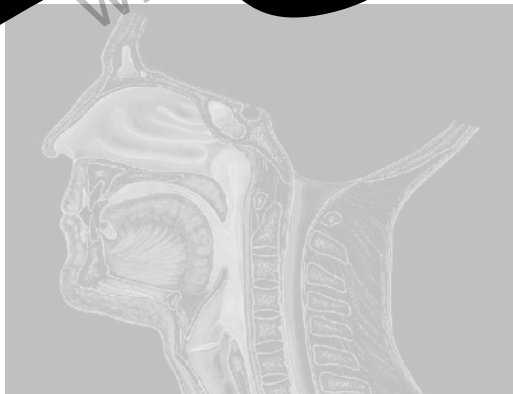


**FOCUS
ON
SCIENCE**

Human Body Systems

Advanced Level



Life Science
Dynamic Equilibrium

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Scientific Inquiry

Students will use mathematical analysis, scientific inquiry, and engineering design, as appropriate, to pose questions, seek answers, and develop solutions.

Life Science

Living things are both similar to and different from each other and from nonliving things

The digestive system consists of organs that are responsible for the mechanical and chemical breakdown of food. The breakdown process results in molecules that can be absorbed and transported to cells.

During respiration, cells use oxygen to release the energy stored in food. The respiratory system supplies oxygen and removes carbon dioxide (gas exchange).

The excretory system functions in the disposal of dissolved waste molecules, the elimination of liquid and gaseous wastes, and the removal of excess heat energy.

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

Locomotion, necessary to escape danger, obtain food and shelter, and reproduce, is accomplished by the interaction of the skeletal and muscular systems, and coordinated by the nervous system.

The nervous and endocrine systems interact to control and coordinate the body's responses to changes in the environment, and to regulate growth, development, and reproduction. Hormones are chemicals produced by the endocrine system; hormones regulate many body functions.

Organisms maintain a dynamic equilibrium that sustains life.


All organisms require energy to survive. The amount of energy needed and the method for obtaining this energy vary among cells. Some cells use oxygen to release the energy stored in food.

Regulation of an organism's internal environment involves sensing the internal environment and changing physiological activities to keep conditions within the range required for survival. Regulation includes a variety of nervous and hormonal feedback systems.

Food provides molecules that serve as fuel and building material for all organisms. All living things, including plants, must release energy from their food, using it to carry on their life processes.

Foods contain a variety of substances, which include carbohydrates, fats, vitamins, proteins, minerals, and water. Each substance is vital to the survival of the organism.

Metabolism is the sum of all chemical reactions in an organism. Metabolism can be influenced by hormones, exercise, diet, and aging.



Human Body Systems

English Language Arts

The following is a selective listing of the competencies and indicators addressed in this book.

Word Recognition


- Use word recognition skills and strategies quickly, accurately, and automatically when decoding unfamiliar words

Background Knowledge and Vocabulary Development

- Use self-monitoring strategies to identify specific vocabulary difficulties that disrupt comprehension, and employ an efficient course of action, such as using a known word base or a resource such as a glossary to resolve the difficulty

Comprehension Strategies

- Use a variety of strategies (e.g., summarizing, forming questions, visualizing, and making connections) to support understanding of texts read



Human Body Systems

Published by FOCUScurriculum
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www.focuscurriculum.com

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Order Number: LS-52AL

Written by Tom Sibila
Created by Kent Publishing Services, Inc.
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How to Help Your Students Make the Best Use of This Book

Encourage students to develop nonfiction literacy skills by completing the Active Reader activities. Also encourage them to . . .

- Underline main ideas in paragraphs.
- Circle details that support the main ideas.
- Write down questions as they read.
- Circle key words as well as unfamiliar words.

Printing Instructions

Student Book: print pages 5–38

Assessments: print pages 39–42

Answer Key: print pages 43–46

**FOCUS
ON
SCIENCE**

Human Body Systems



How do Human Body Systems function to maintain homeostasis?

Homeostasis is the balance within the human body's internal environment. This balance is necessary in order to maintain healthy life. For example, the body works to maintain a regular body temperature, hormone levels, and water balance.

Many body systems work together to achieve homeostasis. The digestive system allows the body to take in food for energy and eliminate waste. The respiratory system supplies oxygen to the body and releases carbon dioxide waste. The circulatory system is the engine that pumps blood through the body to carry the oxygen, food, and waste products. The skeletal and muscular systems provide movement and stability. The nervous system and endocrine systems work together to communicate between the brain and other body parts.

In this book, you will learn about the amazing systems found in the human body that work together to maintain homeostasis, and allow us to survive.

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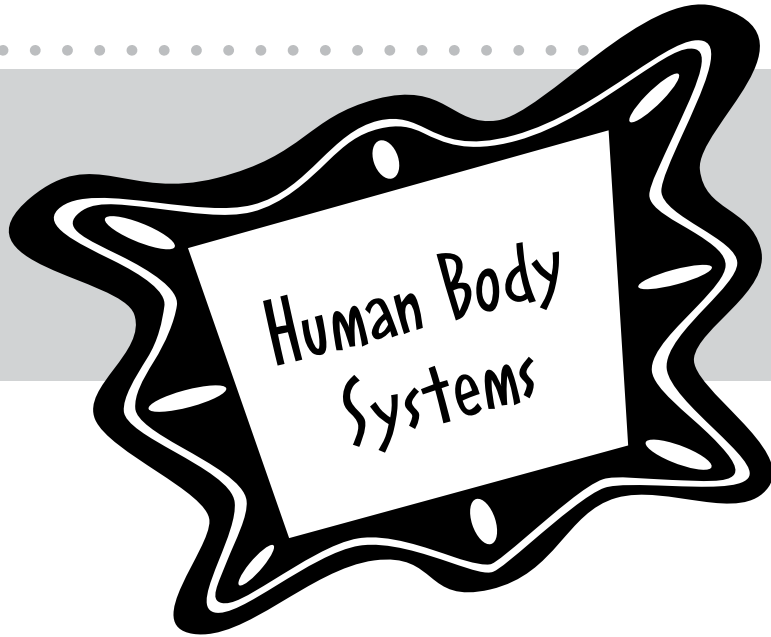


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Build Background

Use Your Knowledge

1. What do you already know about human body systems? Write a sentence explaining what you already know about each body system listed below.

Digestive System _____

Respiratory System _____

Circulatory System _____

Nervous System _____

2. Here is a list of important parts of the body. Write its body system on the line beside each word.

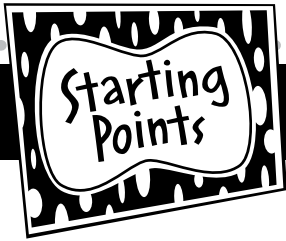
Stomach _____

Brain _____

Lungs _____

Esophagus _____

Heart _____

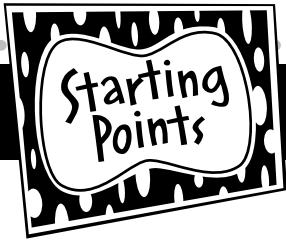


Key Vocabulary

Rate Your Knowledge

Each word in the list below is important, but some may be new to you. Rate your knowledge of each by putting a check or a few words in the appropriate column. After completing this book, come back to this page and write the definitions of words you did not know.

	I don't know it.	I've seen it, but I'm not sure what it means.	I know it well. It means...
vertebrae			
carbohydrates			
tendons			
locomotion			
metabolism			
mucus			
nutrients			
saliva			
cartilage			
gland			
aorta			
glucose			



Key Concepts

Food for Energy

The body needs food, water, and oxygen to obtain energy to live. Healthy foods provide all the nutrients the body needs to grow and maintain good balance. Protein, found in eggs and peanuts, for example, helps strengthen muscles, organs, hair, skin, even blood cells. Vitamins and minerals, found in healthy foods, provide nutrients to help the body grow. Fiber, found in many fruits and vegetables, whole grains and nuts, helps the body digest nutrients.

The Parts of a Cell

All organisms, including the human body, are made up of cells. Cells contain a nucleus, sometimes called the “brain” of the cell. Cytoplasm is the fluid that fills the cell. Organelles, floating in cytoplasm, are the parts of the cell that perform different functions. The cell membrane is the outer layer that holds everything together. Nutrients and waste materials pass through the cell membrane.

The Working Body

Several body systems work together to keep us alive and help us grow. The digestive system takes in food for body energy. The respiratory system takes in oxygen and eliminates carbon dioxide as we breathe. Animals that live in the water use gills to exchange these gases. Frogs and salamanders use their moist skin along with their lungs to exchange gases. Animals that live on dry land, including humans, use their lungs.

