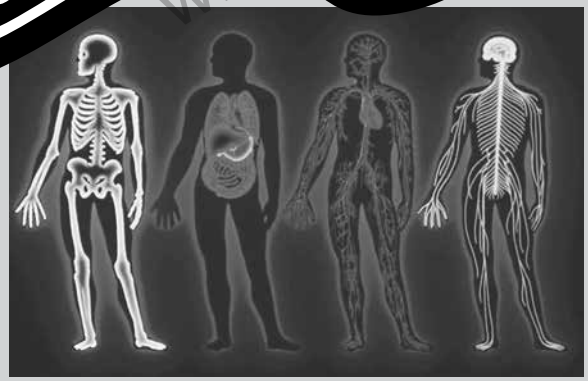
FOCUS ON SCIENCE

Cells to Systems

On Level



Life Science
Dynamic Equilibrium

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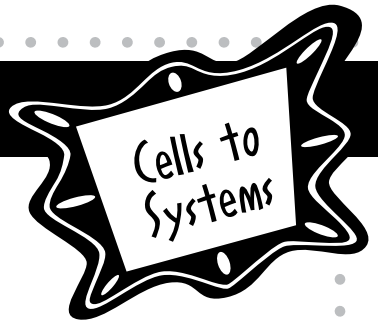


Scientific Inquiry

The central purpose of scientific inquiry is to develop explanations of natural phenomena in a continuing, creative process.

Seek to clarify, to assess critically, and to reconcile with their own thinking the ideas presented by others, including peers, teachers, authors, and scientists.

Life Science

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

Some organisms are single cells; others, including humans, are multicellular.

Cells are organized for more effective functioning in multicellular organisms. Levels of organization for structure and function of a multicellular organism include cells, tissues, organs, and organ systems.

Many plants have roots, stems, leaves, and reproductive structures. These organized groups of tissues are responsible for a plant's life activities.

Multicellular animals often have similar organs and specialized systems for carrying out major life activities.

Organisms maintain a dynamic equilibrium that sustains life.

Animals and plants have a great variety of body plans and internal structures that contribute to their ability to maintain a balanced condition.

An organism's overall body plan and its environment determine the way that the organism carries out the life processes.

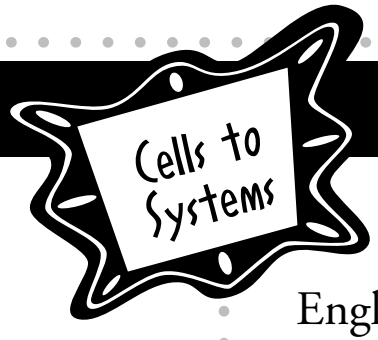
All organisms require energy to survive. The amount of energy needed and the method for obtaining this energy vary among cells. Some cells use oxygen to release the energy stored in food.

The methods for obtaining nutrients vary among organisms. Producers, such as green plants, use light energy to make their food. Consumers, such as animals, take in energy-rich foods.

Herbivores obtain energy from plants. Carnivores obtain energy from animals. Omnivores obtain energy from both plants and animals. Decomposers, such as bacteria and fungi, obtain energy by consuming wastes and/or dead organisms.

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.

The survival of an organism depends on its ability to sense and respond to its external environment.



Life Science *(continued)*

Organisms maintain a dynamic equilibrium that sustains life.

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.

In order to maintain a balanced state, all organisms have a minimum daily intake of each type of nutrient based on species, size, age, sex, activity, etc. An imbalance in any of the nutrients might result in weight gain, weight loss, or a diseased state.

Plants and animals depend on each other and their physical environment.

Photosynthesis is carried on by green plants and other organisms containing chlorophyll. In this process, the Sun's energy is converted into and stored as chemical energy in the form of a sugar. The quantity of sugar molecules increases in green plants during photosynthesis in the presence of sunlight.

English Language Arts

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

Word Recognition

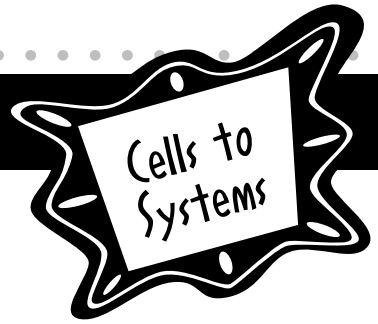
- Use varied sources of information, including context, to monitor and self-correct for word-reading accuracy

Background Knowledge and Vocabulary

- Determine the meaning of unfamiliar words, terms, and idioms by using prior knowledge and context clues

Comprehension/Response

- Combine multiple strategies (e.g., predict/confirm, question, visualize, summarize, monitor, self-correct) to enhance comprehension and response



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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

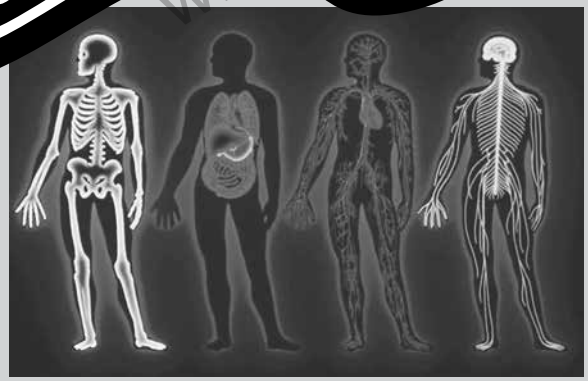
Student Book: print pages 5–36

Assessments: print pages 37–40

Answer Key: print pages 41–46

FOCUS ON SCIENCE

Cells to Systems

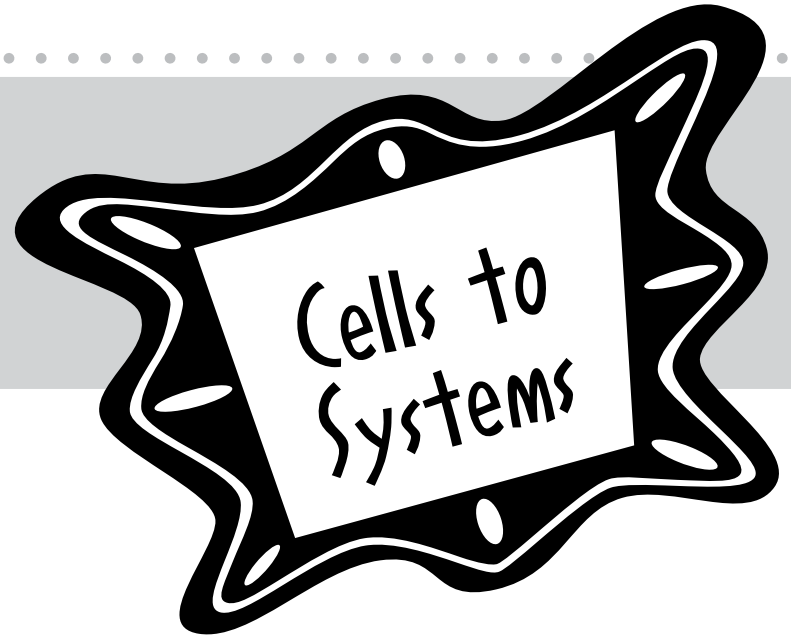


How is homeostasis maintained in other organisms?

All living organisms are made up of cells. Organisms range in size. They can be single-celled microorganisms or large multicellular plants and animals.

Organisms have a variety of body structures and systems. All organisms need energy to carry on their life functions.

Look at the illustration on this page. What body structures and systems do you have?



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Starting Points

Build Background

Use Your Knowledge

Your body is made up of many parts that work together. Write a few sentences about how your body works.

Brainstorm

What do you already know about different types of organisms? List what you know about microorganisms, plants, and animals in the chart below.

Microorganisms	Plants	Animals

Label It

Here are two groups of words that have to do with Cells to Systems. Add a word to each list. Then, write a label in the gray box that describes the words in the list.

1.

nucleus
cytoplasm
mitochondria

2.

skeletal system
digestive system
nervous system

Starting Points

Key Vocabulary

Rate Your Knowledge

The words listed below have to do with Cells to Systems. Each word is important, but some of them may be new to you. Rate your knowledge of each one by checking the appropriate column. Give the definition if you know the word. 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...
cell			
nucleus			
system			
eukaryote			
prokaryote			
microorganism			
heterotrophic			
autotrophic			
photosynthesis			
invertebrate			
vertebrate			
bacteria			

Starting Points

Key Vocabulary

Use Roots and Prefixes to Unlock Meaning

Many science words come from Greek or Latin. Knowing Greek and Latin prefixes and roots can help you unlock the meaning of many science terms. Use your knowledge to discover the meanings of the following words. Write your definitions on the lines below.

