

How Are Animals & Airplanes Connected?



For thousands of years, people dreamed of flying like birds. Detailed sketches of flying machines were made about 500 years ago. Many of these machines featured mechanical wings that were intended to flap like the wings of a bird. But human muscles are not powerful enough to make such wings flap. Later, inventors studied birds such as eagles, which often glide through the air on outstretched wings. Successful gliders were built in the 1800s, but the gliders had no source of power to get them off the ground—and they were hard to control. Around 1900, two inventors studied bird flight more carefully and discovered that birds steer by changing the shape and position of their wings. The inventors built an engine-powered flying machine equipped with wires that could cause small changes in the shape and position of the wings. Though hardly as graceful as a soaring bird, the first powered, controlled flight took place in 1903, in the airplane seen here.



unit projects

Visit red.msscience.com/unit_project to find project ideas and resources.

Projects include:

- **History** Research Charles Darwin and his system for classifying animals. Write a time-travel interview to express your new knowledge.
- **Technology** Explore a biology-related career, and then write a want ad for a new job position.
- **Model** Study an animal, its characteristics, and habitat. Design a lunch bag with your new knowledge. A snack related to your animal may be placed inside to share with your classmates.



Investigate *Origins of Birds* to learn about the theory that birds descended from theropod dinosaurs. Compare and contrast bird characteristics with other animals.

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Cells—The Units of Life

chapter preview

sections

- 1** The World of Cells
Lab Observing Algae
- 2** The Different Jobs of Cells
Lab Water Movement in Plants
-  **Virtual Lab** How do animal and plant cells work?

Life's Building Blocks

If you look closely, you can see that these frogs and crocodiles are made up of small, plastic building blocks. Similarly, living organisms also are made up of small building blocks. The building block of all living things is the cell.

Science Journal Describe how plastic building blocks fit together to build a larger structure.

Start-Up Activities



Observe Onion Cells

An active, organized world is inside you and in all other living things. Yet it is a world that you usually can't see with just your eyes. Make the magnifier in the lab below to help you see how living things are organized. 



1. Cut a 2-cm hole in the middle of an index card. Tape a piece of plastic wrap over the hole.
2. Turn down about 1 cm of the two shorter sides of the card, then stand it up.
3. Place a piece of onion skin on a microscope slide, then put it directly under the hole in the card.
4. Put a drop of water on the plastic wrap. Look through the water drop and observe the piece of onion. Draw what you see.
5. **Think Critically** In your Science Journal, describe how the onion skin looked when viewed with your magnifier.

FOLDABLES™ Study Organizer

Compare Cells Make the following Foldable to help you see how plant and animal cells are similar and different.

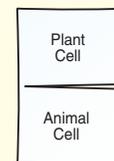
- STEP 1** **Fold** a vertical sheet of paper in half from top to bottom.



- STEP 2** **Fold** in half from side to side with the fold at the top.



- STEP 3** **Unfold** the paper once. **Cut** only the fold of the top flap to make two tabs. **Turn** the paper vertically and **draw** on the front tabs as shown.



Read and Write Before you read the chapter, write what you know about each of these cells. As you read the chapter, add to or correct what you have written under the tabs. Compare and contrast the two types of cells.

 Science online

Preview this chapter's content and activities at red.msscience.com

The World of Cells

as you read

What You'll Learn

- **Discuss** the cell theory.
- **Identify** some of the parts of animal and plant cells.
- **Explain** the functions of different cell parts.

Why It's Important

Cells carry out the activities of life.

Review Vocabulary

theory: an explanation of things or events based on scientific knowledge that is the result of many observations and experiments

New Vocabulary

- bacteria
- cell membrane
- cell wall
- cytoplasm
- organelle
- nucleus
- vacuole
- mitochondria
- photosynthesis
- chloroplast

Importance of Cells

A cell is the smallest unit of life in all living things. Cells are important because they are organized structures that help living things carry on the activities of life, such as the breakdown of food, movement, growth, and reproduction. Different cells have different jobs in living things. Some plant cells help move water and other substances throughout the plant. White blood cells, found in humans and many other animals, help fight diseases. Plant cells, white blood cells, and all other cells are alike in many ways.

Cell Theory Because most cells are small, they were not observed until microscopes were invented. In 1665, scientist Robert Hooke, using a microscope that he made, observed tiny, boxlike things in a thin slice of cork, as shown in **Figure 1**. He called them cells because they reminded him of the small, box-like rooms called cells, where monks lived.

Throughout the seventeenth and eighteenth centuries, scientists observed many living things under microscopes. Their observations led to the development of the cell theory. The three main ideas of the cell theory are:

1. All living things are made of one or more cells.
2. The cell is the basic unit of life in which the activities of life occur.
3. All cells come from cells that already exist.



Figure 1 Robert Hooke designed this microscope and drew the cork cells he observed.



The Microscopic Cell All the living things pictured in **Figure 2** are made up of cells. The smallest organisms on Earth are **bacteria**. They are one-celled organisms, which means they are made up of only one cell.

Reading Check How many cells does each bacterium have?

Larger organisms are made of many cells. These cells work together to complete all of the organism's life activities. The living things that you see every day—trees, dogs, insects, people—are many-celled organisms. Your body contains more than 10 trillion (10,000,000,000,000) cells.

Microscopes Scientists have viewed and studied cells for about 300 years. In that time, they have learned a lot about cells. Better microscopes have helped scientists learn about the differences among cells. Some modern microscopes allow scientists to study the small features that are inside cells.



The microscope used in most classrooms is called a compound light microscope. In this type of microscope, light passes through the object you are looking at and then through two or more lenses. The lenses enlarge the image of the object. How much an image is enlarged depends on the powers of the eyepiece and the objective lens. The power—a number followed by an \times —is found on each lens. For example, a power of $10\times$ means that the lens can magnify something to ten times its actual size. The magnification of a microscope is found by multiplying the powers of the eyepiece and the objective lens.

Figure 2 All living things are made up of cells.



Magnification: $67500\times$

E. coli—a bacterium—is a one-celled organism.



Plant cells are different from animal cells.



Human cells are similar to other animal cells like those in cats and turtles.





Topic: Electron Microscopes

Some cell parts could not be seen until the electron microscope (EM) was invented. Visit red.msscience.com for Web links to information about electron microscopes.

Activity Make a pamphlet describing an electron microscope. Include a section on cell parts that were first seen using an EM.

What are cells made of?

As small as cells are, they are made of even smaller parts, each doing a different job. A cell can be compared to a bakery. The activities of a bakery are inside a building. Electricity is used to run the ovens and other equipment, power the lights, and heat the building. The bakery's products require ingredients such as dough, sugar, and fillings, that must be stored, assembled, and baked. The bakery's products are packaged and shipped to different locations. A manager is in charge of the entire operation. The manager makes a plan for every employee of the bakery and a plan for every step of making and selling the baked goods.