ACTIVE READER

1 Infer Why do you think having some knowledge of cells will help you study human body systems?

2 Illustrate Draw a picture of a cell showing nucleus, cytoplasm, organelles, and cell membrane.

Chapter 1 The Digestive System

FOCUS

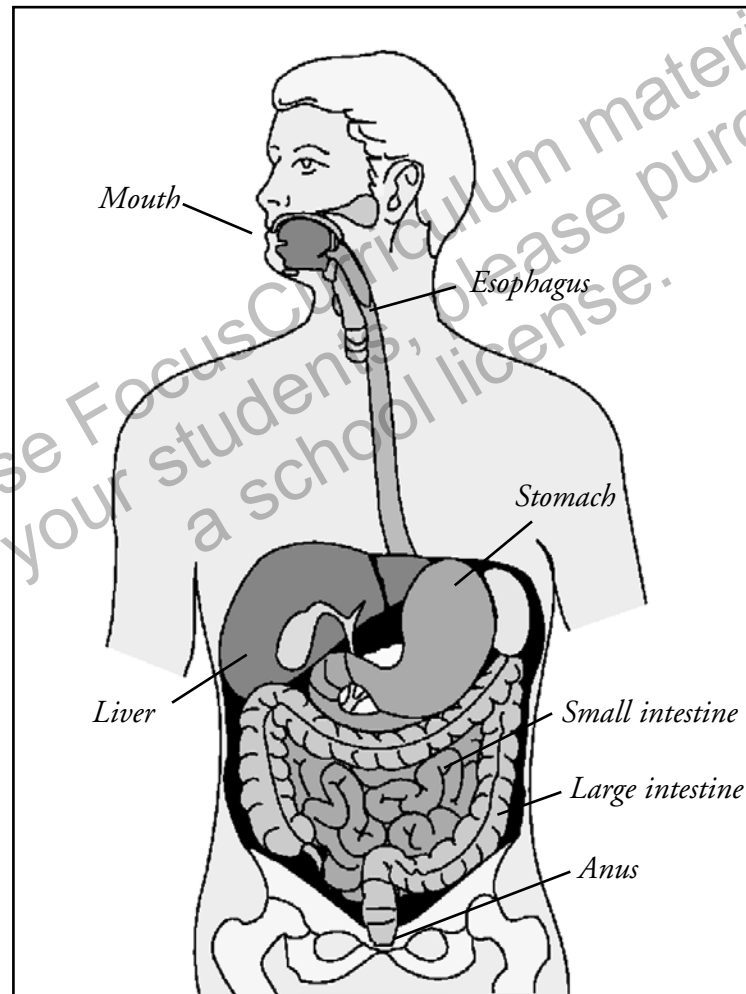
As you read about the digestive system, think about its purpose. What does the digestive system do?

All animals, including humans, need food, water, and oxygen to obtain energy. Energy is used by the body to move, grow, and repair itself. Humans cannot survive without energy.

Digestion

The digestive system is responsible for converting the food we eat into energy. Digestion, or the breaking down of food, is important because the foods we eat, such as bread, meat, and vegetables, are not in a form that our bodies can use as **nourishment**. Our bodies need consistent energy for processes such as breathing, blood circulation, moving, and thinking.

The main organs that make up the digestive system are the mouth, esophagus, stomach, small intestine, liver, large intestine (including the colon and rectum), and anus.



ACTIVE READER

1 Define What is the meaning of nourishment?

2 Explain What is a synonym for the word converting?

Good to Know

The United States Department of Agriculture (USDA) lists these guidelines for healthy nutrition: Make half of your grains whole; Vary your veggies; Focus on fruit; Get your calcium rich foods, Go lean with protein; Find balance between food and healthy activity; Keep food safe to eat.

During digestion, the food and drink we eat are changed into smaller molecules of nutrients that can be absorbed into the blood and transported to cells throughout the body.

The cells use some of the molecules to produce energy for living. Others are used as raw materials for the growth and repair of cells and tissues.

Keeping nutrition well-balanced means we are feeding our body good sources of fuel for energy.

FOCUS QUESTIONS

1. What is the main purpose of the digestive system?

2. Why is this process important?

ACTIVE READER

1 Analyze Which sentence on this page explains a cause and effect process?

2 Identify List five healthy foods.

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FOCUS

This section discusses the processes of the digestive system. As you read, think of the steps it takes to turn food into fuel for energy.

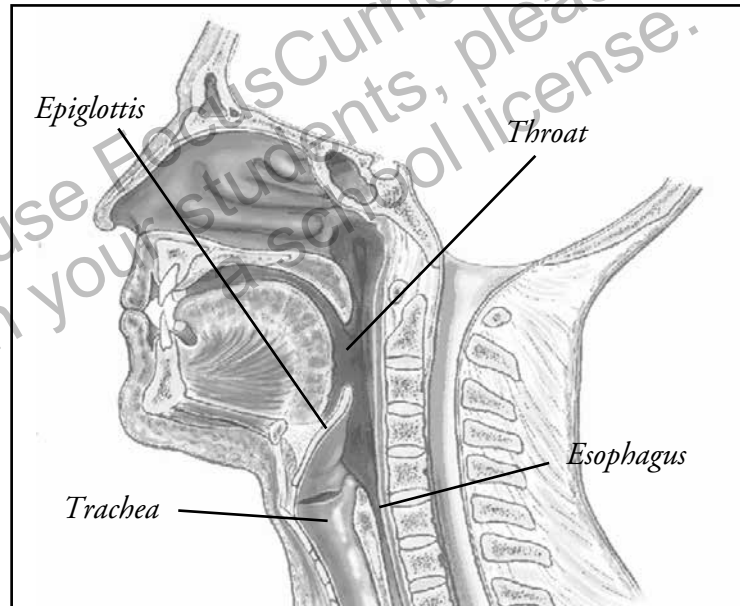
Mouth

Digestion begins when you put food into your mouth and begin to chew. Your teeth start to break the food into smaller pieces. **Saliva** in your mouth helps soften the food. **Enzymes** in the saliva also help begin the digestion of starch in the food. When the food is small and soft enough, your tongue can push the food into your throat to swallow.

Esophagus

Swallowed food is pushed into the esophagus which connects the back of the throat to the stomach. When food enters, muscles in the walls of the esophagus squeeze the food downward to the stomach.

The trachea is in the back of your throat. When you eat, a small flap called the **epiglottis** closes your windpipe keeping food out of the trachea. Sometimes, when eating or drinking, the flap does not close fast enough. Then the food goes “down the wrong pipe” and you cough to clear your windpipe.



The epiglottis is a flap that keeps food from entering the trachea.

ACTIVE READER

1 Interpret List three words on this page that suggest movement or change.

2 Identify Name two things that happen in the mouth when food enters.

Good to Know

If you smell food before putting it into your mouth, you can activate saliva. In this case, your digestion process starts **BEFORE** you put the food in your mouth!

Stomach

The stomach is a muscular sack that receives food and liquid from the esophagus. It has three functions, or jobs.

1. It stores food and liquid.
2. It breaks down the food into a thick liquid or paste.
3. It empties the broken down food and liquid into the small intestine.

The stomach receives and stores the food you eat and the liquid you drink. It also acts like a mixer and grinder.

The stomach produces digestive juices that help further break down the food. The strong muscles in the walls of the stomach then mix the food, liquid, and digestive juices. Food is usually treated in the stomach for about two hours and then empties into the small intestine.

Small Intestine

After leaving the stomach, food enters the small intestine. This is a long tube about 2 inches around and about 20 to 25 feet long. The small intestine is loosely coiled and packed beneath the stomach.

The small intestine breaks down the food mixture even more so that the body can absorb all the vitamins, minerals, proteins, carbohydrates, and fats from the food. Food may stay in the small intestines for as long as 4 hours. This allows the food to be absorbed into your blood stream and the nutrients to be carried to all the cells in the body.

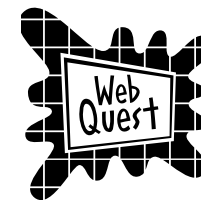
Liver

The nutrient-rich blood coming from the stomach, small intestine, and large intestine passes through the liver. The liver has many functions in processing the nutrients. These include removing harmful substances and storing nutrients not immediately needed.

ACTIVE READER

1 Explain How are nutrients carried to all the cells in the body?

2 Interpret What type of tissue is the stomach made of?



You can find fascinating illustrations and videos of the digestive system online. Do a search for “digestive system” to learn more. Remember, you are more likely to find reliable information on sites that end in .gov, .edu, or .org.

Large Intestine

The body does not digest all the food we eat. Leftover food passes from the small intestine to the large intestine. The large intestine is thicker and wider than the small intestine, about 4 inches around, but it is only about 5 feet long.

