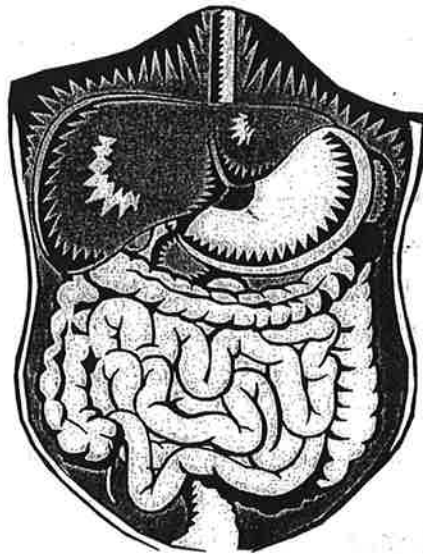


Name : _____

Human Systems PACKET



Circulatory and Respiratory Systems

Key Words

- circulation:** movement of blood through the body
- atria:** upper chambers of the heart that receive blood as it returns to the heart
- ventricles:** lower chambers of the heart through which blood passes when pumped from the heart
- arteries:** blood vessels that carry blood away from the heart
- capillaries:** tiny, thin-walled blood vessels through which the exchange of substances between blood and body cells takes place
- veins:** blood vessels that carry blood to the heart
- plasma:** liquid part of blood mostly made of water containing dissolved nutrients, minerals, vitamins, and wastes
- respiration:** process of taking oxygen in and removing carbon dioxide from the body
- diaphragm:** large flat muscle at the bottom of the rib cage that assists breathing

KEY IDEAS

Blood moves through the body by a network of blood vessels. The heart pumps blood through this network. The blood vessels and heart make up the circulatory system. As blood flows through vessels in the lungs, oxygen moves into the blood cells. At the same time, carbon dioxide leaves the cells. The respiratory system moves air into and out of the body to ensure the constant exchange of gases.

An aerobics instructor shows people how to exercise properly. The instructor designs exercise routines that increase heart and respiratory rates. Aerobic exercise burns calories and strengthens heart muscles. To design helpful and safe aerobic routines, the instructor must be aware of the structure and function of the body's circulatory and respiratory systems.

Circulatory System. The movement of blood through the body is **circulation** (suh-kyoo-LAY-shun). Materials the body needs must be transported in the blood. The job of the circulatory system is to transport these materials throughout the body. For example, the circulatory system brings food and oxygen to body cells. It also removes waste products, such as carbon dioxide, from body cells.

The Heart. The circulatory system is powered by the heart. The heart is a muscular organ that pumps blood throughout the body. The structure of the heart is like a two-sided pump. A thick wall of muscle divides the heart into two sides. The right side of the heart pumps blood only to the lungs. The blood picks up oxygen in the lungs. The blood then returns to the left side of the heart. The left side pumps the oxygen-rich blood throughout the entire body. When the body has used the blood's oxygen, the blood returns to the right side of the heart.

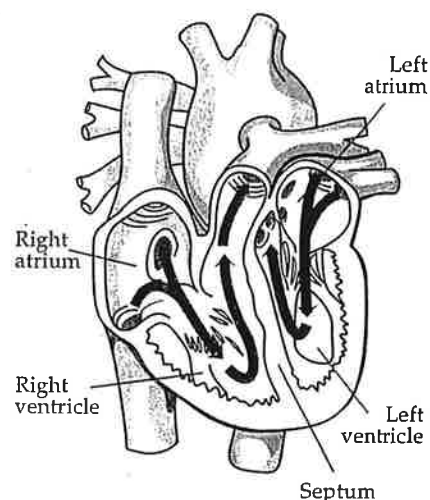
The heart is divided into four chambers, shown in Fig. 44-1. The two upper chambers are the right atrium and the left atrium (plural, *atria*). These two **atria** (AY-tree-uh) receive blood as it returns to the heart. The two lower chambers are the right ventricle and the left ventricle. Blood is pumped from the heart by the **ventricles** (VEHN-trih-kuhlz).

Between the atrium and ventricle on each side of the heart are valves. The valves are strong flaps of tissue that act like doors. The job of valves is to prevent blood from flowing backward. By opening and closing at certain times, the valves ensure that blood flows in only one direction from the atria to the ventricles.

Blood Vessels. Blood is continuously transported through the body in a closed network of tubes, or blood vessels. Blood vessels are made of muscle tissue. The three kinds of blood vessels are arteries, veins, and capillaries. When the heart muscle contracts, blood is pumped into the arteries. **Arteries** (AHRT-uhr-eez) are muscular blood vessels that carry blood away from the heart.