A living cell operates in a similar way. Like the walls of the bakery, a cell has a boundary. Inside this boundary, the cell's life activities take place. These activities must be managed. Smaller parts inside the cell can act as storage areas. The cell also has parts that use ingredients such as oxygen, water, minerals, and other nutrients. Some cell parts can release energy or make substances that are necessary for maintaining life. Some substances leave the cell and are used elsewhere in the organism.

Figure 3 These are some of the parts of an animal cell that perform the activities necessary for life.

Cell membrane helps control what enters and leaves the cell.

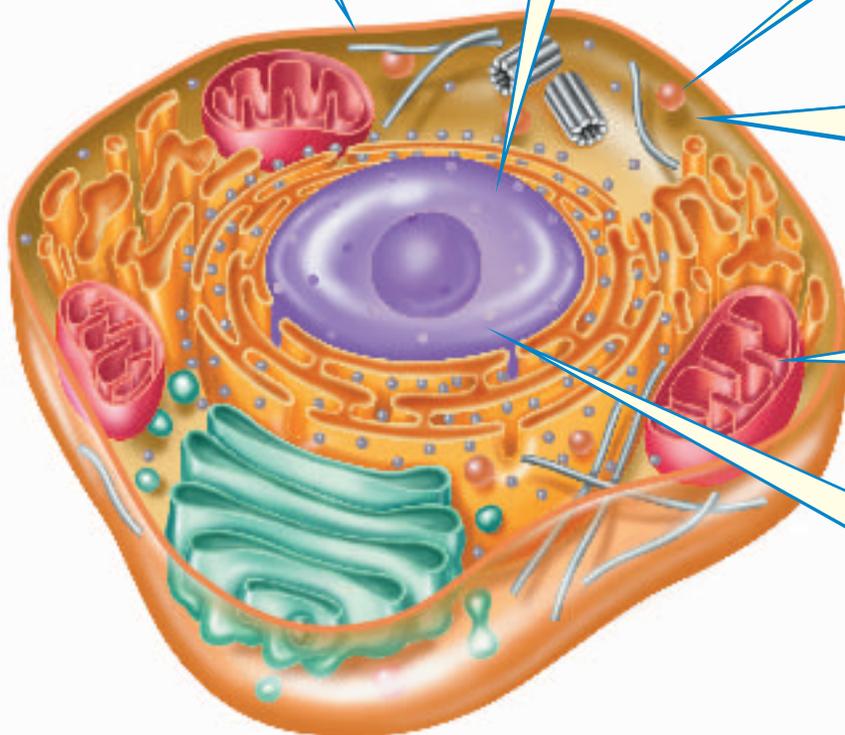
Nucleus controls most of the cell's activities.

Vacuole stores food, water, minerals, and wastes.

Cytoplasm is a gelatinlike substance that contains many chemicals that the cell needs.

Mitochondrion converts food energy into a form that the cell can use.

Chromosomes are in the nucleus. They contain DNA, a chemical that determines which traits an organism will have.





Outside the Cell The **cell membrane**, shown in **Figure 3**, is a flexible structure that holds the cell together, similar to the walls of the bakery. The cell membrane forms a boundary between the cell and its environment. It also helps control what goes into and comes out of the cell. Some cells, like those in plants, algae, fungi, and many types of bacteria, also have a structure outside the cell membrane called a **cell wall**, shown in **Figure 4**. The cell wall helps support and protect these cells.

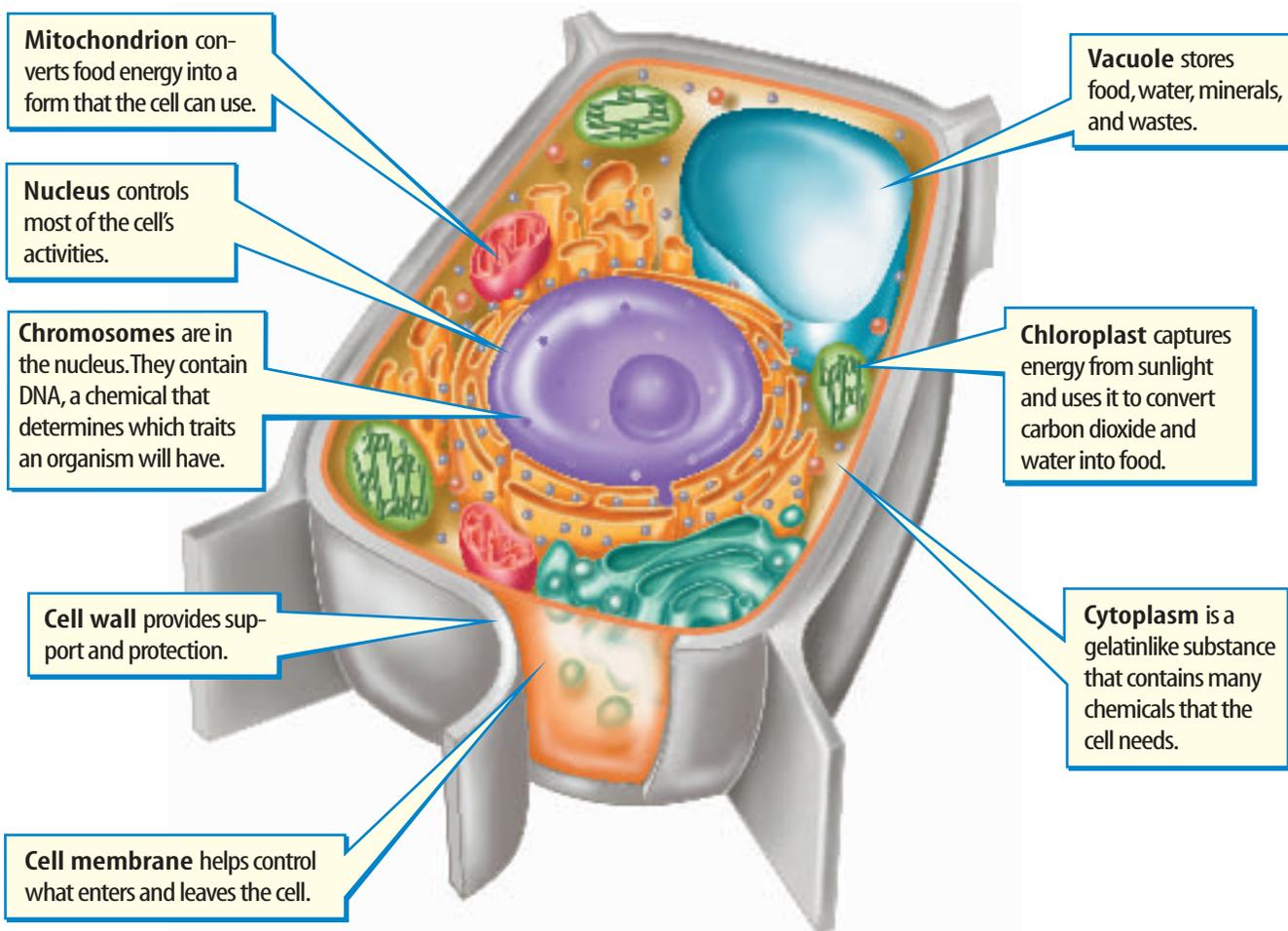
Inside the Cell The inside of a cell is filled with a gelatinlike substance called **cytoplasm** (SI tuh pla zum). Approximately two-thirds of the cytoplasm is water, but it also contains many chemicals that are needed by the cell. Like the work area inside the bakery, the cytoplasm is where the cell's activities take place.