1. *heterotrophic* and *autotrophic*

hetero- Greek prefix meaning "other"
auto- Greek prefix meaning "self"
-troph Greek root meaning "to feed"

2. *eukaryote* and *prokaryote*

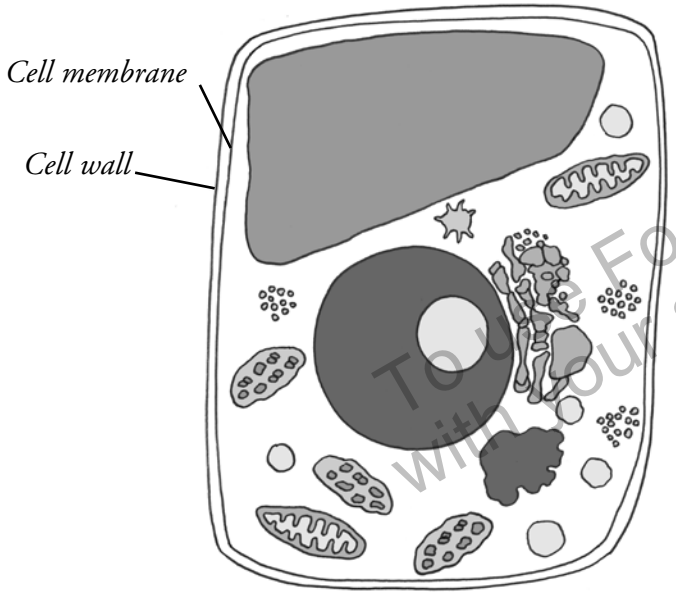
eu- Greek prefix meaning "good" or "true"
pro- Greek prefix meaning "before"
-kary Greek root meaning "nut" or "kernel"

Key Concepts

How Organisms Function

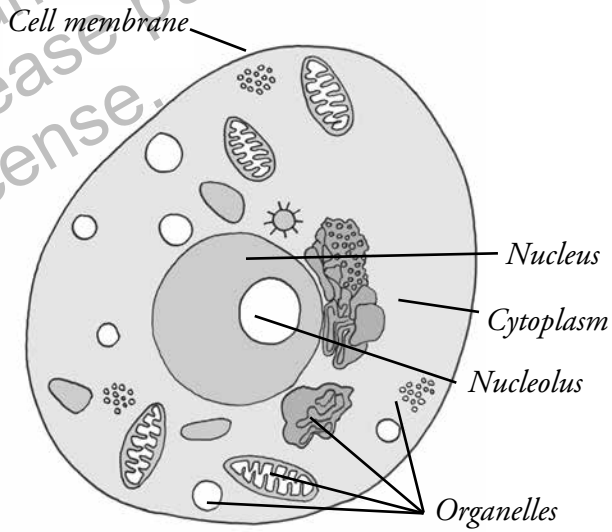
All organisms are made up of cells. Cells may exist on their own as single-celled organisms, or they may work together to form multicellular organisms, like plants and animals. Cells are made up of a few basic parts, usually including a nucleus, cytoplasm, organelles, and a cell membrane.

Plant Cell



A plant cell wall is very strong.

Animal Cell



An animal cell is made up of many parts, all working together.

Starting Points

Key Concepts

Energy for Life

All living cells and organisms need energy to stay in balance and perform their functions. Food provides living things with that energy. Some organisms make their own food. Plants, for example, make their own food through photosynthesis. Such organisms are called producers. Animals, on the other hand, are consumers. They eat other organisms to obtain food. They can be plant eaters (herbivores) meat eaters (carnivores), or they can eat both plants and animals (omnivores).

The body breaks food down into molecules including carbohydrates, fats, protein, minerals, and water, and delivers these molecules to the cells. Chemical reactions in the cells release the energy. The cell uses it to carry on life processes.

All of the chemical reactions that take place in the body of an organism to maintain life are called metabolism. In other words, metabolism is the transformation of matter and energy in the body. The metabolism of an organism determines which foods it will find nutritious and which it will find poisonous. An organism's metabolism can be affected by such things as hormones, diet, aging, and exercise.

A proper diet, for example, is important in maintaining a healthy balance. An organism must take in certain nutrients on a regular basis depending on the organism's size, age, activity level, etc. Too much or too little intake of nutrients can result in an imbalance that is reflected in weight gain, weight loss, or disease.

ACTIVE READER

1 Identify *Underline the name of the process by which plants make their own food.*

2 Restate *What is metabolism?*

Chapter 1 Organisms Are Made of Cells

FOCUS

This section discusses microorganisms. As you read, find out about three types of microorganisms. What characteristics and body structures does each one have?

Microorganisms

Microorganisms are the smallest organisms. Micro means "small." Microorganisms are too small to be visible to the human eye; they have to be viewed through a microscope.

They can be **heterotrophic**, meaning they eat other things, or **autotrophic**, meaning they make their own food. Some microorganisms live alone while others live and work together in colonies. Microorganisms are also called microbes.

Bacteria

Bacteria are the simplest single-celled organisms. They are prokaryotes, so they have no defined nucleus. They have no organelles except ribosomes. They do have a cell membrane and a protective cell wall. Bacteria can be found just about everywhere, including in the soil, on food, and in your body. Some bacteria are helpful, such as bacteria that live in a cow's stomach to help break down plant material. Other bacteria are harmful, such as bacteria found on food that cause stomach pain in humans.

Bacteria are single-celled microorganisms that live almost everywhere.

Protozoa

Protozoa are another type of single-celled microorganism. Protozoa are eukaryotes and they are heterotrophic. They are bigger and more advanced than bacteria. There are many types of protozoa in the world. One is the amoeba. Amoebas ooze from place to place and wrap around their food to dissolve it.

ACTIVE READER

1 Identify *Circle three places where bacteria can be found.*

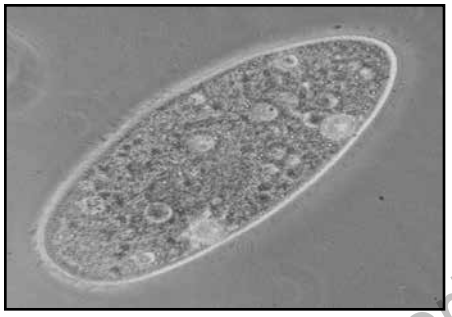
2 Explain *Underline the sentences that answer this question: Are bacteria helpful or harmful?*

Good to Know

The study of microorganisms is called microbiology. A scientist who studies microorganisms is called a microbiologist.

Microbiologists work in fields such as medicine, agriculture, engineering, veterinary science, and geology.

Another protozoa is the paramecium. They have tiny hairs called **cilia** that propel them through water. Cilia also capture food, pushing it into a mouth-like opening. The paramecium is very advanced for its size.



Protozoa are larger than bacteria.

Fungi

Fungi are microorganisms that are also eukaryotic and heterotrophic. However, they can be either single-celled or multicellular. Yeast are single-celled, microscopic fungi. They are used to make bread and alcohol. They are often found in colonies living and working together.

Some fungi start out microscopic but grow to large sizes. Molds and mushrooms are examples of multicellular fungi that are large enough to be seen by humans.

ACTIVE READER

1 List *What are three types of protozoa?*

_____

_____

_____

2 Identify *Underline an example of single-celled fungi. Circle an example of multicellular fungi.*

3 Research *Identify three types of mold you might find around your home.*

_____

_____

_____

FOCUS QUESTIONS

1. How are bacteria and protozoa similar and different?

_____

_____

2. Where can you find these microorganisms? Write a place for each one.

bacteria **protozoa** **fungi**

_____

_____

Good to Know

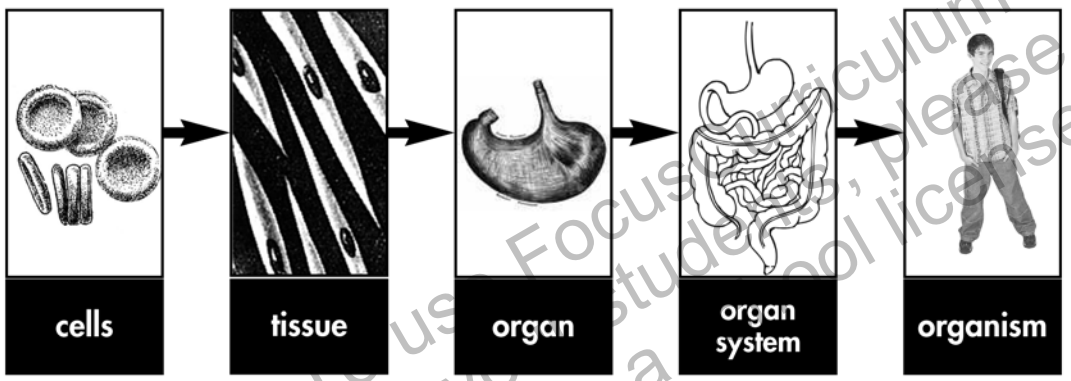
The invention of the microscope in the seventeenth century allowed scientists to see and study microorganisms for the first time.

FOCUS

This section describes how cells are organized in multicellular organisms. As you read, find out about different levels of organization.

Cells to Systems

As organisms get bigger, their cells specialize to perform specific functions. The trillions of cells that make up the human body are very different from the single cell that makes up an amoeba. Humans and other multicellular organisms have several levels of organization. From smallest to largest, these levels are cells, tissues, organs, and systems.



Tissues

A **tissue** is a group of cells that comes together to perform a specific function. For example, nervous cells join to form nervous tissue. Bone cells join to form bone tissue. There are four basic types of tissues:

1. Epithelial tissue, which forms sheets that serve as layers or linings
2. Connective tissue, which supports and structures the body
3. Muscle tissue, which contracts and allows movement
4. Nerve tissue, which generates and conducts electrical signals

ACTIVE READER

1 Infer *In what part of the body might epithelial tissue be found?*

_____

_____

Web Quest

The specialized cells that make up the human body are many different shapes and sizes. Use the phrase "cells in the human body" when searching the Internet. Find out what they look like and what they do.

