

# Interactions of Human Body Systems

## How Body Systems Interact

### ..... Before You Read .....

<b>What do you think?</b> Read the three statements below and decide whether you agree or disagree with them. Place an A in the Before column if you agree with the statement or a D if you disagree. After you've read this lesson, reread the statements to see if you have changed your mind.		
Before	Statement	After
	4. Nutrients are processed by the skeletal system.	
	5. The nervous system moves oxygen through the body.	
	6. You do not control reflexes.	

### ..... Read to Learn .....

## Homeostasis

Your body has a system to keep its internal temperature constant. That system works much like a thermostat that keeps a building's temperature constant. The endocrine system regulates body temperature. It sends messages through the nervous system.

For example, when temperatures in the body fall below 37°C, the nervous system signals the muscular system to cause the body to shiver. When you shiver, your muscles move. Tiny muscles attached to hairs on the skin contract and pull the hairs up straight, forming goose bumps. This movement generates thermal energy and helps raise body temperature. Keeping the body's temperature constant requires that the endocrine system, the nervous system, and the muscular system work together.

Your body's organ systems work together and maintain many types of homeostasis (hoh mee oh STAY sus). These include temperature, nutrient levels, oxygen, fluid levels, and pH. **Homeostasis** is the ability to maintain constant internal conditions when outside conditions change. In this lesson, you will read how organ systems work together and maintain homeostasis.

### Key Concepts

- How are nutrients processed in the body?
- How does the body transport and process oxygen and wastes?
- How does the body coordinate movement and respond to stimuli?
- How do feedback mechanisms help maintain homeostasis?

### Study Coach

#### Identify the Main Ideas

Work with a partner. Read a paragraph together. Then discuss what you learned in the paragraph. Continue until you and your partner understand the main ideas of the lesson.

### SCIENCE USE V. COMMON USE

#### organ

**Science Use** a group of tissues performing a specific function

**Common Use** a keyboard instrument in which pipes are sounded by compressed air

## Processing Nutrients

Maintaining homeostasis keeps the internal environment in the body functioning properly. Many organ systems work together and maintain energy homeostasis.

The body gets most of its energy from carbohydrates. Lipids and proteins also provide energy. The food you eat is broken down by chemical and mechanical digestion.

Chemical digestion occurs when enzymes in saliva and acid in your stomach break down food. Mechanical digestion happens when you chew your food. The digestive system, the circulatory system, and the muscular system work together and process and obtain nutrients from food. The skeletal system, the endocrine system, and the lymphatic system also work with the digestive system and process those nutrients.

## Muscles and Digestion

Food enters the body through the digestive system. There it is broken down into nutrients that can be absorbed into the body. However, the muscular system is needed to get food through the digestive system. Muscles that surround the stomach contract and move food to the small intestine. These contractions are called peristalsis (per uh STAHL sus).

Muscles help the jaw move when you chew. They help you swallow. Muscles also surround the esophagus, the stomach, the small intestine, and the large intestine. These muscles help move food through the digestive system. ✓

## Circulation and Digestion

The small intestine has two important jobs. It breaks down food and absorbs nutrients. The muscular system and the circulatory system work with the small intestine.

The muscular system helps the small intestine break down food. The circulatory system works with the small intestine and gets nutrients to the rest of the body.

Nutrients are absorbed by small, fingerlike projections called villi (VIH li; singular, villus) in the small intestine. The villi have blood vessels inside them, which are part of the circulatory system. Nutrients enter these blood vessels and are then transported to the rest of the body. The muscular system also surrounds the blood vessels and helps blood and nutrients move through the body. The figure on the next page shows a close look at one villus and how the digestive system and the circulatory system work together. ✓