Organelles Except for bacterial cells, cells contain **organelles** (or guh NELZ) like those in **Figure 3** and **Figure 4**. These specialized cell parts can move around in the cytoplasm and perform activities that are necessary for life. You could think of these organelles as the employees of the cell because each type of organelle does a different job. In bacteria, most cell activities occur in the cytoplasm.



Phospholipids The cell membrane is a double layer of complex molecules called phospholipids (fahs foh LIH pudz). Research to find the elements that are in these molecules. Find those elements on the periodic table at the back of this book.

Figure 4 Most plant cells contain the same types of organelles as in animal cells. Plant cells also have a cell wall and chloroplasts.





Mini LAB

Modeling a Cell

Procedure

1. Collect household materials such as clay, cardboard, yarn, buttons, dry macaroni, or other objects.
2. Using the objects that you collected, make a three-dimensional model of an animal or plant cell.
3. On a separate sheet of paper, make a key to the materials in your cell model.

Analysis

1. What does each part of your cell model do?
2. Have someone look at your model. Which of the cell parts could they identify without using the key?
3. How could you improve your model?



The Nucleus A bakery's manager follows a business plan to make sure that the business runs smoothly. A business plan describes how the business should operate. These plans could include how many donuts are made and what kinds of pies are baked.

The hereditary material of the cell is like the bakery's manager. It directs most of the cell's activities. In the cells of organisms except bacteria, the hereditary material is in an organelle called the **nucleus** (NEW klee us). Inside the nucleus are chromosomes (KROH muh zohmz). They contain a plan for the cell, similar to the bakery's business plan. Chromosomes contain an important chemical called DNA. It determines which traits an organism will have, such as the shape of a plant's leaves or the color of your eyes.



Which important chemical determines the traits of an organism?

Storage Pantries, closets, refrigerators, and freezers store food and other supplies that a bakery needs. Trash cans hold garbage until it can be picked up. In cells, food, water, and other substances are stored in balloonlike organelles in the cytoplasm called **vacuoles** (VA kyuh wohlz). Some vacuoles store wastes until the cell is ready to get rid of them. Plant cells usually have a large vacuole that stores water and other substances.

Energy and the Cell

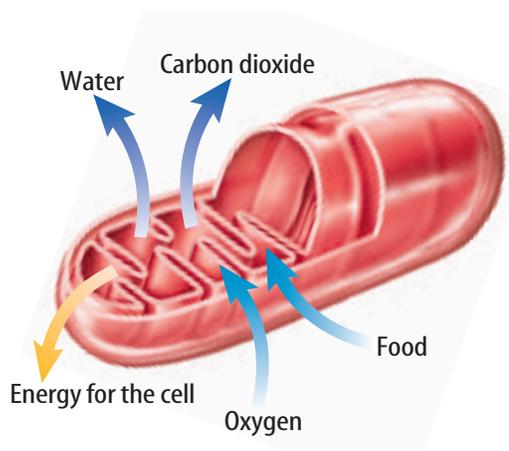
Electrical energy or the energy in natural gas is converted to heat energy by the bakery's ovens. The heat then is used to bake the breads and other bakery products. Cells need energy, too. Cells, except bacteria, have organelles called **mitochondria** (mi tuh KAHN dree uh)(singular, *mitochondrion*). An important process called cellular respiration (SEL yuh lur • res puh RAY shun) takes place inside a mitochondrion as shown in

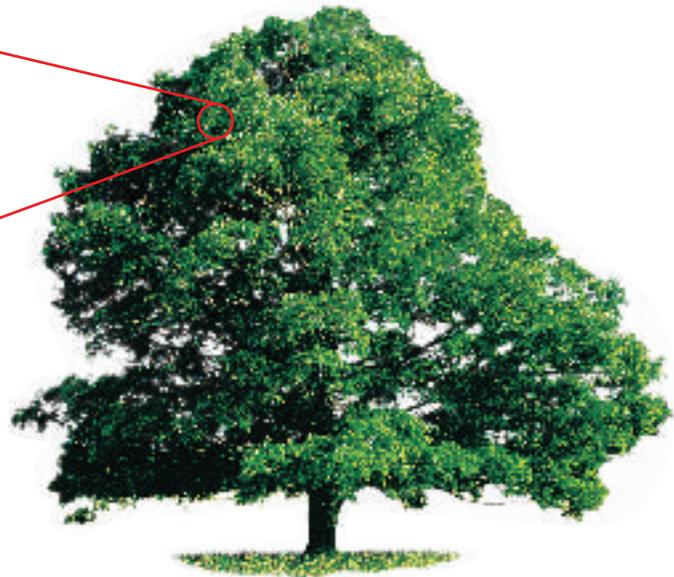
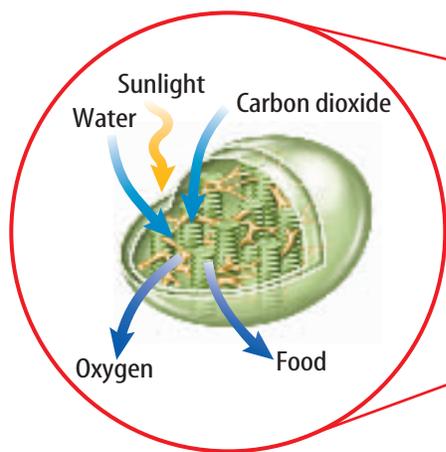
Figure 5. Cellular respiration is a series of chemical reactions in

which energy stored in food is converted to a form of energy that the cell can use. This energy is released as food and oxygen combine. Waste products of this process are carbon dioxide and water. All cells with mitochondria use the energy from cellular respiration to do all of their work.

Figure 5 Inside a mitochondrion, food energy is changed into a form of energy that a cell can use.

Infer what happens to the water and carbon dioxide produced by mitochondria in human cells.





Nature's Solar Energy Factories Animals obtain food from their surroundings. A cow grazes in a pasture. A bird pecks at worms, and a dog eats from a bowl. Have you ever seen a plant eat anything? How do plants get energy-rich food?

Plants, algae, and many types of bacteria make food through a process called **photosynthesis** (foh toh SIHN tuh sus). Most photosynthesis in plants occurs in leaf cells. Inside these cells are green organelles called **chloroplasts** (KLOR uh plasts). Most leaves are green because their cells contain so many chloroplasts. During plant photosynthesis, as shown in **Figure 6**, chloroplasts capture light energy and combine carbon dioxide from the air with water to make food. Energy is stored in food. As the plant needs energy, its mitochondria release the food's energy. The captured light energy is passed to other organisms when they eat organisms that carry on photosynthesis.