Organs

An **organ** is made up of tissues that have similar functions and work together for a common purpose. Examples of organs in the human body are the heart, brain, liver, kidneys, and skin. Let's look more closely at the skin. Epithelial tissue forms a barrier between the inside and outside of the body. Connective tissue provides support for the skin. Nerve tissues provide feeling in the skin. Together, all the tissues that make up the skin have a common purpose: protecting the body.

Many types of organs can be found in multicellular organisms. Many of the organs found in humans can also be found in other animals. Additionally, some animals have specialized organs such as those in sea animals that remove salt from water. Plants have different types of organs than animals, including roots, stems, leaves, flowers, and seeds.

Organ Systems

A **system** is a group of organs that work together for a common purpose. Systems in the human body include the circulatory system, respiratory system, digestive system, skeletal system, and nervous system. These systems are found in most mammals and other complex animals. Plants have their own systems, including vascular systems, root systems, and shoot systems. We'll look more closely at these different types of systems later in this book.

ACTIVE READER

1 Identify *Underline the tissues that make up the skin. Circle the purpose of the skin.*

2 Recall *List some systems in the human body not mentioned on this page.*

_____

_____

_____

3 Research *Choose a system in the human body and find out what organs make up that system. List them below.*

_____

_____

_____

FOCUS QUESTIONS

1. Explain the organization of multicellular organisms.

_____

2. How are the organs and systems in plants different from those in animals?

_____

Stop and Think

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

Tip:
Look back through the chapter to find the words in the answer choices. Reread the sentences that contain those words.

1. Paramecia use tiny hairs called cilia to capture food and push it into their bodies. This indicates that paramecia are which kind of microorganism?

(1) autotrophic
(2) multicellular
(3) parasitic
(4) heterotrophic

2. The stomach is made up of several types of tissue including mucus membrane tissue, muscle tissue, and tissue lining the abdomen. Which term best describes the stomach?

(1) system
(2) organelle
(3) organ
(4) tissue group

3. Which is a function of epithelial tissue?

(1) to support and structure
(2) to generate and conduct electrical signals
(3) to serve as layers or linings
(4) to contract and allow movement

Use the statement below and your knowledge of science to answer questions 4 and 5.

Microorganisms are the smallest organisms. They can be classified in two ways.

4. What are the two possible classifications for microorganisms? _____

_____

5. What makes them different? _____

_____

Dear Ms. Understanding,

My teacher says some bacteria are good for you, but I just went to the doctor and she told me I have a bacterial infection that made me really sick. How can bacteria be good for me if they made me sick?

Doubtful in Delmar

Dear Doubtful,

There are trillions of species of bacteria on Earth, and they are all different. Most of them are harmless to humans, and some are good for you! Of course some bacteria do make you sick, but you can't judge all bacteria by a few bad ones. An example of good-for-you bacteria are the ones found in yogurt. Did you know that when you eat yogurt you are eating live bacteria? These bacteria are beneficial to your digestive health.

Ms. Understanding

Chapter 2 Plants

FOCUS This section describes the structure of plants. As you read, find out about some of the systems found in plants. What does each system do?

Plant Structure

Vascular System

Plants can be vascular or non-vascular. Vascular plants have a **vascular system,** which is a system of tubes that transports water and nutrients. The vascular system allows plants to grow tall and have an upright structure. Examples of vascular plants include ferns, shrubs, and trees.

The vascular system is made up of two types of tissue: xylem and phloem. The main function of xylem is to transport water throughout the plant. Xylem can transport water all the way from the roots to the top of a tall tree. The wood in a tree trunk is an example of xylem. Phloem, on the other hand, transports nutrients like sugars throughout the plant. Phloem can be found just under the bark in trees or on the bottom of leaves.

Non-vascular plants do not have a vascular system. Because they don't have a tube system to give the plant structure, non-vascular plants cannot grow very large or tall. Mosses are examples of non-vascular plants. Mosses grow along the ground and are usually less than one inch high.

Buttercups use a vascular system to hold up their flowers. Mosses have no vascular system and grow along the ground.

ACTIVE READER

1 Identify *Underline an example of a vascular plant. Circle an example of a non-vascular plant.*

2 Compare *How are xylem and phloem similar? How are they different?*

_____

_____

_____

_____

Good to Know

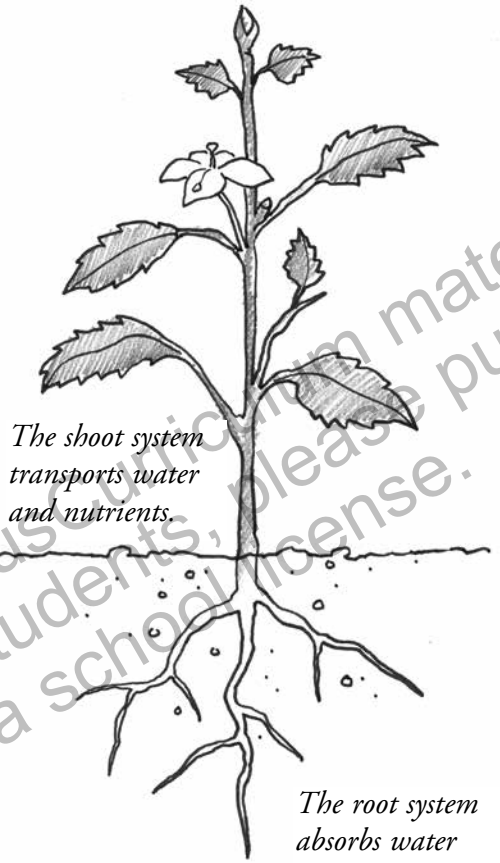
Vascular systems in the tallest trees can extend hundreds of feet high. The vascular system in a Giant Sequoia tree, for example, transports water and nutrients to heights over 380 feet.

Root and Shoot Systems

Most vascular plants share a common structure made up of roots, stems, and leaves. This basic structure can be divided into the **root system**, which is usually below ground, and the **shoot system,** which is usually above ground.

The root system is made up of the roots. Roots absorb water and nutrients from the surrounding area then conduct it to the rest of the plant. The roots support the plant by anchoring it, usually in soil. Think of tree roots that reach deep into the ground. Without the roots, the tree would fall over. Some plants, like water hyacinth, grow in the water. Rather than having their roots underground, these plants have their roots underwater.

The shoot system is made up of the stems and leaves. The stems are the above-ground structures that transport water and nutrients and provide support to the plant. Stems include the main stalk of a plant and smaller stalks that support parts like leaves and flowers. In a tree, the stems are the trunk and branches. Leaves are usually green and flat and grow off of stems. The main function of leaves is to make food for the plant through a process called photosynthesis. Leaves also absorb carbon dioxide for the plant. In some plants, the shoot system includes flowers and fruits, which are reproductive organs for the plant.



The shoot system transports water and nutrients.

The root system absorbs water and nutrients.

ACTIVE READER

1 Create *Draw a carrot growing in the ground. Then label the root and shoot systems.*

What part of the carrot do you usually eat?

_____

There are many variations on the basic structures of plants. Some plants called **epiphytes** have roots that grow on rocks or trees instead of underground. These specialized roots allow them to grab onto a hard surface. Other epiphytes, such as air plants, appear to live on nothing but the air around them.

Stems can be as thick and tall as a tree trunk or as thin and flexible as a dandelion stem. A cactus is one large stem that is specialized to hold a lot of water. This helps the cactus survive for long periods without rain.

Leaf shape and size also has to do with retaining water. Leaves can be long and straight like grass or a complex shape like a maple tree leaf. The needles on pine trees are very small leaves. Some plants, like cacti, don't have any leaves at all. Instead, their leaves are sharp rigid spikes.

Leaves also have many other functions—they may trap food or protect the plant from becoming someone's dinner. Venus flytrap leaves snap shut around insects, trapping them until they are eaten. Cactus spikes deter animals from eating the plant.

FOCUS QUESTIONS

1. Is a dandelion a vascular or non-vascular plant? How do you know?

_____

_____

2. How are roots and stems similar and different?

_____

_____

ACTIVE READER

1 Infer *Why do you think pine trees have needles instead of broad leaves like other trees?*

_____

_____

_____

_____

_____

_____

_____

A few specialized plant structures are described here. Can you think of any others? Use the phrase specialized plant structures to search the Internet. Provide pictures of the plant and write a paragraph explaining how it is specialized.

Hands On Science

Examine a Vascular Plant Find an example of a vascular plant in your environment. This can be a plant that grows outside, such as a tree, shrub, or flowering plant, or inside, such as a house plant. Examine your plant and complete the activity below. When examining your plant, be careful not to disturb important parts like the roots. Dig around the roots to examine them, but do not pull the plant out of the ground or cause any harm to the plant.