Arteries are connected to very small, thin-walled blood vessels called **capillaries** (KAP-uh-lehr-eez). The exchange of substances between the blood and body cells takes place through the thin capillary walls. Food and oxygen move from blood into body cells. Carbon dioxide and other waste products move from body cells into the blood. The capillaries that carry away the waste products are connected to veins. **Veins** (vaynz) are blood vessels that carry blood back to the heart. Veins have less muscle in their walls than arteries do.

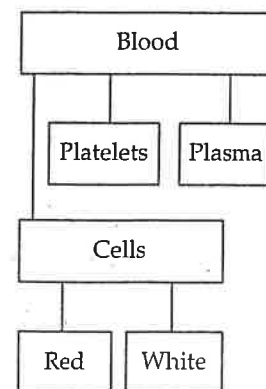
Fig. 44-1



1. How are arteries and veins alike? How are they different?

Blood. Blood is a type of tissue that is a mixture of plasma, red blood cells, white blood cells, and platelets. Fig. 44-2 shows the four components of blood. **Plasma** (PLAZ-muh) is the liquid part of blood. It is mostly water. Dissolved in this water are nutrients, minerals, vitamins, and wastes. Red blood cells carry oxygen throughout the body. A red protein called hemoglobin is contained in red blood cells. Hemoglobin is the part of the cell that holds the oxygen. It also gives the cell its red color.

Fig. 44-2



White blood cells protect the body against infection. Some white blood cells actually digest disease-causing cells. Other white blood cells release chemicals that help the body fight disease.

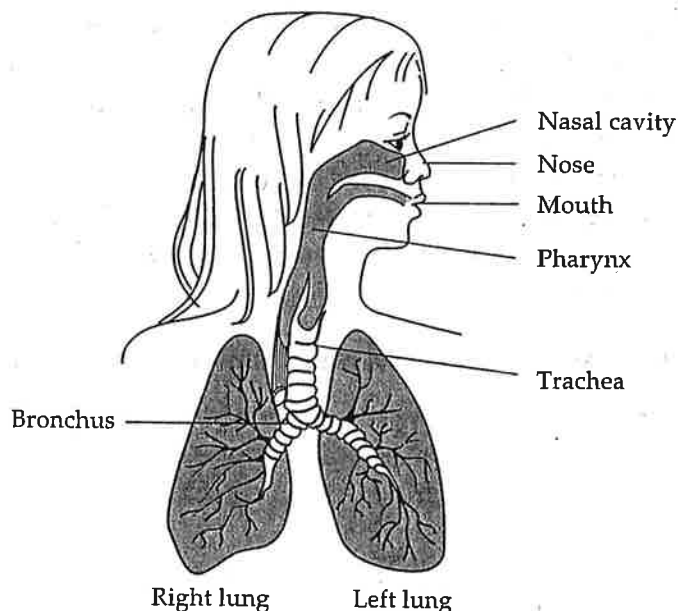
Pieces of cells called platelets are also contained in blood. Platelets work to stop the flow of blood from a wound. If a blood vessel is cut, platelets rush to the wound. The platelets help form a substance that plugs the wound. The plug, or clot, stops the flow of blood from the vessel.

Respiratory System. One of the main functions of the circulatory system is to carry oxygen throughout the body. **Respiration** (reh-s-per-AY-shun) is the process of taking oxygen in and removing carbon dioxide from the body. This is done by the respiratory system. The respiratory system consists of the nose, nasal cavity, pharynx, airways, and lungs. The airways consist of the trachea, the bronchi, and passages within the lungs. Fig. 44-3 shows the parts of the respiratory system.

When you breath in, or inhale, air enters the respiratory system through the nose. Hairs in the nose trap particles of dirt and dust contained in the air. The air then moves into the nasal cavity. The nasal cavity is a hollow opening between the nose and throat. A sticky substance called mucus lines the nasal cavity. The solid particles left in the air stick to the mucus.

Air then moves into the pharynx, or throat. Food also passes through the pharynx. The bottom of the pharynx connects to two tubes. When you swallow, food goes down one of the tubes. Air goes down the other tube called the trachea, or windpipe. The walls of the trachea are lined with mucus. Once again, particles in the air stick to the mucus lining.

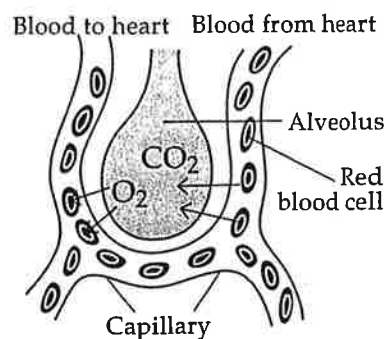
Fig. 44-3



The Lungs. At the end of the trachea lie two smaller tubes called bronchi (sing. *bronchus*). Each bronchus leads to a lung. The lungs are the main organs of the respiratory system. The exchange of gases occurs within the lungs.

