SECTION 2

Blood

Key Concept Blood transports many things through the body, including oxygen, nutrients, wastes, heat, immune system cells, and hormones.

What You Will Learn

- Blood is a tissue that is made up of red blood cells, white blood cells, platelets, and plasma.
- Blood pressure is the force exerted by blood on the inside walls of arteries.
- The loss of blood, mixing blood types, or blood disorders can be fatal.

Why It Matters

All the cells in your body depend on blood to stay alive.

Vocabulary

- blood
- blood pressure

READING STRATEGY

Summarizing Read this section silently. In pairs, take turns summarizing the material. Stop to discuss ideas and words that seem confusing.

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.

Blood is the carrier for the cardiovascular system. It moves through miles of blood vessels to reach the cells in your body. So, you must have a lot of blood, right? Not really. An adult human body has about 5 L of blood. Your body most likely has a little less than that. All the blood in your body would not fill two 3 L soda bottles.

Components of Blood

Your cardiovascular system is made up of your heart, your blood vessels, and blood. **Blood** is a connective tissue made up of plasma, red blood cells, platelets, and white blood cells. Blood carries important materials to all parts of your body.

Plasma

The fluid part of the blood is called plasma (PLAZ muh). *Plasma* is a mixture of water, minerals, nutrients, sugars, proteins, and other substances. Red blood cells, white blood cells, and platelets are found in plasma.

Red Blood Cells

Most blood cells are *red blood cells,* or RBCs. RBCs, such as the ones shown in **Figure 1,** supply oxygen for every living cell in your body. Cells need this gas to carry out their functions. Each RBC has hemoglobin (HEE moh GLOH bin). *Hemoglobin* is an oxygen-carrying protein. Hemoglobin attaches to the oxygen you inhale. RBCs can then move oxygen throughout the body. Hemoglobin also gives RBCs their red color.

Standards Check **Describe the function of red blood cells.** 7.5.a

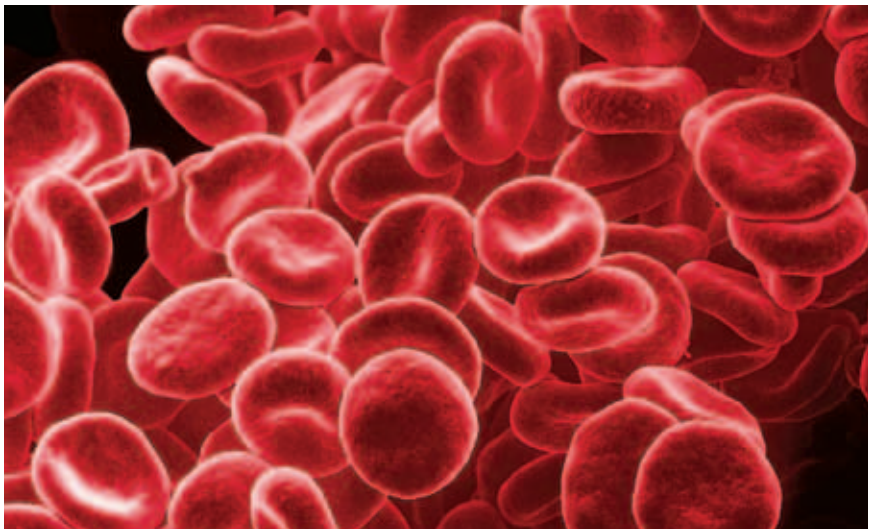


Figure 1 *Red blood cells are made in the bone marrow of certain bones. As red blood cells mature, they lose their nucleus and their DNA.*