Figure 6 Photosynthesis can take place inside the chloroplasts of plant cells.

section 1 review

Summary

Importance of Cells

- Cells are organized structures that help living things carry on the activities of life.
- The main ideas behind cells are described in the cell theory.
- Microscopes helped scientists study cells.

What are cells made of?

- Different cell parts do different jobs.

Energy and the Cell

- Cells need energy to function. This energy comes mainly from cellular respiration.
- Plants, algae, and some bacteria make food through photosynthesis.

Self Check

1. **List** the three main ideas of the cell theory.
2. **Explain** why the nucleus is so important to the living cell.
3. **Describe** how cells get the energy they need to carry on their activities.
4. **Describe** the purpose of a cell membrane.
5. **Think Critically** Suppose your teacher gave you a slide of an unknown cell. How would you tell whether the cell was from an animal or from a plant?

Applying Skills

6. **Compare and contrast** the parts of animal cells and plant cells and the jobs that they do.

Observing Algae

You might have noticed mats of green algae growing on a pond or clinging to the walls of the aquarium in your classroom. Why are algae green? Like plants, algae contain organelles called chloroplasts. Chloroplasts contain a green pigment called chlorophyll. It captures light energy that is needed to make food. In this lab, you'll describe chloroplasts and other organelles in algal cells.

Real-World Question

What organelles can be seen when viewing algal cells under a microscope?

Goals

- **Observe** algal cells under a microscope.
- **Identify** cell organelles.

Materials

microscope	pond water
microscope slides	algae
coverslips	dropper
large jars	colored pencils

Safety Precautions



WARNING: *Thoroughly wash your hands after you have finished this lab.*

Procedure

1. Fill the tip of a dropper with pond water and thin strands of algae. Use the dropper to place the algae and a drop of water on a microscope slide.
2. Place a coverslip over the water drop and then place the slide on the stage of a microscope.



3. Using the microscope's lowest power objective, focus on the algal strands.
4. Once the algal strands are in focus, switch to a higher power objective and observe several algal cells.
5. **Draw** a colored picture of one of the algal cells, identifying the different organelles in the cell. Label on your drawing the cell wall, chloroplasts, and other organelles you can see.

Conclude and Apply

1. **List** the organelles you found in each cell.
2. **Explain** the function of chloroplasts.
3. **Infer** why algal cells are essential to all pond organisms.

Communicating Your Data

Work with three other students to create a collage of algal cell pictures complete with labeled organelles. Create a bulletin board display about algal cells.

The Different Jobs of Cells

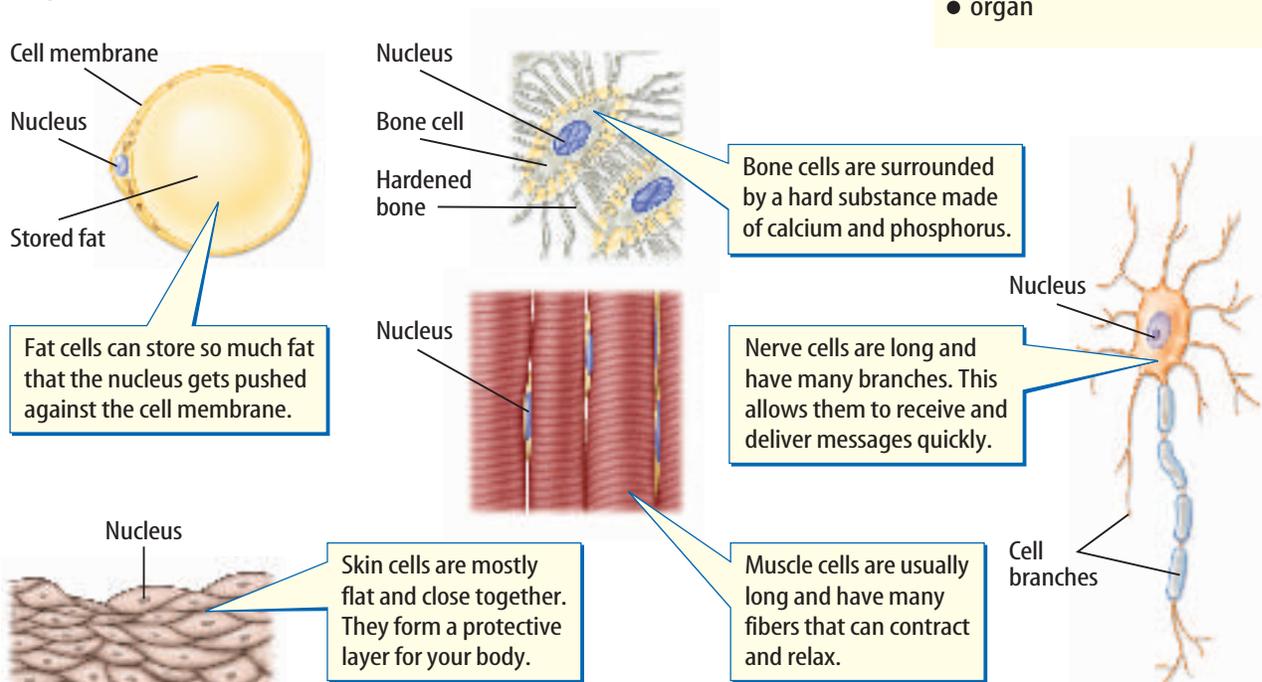
Special Cells for Special Jobs

Choose the right tool for the right job. You might have heard this common expression. The best tool for a job is one that has been designed for that job. For example, you wouldn't use a hammer to saw a board in half, and you wouldn't use a saw to pound in a nail. You can think of your body cells in a similar way.

Cells that make up many-celled organisms, like you, are specialized. Different kinds of specialized cells work as a team to perform the life activities of a many-celled organism.

Types of Human Cells Your body is made up of many types of specialized cells. The same is true for other animals. **Figure 7** shows some human cell types. Notice the variety of sizes and shapes. A cell's shape and size can be related to its function.

Figure 7 Human cells come in different shapes and sizes.



as you read

What You'll Learn

- **Discuss** how different cells have different jobs.
- **Explain** the differences among tissues, organs, and organ systems.

Why It's Important

You will understand how different types of cells work together to keep you healthy.

Review Vocabulary

organism: anything that possesses all the characteristics of life

New Vocabulary

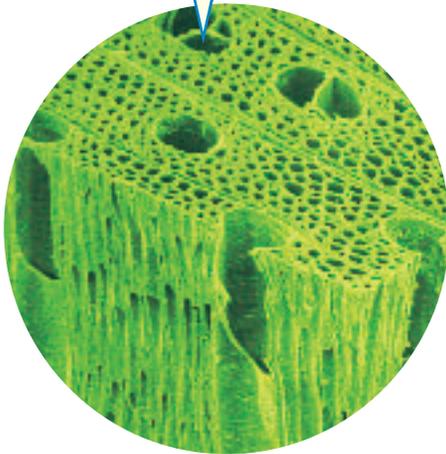
- tissue
- organ
- organ system



Figure 8 Plants, like animals, have specialized cells.