1. **Draw a picture of your plant. Label the root system and its parts. Label the shoot system and its parts.**

2. **Carefully cut a stem or branch and a leaf from your plant. Can you see any tubes? Do you think these are xylem or phloem? Draw a picture of any tubes you see in your plant.**

3. **Do you see any specialized structures in your plant? If so, describe what they are and what you think they do. What makes your plant different from other plants?**

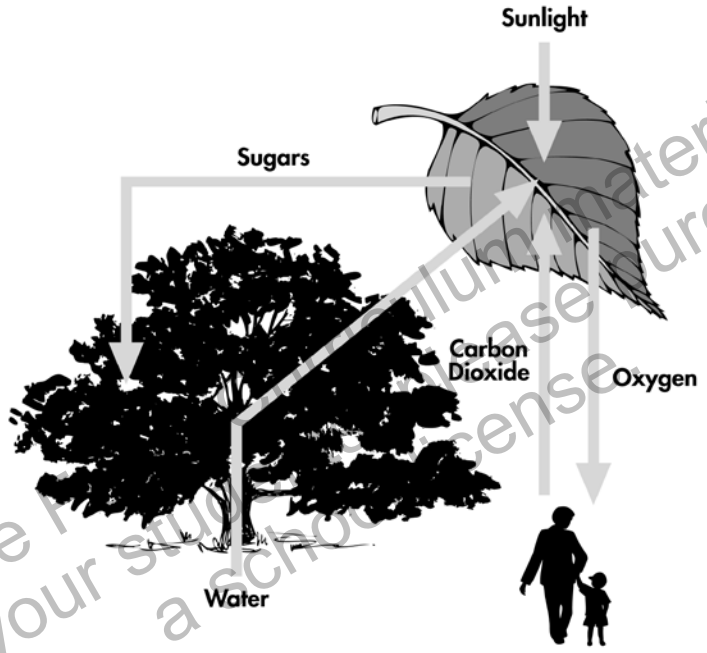
FOCUS

This section explains how photosynthesis works. As you read, learn about how this process takes place in plants.

Photosynthesis

One thing that almost all plants have in common is a process called photosynthesis. In photosynthesis, plants take in energy from the sun and convert it to food in the form of sugars. Photosynthesis takes place in the chloroplasts.

The chloroplasts are organelles that contain chlorophyll, which captures sunlight. After the sunlight is taken into the chloroplast, it combines with carbon dioxide and water to produce glucose, or sugar. Oxygen is also produced during this process. Glucose is used as food by the plant and also by animals that eat the plant.



Photosynthesis takes place in chloroplasts within plant cells. They combine the energy from sunlight with water and carbon dioxide to produce glucose and oxygen.

FOCUS QUESTION

1. Fill in the blanks below to explain what happens during photosynthesis.

_____ + _____ + _____ = _____ + _____

ACTIVE READER

1 Summarize *How does photosynthesis provide plants with food?*

_____

_____

2 Hypothesize *What would happen if a plant didn't get any sunlight?*

_____

_____

3 Research *Some plants need more sunlight than others. Make a list of plants that grow well in sunlight and plants that grow well in shade. Does each group have things in common?*

_____

_____

_____

_____

_____

_____

Stop and Think

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

1. The grass plant is made of many parts, each with a different function.

Grass is an example of what kind of plant?

(1) xylem
(2) vascular
(3) epiphyte
(4) non-vascular

2. Which items make up the shoot system of the grass plant?

(1) roots, stem, and leaves
(2) stem, flower stem, and seed head
(3) roots, stem, leaves, and flower stem
(4) stem, leaves, flower stem, and seed head

Base your answers to questions 3 and 4 on your knowledge of science.

3. What is one type of vascular plant?

_____

_____

4. What makes a plant a vascular plant? _____

_____

Dear Ms. Understanding,

My mom gives the plants in our house "plant food." Do all plants eat plant food?

Unsure in Utica

Dear Unsure,

What your mom calls "plant food" is fertilizer. Fertilizer provides additional nutrients that help plants grow, but plants don't need fertilizer to live. Plants that grow outside get the same nutrients through the soil. Fertilizer is not actually food, because plants don't eat the same way people do! Many plants make their own food through photosynthesis.

Ms. Understanding

Chapter 3 Animals

FOCUS

The underlined sentence states an important idea about how scientists organize animals into groups of related species. Read this section to find out more about animals without a backbone.

Scientists have recognized about 38 different groups among the animals. All animals are classified into groups according to the type of body plan they have.

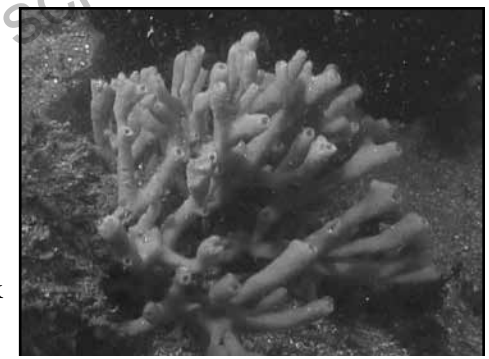
Invertebrates

Invertebrates are the group of animals that do not have a backbone. This group includes many simple animals such as sponges, mollusks, and insects. Invertebrates are multicellular and heterotrophic—they eat other things instead of making their own food. Most invertebrates have tissues that perform specific functions, and they can move on their own. Most invertebrates are also **symmetrical**, although sponges are not. Think of a lobster or an octopus—if you draw a line down the middle, one side would look like a mirror image of the other. Let's look at a few types of invertebrates.

Sponges

Sponges have the simplest body plan of any invertebrate. They are multicellular, and they start their lives swimming around. When they become adults, they anchor to a hard surface like a rock and stay there.

Sponges don't have tissues like most invertebrates. They are basically hollow tubes with pores and openings to take in water, filter out food, and send the water back out. They lack brains, mouths, and lungs. But they do have specialized cells that perform the functions of a nervous system, digestion, and respiration. For example, "collar" cells line the inner cavity. These sticky, funnel-shaped cells collect food as it passes by.



The sponge is an invertebrate that has an asymmetrical body plan.

ACTIVE READER

1 Extend *Is the human body symmetrical? Draw a picture of the human body and draw a line down the middle. Are both sides similar?*

Good to Know

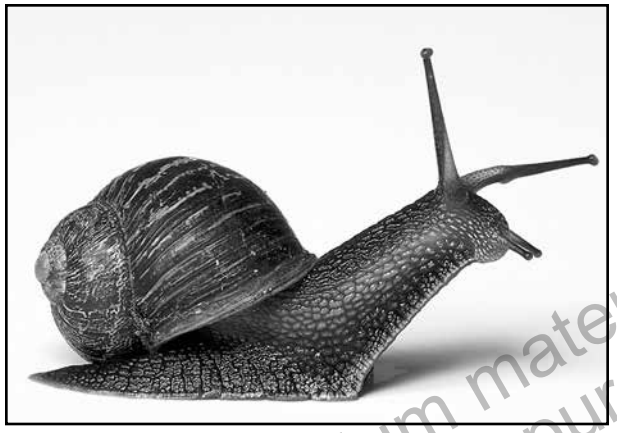
People use sponges for bathing and for cleaning around the house. Most of these sponges are synthetic, or made in factories. However, some people use natural sea sponges for bathing or cleaning. Only a few types of sponges with soft skeletons are soft enough for these purposes.

Mollusks

Animals like clams and snails have soft bodies. Many **mollusks** build a thin shell around themselves for protection. Their bodies consist of two parts: a head-foot, such as the part you can see on a snail, and a **visceral** mass which contains organs such as a heart. This part of the mollusk's body is covered by the **mantle**, a body wall which creates the shell.

The octopus is also a mollusk, although most octopi have no shell. Its muscular head-foot has developed into eight arms, or tentacles, with strong suckers. The tentacles and suckers allow octopi to grab animals for food and to hold onto rocks for movement.

The mantle contains the visceral mass with vital organs. Octopi have tissues, organs, and systems. They even have a brain. The octopus is the smartest invertebrate. In some octopi and related species, the mantle creates a shell, but it is inside the body. The mantle can also be used to help the animal move.



The snail is a mollusk that has a head-foot for eating and moving. Its visceral mass is protected by a thin shell.

The octopus is a mollusk that has a soft body with unsegmented tentacles.

ACTIVE READER

1 Define *What is a mollusk?*

_____

_____

Can you name any other mollusks besides the octopus?

_____

_____

_____

_____

_____

_____

Arthropods

Arthropods are invertebrates that have hard outer shells and jointed legs, or appendages. The name means *joint-footed.* Insects, spiders, crabs, and lobsters are arthropods. All arthropods have exoskeletons, which are hard outer shells, and pairs of legs made up of segments.

Arthropods have tissues, organs, and systems. Their bodies are symmetrical and they have heads with eyes and a mouth. They have advanced sense organs, such as compound eyes in flies and antennae in butterflies. Many arthropods have specialized body structures, such as wings on flying insects and poisonous stingers on bees. Some have specialized exoskeletons, such as crabs that have one large shell to protect their entire body.

The lobster is joint-footed arthropod with a symmetrical body.