### ✓ Reading Check

**1. Locate** Where are muscles found in the digestive system?

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### ✓ Key Concept Check

**2. Describe** How are nutrients processed in the body?

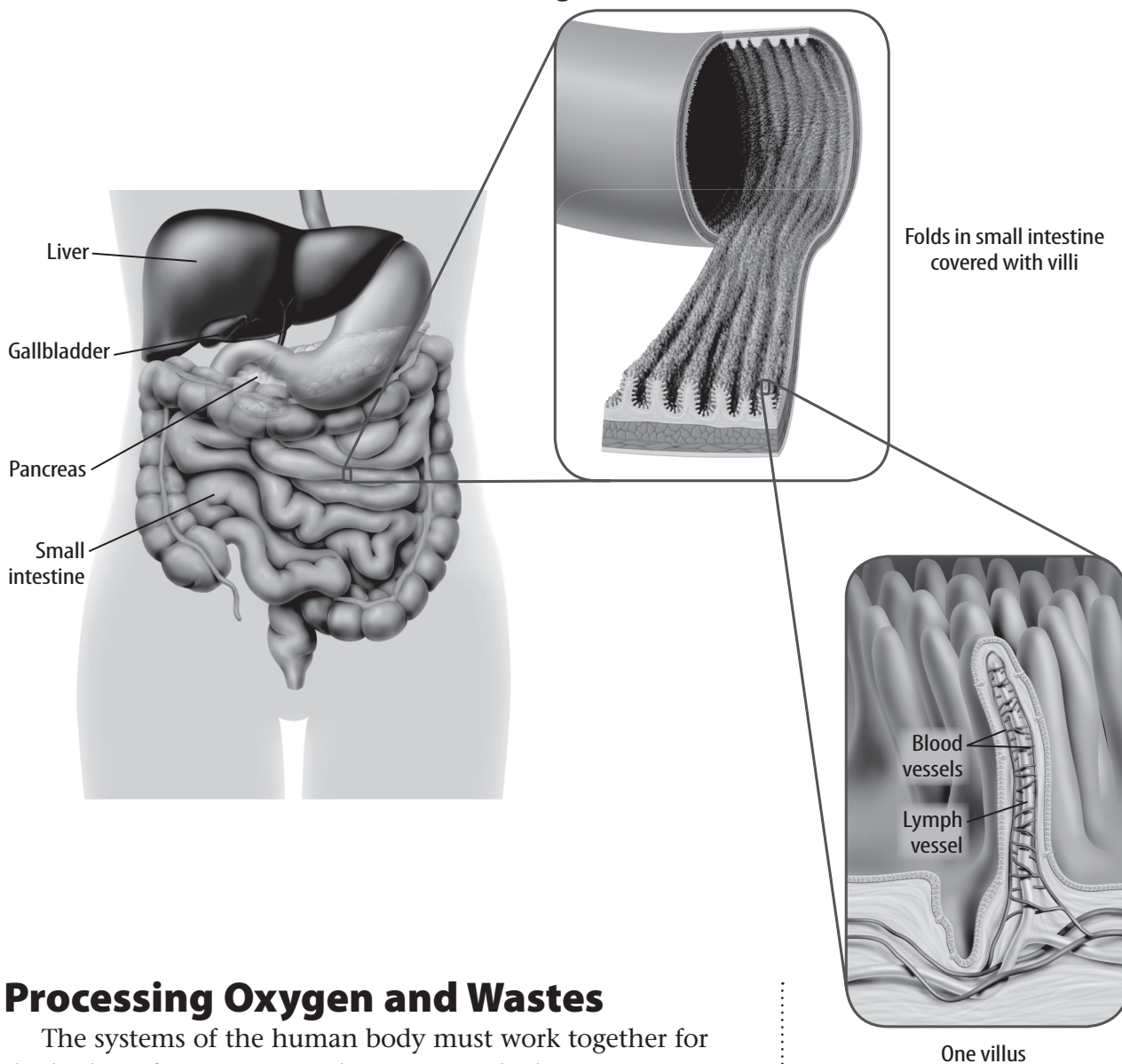
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## Absorbing Nutrients



## Processing Oxygen and Wastes

The systems of the human body must work together for the body to function properly. For example, humans require oxygen to survive. Your lungs take in oxygen and release carbon dioxide. The cells in your body use oxygen to help process the energy in nutrients into energy that cells can use. Oxygen helps the body obtain energy from nutrients by performing cellular respiration. As discussed next, various organ systems work together and help the body take in oxygen and move it through the body.

### Oxygen Transport

Oxygen enters the body through the respiratory system. When you inhale, the respiratory system works with the circulatory system and transports oxygen to all cells in the body. The muscular system also helps the respiratory system by expanding the chest so that cells in the lungs fill up with oxygen.