The undigested food enters the large intestine as a liquid paste. The large intestine removes the water and turns what is left into a solid waste. The waste then passes through the part of the large intestine called the colon. This is the body's last chance to absorb water and nutrients into the body.

FOCUS QUESTIONS

- Place these organs in the order that food passes through during the conversion to fuel for energy: esophagus, mouth, large intestine, stomach, large intestine, liver.

- How can the digestive system be called a transportation system?

ACTIVE READER

1 Infer Which body part in the digestive system might be called a filter?

2 Differentiate Compare the size of the small intestine to the size of the large intestine.

Good to Know

Water makes up about 60% of your body weight. All body systems depend on water. Every day, the body loses water through waste, breath, and perspiration. That's why it's important to drink plenty of water.

FOCUS

This section talks about how the body eliminates waste. Read to find out the different forms of body waste.

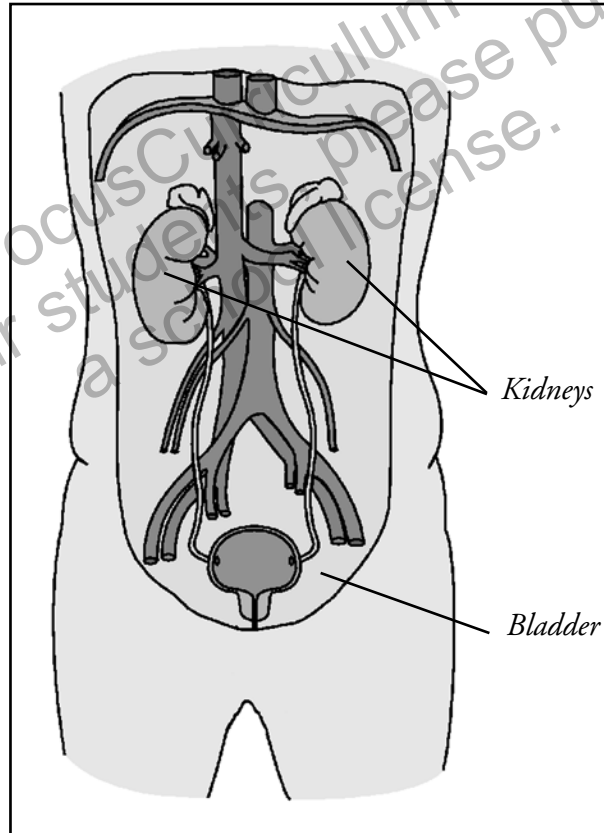
Excretion

Finally, the waste leaves the colon and is pushed into the rectum. The waste is stored there until the body is ready to get rid of it. This is known as the excretory system. When you go to the bathroom, you get rid of, or excrete, this solid waste through the anus. Waste in this disposal process can also be in the form of liquid and gaseous wastes and excess heat energy.

Kidneys

Your body has another filtering system as well. The kidneys are bean-shaped organs, each about the size of your fist. They are located on either side of the spine just below the rib cage.

Your kidneys filter harmful waste products carried from the cells by the blood. Much of the liquid waste is processed into urea by the liver and then transported to the kidneys. **Urea** is filtered out of the blood by the kidneys and stored in the bladder as urine.



ACTIVE READER

1 Infer Which sentence begins with a word that tells sequence?

2 Identify Underline the phrase that defines the word excrete. Circle another form of the word excrete.

Each day, the kidneys process about 200 quarts of blood resulting in about two quarts of urine. Urine is released through the urethra when you go to the bathroom.

Metabolism is the sum of all the chemical changes in the body's cells that convert the fuel from food into energy, including waste disposal. Thousands of chemical reactions happen simultaneously to keep the body working. Metabolism affects how we lose or gain weight. The amount of energy we take in and the amount of energy we burn each day affect weight gain or loss.

FOCUS QUESTIONS

1. What are three forms of body waste?

2. What is the last stage of metabolism?

ACTIVE READER

1 Recall What is metabolism?

2 Define Underline the word on the page that means "at the same time."

Good to Know

Occasionally, most people have feelings of indigestion, or a stomach ache called heartburn. It can be caused by eating too much, too fast, or just eating something that doesn't agree with you. Heartburn is a burning feeling in the chest and throat, and can even leave a bad taste in your mouth. Heartburn is caused by stomach acids splashing up and irritating the esophagus. Despite its name, heartburn is not in the heart!

Stop and Think

This page will help summarize what you have read so far.

1. What is the main function of the digestive system?

- (1) pump blood through the body
- (2) excrete waste materials
- (3) turn the food we eat into energy
- (4) grow and repair cells and tissues

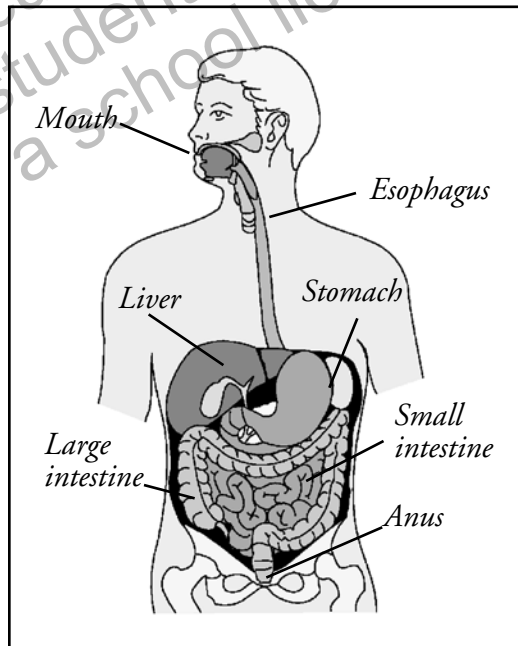
2. How does the epiglottis provide protection?

- (1) It pushes swallowed food into the esophagus.
- (2) It squeezes food downward to the stomach.
- (3) It starts to break food down into smaller particles.
- (4) It closes the trachea to keep swallowed food out.

Base your answer to questions 3 and 4 on the diagram at the right and your knowledge of science.

3. Where does digestion begin?

4. When and where is the body's last opportunity to absorb water and nutrients into the body?



Dear Ms. Understanding,

My stomach growls a lot! It can be very embarrassing when it rumbles so loud that others can hear it. People tell me I must be hungry, or that I should see a doctor, but I feel fine! What makes my stomach growl?



Grumbling in Greenwich Village

Dear Grumbling,

The growling sounds you hear mean your body is at work. When your food moves from your stomach to your intestines, gas and air can sometimes get mixed in. The gas and air make the grumbling sounds. It can be a signal that you need food, but it usually doesn't mean you have a problem, unless you feel pain or discomfort. Some people find it helps the digestive process work more smoothly when they eat small, frequent meals.



Ms. Understanding

Chapter 1 The Respiratory and Circulatory Systems

FOCUS

This section describes the respiratory system. As you read, think about how we exchange gases as we breathe.

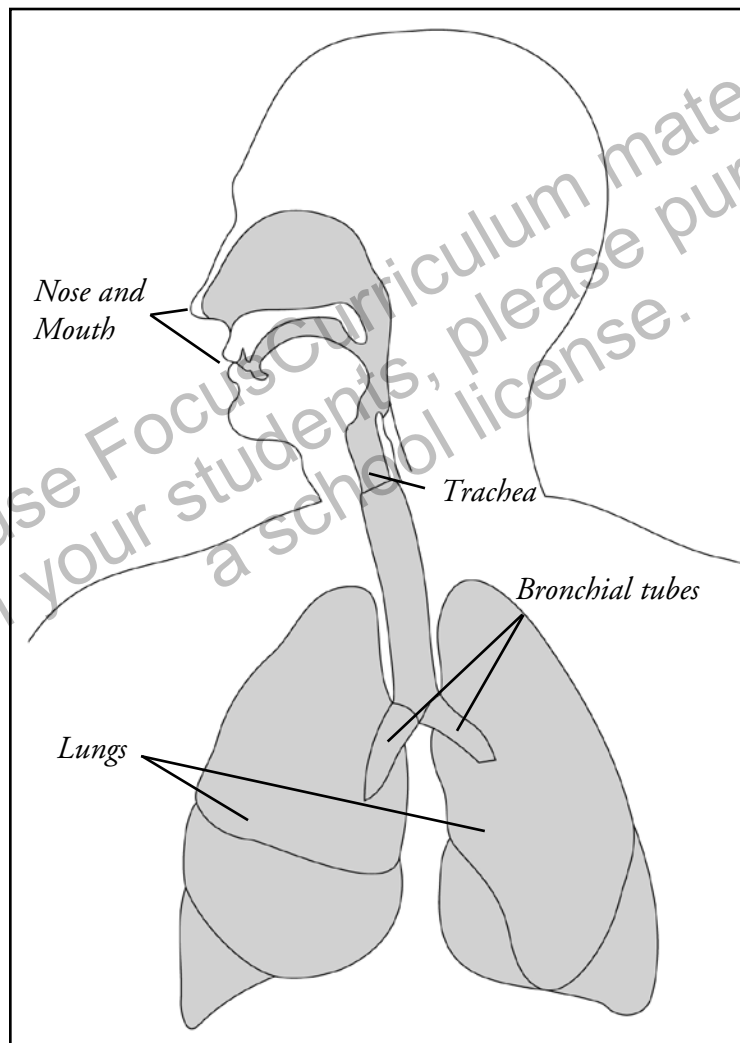
Respiration

To survive, humans must exchange the air inside their bodies with the air outside their bodies. The system that transports air into and out of the body is called the respiratory system.