In the lungs are clusters of tiny air sacs called alveoli (sing. *alveolus*). Surrounding the alveoli is a network of capillaries. The very thin walls of the alveoli and capillaries permit the passage of oxygen and carbon dioxide. Fig. 44-4 shows the exchange of gases at an alveolus. Oxygen moves from the alveolus into the blood in the capillaries. At the same time, carbon dioxide moves from the blood in the capillaries into the alveolus. The oxygen-rich blood then returns to the heart. The heart pumps this oxygen-rich blood to the cells of the body. Carbon dioxide is released from the body when you exhale, or breath out.

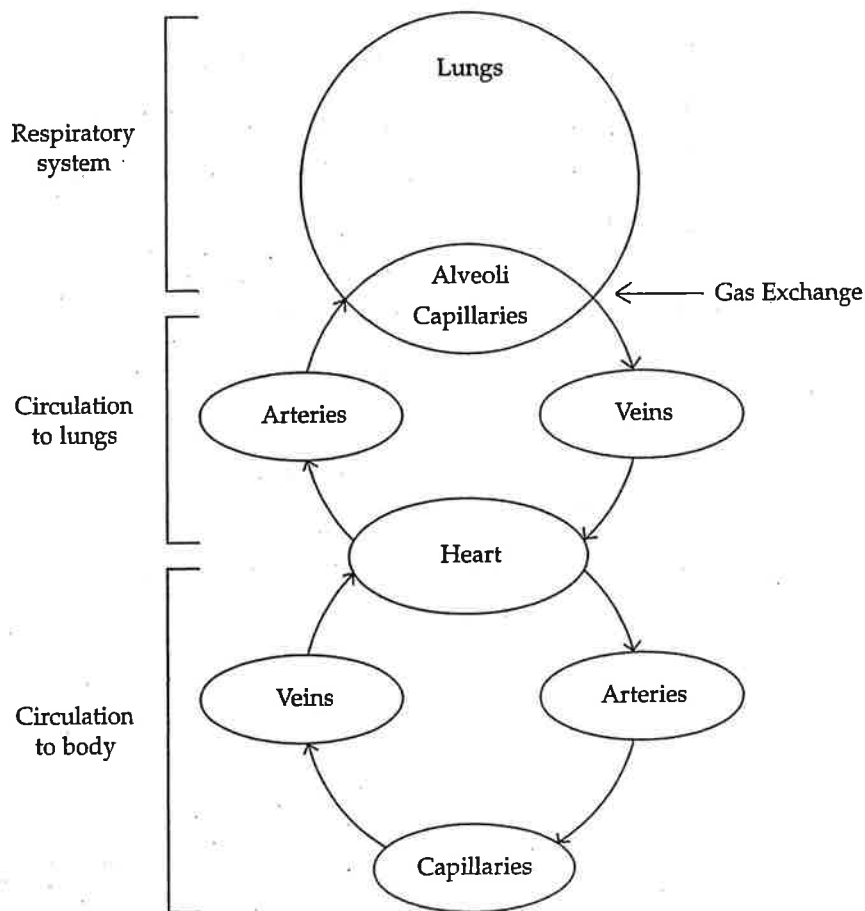
Fig. 44-4



Breathing draws air into and out of the body. A muscle called the diaphragm assists breathing. The **diaphragm** (DY-uh-fram) is a large, flat muscle that lies at the bottom of the rib cage. When the diaphragm contracts, air is drawn into the lungs. When the diaphragm relaxes, air is pushed out of the lungs.

Fig. 44-5 summarizes the relationship among the circulatory and the respiratory systems.

Fig. 44-5



**TAKE
ANOTHER
LOOK**

Check Your Understanding

Complete the outline using the following words: *alveoli, arteries, atria, bronchi, capillaries, diaphragm, lungs, plasma, platelets, pump, red blood cells, respiration, trachea, veins, ventricles, white blood cells*

I. Circulatory System

A. Heart

1. The heart is a two-sided (2)_____.
2. Right and left (3)_____ receive blood.
3. Blood leaves through right and left (4)_____.

B. Blood Vessels

1. (5)_____ carry blood away from the heart.
2. (6)_____ carry blood to the heart.
3. Oxygen enters blood by passing through the thin walls of the (7)_____.

C. Blood

1. (8)_____ carry oxygen.
2. (9)_____ fight infections.
3. (10)_____ help to form clots.
4. (11)_____ is the liquid part of blood.

II. Respiratory System

A. (12)_____ is the process of taking oxygen in and removing carbon dioxide from the body.

1. From the pharynx, air goes down the windpipe, or (13)_____.
2. At the end of the trachea are the (14)_____ which lead to the lungs.
3. The main organs of gas exchange are the (15)_____.
4. Oxygen moves from the (16)_____ into capillaries.