FOCUS QUESTIONS

1. **What traits do all invertebrates share?**

2. **In what ways are octopi more advanced than sponges?**

ACTIVE READER

1 Differentiate *Spiders and crabs are both arthropods. How are they different from each other?*

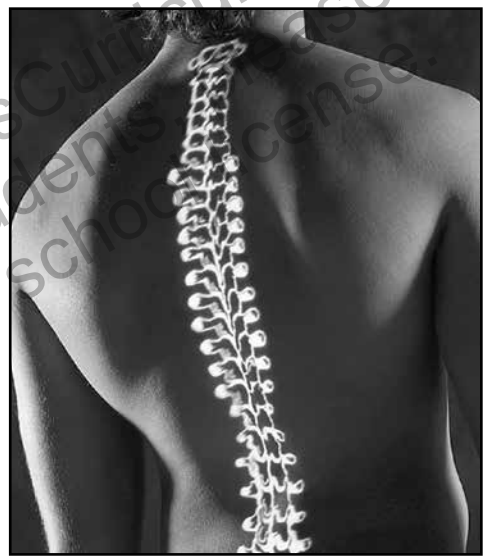
FOCUS

This section discusses the group of animals called vertebrates. As you read, find out about the different types of vertebrates. What are the traits of each type of vertebrate?

Vertebrates

Vertebrates are the group of animals that have a backbone. The backbone is a jointed series of bones called vertebrae that encloses the spinal cord and provides support for the body. The spinal cord is nervous tissue that runs from the brain along the back. Vertebrates are the most advanced organisms. They have complex nervous systems that make even the simplest vertebrates smarter than most invertebrates. They also have muscular and skeletal systems that allow them to perform complex movements. Vertebrates include fish, amphibians, reptiles, birds, and mammals.

Fish live in the water and are **cold-blooded,** meaning their body temperature is the same as their surroundings. Fish can have skeletons made of bones or cartilage, which is a tough, flexible tissue. Sharks and sting rays have cartilage, while goldfish and trout have bony skeletons. Most fish share some basic body structures. These include fins that help them swim, gills that allow them to take in oxygen, and scales that cover and protect their skin. Fish can be found in a wide variety of shapes and sizes. Think of how different a seahorse looks from an eel!



All vertebrates have a backbone that supports the body.

ACTIVE READER

1 Explain *Which characteristics make vertebrates the most advanced organisms?*

_____

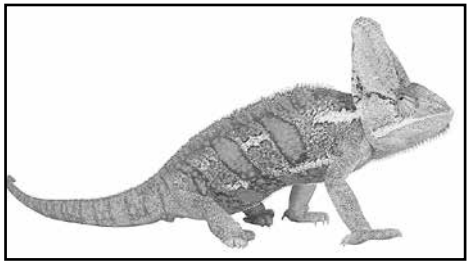
_____

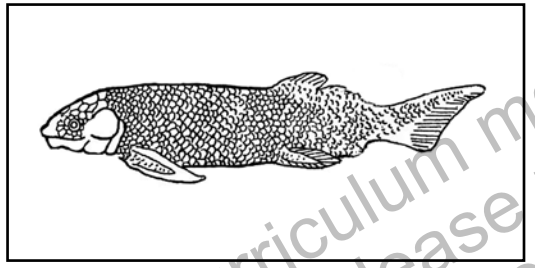
_____

2 Create *Draw a picture of a fish and label the fins, gills, and scales.*

The Tetrapod Body Plan

The pictures below show various animals. Included are an ancient fish, a reptile, a bird, and a human. One thing they all have in common is that they are vertebrates. But they have other things in common, as well. For example, they all share a similar body plan, called a **tetrapod** body. The term tetrapod means "four-footed."





As you can see, the reptile has four legs with feet. Even though the other animals shown don't have four feet, they do have four appendages. The fish has fins. The bird has feet and wings, which enable it to fly. And the human has arms with hands and legs with feet.

All animals have bodies that contain organs such as hearts, lungs, and livers. And they have heads with eyes, mouths, and brains. Their bodies are also symmetrical with a left side, a right side, a topside (or front), and a bottom side (or back).

ACTIVE READER

1 Explain *Why aren't arthropods considered to be tetrapods?*

_____

_____

_____

2 Identify *What are some other ways in which the tetrapods shown on this page are alike?*

_____

_____

_____

_____

_____

Amphibians

Amphibians include frogs, toads, and salamanders. They are cold-blooded like fish, and when they are born they live in water and breathe through gills. However, they undergo a process called metamorphosis in which their body changes to allow them to live on land. Then they develop lungs that breathe air, and most grow four legs so they can walk. Most amphibians have moist skin that absorbs oxygen from the air. Like many other types of animals, some amphibians have unique features. Toads have dry skin. Caecilians are snake-like amphibians that don't have any legs. But they are tetrapods because their ancestors had bodies with four limbs.

This caecilian may look like a snake, but it is an amphibian, not a reptile.

Reptiles

Reptiles are cold-blooded, have dry skin, and breathe air through lungs. Most lay eggs and have four legs. They have larger skeletons than fish and amphibians, which allows them to reach greater sizes, like alligators and crocodiles. Snakes, lizards, turtles, and tortoises are all reptiles. Some reptiles have specialized body structures. Snakes have jaws that come apart so they can swallow food larger than their mouths. Turtles and tortoises have shells that protect their soft bodies.

Birds

Birds are different from most other animals because they can fly. They have wings, feathers, and lightweight bones that help them. They are **warm-blooded**, meaning they can regulate their own body temperature. Being warm-blooded allows birds to live in cold environments. Birds also lay eggs with hard shells, and they have beaks. Birds have large nervous systems in relation to their size, which make them pretty smart.

Birds have a variety of body shapes and sizes. They vary in size from tiny hummingbirds to large eagles. Some birds have specialized body structures. Webbed feet help ducks swim. Sharp talons help hawks hunt. Long beaks allow some birds to eat nectar from flowers. Some birds have become so specialized that they cannot fly. Ostriches have strong legs to run extremely fast on land, but they are too heavy to fly. Penguins have dense, waterproof feathers and solid, heavy bones that help them to swim underwater, but don't allow them to fly.

ACTIVE READER

1 Explain *How does an amphibian change during its lifetime?*

_____

_____

_____

_____

2 Infer *How does having lightweight bones help birds fly?*

_____

_____

_____

_____

_____

Mammals

Mammals are warm-blooded animals that have hair covering their skin. They also feed their young with milk. Most mammals give birth to live young, rather than laying eggs. Mammals have larger, more developed brains than other vertebrates. Humans are the smartest of all animals. But many other mammals such as chimpanzees, rats, dogs, and dolphins have the ability to learn tasks, remember things, and communicate.

Mammals can be divided into three groups based on how they give birth. The largest group is the placentals, who give birth to live young that are fully developed. Humans are placental mammals and so are dogs, cats, mice, monkeys, elephants, and whales. The next group is the marsupials. They also give birth to live young, but the babies mature in the mother's pouch. Kangaroos, koalas, and possums are marsupials. The smallest group of mammals is the monotremes. They lay eggs, similar to reptiles. The platypus and echidna are monotreme mammals.

This kangaroo is a marsupial because its baby matures in a pouch. Like the kangaroo, the platypus feeds its baby milk.

ACTIVE READER

1 Interview *Talk to someone who owns a mammal as a pet, such as a dog, cat, or rabbit. Ask them to describe an example of their pet learning a task, remembering things, or communicating.*

Good to Know

When the duck-billed platypus was first discovered and sent to England, it was such an unusual animal that some scientists thought it was a hoax. They thought that someone might have sewn a duck's beak onto another animal!

The bodies of mammals vary in size and form. Mice and bats are very small. Elephants and whales are among the largest animals on Earth. Many mammals have specialized body parts. These include antlers on deer, quills on porcupines, and long necks on giraffes. The bodies of whales and dolphins are specialized to live in the water. But, they still breathe air and have tiny hairs on their skin like other mammals.

Use the Internet to find out about the world's smallest and largest mammal. Explain how these two mammals are similar and how they are different.

FOCUS QUESTION

1. Use what you know about vertebrates to complete the chart below.

Type of Animal	Common Traits and Body Structures	Unique or Specialized Features
Fish		
Amphibians		
Reptiles		
Birds		
Mammals		

Identify an Animal

You are a scientist working in the field. If you come across a species of animal, how will you identify it? Scientists must be able to ask a series of questions to identify an animal.

1. **Think about the questions you could ask to identify an animal. You might start with the first question in the chart below. Add other questions you would ask to help identify an animal.**

Question	Answer
Does it have a backbone?	
I think the animal is:	

2. **Think of an animal and write its name on a slip of paper. Now work with a partner to try to identify each other's animal. Ask each question you wrote above and write your partner's answer in the chart. After all the questions have been answered, try to identify your partner's animal. Write it on the last line of the chart.**

3. **Did you identify the animal correctly? How did your questions help you figure it out? If you did this activity again, how would you change your questions?**

_____

_____

FOCUS

This section describes the body systems found in animals. As you read, find out about the function of each system.

Animal Body Systems

As you know, the bodies of all but the simplest animals are made up of systems. They include the circulatory system, respiratory system, digestive system, skeletal system, and nervous system.

Circulatory System

The circulatory system transports nutrients, gases like oxygen and carbon dioxide, and waste products throughout the body. The major organs that make up the circulatory system in humans are the heart, blood vessels, and blood. Humans have a closed circulatory system. This means the heart is connected to a system of vessels. Some simple animals have an open circulatory system, in which the heart pumps fluid throughout the body.