The respiratory system is a gas exchange. It takes in oxygen for the body so the cells can release the energy stored in food. It also eliminates carbon dioxide, a waste product, from the body.

The respiratory system allows us to adjust the flow of gases in and out of the body to meet its needs. More activity requires more energy. To get this energy, more oxygen is needed.

Humans have two lungs inside their bodies. The lungs are rich in blood vessels that pick up inhaled oxygen and drop off carbon dioxide to be exhaled.



ACTIVE READER

1 Analyze Explain why the respiratory system is called a transportation system.

2 Interpret List words that describe your breathing when you sit still and when you run or exercise.



We know we can take in air through the nose or mouth, but which is preferable? Use the Internet to search "Breathe through nose or mouth?" to research this question. Then share your conclusion in class.

Think about how you breathe when you are sitting and how you breathe when you are running. Activity requires us to breathe harder in order to get more oxygen.

Lungs

The respiratory system is made up of the organs that help us breathe. Lungs are the main organ of the respiratory system. Air that is rich in oxygen is inhaled into the lungs and air with more carbon dioxide is exhaled, or breathed out. These gases are exchanged in the lungs and transported through the body by blood.

When we inhale, red blood cells in the lungs pick up oxygen and carry it to all the cells in the body. The red blood cells drop off the oxygen to the body cells and pick up carbon dioxide from those same cells.

Carbon dioxide is a waste product created when the cells use oxygen to release energy from **carbohydrates** in the food. After dropping oxygen off, the red blood cells pick up and transport carbon dioxide back to the lungs. When we exhale, the carbon dioxide is released into the air.

ACTIVE READER

1 Contrast Look up the prefixes *in-* and *ex-*. Then explain how they relate to the words *inhale* and *exhale*.

FOCUS

QUESTIONS

1. What gases are exchanged during respiration?

2. Why is this exchange important?

FOCUS

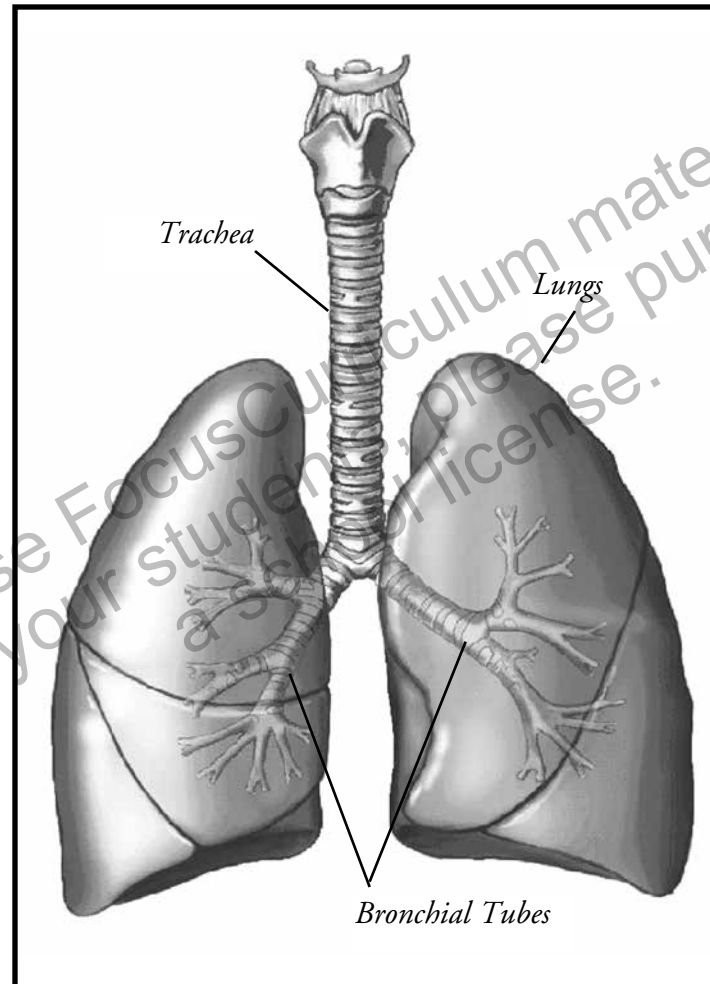
As you read about the steps in the respiratory process, think about air, or oxygen, passing through these organs.

Trachea

The trachea, also called the wind-pipe, is located in the back of the throat. **Mucus** lining the trachea helps filter the air breathed in. It has rings around the outside. These rings are made of strong, flexible tissue. You can feel these rings on the front of your neck. They keep the trachea open when you turn or bend your neck.

Bronchial Tubes

The bronchial tubes are two tubes that branch off the trachea and carry air directly into the lungs. In each lung, the bronchial tubes divide into hundreds of smaller tubes. At the ends of these smaller tubes are clusters of tiny air sacs called **alveoli**. There are about 300 million alveoli in a pair of human lungs.



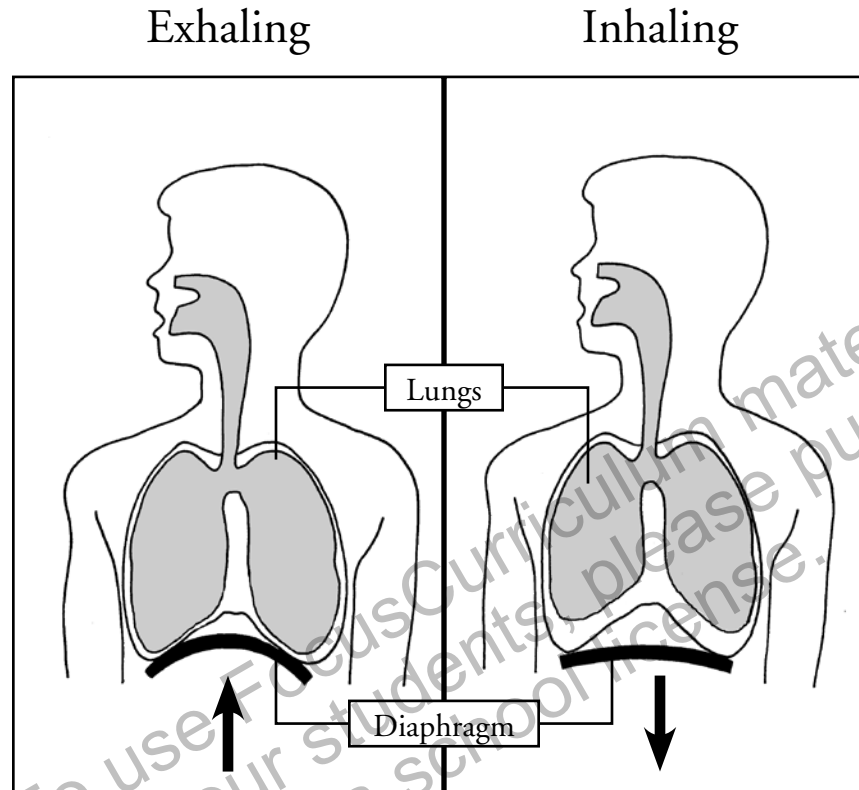
ACTIVE READER

1 Illustrate Draw arrows on the diagram to illustrate the direction of air flow during exhaling and inhaling.

2 Translate Write 300 million as a number.

Diaphragm

The diaphragm is a muscle below your lungs. When you inhale, your diaphragm contracts, flattens, and pulls downward. This makes your chest cavity larger and the empty space pulls in the air (kind of like a vacuum). This inflates the lungs by pulling air into the body through the trachea. When you exhale, the diaphragm expands, making the chest cavity smaller and pushing air out as the lungs deflate.



ACTIVE READER

1 Identify Besides inhale and exhale, there are two pairs of antonyms on this page. Find them and write them here.

2 Exemplify Name some non-living things that contract and expand with air.

FOCUS QUESTIONS

1. Why is the trachea also called the windpipe?

2. Why does the chest cavity get larger and smaller?

FOCUS

The circulatory system is explained in this section. What is transported during circulation?