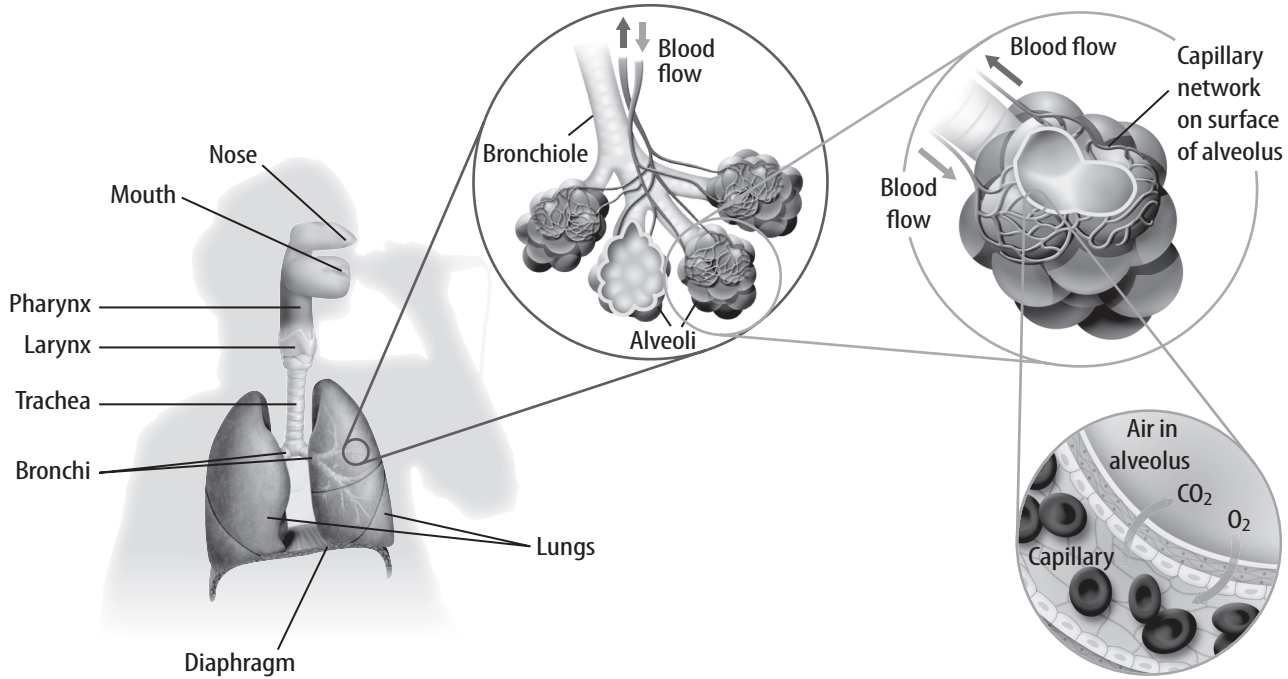
### Visual Check

**3. Identify** What does each villus contain?

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## Transporting Oxygen



### Visual Check

**4. Name** What do capillaries release?

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Recall that the circulatory system works with the small intestine and moves nutrients into the body. The circulatory system also works with the lungs and helps oxygen travel through the body, as shown in the figure above. Oxygen that is taken in by capillaries is transported to the rest of the body through larger blood vessels.

### Eliminating Wastes

The excretory system works with several other organ systems and eliminates wastes. Recall that the body processes food, oxygen, and liquids.

Food and liquids are processed by the digestive system. After nutrients are absorbed during digestion, the excretory system removes solid waste products, or feces, through the rectum.

The excretory system also works with the respiratory and circulatory systems and removes carbon dioxide ( $\text{CO}_2$ ) from the body. Oxygen is used in all organs of the body. The  $\text{CO}_2$  produced by cells in the body enters capillaries and is transported to the lungs, where it is exhaled. These three systems work together and maintain oxygen homeostasis by making sure that  $\text{CO}_2$  is removed.

The excretory system also maintains fluid homeostasis. Liquid waste travels through the circulatory system to the kidneys, as shown in the figure on the next page. The kidneys make urine. Liquid waste also travels to the skin where fluid is released during sweating. 