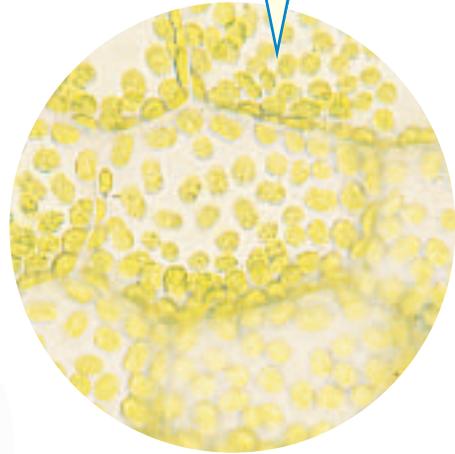
Infer what process can occur in leaf cells but not in root cells.

Many of the cells in stems are long and tube-shaped. They move water and other materials through the plant.



SEM Magnification: 1500×

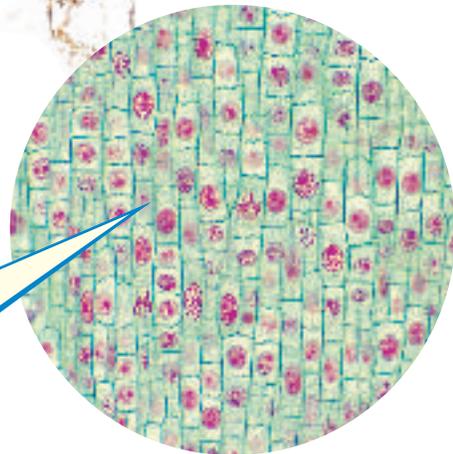
Some leaf cells are brick shaped and contain many chloroplasts.



LM, Magnification: 900×



Most root cells are block shaped and do not contain chloroplasts.



Magnification: 450×

Mini LAB

Analyzing Cells

Procedure

1. Examine prepared slides of human cells.
2. Draw each type of cell that you observe in your **Science Journal**. Label cell parts that you can see.

Analysis

1. In what ways were the cells that you observed similar? How were they different?
2. Hypothesize how the cells' shapes relate to their jobs.

Types of Plant Cells Like animals, plants also are made of several different cell types, as shown in **Figure 8**. For instance, plants have different types of cells in their leaves, roots, and stems. Each type of cell has a specific job. Some cells in plant stems are long and tubelike. Together they form a system through which water, food, and other materials move in the plant. Other cells, like those that cover the outside of the stem, are smaller or thicker. They provide strength to the stem.

 **Reading Check** What do long, tubelike cells do in plants?



Cell Organization

How well do you think your body would work if all the different cell types were just mixed together in no particular pattern? Could you walk if your leg muscle cells were scattered here and there, each doing its own thing, instead of being grouped together in your legs? How could you think if your brain cells weren't close enough together to communicate with each other? Many-celled organisms are not just mixed-up collections of different types of cells. Cells are organized into systems that, together, perform functions that keep the organism healthy and alive.



Studying Space

Astronomers study systems that are found in space. The solar system is just one of many systems that make up the Milky Way Galaxy. Research to learn the education requirements and job description of an astronomer. Write a want ad for an astronomer.

Applying Math Solve One-Step Equations

RED BLOOD CELLS Each milliliter of blood contains 5 million red blood cells (RBCs). On average, an adolescent has about 3.5 L of blood. On average, how many RBCs are in an adolescent's body?

Solution

- 1 *This is what you know:*
 - number of RBCs per 1 mL = 5,000,000
 - 1,000 mL = 1 L
 - average volume of blood in an adolescent's body = 3.5 L
- 2 *This is what you need to find out:* On average, how many RBCs are in an adolescent's body, N ?
- 3 *This is the procedure you need to use:*
 - Use the following equation:
 $N = (\text{number of RBCs/1mL}) (1,000 \text{ mL/1 L}) (3.5 \text{ L of blood})$
 - Substitute the known values
 $N = (5,000,000 \text{ RBCs/1 mL}) (1,000 \text{ mL/1 L}) (3.5 \text{ L of blood})$
 $N = 17,500,000,000 \text{ RBCs}$
 - On average, there are 17.5 billion red blood cells in an adolescent's body.
- 4 *Check your answer:* Divide 17,500,000,000 RBCs by 1,000 mL/1 L then divide that answer by 3.5 L, and you should get 5,000,000 RBCs/1 mL.

Practice Problems

1. Each milliliter of blood contains approximately 7,500 white blood cells. How many white blood cells are in the average adolescent's body?
2. There are approximately 250,000 platelets in each milliliter of blood. How many platelets are in the average adolescent's body?

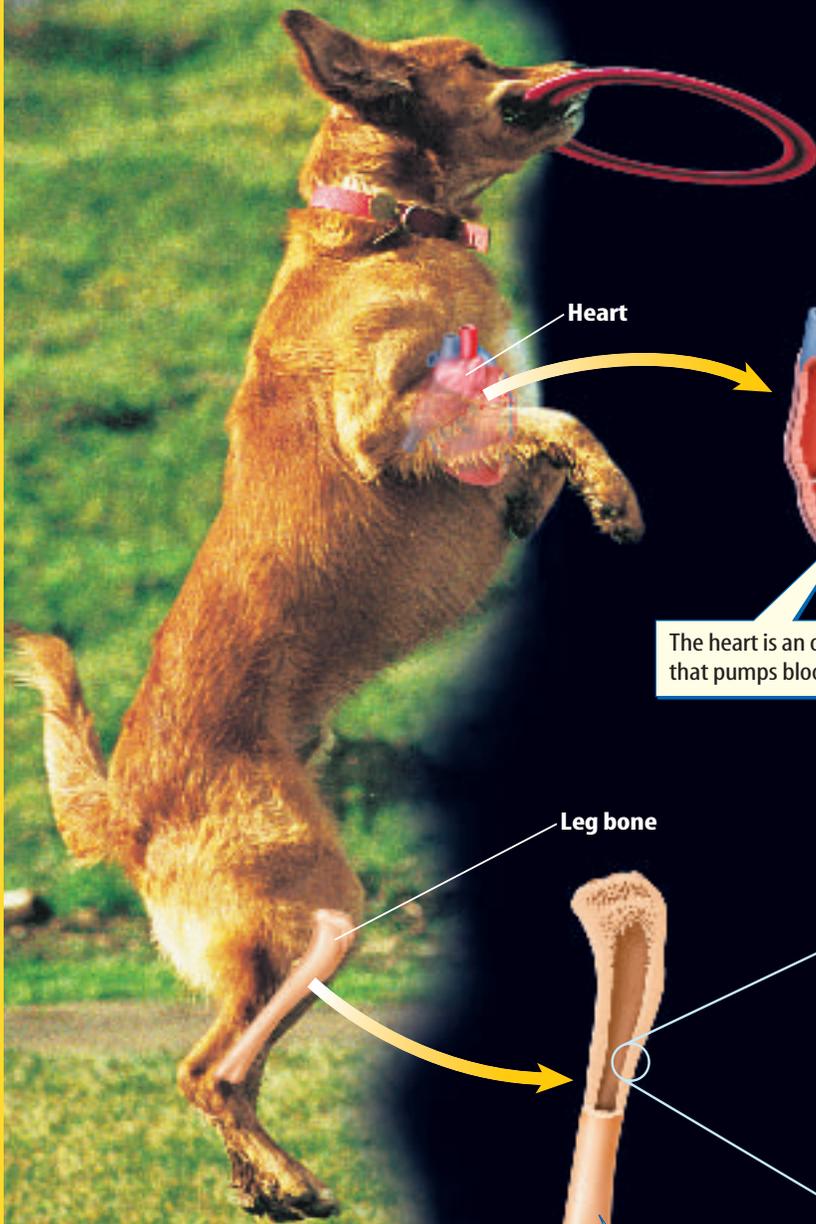


For more practice, visit
[red.msscience.com/
 math_practice](http://red.msscience.com/math_practice)