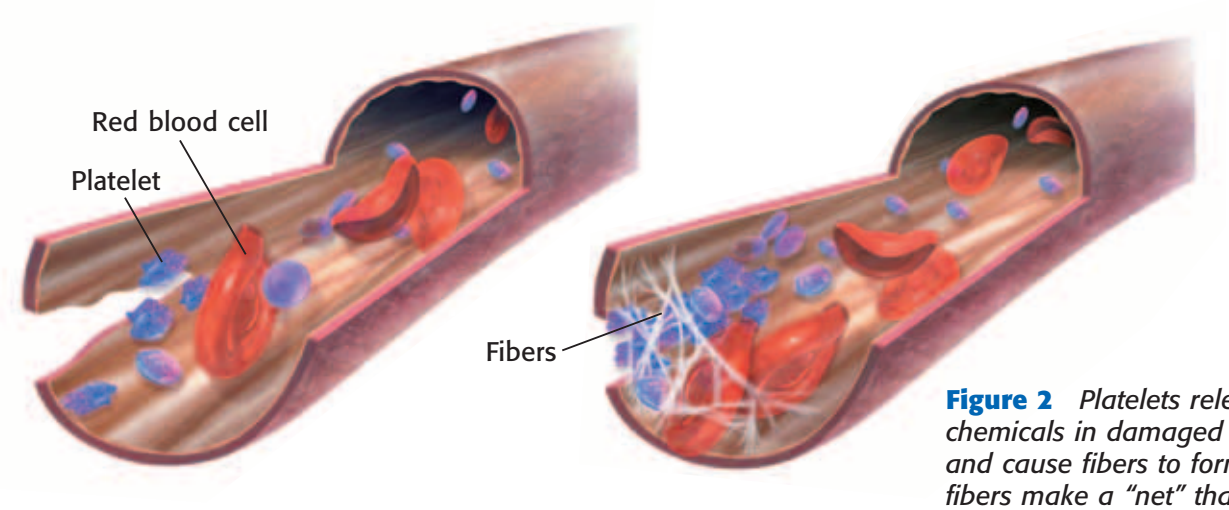


Figure 2 *Platelets release chemicals in damaged vessels and cause fibers to form. The fibers make a "net" that traps blood cells and stops bleeding.*

Platelets

Drifting among the blood cells are tiny particles called platelets. *Platelets* are pieces of larger cells found in bone marrow. These larger cells remain in the bone marrow, but pieces are pinched off. Then, these pieces enter the bloodstream as platelets. Platelets last for only 5 to 10 days, but they are an important part of blood. When you cut or scrape your skin, you bleed because blood vessels have been opened. As soon as bleeding starts, platelets begin to clump together in the damaged area. They form a plug that helps reduce blood loss, as shown in **Figure 2.** Platelets also release chemicals that react with proteins in plasma. The reaction causes tiny fibers to form. The fibers help make a blood clot.

blood (BLUHD) the fluid that carries gases, nutrients, and wastes through the body and that is made up of platelets, white blood cells, red blood cells, and plasma

White Blood Cells

Sometimes *pathogens* (PATH uh juhnz)—bacteria, viruses, and other microscopic particles that can make you sick—enter your body. When they do, they often meet *white blood cells,* or WBCs. WBCs, shown in **Figure 3,** help keep you healthy by destroying pathogens. WBCs also help clean wounds.

WBCs fight pathogens in several ways. Some WBCs squeeze out of blood vessels and move around in tissues, searching for pathogens. When they find a pathogen, they destroy it. Other WBCs release antibodies. *Antibodies* are chemicals that identify or destroy pathogens. WBCs also keep you healthy by destroying body cells that have died or been damaged. Most WBCs are made in bone marrow. Some WBCs mature in the lymphatic system.

Standards Check **What functions do WBCs perform?** 7.5.a

Figure 3 *White blood cells defend the body against pathogens. These white blood cells have been colored yellow to make their shape easier to see.*

SCHOOL to HOME

Healthy Pressure

Maintaining healthy blood pressure is important for good health. Ask an adult to help you research blood pressure in books or on the Internet. Find three strategies you can use to maintain healthy blood pressure. Discuss how you can make these strategies part of your daily life.

ACTIVITY

Body Temperature Regulation

Your blood does more than carry oxygen and nutrients to your cells. It also helps regulate your body temperature. When you are hot, your blood vessels enlarge. Blood flow to the skin is increased. Heat can then be released into the environment to cool your body. When you are cold, the blood vessels to the skin narrow. Blood flow to the skin is decreased. So, less heat is lost to the environment through your skin.

Blood Pressure

Every time your heart contracts, blood is pushed out of the heart and into your arteries. The force of the blood on the inside walls of arteries is called **blood pressure.**

Blood pressure is expressed in millimeters of mercury (mm Hg). For example, a blood pressure of 110 mm Hg means that the pressure on the artery walls can push a column of mercury to a height of 110 mm.

Blood pressure is usually given as two numbers, such as 110/70 mm Hg. Systolic (sis TAHL ik) pressure is the first number. *Systolic pressure* is the pressure inside large arteries when the ventricles contract. The surge of blood causes the arteries to bulge and produce a pulse. The second number, *diastolic* (DIE uh STAHL ik) *pressure,* is the pressure inside arteries when the ventricles relax. For adults, a blood pressure of 120/80 mm Hg or below is considered healthy. High blood pressure can cause heart or kidney damage.

blood pressure (BLUDH PRESH uhr) the force that blood exerts on the walls of the arteries

Wordwise The root *press-* means "to press."