Circulation

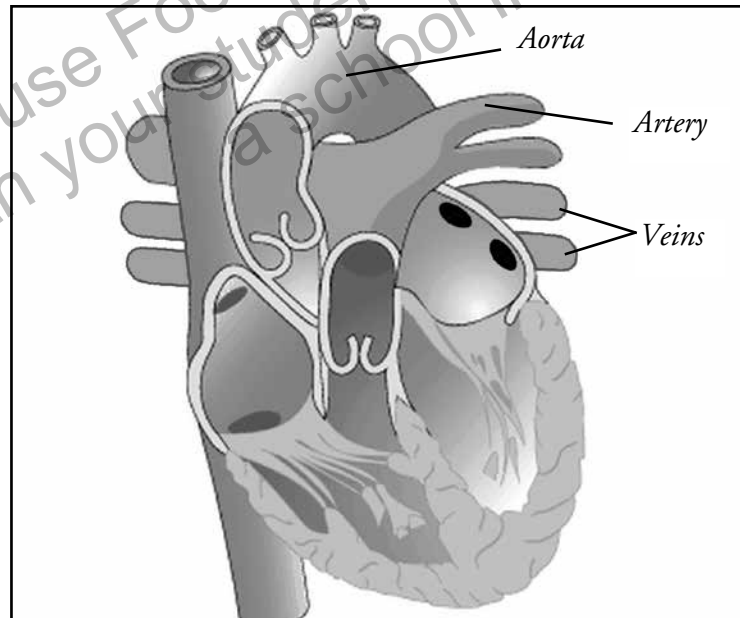
The circulatory system transports blood, oxygen, and nutrients to cells. You know oxygen is carried to cells in the body through blood. Other nutrients are also carried by blood. The circulatory system moves blood through the body to provide oxygen and nutrients as needed by cells.

The circulatory system is made up of the vessels and the muscles that control the flow of blood around the body. This process is called circulation. The main parts of the system are the heart, arteries, and veins.

Heart

The heart is the strongest muscle in your body. Its job is to pump blood around your body. It is divided into two sides. The right side receives blood from all parts of the body except the lungs and pumps blood to the lungs where it picks up oxygen and gets rid of carbon dioxide. The blood leaves the lungs and enters the left side of the heart and then is pumped to the rest of the body.

The left side of the heart receives oxygen-rich blood from the lungs and pumps it to the rest of the body. The right side of the heart pumps blood back to the lungs to release carbon dioxide and receive a fresh supply of oxygen.



ACTIVE READER

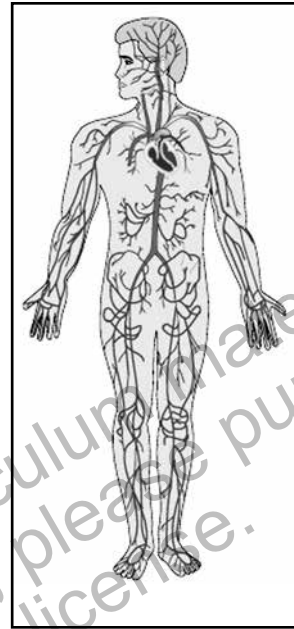
1 Extend Why do you think the circulatory system is referred to as a closed system?

2 Paraphrase Write in your own words why the heart is the strongest muscle in the body.

Arteries and Veins

Blood leaves the left side of the heart through the **aorta**. The aorta is the largest artery in our body. Arteries are tubes that carry blood away from the heart. As the arteries move into tissues and organs they become smaller and smaller. The smallest blood vessels are called capillaries. The capillaries deliver oxygen and nutrients to individual cells and pick up waste products such as carbon dioxide and some nitrogen compounds.

After picking up the waste materials from the cells, the blood moves through larger and larger veins on its way back to the right side of the heart. The pulmonary artery carries the blood back to the lungs and the cycle is repeated thousands of times each day.



*Arteries and veins are called blood vessels.
Arteries carry blood away from the heart.
Veins carry blood back to the heart.*

FOCUS QUESTIONS

1. How and where are blood, oxygen, and nutrients transported?

2. In the circulatory system, what is meant by the word circulate?

ACTIVE READER

1 Identify Tell where the heart is in the human body.

2 Recall What waste products are picked up from cells by the capillaries?

Stop and Think

This page will help summarize what you have read so far.

1. What is the primary purpose of the respiratory system?

- (1) Take in oxygen for the body and eliminate carbon dioxide.
- (2) Turn food into fuels for cells to create energy.
- (3) Eliminate waste products from the body.
- (4) Transport cells, nutrients and messages through blood in cells.

2. In what organ are gases oxygen and carbon dioxide exchanged?

- (1) trachea
- (2) lungs
- (3) bronchial tubes
- (4) diaphragm

3. In the circulatory system, what carries blood away from the heart?

- (1) veins
- (2) capillaries
- (3) cells
- (4) arteries

Base your answer to question 4 on your knowledge of science.

4. What are the names of three different blood vessels?

Dear Ms. Understanding,

Sometimes I have a sneezing fit! I don't have a cold, and I don't have allergies that I know of. Could I be developing allergies that cause sneezing?



Sneezy in Schenectady

Dear Sneezy,

Frequently dust, pollen, even cold air can irritate the mucous membranes in your nose. Sneezing is just the body's way of getting rid of them. Think of it as a cough from your nose!



Ms. Understanding

Chapter 3 The Skeletal and Muscular Systems

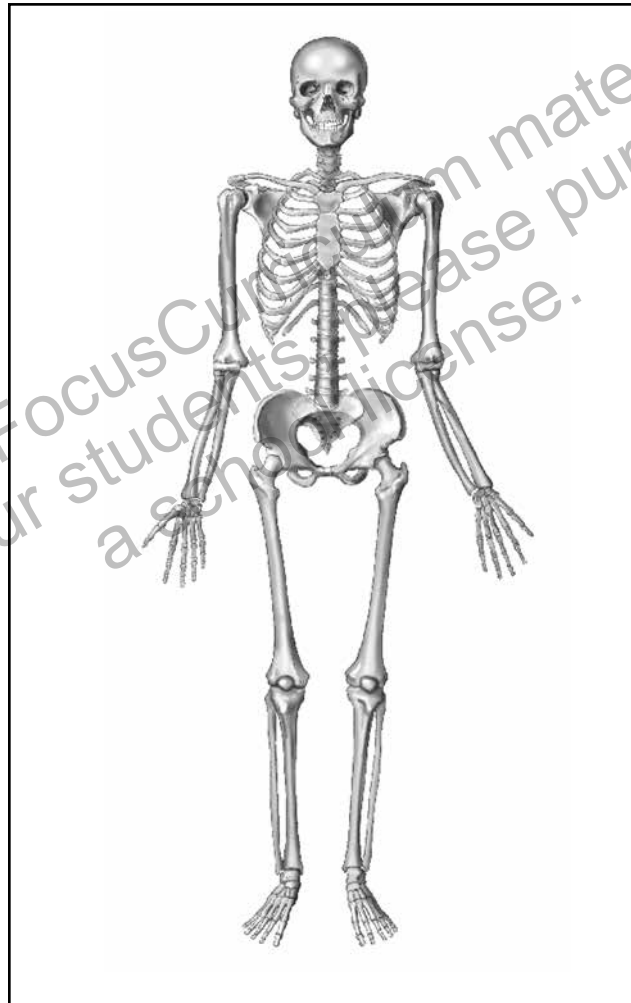
FOCUS

In this section, you will learn the functions of the skeletal and muscular systems. Did you know there are two parts of the human skeleton?

The Skeleton

The skeleton supports our movement and protects our internal body parts. The human skeleton has two major parts. The **axial skeleton** is made of the bones that protect or carry other body parts: the skull, the spine (vertebral column), and the rib cage (thorax). The **appendicular skeleton** is made of the bones that provide support and movement. Arms, legs, hands, feet, and thighs are parts of the appendicular skeleton.

The parts of the skeletal system are the bones, joints, muscles, and the **tendons** that help them move.



The Skeletal System

ACTIVE READER

1 Infer How do the bones such as the skull, the spine, and the rib cage provide protection?

Good to Know

Take a good look at your hand. Do you know how many bones are in the human hand? There are 27 bones. The human foot has 26 bones.

Bones

The human skeleton contains 206 bones. Bones provide support and body protection. The skull is made of bones that protect the brain. The rib bones come together to make the rib cage to protect the heart and lungs. The vertebral column, or spine, contains 33 bones called **vertebrae**. The vertebrae are separated by spinal discs, which are made of **cartilage** with a soft center to absorb shock during movement such as running and jumping. A spinal cord runs through a tunnel in the spinal column and sends messages from the brain to organs.