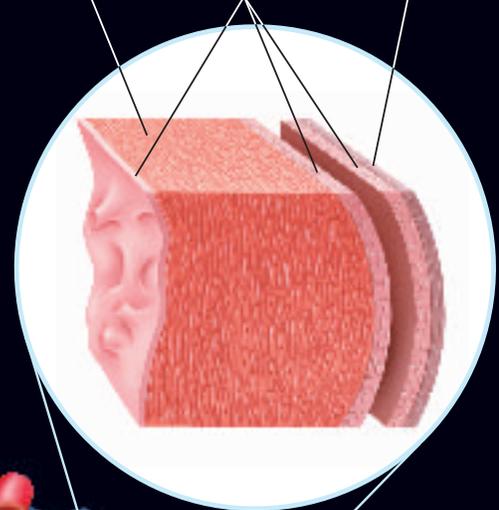


Figure 9

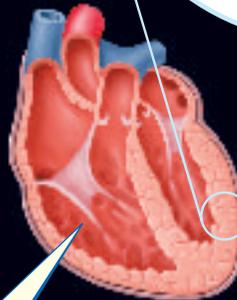
Organs are two or more tissue types that work together. An organ performs a task that no other organ performs.



Muscle tissue Covering and lining tissue Connecting tissue



Heart

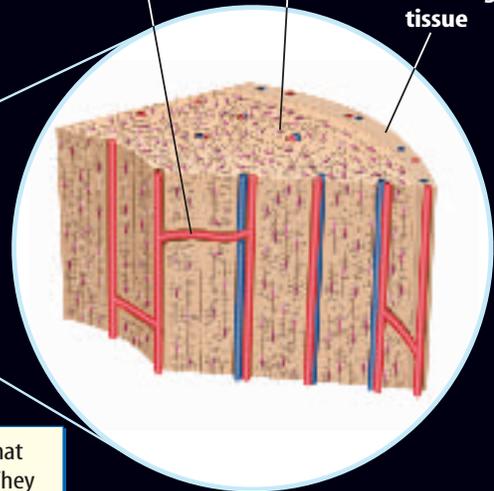


The heart is an organ that pumps blood.

Leg bone



Blood tissue Bone cell Connecting tissue



Bones are organs that support the body. They also store some minerals and make blood cells.



Tissues and Organs Cells that are alike are organized into tissues (TIH shewz). **Tissues** are groups of similar cells that all do the same sort of work. For example, bone tissue is made up of bone cells, and nerve tissue is made up of nerve cells. Blood, a liquid tissue, includes different types of blood cells.

As important as individual tissues are, they do not work alone. Different types of tissues working together can form a structure called an **organ** (OR gun). For example, the stomach is an organ that includes muscle tissue, nerve tissue, and blood tissue. All of these tissues work together and enable the stomach to perform its digestive functions. Other human organs include the heart and the kidneys.

Reading Check

Which term means “two or more tissue types that work together”?

Organ Systems A group of organs that work together to do a certain job is called an **organ system**. The stomach, mouth, intestines, and liver are involved in digestion. Together, these and several other organs make up the digestive system. Other organ systems found in your body include the respiratory system, the circulatory system, the reproductive system, and the nervous system.

Organ systems also work together, as shown in **Figure 9**. For example, the muscular system has more than 600 muscles that are attached to bones. The contracting cells of muscle tissue cause your bones, which are part of the skeletal system, to move.



Topic: One-Celled Organisms

Visit red.msscience.com for Web links to information about what types of organisms are made up of only one cell.

Activity Create a table that includes images and information about five of these organisms.

section **2** review

Summary

Special Cells for Special Jobs

- Plant and animal cells come in a variety of sizes and shapes.
- The function of an animal cell can be related to its shape and size.
- The leaves, roots, and stems of plants are made of different types of cells to perform different functions.

Cell Organization

- Many-celled organisms are organized into tissues, organs, and organ systems.
- Each organ system performs a specific function that, together with other systems, keeps an organism healthy and alive.

Self Check

1. **Describe** three types of cells that are found in the human body.
2. **Compare and contrast** the cells found in a plant’s roots, stems, and leaves.
3. **Explain** the difference between a cell and a tissue and between a tissue and an organ.
4. **Think Critically** Why must specialized cells work together as a team?

Applying Skills

5. **Concept Map** Make an events-chain concept map of the different levels of cell organization from cell to organ system. Provide an example for each level of organization.

Water Movement in Plants

Goals

- **Design** an investigation to show where water moves in a plant.
- **Observe** how long it takes water to move in a plant.

Possible Materials

fresh stalk of celery with leaves
clear drinking glass
scissors
red food coloring
water

Safety Precautions

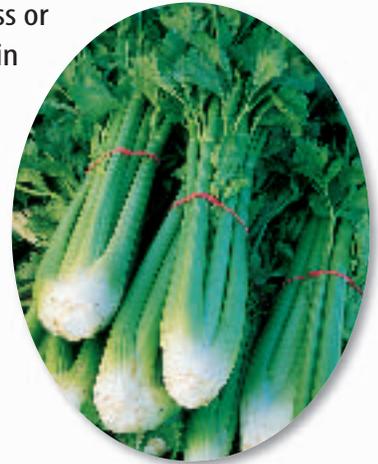


WARNING: Use care when handling sharp objects such as scissors. Avoid getting red food coloring on your clothing.



Real-World Question

When you are thirsty, you can sip water from a glass or drink from a fountain. Plants must get their water in other ways. In most plants, water moves from the soil into cells in the roots. Where does water travel in a plant?



Form a Hypothesis

Based on what you already know about how a plant functions, state a hypothesis about where you think water travels in a plant.

Test Your Hypothesis

Make a Plan

1. As a group, agree upon a hypothesis and decide how you will test it. Identify which results will support the hypothesis.
2. **List** the steps you will need to take to test your hypothesis. Be specific. Describe exactly what you will do in each step. List your materials.
3. Prepare a data table in your Science Journal to record your observations.
4. **Read** the entire investigation to make sure all steps are in logical order.
5. **Identify** all constants, variables, and controls of the investigation.