### Key Concept Check

**5. Relate** How does the body transport and process oxygen and wastes?

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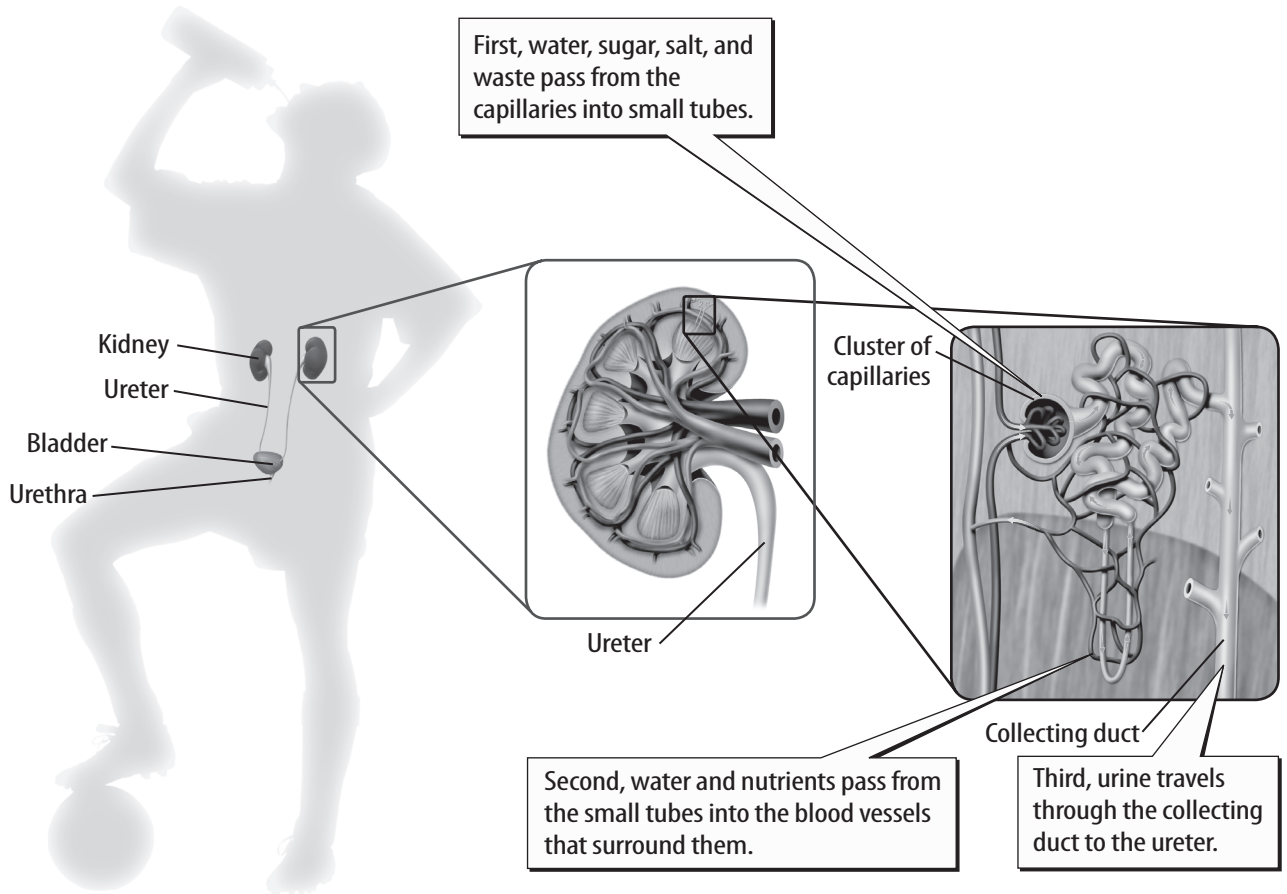


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## Kidney Function



## Control and Coordination

How does your heart beat without you thinking about it? The heart contains a group of specialized cells called pacemaker cells. Pacemaker cells control the rate at which the heart beats by responding to signals from the nervous system.

The nervous system speeds up your heartbeat when you are exercising. It slows the rate at which your heart beats when you are sleeping. The nervous system also works with other organ systems to control the body's functions.

The nervous system uses electrical signals to help organ systems of the body respond quickly to changes in internal and external environments. The body also uses the endocrine system to help it respond to changes in environments and maintain homeostasis.

The nervous system coordinates rapid changes. The endocrine system coordinates slower responses. 

### Visual Check

**6. Interpret** How are wastes transported to the kidneys?

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### Key Concept Check

**7. Explain** How does the body coordinate movement and respond to stimuli?

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## Visual Check

**8. Relate** When does the iris contract?

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## Math Skills

Volume is a measure of the amount of matter that a hollow object, such as the stomach or the lungs, will hold. For example, the volume of an empty stomach is about 0.08 L. After eating, a person's stomach is 1.5 L. What volume of food was consumed?