Respiratory System

The respiratory system exchanges gases between the body and the environment. All animals need oxygen to survive, so the respiratory system brings in oxygen and gives off carbon dioxide. The human respiratory system is made up of the nose, mouth, larynx, two tubes called the pharynx and trachea, bronchi, and the lungs. Mammals, birds, and reptiles all have lungs as part of their respiratory systems. Birds also have air sacs as part of their respiratory system that help make the body lighter. Adult amphibians have lungs as well, but many also take in oxygen through their moist skin. Fish don't have lungs, but use gills to breathe instead.

Digestive System

The digestive system takes in food, breaks it down, absorbs nutrients, and gets rid of anything the body doesn't need. All animals are heterotrophic—they eat other things—so they must have a digestive system to bring in food. In humans, food is taken in at the mouth and then it travels through the stomach, small intestine, and large intestine. The food is broken down and nutrients are absorbed into the rest of the body. Anything the body can't use is then passed out of the body.

ACTIVE READER

1 Identify *Underline the definition of a closed circulatory system. Circle the definition of an open circulatory system.*

2 Recall *How are gases taken in and given off by animals different than those taken in and given off by plants?*

Skeletal System

The skeletal system provides support and protection to the body. Skeletal systems can be inside the body (endoskeleton) or outside the body (exoskeleton). Humans have endoskeletons made up of bones that support the muscles and organs. Some bones, such as the skull and ribs, also protect parts of the body. Other animals like crabs and insects have exoskeletons. These animals have hard outer plates or a shell that supports and protects a soft body inside. Some animals don't have a hard skeleton at all. For example, starfish have tubes filled with fluid that support the body.

Nervous System

The nervous system senses and reacts to things inside and outside the body. The more developed the nervous system in an animal, the smarter the animal is. However, even simple animals like insects have nervous systems that allow them to move and react to things in their environment. In humans, the nervous system includes the brain, spinal cord, and neurons. Having a large brain and a complex nervous system makes humans smarter than any other animal.

FOCUS QUESTIONS

1. **Choose two animal body systems and explain why they are an important part of how the body functions.**

_____

_____

2. **How does having a nervous system give animals an advantage over plants?**

_____

_____

ACTIVE READER

1 Summarize *What do each of the following systems do?*

Digestive _____

_____

_____

Skeletal _____

_____

_____

Nervous _____

_____

_____

Respiratory _____

_____

_____

Circulatory _____

_____

_____

Stop and Think

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

Base your answers to questions 1 and 2 on your knowledge of science.

Tip:
To compare two things, list their similarities. To contrast them, list their differences.

1. What is one difference between invertebrates and vertebrates?

_____

_____

_____

2. What is one similarity between invertebrates and vertebrates?

_____

_____

_____

3. A crayfish is an animal that has a hard exoskeleton, eight jointed legs, a segmented body, two large claws, antennae, and compound eyes. It lives in the water and breathes through gills.

What kind of animal is a crayfish?

(1) fish
(2) reptile
(3) mammal
(4) arthropod

Dear Ms. Understanding,

Aren't jellyfish and starfish in the fish group? I mean, they have the word "fish" in their names.

Confused in Canandaigua

Dear Confused,

Unfortunately, not every animal called a "fish" is actually a fish! Some animals that live in the water have the word "fish" in their name but are actually part of other animal groups.

To classify an animal you need to look at other characteristics, such as if it has a backbone, and what types of body parts and systems it has. Jellyfish and starfish don't have backbones, so they are invertebrates, not fish.

Ms. Understanding

Glossary

arthropods – animals, such as insects, spiders, crabs, and lobsters that have exoskeletons and pairs of legs made up of segments

autotrophic – organisms that make their own food

cells – tiny units that are the smallest parts of an organism and carry on the basic functions of life

cell membrane – the outer layer of a cell that holds everything together

cell wall – the rigid outside layer of a plant cell

cilia – tiny hair-like structures found on some protozoans that move food into the mouth part and aid with locomotion

cold-blooded – animals whose body temperature is the same as their surroundings

cytoplasm – the fluid that fills a cell

epiphytes – plants that grow on rocks or other plants such as certain orchids or mosses

eukaryotes – cells that have a defined nucleus

heterotrophic – organisms that eat other things

invertebrates – the group of animals that do not have a backbone

microorganisms – organisms too small to be visible to the human eye

mollusks – a group of invertebrate animals with a thin shell covering the visceral mass and a head-foot

nucleus – the part of a cell that controls the functions of the cell

organelles – parts of a cell that perform various functions

organ – a group of tissues that have similar functions and work together for a common purpose

photosynthesis – a process through which plants take in energy from the sun and convert it to food in the form of sugars

prokaryotes – cells that do not have a defined nucleus

root system – a system in plants that absorbs water and nutrients and provides support to the plant

shoot system – a system in plants made up of the stems and leaves that transports water and nutrients and provides support to the plant

system – a group of organs that work together for a common purpose

symmetrical – having a similar arrangements of parts on opposite sides of a center line

tetrapod – an animal having a body plan that includes four appendages

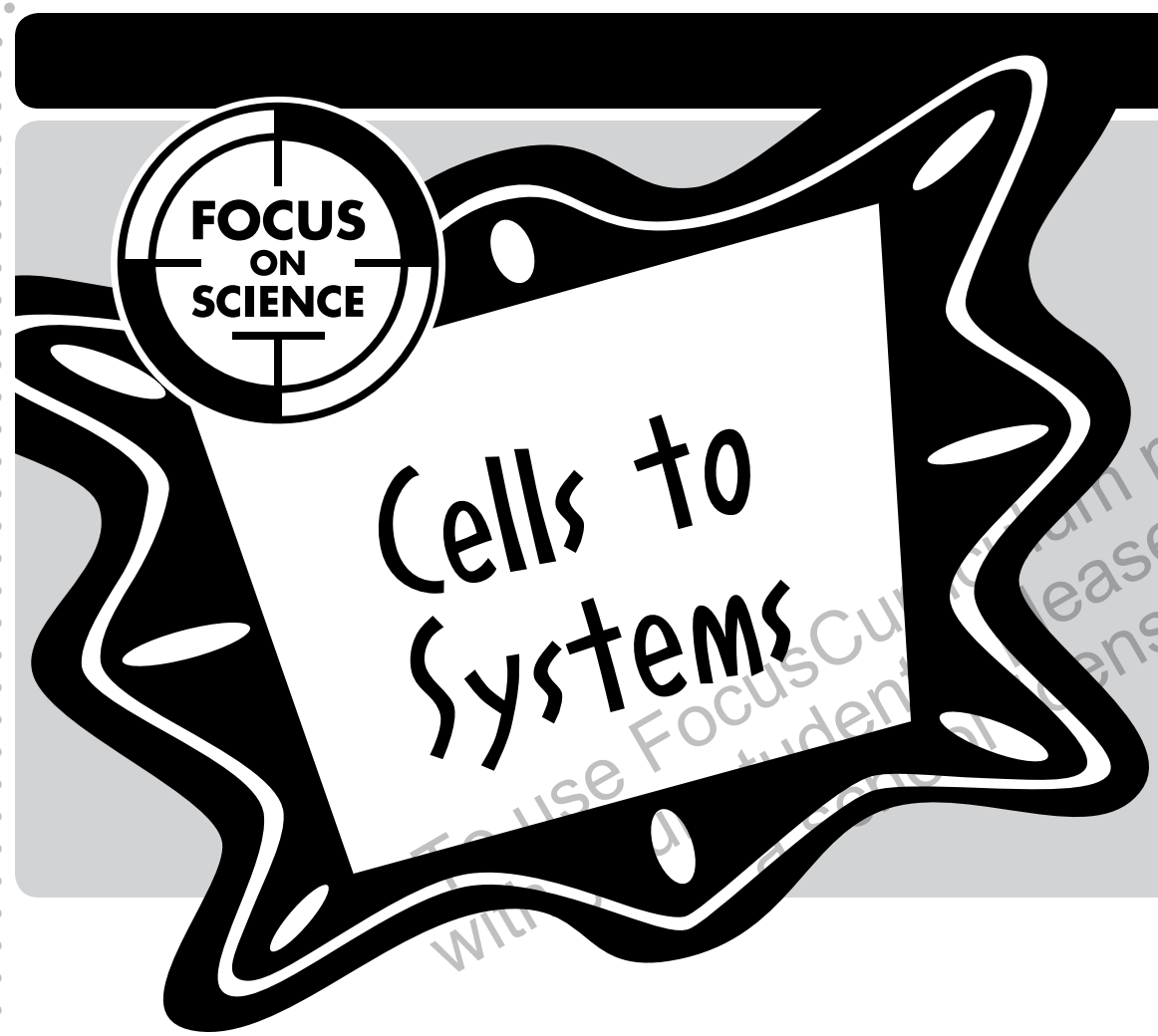
tissue – a group of cells that comes together to perform a specific function

vascular system – a system of tubes in a plant that transports water and nutrients and provides structure to the plant

vertebrates – the group of animals that have a backbone

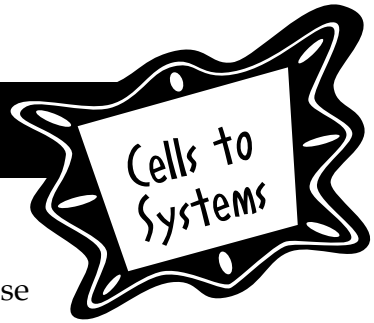
visceral – having to do with the internal organs of the body

warm-blooded – animals who can regulate their own body temperature



Assessments

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. What microorganism is single-celled and prokaryotic, and has ribosomes, a cell membrane, and a cell wall?