Joints

Joints allow movement. Joints are the connections between two bones. Two bones meet in a ball-and-socket type fit at a joint. The bones are protected by soft cartilage for protection and flexibility at the joint.



Knee Joint

ACTIVE READER

1 Clarify Why is it important to have cartilage between bones as a shock absorber?

FOCUS QUESTIONS

1. Describe the two parts of the skeleton and tell what each does.

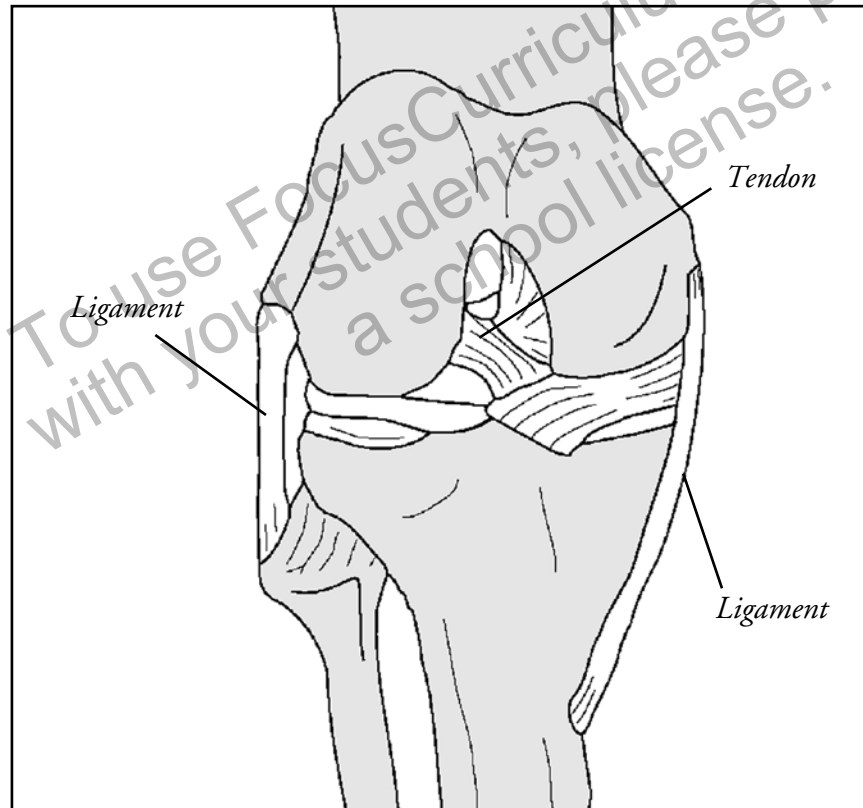
2. What does the skull protect?

FOCUS

The muscular system works with the skeletal system. How is movement created?

The Muscles

Muscles provide power for movement and tension for sitting or standing. Muscles contract to create action and movement. They are connected to bones by tough but flexible tendons, which pull on bones at the joints.



Tendons attach muscle to bone; ligaments attach bone to bone as shown in this illustration of a knee joint.

ACTIVE READER

1 Interpret Use information on this page to write a sentence that describes a cause and effect relationship.

2 Compare Explain how a muscle contracts compared to how the diaphragm contracts.

Muscle Types

There are three types of muscles.

Skeletal muscles are attached to bone. They hold the skeleton together, provide shape, and control movement. Skeletal muscles are legs, arms, abdomen, neck, chest, face. They are known as voluntary muscles. It takes over 200 voluntary muscles to smile!

Smooth muscles, also known as involuntary muscles, are controlled by the nervous system. Stomach and intestinal muscles are smooth muscles.

Cardiac muscle makes up the heart. Cardiac muscle is involuntary. A heartbeat is the heart muscle contracting to push blood out of the heart. The human heart beats about 100,000 times a day.

ACTIVE READER

1 Illustrate Draw and label an example of the three types of muscles.

FOCUS QUESTIONS

1. How do muscles create movement?

2. Complete the graphic organizer below to list voluntary muscles and involuntary muscles.

Voluntary Muscles	Involuntary Muscles

Chapter 4 The Nervous and Endocrine Systems

FOCUS

This section describes how the nervous system and endocrine system work together. As you read, think about the power and importance of the brain.

The nervous system and the endocrine system work together to control and coordinate the body's responses to changes in the external environment, to regulate growth, development and reproduction.

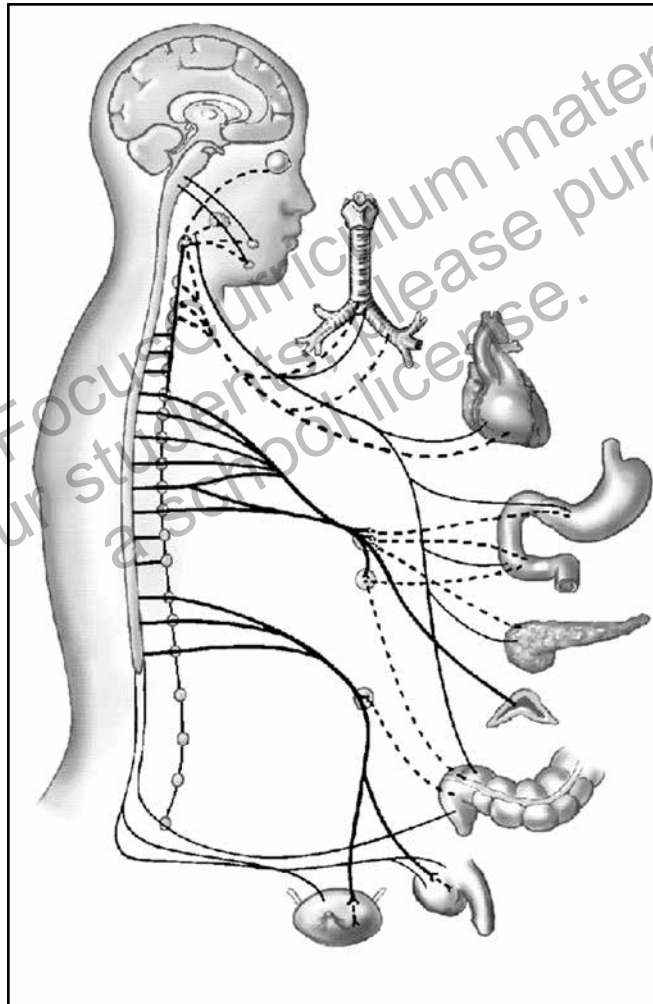
The Nerves

The nervous system is the control center of the body. It also receives stimuli from and responds to the external environment. For example, if you were stung by a bee you would immediately feel pain. External stimuli (bee sting) – Internal response (pain).

Working with the skeletal and muscular systems, the nervous system allows **locomotion**, or movement, necessary to escape danger, obtain food and water, and reproduce.

There are two main parts of the nervous system: the central nervous system and the peripheral nervous system.

The nervous system is the brain, the spinal cord, and a complex system of nerves.



ACTIVE READER

1 Define Write a definition for each term below:

external stimuli _____

internal response _____

Good to Know

A doctor who specializes in the study of the nervous system is a neurologist. Neurologists diagnose and treat illness or injuries that affect the brain, the spinal cord, and the nerves. Because the nervous system directly affects the body, a neurologist must have thorough knowledge of all body systems. An MRI (magnetic resonance imaging) gives doctors detailed views of the body, including the brain.

Central Nervous System

The central nervous system consists of the brain and the spinal cord.

BRAIN: The brain controls all of the body systems. Outside stimuli, such as heat, cold, smells, sounds, and feelings are sent to the brain by the nerve cells, or **neurons**. The brain then sends messages to the body to react. The brain weighs about three pounds and has many folds.

SPINAL CORD: The spinal cord, starting at the lower part of the brain down through the spine, is a bundle of nerve tissue about 18 inches long and $\frac{3}{4}$ inch thick. Nerves in the spinal cord divide and spread out to reach all parts of the body.

Peripheral Nervous System

The peripheral nervous system is made of all the nerves and wiring through the spinal cord. Nerve cells, or neurons, pass messages through the body but they don't make contact with one another. They are transferred by chemical carrier substances called **transmitters**. The human body contains about 100 billion neurons. The brain receives messages through the neurons, and sends those messages to the body.

ACTIVE READER

1 Interpret Circle the word on the page that means "situated away from the center." Use the word in a sentence.

FOCUS QUESTIONS

1. Classify each item in the list as external stimuli (e), or internal response (i).

___ thunder ___ stomach ache ___ hiccups ___ smell of perfume ___ hot sun ___ sunburn

2. How is locomotion created?



Different kinds of messages are sent through the endocrine system. Find out how they affect all body systems.