Subtract the starting volume from the final volume.

$$1.5 \text{ L} - 0.08 \text{ L} = 1.42 \text{ L}$$

**9. Use Volume** A certain person's bladder has a volume of 550 mL. The person has the urge to urinate when the bladder contains 200 mL of urine. What volume of the bladder remains empty?

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## Reading Check

**10. Define** What are hormones?

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## Sensory Input

The nervous system coordinates the body's response to external stimuli. For example, your pupils change in size in dim and bright light, as shown in the figure to the right.

Your body also responds to the sight, smell, touch, and taste of food. The nervous system works with the respiratory and muscular systems to detect food smells. It coordinates muscles in the eyes to see the food. The nervous system also works with the digestive system and prepares for eating the food by producing saliva. It also coordinates the digestive and muscular systems so that the food is broken down and moved through the body.

## Reflexes

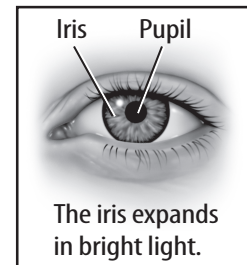
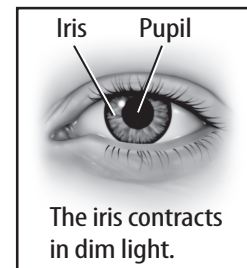
Neurons send electrical signals to the brain for processing so the nervous system can coordinate a response. However, the nervous system can also coordinate responses so quickly that the brain does not first process information it receives. The response to touching a hot stove is so fast that you don't think before you remove your hand. This is because the nervous system has a rapid response system, called a reflex. A reflex reacts to stimuli without sending information to the brain for processing. Reflexes allow the nervous system to coordinate a rapid response and tell the muscular system and the skeletal system to move without thought.

## Hormones

The endocrine system coordinates other organ systems by using chemical signals called hormones. Hormones are secreted from endocrine organs such as the thyroid gland, the adrenal gland, and the pancreas. ✓

These chemical signals travel through the circulatory system to organ systems such as the digestive and muscular systems. They also control processes that maintain homeostasis. In the beginning of this lesson, you read that temperature homeostasis is maintained by producing thermal energy. The endocrine, nervous, and muscular systems work together and maintain temperature homeostasis. Insulin, a hormone released from the pancreas, works with the digestive system and maintains energy homeostasis.

## Eye Function




# Feedback Mechanisms

As stated earlier, homeostasis helps the body maintain a constant internal environment. The endocrine and nervous systems help detect changes in either the internal or the external environment and respond to those changes. Organ systems use feedback mechanisms to maintain homeostasis.

## Negative Feedback

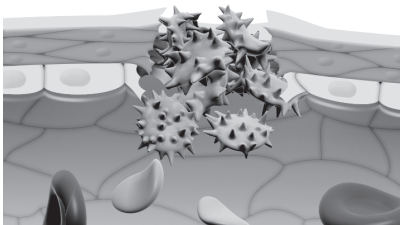
**Negative feedback** is a control system that helps the body maintain homeostasis by sending a signal to stop a response. Negative feedback is the type of control system in effect when you feel hungry and eat. The digestive system receives signals that it is time to eat. When you eat, the digestive and circulatory systems work together and increase the amount of nutrients in your body. As the nutrients are processed, your stomach sends signals to your brain to tell your body that you are full and to stop eating.

## Positive Feedback

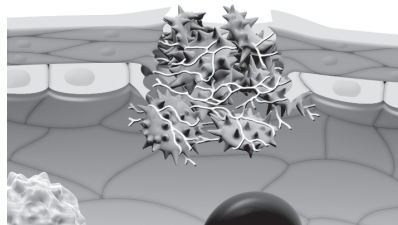
**Positive feedback** is a control system that sends a signal to increase a response. One example of a positive feedback system is blood clotting. When you are bleeding, the circulatory system maintains homeostasis by controlling blood loss. Blood cells called platelets move to the site of the wound. The platelets help control bleeding by forming a clot with a protein called fibrin. As the clot forms, more platelets travel to the clot. The figure below shows how the body uses positive feedback to clot blood. 

