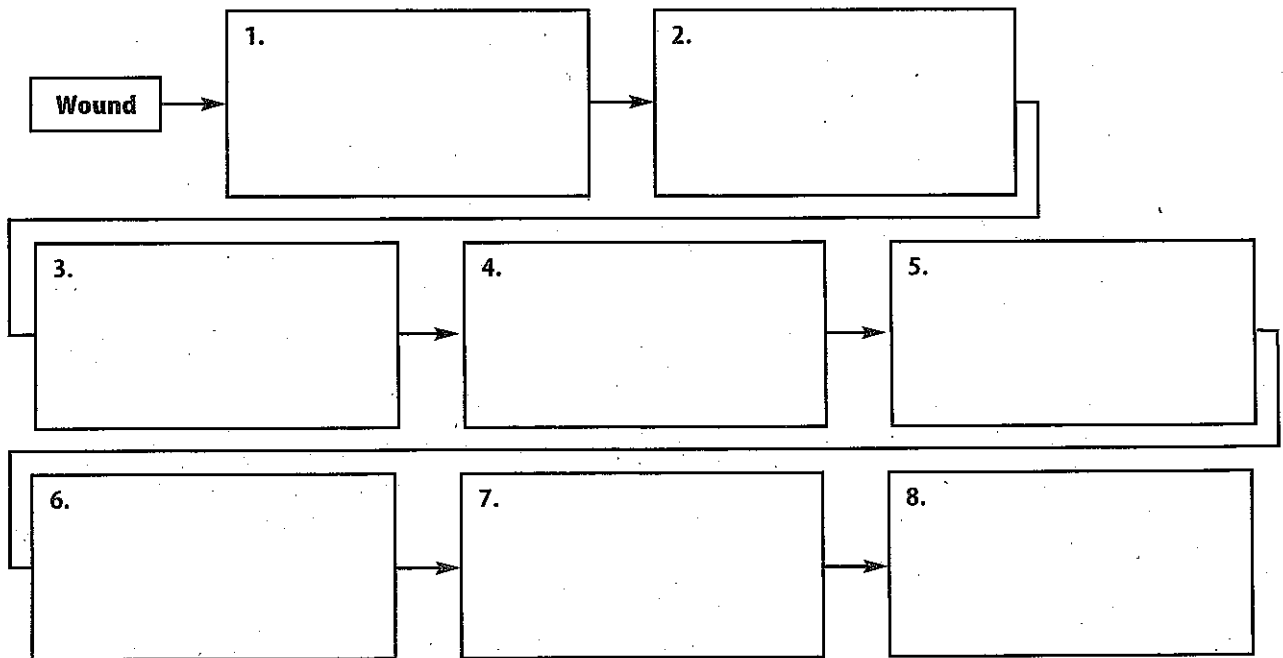
Fibrin forms.

Net traps blood cells.

Platelets stick to wound.

Scab falls off.

Skin cells repair under scab.



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section 15 The Lymphatic System



LE 1.2f: The circulatory system moves substances to and from cells, where they are needed or produced, responding to changing demands.
Also covered: LE 1.2a, 1.2j

What You'll Learn

- the functions of the lymphatic system
- where lymph comes from
- how lymph organs help fight infections

Before You Read

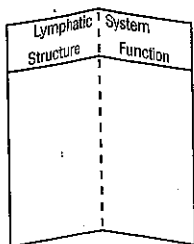
When you fill a glass with water from a water faucet, what happens to the water that does not go into your glass?

Study Coach

Make Flash Cards Write a quiz question on one side of a flash card and the answer on the other side. Work with a partner to quiz each other using the flash cards.

FOLDABLES

D Explain Make a half-book foldable as shown below, to explain the structure and function of the lymphatic system.



Read to Learn

Functions of the Lymphatic System

When you fill a glass with water from the faucet, some of the water likely runs down the drain. In a similar way, your body's excess tissue fluid is removed by the lymphatic (lihm FA tihk) system. The nutrient, water, and oxygen molecules in blood diffuse through capillary walls to nearby cells. Water and other substances become part of the tissue fluid that is found between cells. This fluid is collected and returned to the blood by the lymphatic system.

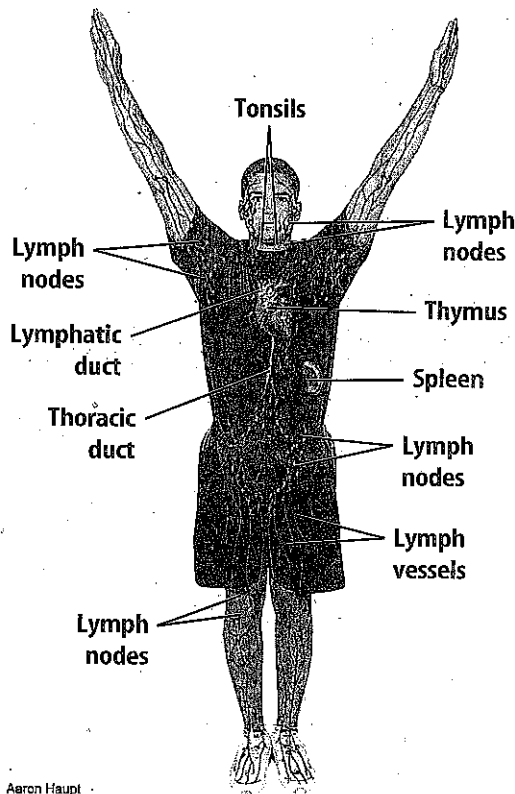
After tissue fluid diffuses into the lymphatic capillaries, it is called **lymph** (LIHMF). Lymph contains water, other materials, and **lymphocytes** (LIHM fuh sites), a type of white blood cell.