The Endocrine Glands

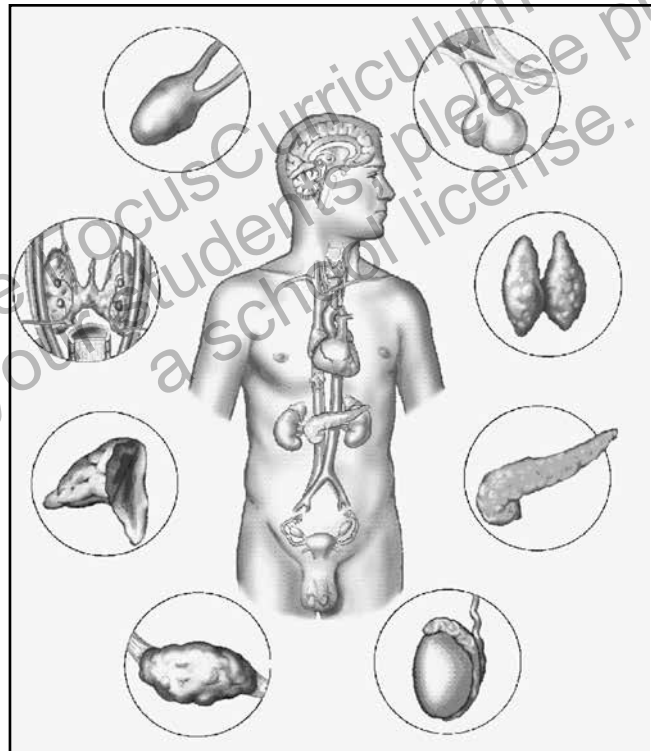
While the nervous system controls fast-moving processes such as breathing and moving, the endocrine system controls slower-moving processes, such as cell growth. A **gland** is a group of cells that produces and sends chemical messages. The glands of the endocrine system release chemical messages known as **hormones** through the bloodstream from one set of cells to another. Hormones help to regulate mood, development, growth, reproduction, and metabolism.

Glands in the endocrine system include:

HYPOTHALAMUS: Located in the lower center of the brain, the hypothalamus connects the endocrine and nervous systems and controls the pituitary gland.

PITUITARY GLAND: A pea-size gland located at the base of the brain, the pituitary gland helps to control growth. It also regulates the thyroid, adrenals, and reproductive glands (gonads).

THYROID AND PARATHYROID: Located at the front of the lower neck, the thyroid produces hormones that control the rate cells burn fuels from food into energy. Four tiny glands attached to the thyroid are parathyroids. They release a hormone which regulates the level of calcium in the blood.



The Endocrine System

ACTIVE READER

1 Identify Underline a sentence that makes a comparison. Identify what it compares.

2 Infer Look up the meaning of the prefix para-. Write a sentence using the word parathyroids.

PINEAL GLAND: produces melatonin to help regulate the sleep cycle.

GONADS: The sex glands are testes in men and ovaries in women. They produce hormones.

PANCREAS: produces hormones to regulate intake of sugar, or glucose, in the blood.

ADRENAL GLANDS: Located just above each kidney, adrenal glands regulate water and salt intake, stress response, the immune system, sexual function, and metabolism.

Metabolism

The body gets the energy it needs through metabolism. Metabolism is the chemical reaction in the body's cells that converts fuel from food into energy. An obvious affect of metabolism is how the human body gains or loses weight, which is determined by the rate at which a person's body burns the energy provided by food.

Metabolism is a constant and continuous process that involves all body systems to keep cells working.

FOCUS QUESTIONS

1. Name the gland that secretes hormones that might affect your:

ability to sleep _____

growth and development _____

body's capacity for changing food into fuels _____

2. How are the nervous system and the endocrine system connected?

ACTIVE READER

1 Recall List some of the body's functions that are regulated by hormones.

Stop and Think

This page will help summarize what you have read so far.

1. Nerve cells in the nervous system are called

- (1) stimuli
- (2) neurons
- (3) tissue
- (4) transmitters

2. Locomotion refers to

- (1) movement
- (2) energy
- (3) mood
- (4) control

3. The level of glucose in the blood is regulated by the

- (1) hypothalamus
- (2) thyroid
- (3) pituitary gland
- (4) pancreas

Base your answer to question 4 on your knowledge of science.

4. What are the main functions of the skeleton?

Dear Ms. Understanding,

I have heard, many times that we use only ten percent of our brains! Is this true?



Brainy in Bedford

Dear Brainy,

It is absolutely not true! Virtually all parts of the brain work all of the time. You may not always be doing math, but your brain is still enabling you to sit, move, think, blink, and breathe.



Ms. Understanding

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Check Your Pulse Your pulse is your heart rate, or the number of times your heart beats in one minute. In this activity, you are going to compare your heart rate when your body is at rest and after exercise.

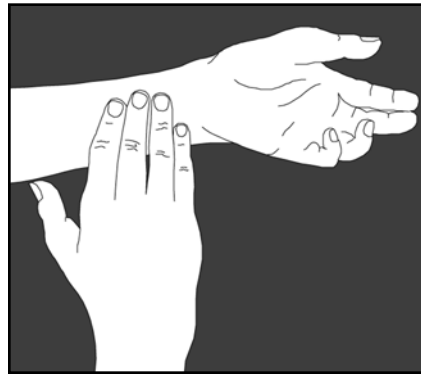
Following the steps described below, you will take your pulse at two different times:

- when your body is relaxed or at rest
- after at least two minutes of exercise or activity.

Then, fill in the chart and answer the questions that follow on the next page.

How to Take Your Pulse

- Step 1:** Place the three middle fingers of one hand on the inside of your other wrist, just below the thumb.
- Step 2:** Press lightly with your fingers until you feel the beat of blood pulsing. You may need to move your fingers around slightly until you find your pulse.
- Step 3:** Using a timer, stopwatch, or clock with a second hand, count the number of beats you feel in 15 seconds. Multiply the number of beats by 4. That is your heart rate per minute. Record your pulse rate in the chart below.
- Step 4:** Take your pulse again after two minutes of exercise and record the rate.
- Step 5:** Wait for twenty minutes and repeat steps 1 to 4.





Check Your Pulse (*continued*) Fill in the chart below and answer the questions as you check your pulse and find your heart rate.

	Session 1	Session 2
Heart Rate at Rest	Beats in 15 seconds _____ $\times 4$ Beats per minute <input type="text"/>	Beats in 15 seconds _____ $\times 4$ Beats per minute <input type="text"/>
Heart Rate After Exercise	Beats in 15 seconds _____ $\times 4$ Beats per minute <input type="text"/>	Beats in 15 seconds _____ $\times 4$ Beats per minute <input type="text"/>

1. Compare your heart rate at rest and after activity.

2. What do you notice about your breathing at rest and after activity?

3. Why is your heart rate different at rest and after activity?

4. Explain how body systems worked together during this activity.

Glossary

alveoli—clusters of tiny air sacs at the end of the bronchial tubes

aorta—the largest artery in the body, carries blood from the left side of the heart

appendicular skeleton—the part of the skeleton made of the bones that provide support and movement

axial skeleton—the part of the skeleton made of the bones that protect or carry other body parts: the skull, the spine (vertebral column), and the rib cage (thorax).

carbohydrates—sugars and starches found in foods we eat

cartilage—translucent flexible tissue

enzymes—materials that speed up some digestive processes

epiglottis—a small flap in the back of the throat that closes your windpipe to keep food out of the trachea

gland—a specialized cell or group of cells

glucose—sugar as it is transported into body cells

homeostasis—the balance of the human body's internal environment in order to maintain healthy life

hormones—products of living cells that circulate through the blood

locomotion—the ability to move

metabolism—the chemical reaction in the body's cells that converts fuel from food into energy, including waste disposal

mucus—a thick liquid that moistens the respiratory system and helps get rid of dust and other particles that are breathed in

neurons—the transmitting cells of the nervous system

nourishment—something that contributes to health and growth

nutrients—any substance found in food that is needed for the life and growth of plants and animals

saliva—a thin, watery liquid produced in the mouth to help in swallowing and digestion

tendons—strong, fibrous tissue that connect muscle to bone

transmitters—chemical substances that transport neurons

urea—a liquid waste product resulting from the breakdown of food particles in cells

vertebrae—the 33 bones that make up the spine

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**FOCUS
ON
SCIENCE**

Human Body Systems

Assessments

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Check Understanding



In the Answer Document on this page, mark your answer in the row of circles for each question by filling in the circle that has the same number as the answer you have chosen.