   (1) yeast
   (2) sponge
   (3) amoeba
   (4) bacteria

2. Which is an example of a group of tissues that work together for a common purpose?

   (1) skin
   (2) organelle
   (3) connective tissue
   (4) respiratory system

3. Which term refers to plants whose roots grow on rocks or trees instead of underground?

   (1) vascular
   (2) epiphyte
   (3) epithelial
   (4) a backbone

4. A dandelion is growing next to a building. The owner of the building puts up a large awning that completely shades the dandelion. The dandelion no longer gets any sunlight.

   What is most likely to happen?

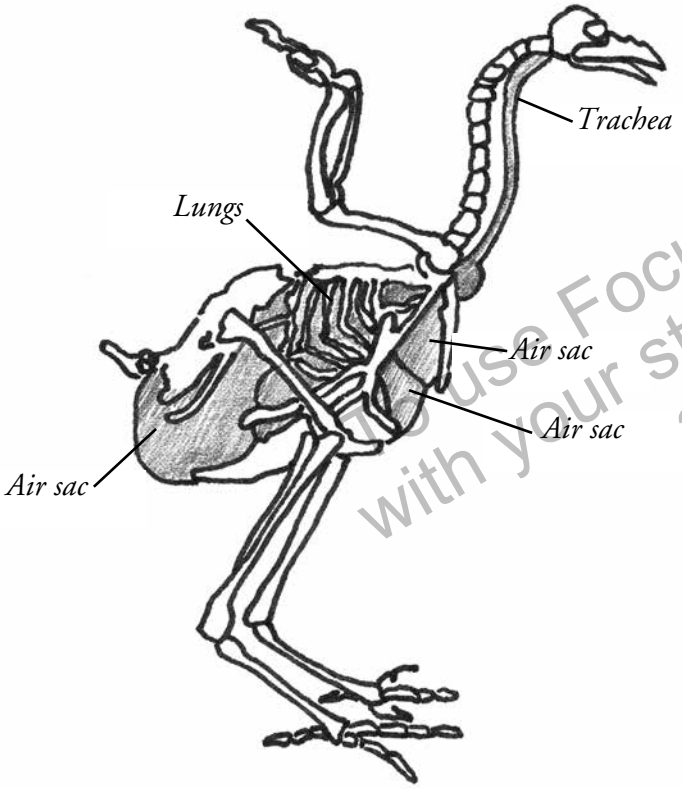
   (1) The dandelion will move to a better location.
   (2) The dandelion will find another source of energy instead of sunlight.
   (3) The dandelion will die within a few hours because it is not getting sunlight.
   (4) The dandelion will live off of stored energy for a while, but will eventually die.

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 and 6 on the diagram of a body system of a chicken below and on your knowledge of science.



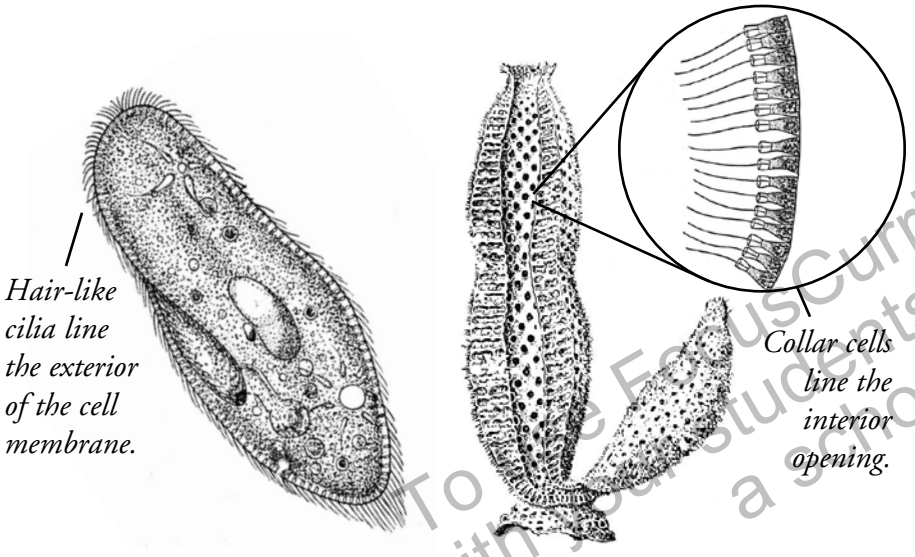
5. What body system is shown in the diagram?

6. What are the similarities and differences of the system in chickens and humans?

Check Understanding

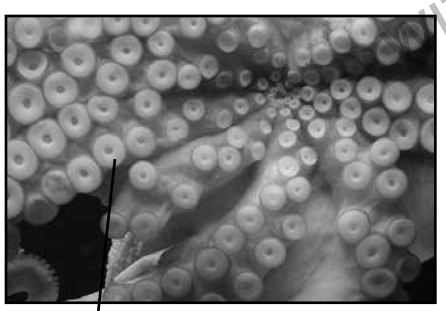
Cells to Systems

Base your answers to questions 7 and 8 on the diagram below showing three inhabitants of a salt water environment and on your knowledge of science.



Hair-like cilia line the exterior of the cell membrane.

Collar cells line the interior opening.



Suckers line the undersides of the tentacles.

The animals shown are not drawn to scale.

7. What three organisms are shown?

_____

_____

_____

8. The labeled structures serve a similar function for each of the organisms. What function do the structures serve and what do they have in common.?

_____

_____

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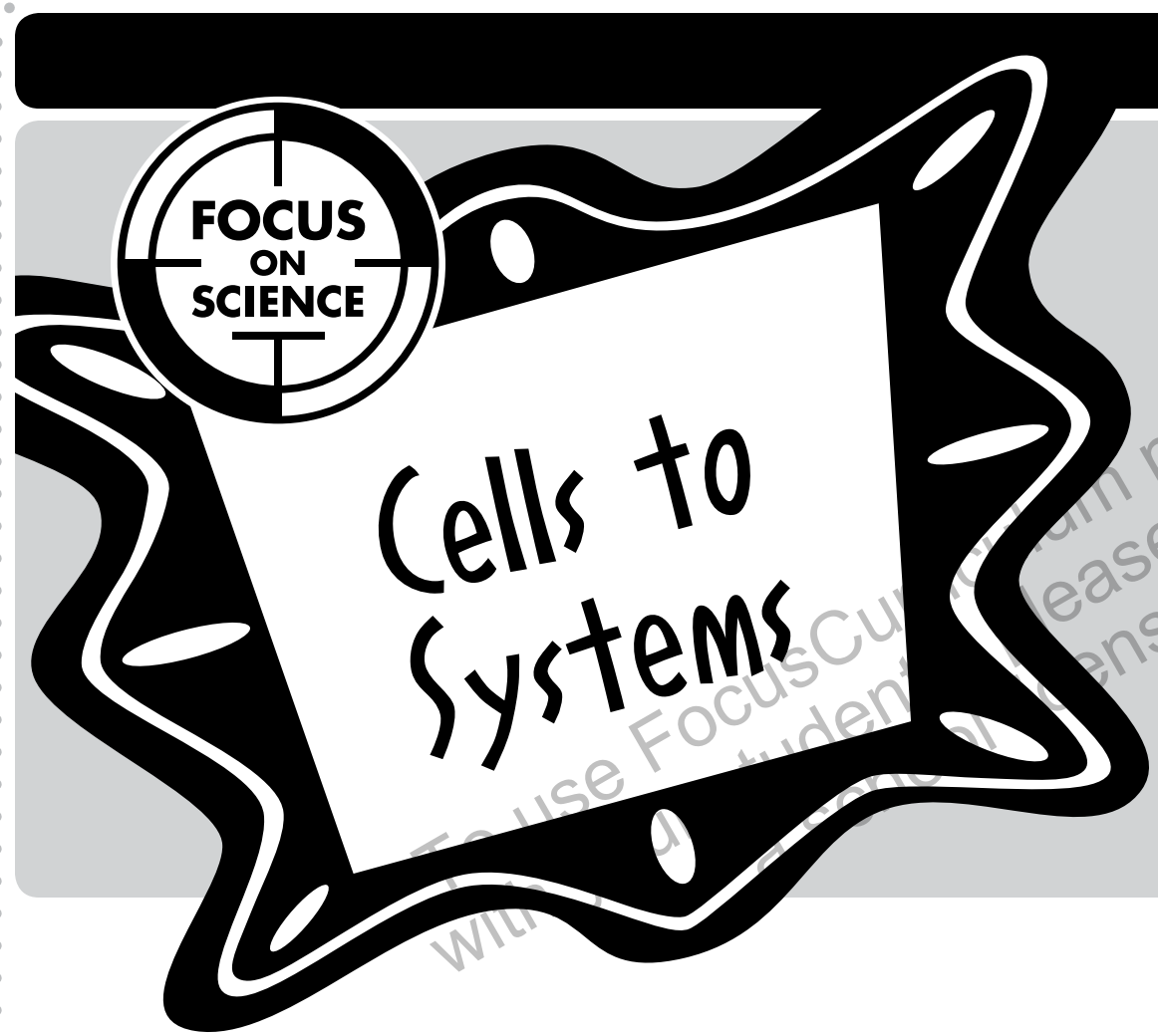

Answer Key

Answer Key

Page 8: Starting Points
Build Background
Use Your Knowledge: Answers will vary according to the student's prior knowledge.
Brainstorm: Answers will vary.
Label It: Answers will vary but may include: 1. Parts of a Cell: nucleus, cytoplasm, mitochondria, ribosomes, chloroplasts, cell membrane; 2. Body Systems: skeletal system, digestive system, nervous system, circulatory system, respiratory system

Page 9: Starting Points
Key Vocabulary
Rate Your Knowledge: Answers will vary.