Standards Check **In what unit is blood pressure normally expressed?**

7.6.j

Quick Lab

Modeling Blood Pressure

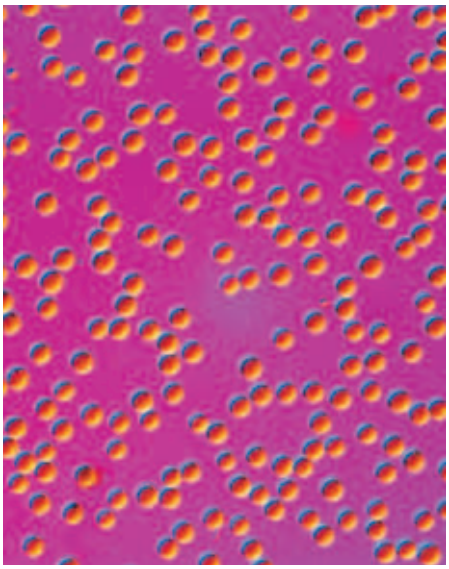
7.6.j
7.7.d

In this activity, you will demonstrate systolic and diastolic blood pressure. You will use a pipet bulb to represent the heart.

1. Fill a **pipet bulb** with **water.** Stretch the mouth of a **long balloon** around the end of the pipet bulb. Secure with **tape.**
2. Carefully squeeze the pipet bulb in one hand. Describe the pressure in the balloon.
3. Release your squeeze on the pipet bulb. Describe the pressure in the balloon now.

4. If the pipet bulb represents the heart, what does the balloon represent?
5. Which state, bulb squeezed or not squeezed, is similar to systolic pressure? Explain.
6. What is your blood pressure if your diastolic pressure is 60 mm Hg and your systolic pressure is 95 mm Hg?

10 min



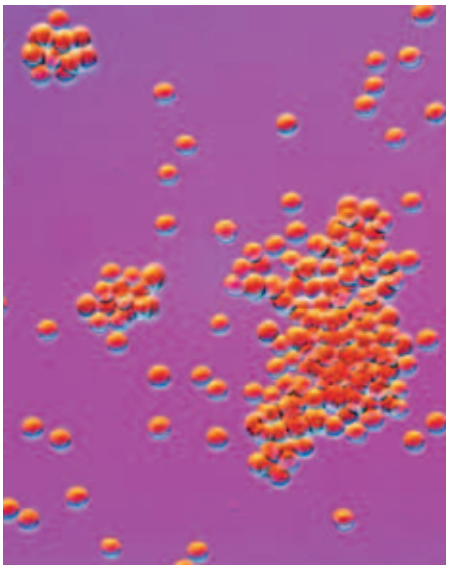


Figure 4 *The slide on the left shows a mixture of blood from two people with the same blood type. The slide on the right shows a mixture of blood from two people with different blood types.* ***What is happening in the slides?***

Blood Types

Your blood type refers to the kinds of molecules you have on the surface of your RBCs. These surface molecules are called *antigens* (AN tuh juhnz). Different blood types have different antigens on their RBCs. Different blood types may also have different antibodies in the plasma. As shown in **Figure 4,** these antibodies react to antigens of other blood types as if the antigens were pathogens.

ABO System

The ABO system is one way of classifying blood based on the kinds of antigens on the surface. Every person has one of four blood types: A, B, AB, or O. Type A blood has A antigens; type B has B antigens; and type AB has both A and B antigens. Type O blood has neither A nor B antigens.

Each blood type may also have different antibodies, as shown in **Figure 5.** For example, type A blood has antibodies that react to type B blood. If a person with type A blood is injected with type B blood, the type B antibodies attach themselves to the type B RBCs. These RBCs begin to clump together, and the clumps may block blood vessels. A reaction to the wrong blood type may be fatal.

Rh System

Another antigen that may be on the surface of RBCs is the Rh antigen. A person with the Rh antigen is considered Rh-positive (Rh^+). A person without the Rh antigen is Rh-negative (Rh^-). If an Rh^- person receives a blood transfusion of Rh^+ blood, antibodies may react and cause the blood to clump.

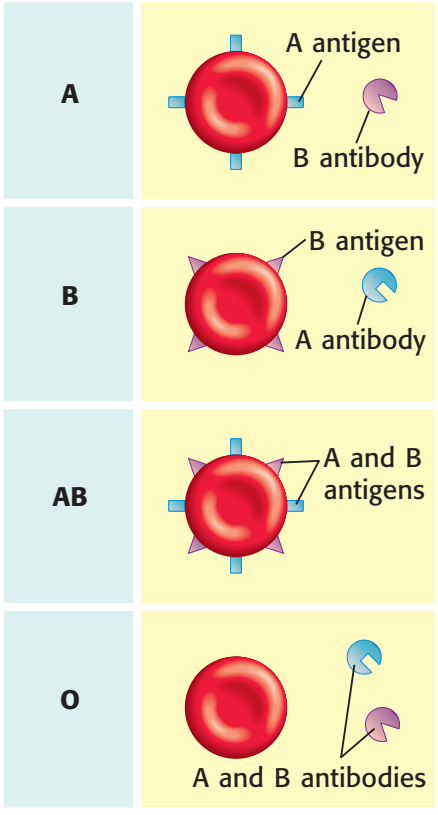


Figure 5 *This figure shows which antigens and antibodies may be present in each blood type.*

MATH PRACTICE

Calculating Heartbeats

A person's heart averages about 70 beats per minute.