1. The human body system that takes in oxygen and releases carbon dioxide is the
 - (1) respiratory system
 - (2) circulatory system
 - (3) nervous system
 - (4) digestive system
2. The endocrine system
 - (1) contains glands that release chemical messages called hormones
 - (2) uses raw materials for growth and repair of cells and tissues
 - (3) filters harmful waste products carried by blood to the cells
 - (4) allows us to adjust the flow of gases in and out of the body
3. The diaphragm is a
 - (1) tendon that connects bones at a joint
 - (2) gland that secretes chemical messages called hormones
 - (3) muscle that contracts and expands during respiration
 - (4) transmitter that sends neurons to cells in the body
4. The central nervous system contains
 - (1) the heart, arteries and veins
 - (2) the brain and the spine
 - (3) nerves and wiring through the spinal cord
 - (4) bones, joints, muscle, and tendons

Answer Document									
1.	①	②	③	④	3.	①	②	③	④
2.	①	②	③	④	4.	①	②	③	④

Check Understanding



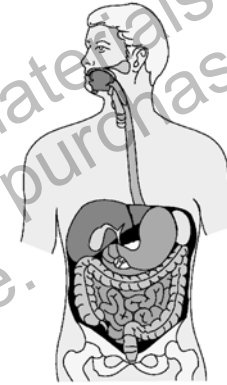
Base your answers to questions 5 – 7 on the illustrations of body systems below and on your knowledge of science. Name each body system, list its main parts, and describe its primary function.



body system A



body system B



body system C

Body System	Major Parts	Primary Function
5. System A is the _____		
6. System B is the _____		
7. System C is the _____		

**FOCUS
ON
SCIENCE**

Human Body Systems

Answer Key

Answer Key

Page 8: Build Background

Use Your Knowledge: Answers will vary according to student's prior knowledge.

Brainstorm: Answers will vary.

Label It: 1. digestive; 2. nervous; 3. respiratory; 4. skeletal; 5. digestive; 6. circulatory

Page 9: Key Vocabulary

Rate Your Knowledge: Answers will vary.

Page 10: Key Concepts

Active Reader: 1. The body is made up of cells.; 2. Diagrams will vary but should include the nucleus, cytoplasm, organelles, and cell membrane.

Page 11: Chapter 1

Active Reader: 1. Something that contributes to health and growth; 2. to change or transform

Page 12: Chapter 1

Active Reader: 1. Food and drink are changed into smaller molecules of nutrients... (cause) so they can be absorbed into the blood and transported to cells throughout the body. (effect); 2. Answers will vary but should name some fruits and vegetables, nuts, and whole grains.

Focus Questions: 1. The purpose of the digestive system is to convert food and drink into energy. 2. The process is important because the body needs energy to live.

Page 13: Chapter 1

Active Reader: 1. Students could name break, push, squeeze, or closes.; 2. In the mouth, teeth break up food, saliva helps to soften food.

Page 14: Chapter 1

Active Reader: 1. Nutrients are carried to cells in the bloodstream.; 2. muscle

Page 15: Chapter 1

Active Reader: 1. the liver; 2. The small intestine is about 2 inches wide and 20-25 feet long. The large intestine is about 4 inches wide and 5 feet long. The small intestine is longer, the large intestine is wider.

Focus Questions: 1. mouth, esophagus, stomach, small intestine, liver, large intestine; 2. Food is transported from one organ to another as it transforms into fuel for energy.

Page 16: Chapter 1

Active Reader: 1. Finally, the waste leaves the colon and is pushed into the rectum.; 2. Underline phrase "get rid of." Circle the word "excretory."

Page 17: Chapter 1

Active Reader: 1. Metabolism is the sum of all of the chemical reactions in cells that convert food to energy.; 2. Underline the word "simultaneously."

Focus Questions: 1. solid waste, liquid waste (urine), gas; 2. The last step in metabolism is waste disposal.

Page 18: Stop and Think

1. (3); 2. (4); 3. Digestion begins in the mouth.; 4. The body's last opportunity to absorb water and nutrients into the body is in the large intestine, before moving to the colon.

Page 19: Chapter 2

Active Reader: 1. It exchanges the air inside the body with air outside the body; it takes in oxygen and eliminates carbon dioxide.; 2. Students may suggest words such as steady, even; students may suggest words such as faster, heavier.

Web Quest: It is better to breathe through the nose, because the nose has better filters.

Page 20: Chapter 2

Active Reader: 1. Prefix in- means in, toward, within; prefix ex- means out of, from. Inhale means to take in air; exhale means to let out air.

Focus Questions: 1. Oxygen comes in, carbon dioxide is released; 2. Oxygen helps cells release energy from food into the body; carbon dioxide is a waste product.

Answer Key

Page 21: Chapter 2

Active Reader: 1. Arrows should be coming upward and out of the mouth in Exhaling and going into the mouth and downward in Inhaling.; 2. 300,000,000

Page 22: Chapter 2

Active Reader: 1. inflate: fill with air, deflate: let air out; contract: make smaller, expand: open up or get bigger; 2. Examples include balloon, accordion, vacuum, tire. Focus Questions: 1. air goes through it as it is breathed in; 2. The chest cavity gets larger when filled with air, smaller when air is released.

Page 23: Chapter 2

Active Reader: 1. The circulatory system is a closed system because all of the transportation is contained in the bloodstream.; 2. It constantly pumps blood through the body.

Page 24: Chapter 2

Active Reader: 1. The heart is a little to the left of the center of the chest.; 2. carbon dioxide and some nitrogen compounds. Focus Questions: 1. Blood, oxygen, and nutrients are transported through blood to cells in the body.; 2. blood, oxygen and nutrients are continuously moving through cells in the body

Page 25: Chapter 2

Stop and Think: 1. (1); 2. (2); 3. (4); 4. blood, veins, arteries;

Page 26: Chapter 3

Active Reader: 1. The bones form a shield to guard sensitive body parts.

Page 27: Chapter 3

Active Reader: Cartilage provides protection from bones against bones and enhances flexibility.

Focus Questions: 1. The axial skeleton protects vital organs; the appendicular skeleton provides movement and body support.; 2. The skull protects the brain.

Page 28: Chapter 3

Active Reader: 1. Example: Bones contract to cause muscles to move.; 2. A diaphragm flattens and gets smaller when it contracts; a muscle contracts to pull in or forward.

Page 29: Chapter 3

Active Reader: 1. Drawings may include: voluntary muscle: hand, arm, leg; involuntary muscle: stomach, intestines; cardiac muscle: heart.

Focus Questions: 1. Muscles contract to create movement. 2. Examples: voluntary muscle: limbs such as arms, legs, feet, hands; involuntary muscle: stomach, intestines, heart.

Page 30: Chapter 4

Active Reader: 1. Examples: External stimuli is anything that affects the body or that the body senses: weather, sounds, smells. Internal response is the body's reaction: shivering, feeling pain, movement, sneezing.

Page 31: Chapter 4

Active Reader: 1. Circle peripheral. Example sentences: Peripheral vision means one can see wider than the central view.; A mouse and a keyboard are peripheral devices to the central computer.

Focus Questions: 1. External stimuli: thunder, smell of perfume, hot sun; internal response: stomach ache, hiccups, sunburn.; 2. The nervous system (brain) sends messages to the skeletal and muscular systems to create locomotion.

Page 32: Chapter 4

Active Reader: 1. Underline the first sentence. The first sentence compares the nervous system to the endocrine system. 2. The prefix para- means beside, or closely resembling. Example sentence: Parathyroids are tiny glands attached to the thyroid.

Answer Key

Page 33: Chapter 4

Active Reader: 1. Examples are mood, growth, development, reproduction, metabolism.

Focus Questions: 1. pineal gland (ability to sleep); pituitary gland (growth and development); thyroid (body's capacity for changing food into fuels for energy).; 2. The nervous system and endocrine system are connected by the hypothalamus.

Page 34: Chapter 4

Stop and Think: 1. (2); 2. (1); 3. (4); 4. The skeleton supports movement and protects internal body parts.

Page 36: Think Like a Scientist

1-3. Answers will vary but should demonstrate understanding of faster pulse and heavier breathing after exercise.; 4. At rest, the circulation system and respiratory system work at a more even rate. During exercise, the body requires more energy, requiring the circulatory system and respiratory system to work together increase flow of oxygen-rich blood.

Page 39: Assessments

Check Understanding: 1. (1); 2. 1); 3. (3); 4. (2).

Page 40: Assessments

Check Understanding: 5. Skeletal system.

Major parts: bones, muscles. Function is to provide support and to protect internal organs; 6. Nervous system. Major parts: brain, spinal cord, nerves. Function is to control and coordinate the body's responses to external environment, regulate growth and development.; 7. Digestive system.

Major parts: mouth, esophagus, stomach, large intestine, liver, small intestine.

Function is to transform foods into fuel for energy for the body.