Page 10: Starting Points
Key Vocabulary
Use Roots and Prefixes to Unlock Meaning: 1. Heterotrophic means eating other things. Autotrophic means making your own food. Both words have the root troph that means "to feed" and the prefix hetero- or auto- changes the meaning to "to feed on others" or "to feed the self." 2. Eukaryote is a cell with a nucleus. Prokaryote is a cell with no nucleus. Both words have the root kary that means "nut" or "kernel," which stands for the nucleus. The prefix eu- or pro- changes the meaning to "true" nucleus, meaning it has a nucleus, or "before" nucleus, meaning it doesn't have a nucleus.

Page 11: Starting Points
Key Concepts
Active Reader: 1. Circle: Cells that have a defined nucleus are called eukaryotes. Some very simple cells, called prokaryotes, do not have a defined nucleus. Answer: Eukaryotes have a defined nucleus; prokaryotes do not. 2. ribosomes, mitochondria, chloroplasts, and vacuoles

Page 12: Key Concepts
Active Reader: 1. Underline: photosynthesis; 2. Metabolism is the sum of all chemical reactions in the body that maintain life.

Page 13: Chapter 1
Active Reader: 1. Circle: soil, on food, in your body; 2. Underline: Some bacteria are helpful, such as bacteria that live in a cow's stomach to help break down plant material. Other bacteria are harmful, such as bacteria found on food that cause stomach pain in humans.

Page 14: Chapter 1
Active Reader: 1. amoeba, paramecium; 2. Underline: yeast. Circle: mold or mushrooms. 3. Answers will vary but may include penicillium, stachybotrys, or alternaria.
Focus Questions: 1. Bacteria and protozoa are both single-celled. Bacteria are prokaryotes and protozoa are eukaryotes, and protozoa are bigger and more advanced than bacteria. 2. Bacteria: soil, on food, in the body; Protozoa: in a host organism; Fungi: in bread and alcohol, in the ground

Page 15: Chapter 1
Active Reader: 1. Answers will vary, but may include skin, stomach lining.

Page 16: Chapter 1
Active Reader: 1. Underline: epithelial tissue, connective tissue, nerve tissues. Circle: protecting the body; 2. endocrine system, excretory system, muscular system, and reproductive system; 3. Answers will vary.
Focus Questions: 1. Multicellular organisms are organized from cells to tissues to organs to systems. 2. Animals have organs like the brain, heart, and skin, while plants have organs like roots, stems, and leaves. Animals have systems like the circulatory and respiratory systems, while plants have systems like vascular, root, and shoot systems.

Page 17: Stop and Think
1. (4); 2. (3); 3. (3); 4. Heterotrophic and Autotrophic.; 5. Heterotrophic organisms eat other organisms. Autotrophic organisms make their own food.

Answer Key

Page 18: Chapter 2
Active Reader: 1. Underline: ferns, shrubs, or trees. Circle: mosses; 2. Xylem and phloem are both tissues that make up the vascular system. They both transport things. Xylem transports water, while phloem transports nutrients.

Page 19: Chapter 2
Active Reader: 1. Drawings will vary. You eat the root of the carrot.

Page 20: Chapter 2
Active Reader: 1. Answers will vary, but should suggest that needles help the evergreen tree retain water in the dry winter.
Focus Questions: 1. A dandelion is a vascular plant because it has an upright structure. 2. Roots and stems both provide support and transport water and nutrients. Roots are different from stems because they also absorb water and nutrients. Also roots are usually below ground and stems are above ground.

Page 21: Hands On Science
Examine a Vascular Plant: Results will vary depending on plant chosen, but students should carefully document what they find when they examine the plant.

Page 22: Chapter 2
Active Reader: 1. Photosynthesis is a process through which plants take in energy from the sun and convert it to food. 2. Answers will vary but may include: it will die, it will not make any food. 3. Answers will vary.
Focus Question: 1. sunlight + carbon dioxide + water = glucose (or sugar) + oxygen

Page 23: Chapter 2
Stop and Think: 1. (2); 2. (2); 3. Answers will vary but might include ferns and flowering plants; 4. Answer should explain that a vascular plant has systems of tubes for carrying food and water.

Page 24: Chapter 3
Active Reader: 1. Yes, humans are symmetrical. Drawings will vary.

Page 25: Chapter 3
Active Reader: 1. A mollusk is an invertebrate with a soft, unsegmented body and a shell. Examples of mollusks will vary, but may include clams, oysters, squids, and snails.

Page 26: Chapter 3
Active Reader: 1. Answers will vary, but may include that crabs live in the water and spiders live on land; crabs have a hard shell and claws and spiders don't; spiders have fangs and spin silk and crabs don't.
Focus Questions: 1. All invertebrates lack a backbone, are multicellular, and are heterotrophic. 2. Octopi have tissues, organs, and systems, including a brain.

Page 27: Chapter 3
Active Reader: 1. Vertebrates have complex nervous systems and muscular and skeletal systems that allow complex movement. 2. Drawings will vary, but students should label the parts of the fish's body.

Page 28: Chapter 3
Active Reader: 1. The arthropod body plan is different from the tetrapod body plan. The arthropod has a segmented body with pairs of jointed legs. 2. Answers will vary, but may include that they use their appendages for locomotion, have a body with a central cavity that contains organs, and reproduce sexually.

Page 29: Chapter 3
Active Reader: 1. When an amphibian is born it lives in the water and breathes through gills; when it becomes an adult it lives on land, develops lungs, and grows four legs. 2. Answers will vary, but may include that lightweight bones make the bird lighter during flight.

Page 30: Chapter 3
Active Reader: 1. Interviews will vary.

Answer Key

Page 31: Chapter 3
Focus Question: 1. Answers may include:

Type of Animal	Common Traits and Body Structures	Unique or Specialized Features
Fish	cold-blooded, cartilage or bony skeletons, fins, gills, scales, variety of shapes and sizes like seahorses or eels	variety of shapes and sizes like seahorses or eels
Amphibians	cold-blooded, metamorphosis, moist skin	toads have dry skin, caecilians don't have legs
Reptiles	cold-blooded, dry skin, lungs, lay eggs, four legs	snakes with jaws that come apart, turtles have shells
Birds	flight, wings, feathers, lightweight bones, warm-blooded, lay eggs, beaks, large nervous systems	ducks have webbed feet, hawks have sharp talons, ostriches run fast, penguins swim underwater
Mammals	warm-blooded, hair, feed milk to young, large brains	deer have antlers, porcupines have quills, walruses have tusks, whales and dolphins live in water

Page 32: Think Like a Scientist
Identify an Animal: Questions and answers will vary.

Page 33: Chapter 3
Active Reader: 1. Underline: the heart is connected to a system of vessels. Circle: the heart pumps fluid throughout the body. 2. Animals take in oxygen and give off carbon dioxide. Plants take in carbon dioxide and give off oxygen.

Page 34: Chapter 3
Active Reader: 1. Digestive: takes in food, breaks it down, absorbs nutrients, and gets rid of waste. Skeletal: supports and protects the body. Nervous: senses and reacts to things.
Focus Questions: 1. Answers will vary depending on systems chosen. 2. Answers will vary but may include: animals can move and react to their environment, but plants can't move.

Page 35: Chapter 3
Stop and Think: 1. Invertebrates have no backbone. Vertebrates have a backbone, spinal cord, and a complex nervous system.; 2. Both are multicellular, heterotrophic, and move on their own.; 3. (4)

Answer Key

Page 38: Assessments
Check Understanding: 1. (4); 2. (1); 3. (2); 4. (4)

Page 39: Assessments
Check Understanding: 5. The respiratory system is shown. The chicken breathes in air through the mouth, then it goes through the trachea, lungs, and air sacs.; 6. The respiratory system in chickens and humans both include the trachea and lungs. Chickens have air sacs and humans do not.

Page 40: Assessments
Check Understanding: 7. A paramecium, an octopus, and a sponge; 8. The structures all help the organism feed itself. Cilia in the paramecium direct food into the mouth opening. The collar cells in the sponge and the tentacles in the octopus serve the same purpose.