B. The motion of the (17)_____ draws air into and out of the body.



18. Why is the heart described as a two-sided pump?

19. What do valves in the heart do? _____

20. What are the three types of blood vessels? What does each one do?

21. How do the functions of red blood cells and white blood cells differ?

Digestion and Excretory Systems

Key Words

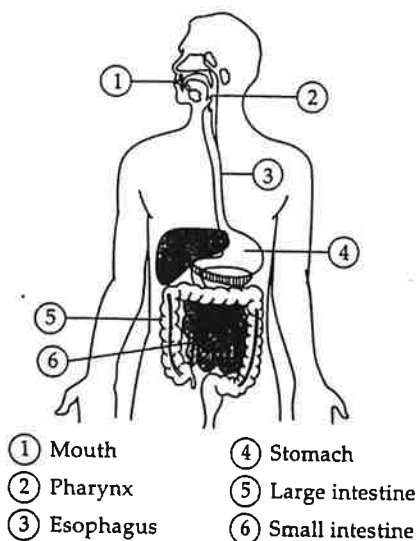
mechanical digestion: breaking down of food into smaller pieces by physical means

chemical digestion: breaking down of food into simple molecules by enzymes

KEY IDEAS

The digestive system changes food into a form that body cells can use. Mechanical digestion and chemical digestion take place in the organs of the digestive system. The excretory system removes waste products from the body.

Fig. 45-1



Did you ever wonder who chooses the food served in your school cafeteria? Dietitians plan menus and supervise the cooking of food. They work in schools, hospitals, and company lunchrooms. Dietitians make sure the meals provide a balanced diet.

Digestive System. Think about the different foods you ate yesterday. Although foods contain many nutrients, your body must change the food before it can be used. The food must be broken down into different forms by the digestive system. The digestive system includes the mouth, pharynx, esophagus, stomach, large intestine, and small intestine. See Fig. 45-1.

Food enters your digestive system through the mouth. The teeth tear and crush the food into smaller pieces. The physical breakdown of food is called **mechanical digestion** (muh-KAN-ih-kuhl dih-JEHS-chuhn). Saliva mixes with the food in the mouth. Saliva contains enzymes that break down certain food molecules. The breaking down of food into simpler molecules by enzymes is called **chemical digestion** (KEHM-ih-kuhl dih-JEHS-chuhn).

From the mouth, the partly digested food enters the pharynx. Recall from Lesson 44 that the pharynx splits into two tubes. One side leads to the windpipe, or trachea. Air goes down this tube. When you swallow, a flap of tissue closes off the trachea. This ensures that food goes down the other tube, called the esophagus. The esophagus is a muscular tube that contracts. The wavelike contractions of the esophagus push food into the stomach.

The Stomach. Both mechanical and chemical digestion take place in the stomach. The stomach walls secrete gastric juices containing enzymes. The gastric juices continue the chemical digestion of food. Contractions of the muscular stomach walls mix food with the juices. This mechanically breaks down the food. As a result of these processes, food is turned into a thick liquid.

The Intestines. The stomach muscles push the liquid from the stomach into the small intestine. Most of the chemical digestion of food occurs in the small intestine. In this organ, food mixes with a variety of enzymes. The cells that line the walls of the small intestine release some of the enzymes. Other enzymes in the small intestine are made in the pancreas and liver. The gallbladder stores the enzyme from the liver until it is needed.

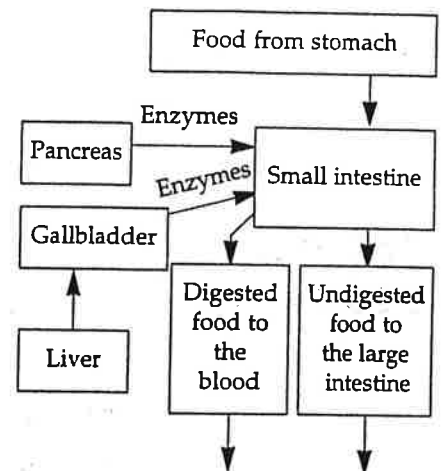
Digestion in the small intestine changes food into substances that the body can use. These substances are ready to be absorbed into the bloodstream. Digested food passes through fingerlike projections that cover the inner lining of the small intestine. The food moves into the bloodstream, where it is carried to body cells. See Fig. 45-2.

Undigested food and water pass out of the small intestine into the large intestine. Water and minerals are absorbed through the lining of the large intestine into the blood. Solid wastes move into the lower part of the large intestine, or rectum. These wastes pass out of the rectum and are eliminated from the body.

Excretory System. Waste products from cells are removed from the body by the excretory system. The lungs are part of the excretory system. They remove carbon dioxide from the body. However, the major organs of the excretory system are the kidneys. The main job of the kidneys is to filter the blood. To filter the blood, the kidneys reabsorb any substances needed by the body and get rid of the cells' waste products.