1. Calculate how many times a heart beats in one day.
2. If a person lives for 75 years, how many times will his or her heart beat?
3. If an athlete's heart beats 50 times per minute, how many fewer times than an average heart will his or her heart beat in 30 days?

Transfusions and Blood Types

Sometimes, a person must be given a blood transfusion. A *transfusion* is the injection of blood or blood components into a person to replace blood that has been lost because of surgery or an injury. Blood loss may lead to shock. *Shock* happens when a person's cells do not get enough blood. Without blood, cells do not get the oxygen and nutrients that they need, and wastes build up. Cell death may occur. Significant cell death may be fatal to the person.

Blood used in transfusions must be carefully handled. **Figure 6** shows bags of blood that may be given in a transfusion. The blood type is clearly marked. Because the ABO blood types have different antigen-antibody reactions, a person receiving blood cannot receive blood from just anyone. **Table 1** shows blood-transfusion possibilities.

Standards Check Why is shock dangerous to a person? 7.5.b

Figure 6 *These bags of blood clearly show the blood type. Giving the wrong type of blood during a transfusion could be fatal for the transfusion patient.*

Table 1 Blood Transfusion Possibilities

Type	Can receive	Can donate to
A	A, O	A, AB
B	B, O	B, AB
AB	A, B, AB, O	AB
O	O	A, B, AB, O

Blood Disorders

Two of the most common blood disorders are hemophilia and leukemia. A person with *hemophilia* (HEE moh FIL ee uh) is missing a protein that helps blood clot. Blood clots form in a healthy person when blood vessels have been damaged or opened. A person with hemophilia does not form blood clots normally. Even a small cut may lead to significant blood loss. *Leukemia* is a type of cancer that affects blood cells. A person with leukemia may not be able to make enough healthy WBCs and RBCs. Doctors may treat leukemia with bone-marrow transfusions. Bone marrow is often taken from the hip bones of donors, as indicated by the purple dots in **Figure 7.**

Figure 7 *Bone marrow must be collected from a donor before it can be given to a patient through a bone-marrow transfusion.*

SECTION Review

7.5.a, 7.5.b, 7.6.j

Summary

- The four main components of blood are plasma, red blood cells, platelets, and white blood cells.
- Blood carries oxygen and nutrients to cells, helps protect against disease, and helps regulate body temperature.
- Blood pressure is the force that blood exerts on the inside walls of arteries. It is often expressed in the unit of millimeters of mercury.
- Every person has one of four ABO blood types.
- Losing blood, mixing blood types, and blood disorders can be fatal.

Using Vocabulary

1. Write an original definition for *blood* and *blood pressure.*

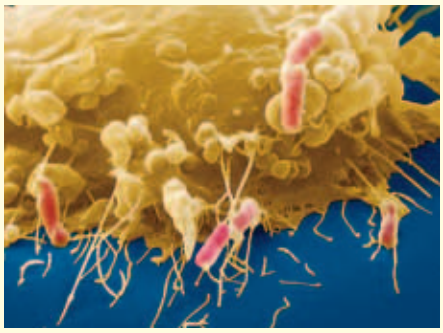
Understanding Concepts

2. **Applying** A person with type B blood can donate blood to people with which type(s) of blood?
3. **Describing** Describe the functions of the four main components of blood.
4. **Concluding** Why is it important for a doctor to know a patient's blood type?
5. **Identifying** What causes blood pressure?

Critical Thinking

6. **Identifying Relationships** How does the body use blood and blood vessels to help maintain proper body temperature?
7. **Predicting Consequences** Some blood diseases affect the ability of red blood cells to deliver oxygen to cells of the body. What might happen to a person with such a disease?

INTERPRETING GRAPHICS The photomicrograph shows a WBC attacking pathogens. Use the image below to answer the next question.



8. **Analyzing Relationships** Explain the function of blood that is being demonstrated in the image.

Math Skills

9. **Making Calculations** What percentage of normal (120 mm Hg) is a systolic pressure of 174 mm Hg?

Internet Resources

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

Topic: Blood; Blood Donations

SciLinks code: HY70175; HY70178