Follow Your Plan

1. Make sure your teacher approves your plan before you start.
2. Carry out the investigation according to the approved plan.
3. While doing the investigation, record your observations and complete the data tables in your Science Journal.

Analyze Your Data

1. **Compare** the color of the celery stalk before, during, and after the investigation.
2. **Compare** your results with those of other groups.
3. Make a drawing of the cut stalk. Label your drawing.
4. What was your control in this investigation? What were your variables?

Conclude and Apply

1. **Explain** whether the results of this investigation supported your hypothesis.
2. **Infer** why only some of the plant tissue is red.
3. **Explain** what you would do to improve this investigation.
4. **Predict** if other plants have tissues that move water.

Communicating Your Data

Write a report about your investigation. Include illustrations to show how the investigation was performed. Present your report to your class.



TEST-TUBE TISSUE

Thanks to advances in science, skin tissue is being “grown” in laboratories

In Chicago, a young woman named Kelly is cooking pasta on her stove. Her clothes catch fire from the gas flame and, in the blink of an eye, 80 percent of her body is severely burned. Will she survive?

Just 20 years ago, the answer to this question probably would have been “no.” Fortunately for Kelly, science has come a long way in recent years. Today, there’s a very good chance that Kelly might lead a long and healthy life.

Like the brain or the heart, the skin is an organ. In fact, it is the body’s largest organ, about 1/12 of your total body weight. Composed of protective layers, skin keeps your internal structure safe from damage, infection, and temperature changes.

Today, just as farmers can grow crops of corn and wheat, scientists can grow human skin. How?



A piece of test skin is removed from its culture.

Tissue Engineers

Scientists, called tissue engineers, take a piece of skin (no bigger than a quarter) from an undamaged part of the burn victim’s body. The skin cells are isolated, mixed with special nutrients, and then they multiply in a culture dish.

After about two to three months, the tissue engineers can harvest sheets of new, smooth skin. These sheets, as large as postcards, are grafted onto the victim’s damaged body and promote additional skin growth.

By grafting Kelly’s own skin on her body rather than using donor skin—skin from another person or from an animal—doctors avoid at least three potential complications. First, donor skin may not even be available. Second, Kelly’s body might perceive the new skin cells from another source to be a danger, and her immune system might reject—or destroy—the transplant. Finally, even if the skin produced from a foreign source is accepted, it may leave extensive scarring.

Tissue Testing

What else can tissue engineers grow? They produce test skin—skin made in the lab and used to test the effects of cosmetics and chemicals on humans. This skin is eliminating the use of animals for such tests. Also, tissue engineers are working on ways to replace other body parts such as livers, heart valves, and ears, that don’t grow back on their own.

Safety List Visit the link shown to the right or your media center to learn about fire safety tips, including kitchen safety and escape routes in your home. Make a list and share it with your family.

Science **nline**

For more information, visit
red.msscience.com/time

Reviewing Main Ideas

Section 1 The World of Cells

1. The cell theory states that all living things are made of one or more cells, the cell is the basic unit of life, and all cells come from other cells.
2. The microscope is an instrument that enlarges the image of an object.
3. All cells are surrounded by a cell membrane and contain hereditary material and cytoplasm. Plant cells have a cell wall outside the cell membrane. Cells, except bacteria, contain organelles.
4. The nucleus directs the cell's activities. Chromosomes contain DNA that determines what kinds of traits an organism will have. Vacuoles store substances.

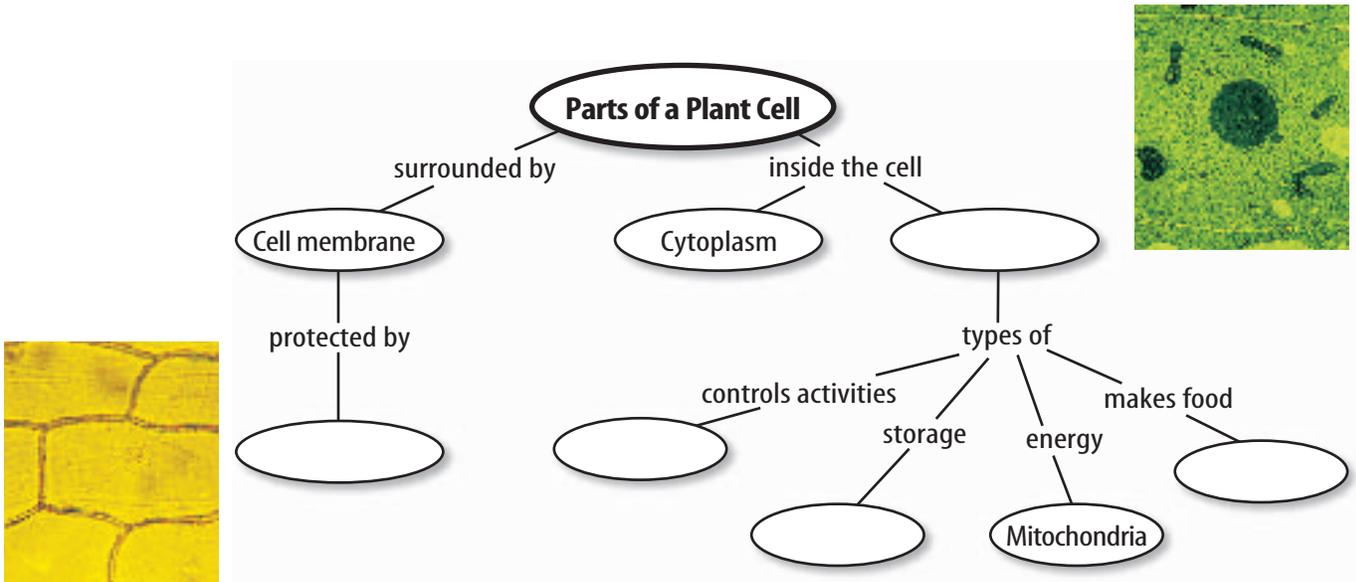
5. In mitochondria, the process of cellular respiration combines food molecules with oxygen. This series of chemical reactions releases energy for the cell's activities.
6. The energy in light is captured and stored in food molecules during the process of photosynthesis. Plants, algae, and some bacteria make their own food by photosynthesis.

Section 2 The Different Jobs of Cells

1. Many-celled organisms are made up of different kinds of cells that perform different tasks.
2. Many-celled organisms are organized into tissues, organs, and organ systems that perform specific jobs to keep an organism alive.

Visualizing Main Ideas

Copy and complete the following concept map on the parts of a plant cell.



Using Vocabulary

bacteria p. 477	organ p. 487
cell membrane p. 479	organ system p. 487
cell wall p. 479	organelle p. 479
chloroplast p. 481	photosynthesis p. 481
cytoplasm p. 479	tissue p. 487
mitochondria p. 480	vacuole p. 480
nucleus p. 480	

Explain the difference between the terms in the following sets.