Arteries carry blood to the kidneys. The arteries lead to tiny clusters of capillaries inside the kidneys. Nutrients, water, salts, and waste products in the blood pass through the tiny capillary walls into cuplike sacs. From the sacs, all the substances move through a long, winding tube. The nutrients

Fig. 45-2

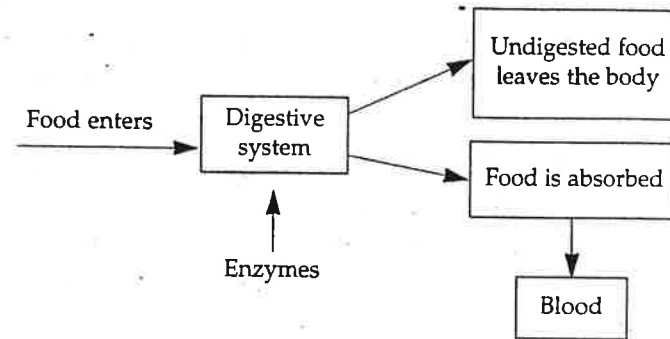


and most of the water pass back into the blood to be used by the body. The wastes that are left, called urine, move to the end of the tube. The urine moves out of the kidneys into a sac of tissue called the urinary bladder. When the urinary bladder is full, the bladder's muscles contract. This push sends the urine from the body.

TAKE ANOTHER LOOK

Fig. 45-3 summarizes how food is digested.

Fig. 45-3



Check Your Understanding

Complete the following paragraphs.

Food enters the digestive system through the (1)_____. Teeth begin the (2)_____ digestion of food. Chemical digestion begins when (3)_____ mixes with the food in the mouth. The partially digested food passes through the (4)_____ on the way to the esophagus. Contractions of the esophagus move the food to the (5)_____. It then passes into the (6)_____ intestine. Enzymes produced by the liver and (7)_____ continue the chemical digestion of food. When digestion is completed, food passes through fingerlike projections in the intestine's lining into the (8)_____. Undigested food passes into the (9)_____ intestine. These wastes are then eliminated from the body.

Waste products from cells are removed by the (10)_____ system. The main job of the (11)_____ is to filter the blood by absorbing nutrients and eliminating waste. The wastes are called (12)_____. When the (13)_____ contracts, urine is eliminated from the body.



14. How does the esophagus help move food through the digestive system?
- _____
- _____
- _____
15. How does mechanical digestion occur in the stomach?
- _____
- _____
- _____
16. How does the liver aid in the digestion of food? _____
- _____
- _____
17. How do body cells obtain nutrients from food in the small intestine?
- _____
- _____
- _____
18. What is the job of the kidneys? _____
- _____
- _____
19. How do nutrients get into and out of the kidneys?
- _____
- _____
- _____
20. To speak, you need to breathe in and out. Why is it dangerous to speak and eat at the same time? (Hint: Think about the way food enters the esophagus.) _____
- _____
- _____
- _____

Nervous System and Senses

Key Words

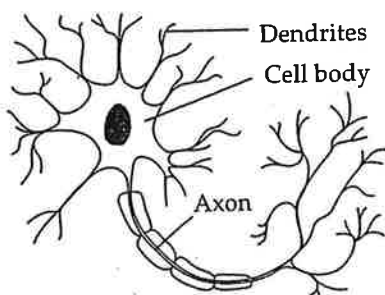
neurons:	nerve cells that carry messages throughout the body
impulses:	messages carried by neurons
cerebrum:	part of the brain that controls all voluntary activities of the body
cerebellum:	part of the brain that coordinates and balances the actions of the voluntary muscles
medulla:	part of the brain that controls involuntary actions
spinal cord:	long bundle of nerve fibers surrounded by the backbone that connects the brain with the rest of the nervous system

KEY IDEAS

The nervous system receives and relays information about activities within the body. The nervous system also receives messages about the environment and responds to those messages. The nervous system is made up of the brain, the spinal cord, and all the nerves of the body.

At this very moment, you are responding to your environment. You are using your sense of sight to read this page. The nervous system controls your senses and their responses.

Fig. 46-1



Neurons. The nervous system receives and relays information about activities within the body. It also monitors and responds to internal and external changes. The nervous system contains billions of neurons. **Neurons** (NUHR-rahnz) are nerve cells that carry messages throughout the body. Fig. 46-1 shows the three parts of a neuron: the cell body, dendrites, and the axon. The nucleus of the neuron and most of the cytoplasm are in the cell body. Branching out from the cell body are threadlike structures called dendrites. Dendrites receive messages from other neurons and carry them to the cell body. The axon is a long, thin fiber that extends from the cell body. The axon carries messages away from the cell body.