Your **lymphatic system** carries lymph through a network of lymph capillaries and larger lymph vessels. Then, the lymph drains into larger veins near the heart. The lymph is moved by the contraction of smooth muscles in lymph vessels and skeletal muscles.

Lymphatic vessels have valves that keep lymph from flowing backward. If the lymphatic system is not working properly, swelling occurs because the tissue fluid cannot get back to the blood.

Lymphatic Organs

Before lymph enters the blood, it passes through lymph nodes. **Lymph nodes** are bean-shaped organs found throughout the body, as shown in the figure below. Lymph nodes filter out microorganisms and foreign materials that have been taken up by the lymphocytes. When your body fights an infection, lymphocytes fill the lymph nodes.



Other important lymphatic organs include the tonsils, the thymus, and the spleen. Tonsils protect you from harmful organisms that enter through your mouth and nose. The thymus makes lymphocytes. The spleen removes worn out and damaged red blood cells from the blood. Cells in the spleen destroy bacteria and other materials that invade your body.

A Disease of the Lymphatic System

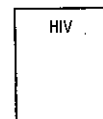
HIV is a virus. It destroys lymphocytes called helper T cells that help make antibodies to fight infections. This makes it difficult for a person with HIV to fight some diseases. Usually, the person dies from these diseases, not from the HIV infection.

Picture This

1. **Identify** Highlight the areas of the body where lymph nodes are found.

FOLDABLES

E Describe Use a quarter-sheet of notebook paper to take notes about HIV.



● After You Read

Mini Glossary

lymph (LIHMF): tissue fluid that passes into the lymphatic capillaries

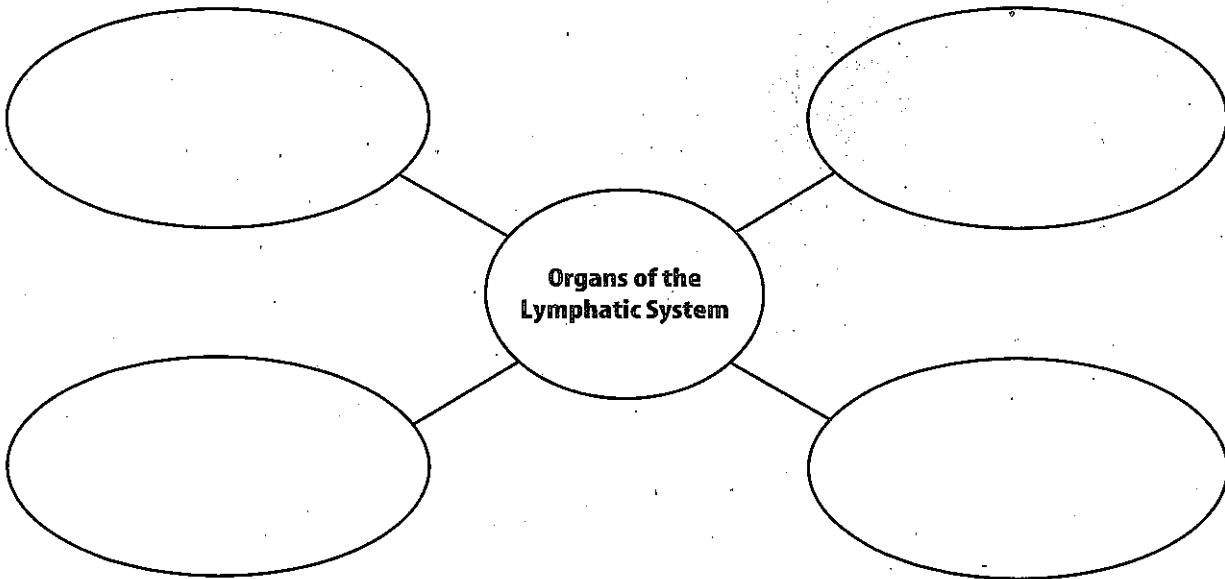
lymphatic system: the system that removes lymph that the body does not need through a network of lymph capillaries and larger lymph vessels

lymph nodes: bean-shaped organs found throughout the body, which filter out microorganisms

lymphocyte (LIHM fuh site): a type of white blood cell

1. Review the terms and their definitions in the Mini Glossary. Write a sentence that summarizes what lymph nodes do.

2. Complete the concept web below to identify the organs of the lymphatic system.



3. Explain how working with a partner helped you learn about the lymphatic system.

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