Childbirth is another example of positive feedback. The endocrine system signals the muscular system to contract. Signals from the muscular system tell the endocrine system to keep activating the muscular system. This continues until the baby is born.

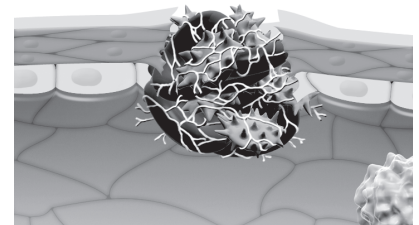
### Blood Clotting



**Step 1**  
Platelets rush to the tear and form a plug that stops the bleeding.



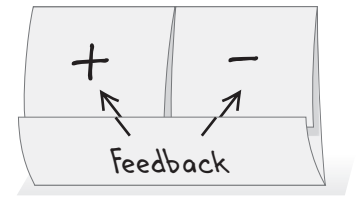
**Step 2**  
A web of fibrin forms around the platelets and holds them in place.



**Step 3**  
The fibrin web catches more platelets and red blood cells, and these form a blood clot.

## FOLDABLES®

Make a two-tab book to compare types of feedback.



### Key Concept Check

**11. Explain** How do feedback systems help maintain homeostasis?

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### Visual Check

**12. Recognize** What holds platelets in place when they form a blood clot?

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## After You Read

### Mini Glossary

**homeostasis (hoh mee oh STAY sus):** the ability to maintain constant internal conditions when outside conditions change

**negative feedback:** a control system that helps the body maintain homeostasis by sending a signal to stop a response

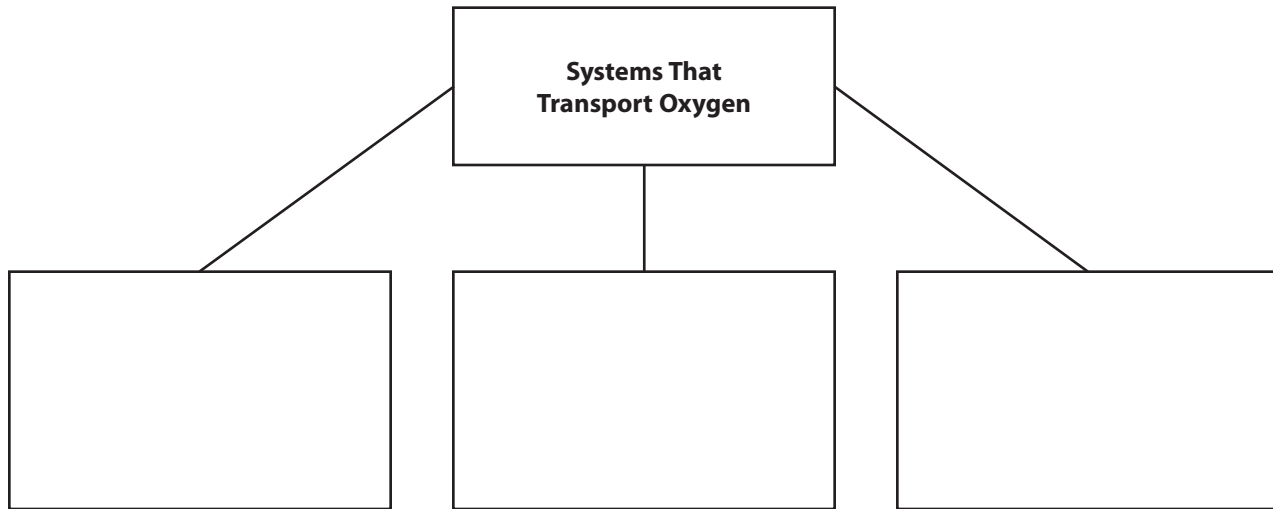
**positive feedback:** a control system that sends a signal to increase a response

1. Review the terms and their definitions in the Mini Glossary. Write a sentence that contrasts negative and positive feedback.

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2. Fill in the diagram below to show the systems that help transport oxygen.



3. In the space below, record one main idea you were able to better understand by working with your partner.

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### What do you think **NOW?**

Reread the statements at the beginning of the lesson. Fill in the After column with an A if you agree with the statement or a D if you disagree. Did you change your mind?



Log on to [ConnectED.mcgraw-hill.com](http://ConnectED.mcgraw-hill.com) and access your textbook to find this lesson's resources.