1. What do neurons do? _____

The Brain. The messages carried by neurons are called **impulses** (IHM-pul-sehz). Impulses are carried from nerves to the brain or from the brain to nerves. The brain is called the control center of the body because it makes the body respond to all the impulses.

The brain has three main parts which are shown in Fig. 46-2. The large, upper part of the brain is the **cerebrum** (SEHR-uh-brum). The cerebrum controls all voluntary activities of the body. It controls movement, speech, memory, and emotions. The cerebrum also identifies the impulses it receives from the senses. The cerebrum controls activities such as learning, reasoning, problem solving, and decision making.

Near the back of the head, beneath the cerebrum, is the **cerebellum** (sehr-uh-BEHL-um). The cerebellum coordinates and balances the actions of the voluntary muscles. It makes your muscles move smoothly and helps you keep your balance.

Bundles of nerves from the cerebrum and cerebellum come together at the base of the brain. They form the brainstem. The lowest part of the brainstem is the **medulla** (mih-DUL-uh). The medulla controls involuntary actions such as breathing, heart rate, and digestion.

The Spinal Cord. The brainstem continues into the spinal cord. The spinal cord is a part of the nervous system. The **spinal cord** (SPY-nuhl KORD) is a long bundle of nerve fibers surrounded by the backbone. It connects the brain with the neurons in all parts of the body.

The Senses. The nervous system receives messages about the environment and then responds to the messages. Some of the messages go through the spinal cord to the brain. Other messages go only to and from the spinal cord. The brain and spinal cord get the messages from the sense organs. The sense organs are the eyes, ears, skin, tongue, and nose. Each sense organ is associated with a specific sense: vision, hearing, touch, taste, or smell. Special cells in the sense organs detect energy. The energy can be light, heat, sound, chemical, or even pressure. Fig. 46-3 shows which organ senses each kind of energy.

Fig. 46-2

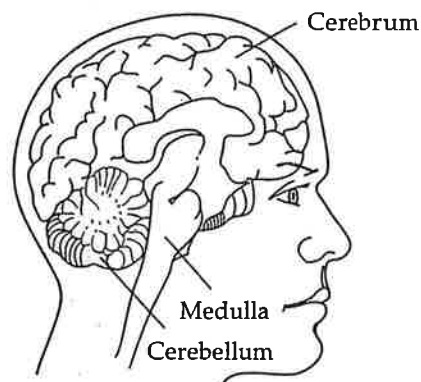







Fig. 46-3

Organ	Sense	Energy
	→ Sight	→ Light
	→ Hearing	→ Sound
	→ Touch	→ Heat, pressure
	→ Taste	→ Chemical
	→ Smell	→ Chemical

The sense organs and nervous system work together to help the body respond to its environment. When the cells sense energy, they send an impulse through neurons. Certain kinds of impulses require quick responses. These impulses travel only to the spinal cord. The spinal cord sends another impulse back to the neurons in the body part that needs to respond. For example, if you touch a very hot pan, nerves in the skin of your fingers sense the heat. The heat impulse travels through neurons to the spinal cord. The spinal cord instantly sends back an impulse that makes your hand pull back. This is an automatic response that takes less than one second. At the same time, a slower impulse travels to your brain. Soon after you've responded, your brain knows what happened.

Other impulses do not cause automatic responses. The neurons in your sense organs relay these impulses through the spinal cord to the brain. The brain then decides what the impulse means. For example, when you hear a friend call your name, neurons in your ears carry the sound impulse to your brain. The brain understands the meaning of the words and tells you who spoke.

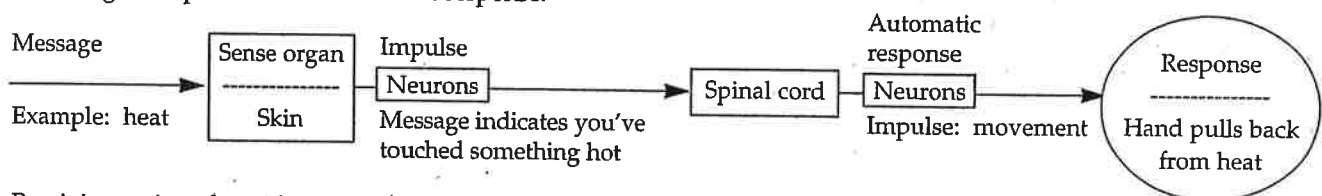
You can then decide if you want to respond. The brain sends an impulse through the spinal cord to the part of the body that you want to move. For example, you decide to turn your head toward your friend, and your neck moves. This response is not automatic. Instead, you respond consciously, or think about how to respond.

TAKE ANOTHER LOOK

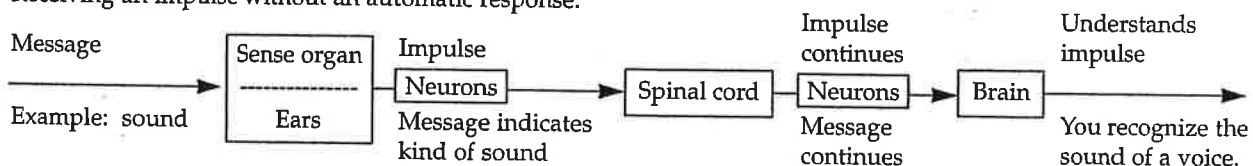
Fig. 46-4 shows how nerve impulses reach the brain and the different ways the body responds.

Fig. 46-4

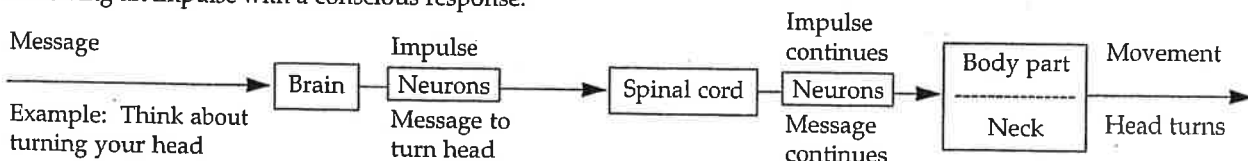
Receiving an impulse with an automatic response:



Receiving an impulse without an automatic response:



Receiving an impulse with a conscious response:



Check Your Understanding

Complete the following paragraph with the correct terms.

The nervous system is made up of billions of (2)_____. Neurons carry (3)_____ throughout the body. (4)_____ organs send messages about the environment. The (5)_____ tells the body how to respond to these messages. The (6)_____ is the part of the brain that controls all voluntary activities. The (7)_____ coordinates and balances the actions of the voluntary muscles. Involuntary actions are controlled by the (8)_____.



-
9. What does the nervous system do? _____

 10. How do dendrites differ from axons? _____

 11. Why is the brain called the control center of the body?

 12. What form of energy do the ears detect? _____

 13. How do sense organs relay information about the environment to the brain? _____

Immune System

Key Words

pathogens:	substances that cause disease
inflammatory response:	process in which special white blood cells move into the tissue where the pathogen lies and destroy the invading pathogen.
antigens:	proteins or chemicals that are foreign to the body
antibodies:	proteins produced by the body to fight off specific pathogens
T-cells:	special white blood cells that fight off specific pathogens

KEY IDEAS

The immune system protects the body from disease. The system uses both nonspecific and specific defenses for destroying disease-causing substances. If the immune system does not work well, the body is not protected.

Have you ever canned vegetables? If so, you probably followed a very specific set of directions to ensure that your vegetables did not contain bacteria that cause disease. Some of the steps you followed, such as boiling the container, kill bacteria. The human body also has ways of killing these disease-causing organisms.

Right now, pathogens surround your body. **Pathogens** (PATH-uh-juhnz) are substances that cause disease. Your body works to fight off these pathogens. The constant struggle to protect the body from disease is the job of the immune system.

Nonspecific Defenses. The immune system consists of both nonspecific and specific defenses. Nonspecific defenses are not directed at a particular type of pathogen. They guard against all disease-causing substances. Nonspecific defenses are the first to protect you from disease-causing substances that enter your body.

The skin is part of the first line of nonspecific defenses. Very few pathogens can get through this barrier. Natural openings to the body, such as the mouth and nose, contain other nonspecific defenses. Mucus and hairs that line the inside of your nose trap pathogens. This keeps the pathogens from moving into the body.

Cilia and mucus in other parts of the respiratory system also trap pathogens. Recall that cilia are tiny hairs.

Digestive juices in the stomach break apart pathogens that enter the digestive system. Body secretions, such as tears, saliva, and sweat, also contain enzymes that break down pathogens.

Inflammatory Response. Despite these defenses, pathogens do get into the body. When this occurs, the body's second line of nonspecific defenses attacks the pathogen. This type of defense is called the inflammatory response. The **inflammatory response** (in-FLAM-uh-toh-ree ree-SPAHNS) is a process in which special white blood cells move from the blood into the tissue where the pathogen lies. The white blood cells then surround and destroy the pathogen. This causes swelling, or inflammation, in the area of the attack.

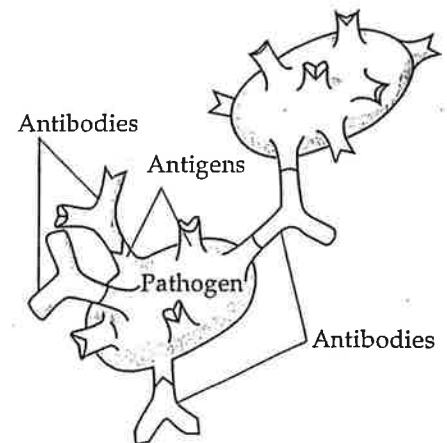


1. List five nonspecific defenses that help protect the body from pathogens. _____

Antigens and Antibodies. Sometimes, a pathogen is able to survive both the first and second line of nonspecific defenses. If this occurs, chemicals on the surface of the pathogen then alert the immune system to begin a specific defense. A specific defense is a response of the immune system to a specific pathogen. The surface of a pathogen has chemicals that the body recognizes as foreign. These foreign chemicals are called **antigens** (AN-tuh-juhnz). The body reacts to the presence of antigens by producing antibodies. **Antibodies** (AN-tih-bahd-eez) are special proteins that fight off pathogens.

One pathogen can have a number of different antigens on its surface. Each kind of antibody works against only one kind of antigen. The body recognizes the antigen and produces the proper antibody. Sites on the antibody are shaped to fit together with sites on a certain antigen. As Fig. 48-1 shows, the antibodies bond with the antigens. Once the antibodies bond with the antigen, they can help destroy the pathogen.

Fig. 48-1



T-cells. The immune system fights some pathogens with another specific defense called T-cells. **T-cells** (TEE-sehlz) are special white blood cells. Some T-cells directly attack the cells of pathogens. The T-cells transfer proteins directly into the cell membrane of the pathogen. This causes the pathogen cell to burst and die. Other T-cells search for and identify pathogens. The T-cells then alert the immune system, which sends antibodies to attack the pathogen. T-cells also help control the immune system so that the system responds only when necessary.

AIDS. AIDS is a disease in which the immune system cannot protect the body from infection. A virus, called HIV, causes this deadly disease. HIV attacks the immune system. Once it enters the body, HIV virus destroys

white blood cells that identify antigens, produce antibodies, or destroy invading antigens. As the virus takes over the cells of the immune system, the infected person is no longer able to fight disease. Diseases that the body normally can fight off become deadly.

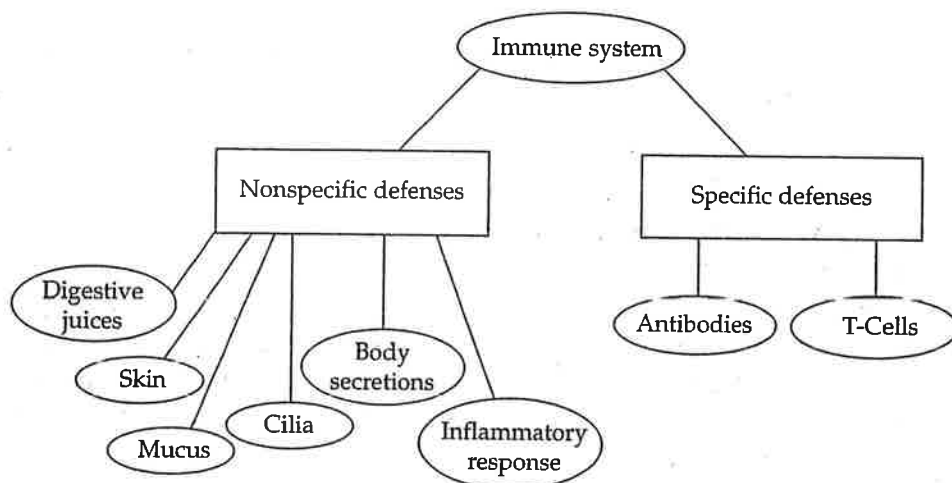


2. What causes AIDS? _____

TAKE ANOTHER LOOK

Fig. 48-2 summarizes the relationship among the nonspecific and specific defenses of the immune system.

Fig. 48-2



Check Your Understanding

Complete the paragraph with the following terms: *antibodies, antigens, HIV virus, immune system, nonspecific, pathogens, skin, specific.*

Substances that cause disease are called (3) _____. The (4) _____ protects the body from these substances. There are two types of defense mechanisms that work against pathogens. (5) _____ defenses guard against all types of pathogens. The (6) _____ belongs to this line of defense. (7) _____ defenses attack certain types of pathogens. This reaction is triggered when the body detects a foreign chemical or (8) _____. The immune system reacts by producing special proteins called (9) _____. The antibodies bond with the antigens to destroy the pathogen.



-
10. What is the difference between the nonspecific defenses and specific defenses of the immune system? _____

11. Why are tears considered to be a nonspecific mechanism of the immune system? _____

12. What is the inflammatory response? _____

13. How do T-cells help fight disease? _____

14. What effect does HIV have on the immune system? _____

15. Why is a common disease, such as a cold, extremely dangerous for a person with AIDS? _____