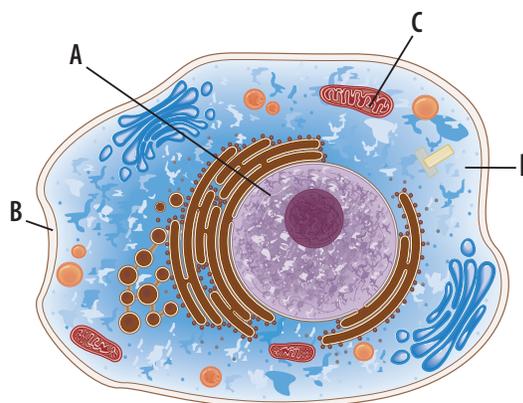
- mitochondria—chloroplast
- tissue—organ
- cell membrane—nucleus
- organ—organ system
- nucleus—organelle
- cytoplasm—nucleus
- vacuole—mitochondria
- organ system—tissue
- organelle—organ
- cell wall—cell membrane

Checking Concepts

Choose the word or phrase that best answers the question.

- Which of the following controls what enters and leaves the cell?
 - mitochondrion
 - cell membrane
 - vacuole
 - nucleus
- Which of the following are found inside the nucleus of the cell?
 - vacuoles
 - chromosomes
 - chloroplasts
 - mitochondria

Use the illustration below to answer questions 13 and 14.



- Which letter is the gelatinlike substance in a cell that contains water and chemicals?
 - A
 - B
 - C
 - D
- Which structure converts food energy to a form of energy the cell can use?
 - A
 - B
 - C
 - D
- Which of the following terms best describes the stomach?
 - organelle
 - organ system
 - organ
 - tissue
- What does photosynthesis make for a plant?
 - food
 - organs
 - water
 - tissues
- What does DNA do?
 - makes food
 - determines traits
 - converts food to energy
 - stores substances
- Which of the following terms is the name of a human organ system?
 - protective
 - growth
 - photosynthetic
 - respiratory
- What cell structure helps support plants?
 - cell membrane
 - cell wall
 - vacuole
 - nucleus

Thinking Critically

- 20. **Predict** what would happen to a cell if the cell membrane were solid and waterproof.
- 21. **Describe** what might happen to a cell if all its mitochondria were removed.
- 22. **Explain** why cells are called the units of life.
- 23. **Infer** what kinds of animal cells might have a lot of mitochondria present.
- 24. **Distinguish** between a bacterium and a plant cell.
- 25. **Compare and contrast** photosynthesis and cellular respiration.
- 26. **Make and Use Tables** Copy and complete this table about the functions of the following cell parts: *nucleus*, *cell membrane*, *mitochondrion*, *chloroplast*, and *vacuole*.

Functions of Cell Parts	
Cell Part	Function
Do not write in this book.	

- 27. **Concept Map** Make an events-chain concept map of the following from simple to complex: *small intestine*, *circular muscle cell*, *human*, and *digestive system*.
- 28. **Identify and Manipulate Variables and Controls** Describe an experiment you might do to determine whether water moves into and out of cells.

- 29. **Recognize Cause and Effect** Why is the brick-like shape of some plant cells important?

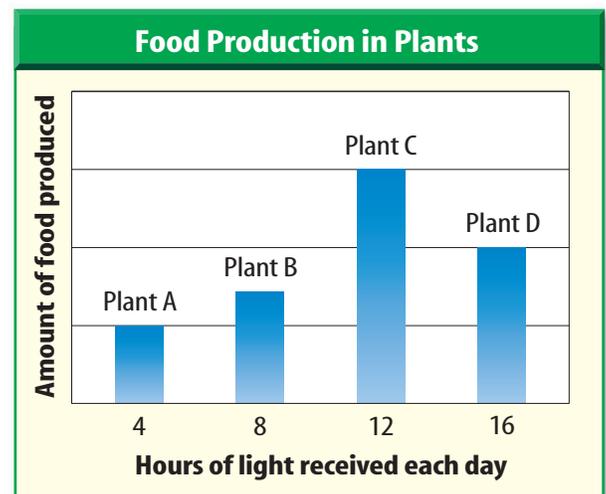
Performance Activities

- 30. **Skit** Working with three or four classmates, develop a short skit about how a living cell works. Have each group member play the role of a different cell part.

Applying Math

- 31. **Magnification** A microscope has an eyepiece with a power of 10 \times and an objective lens with a power of 40 \times . What is the magnification of the microscope?
- 32. **Viruses** Use a computer to make a line graph of the following data. At 37 $^{\circ}$ C there are 1.0 million viruses; at 37.5 $^{\circ}$ C, 0.5 million; at 37.8 $^{\circ}$ C, 0.25 million; at 38.3 $^{\circ}$ C, 0.1 million; and at 38.9 $^{\circ}$ C, 0.05 million.

Use the graph below to answer question 33.



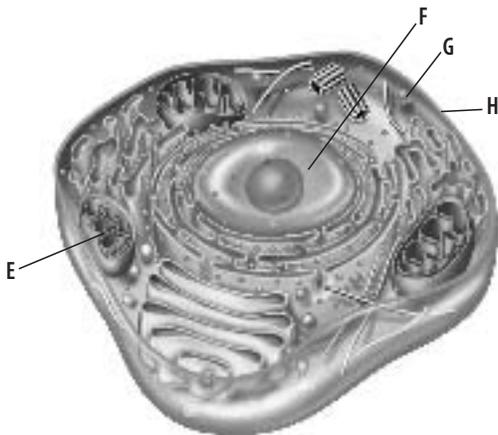
- 33. **Plant Food Production** Light is necessary for plants to make food. Using the graph above, determine which plant produced the most food. How much light was needed by the plant every day to produce the most food?

Part 1 Multiple Choice

Record your answers on the answer sheet provided by your teacher or on a sheet of paper.

- The idea that all cells come from cells that already exist is part of what theory?
 - the microscopic theory
 - the basic theory
 - the Hooke theory
 - the cell theory

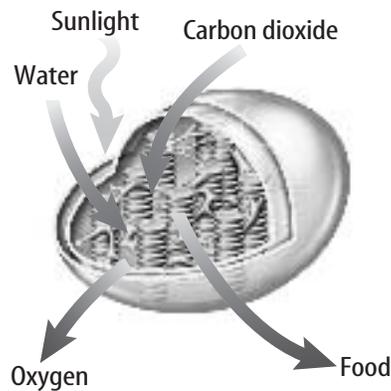
Use the illustration below to answer questions 2 and 3.



- Which letter corresponds to the cell's nucleus?
 - E
 - F
 - G
 - H
- Which letter corresponds to the part of the cell that helps control what enters and leaves the cell?
 - E
 - F
 - G
 - H
- Chromosomes contain what important chemical that helps determine the traits of an organism?
 - DNA
 - NAD
 - carbon dioxide
 - oxygen
- Which one of the following is an organ?
 - leg bone
 - nucleus
 - muscle cell
 - bacterium

- Which of the following describes plant cells used to move water through the plant?
 - brick shaped with many chloroplasts
 - block shaped with no chloroplasts
 - long with fibers that contract and relax
 - long and tube-shaped
- What are groups of cells that all do the same sort of work called?
 - organs
 - organelles
 - tissues
 - nerves

Use the illustration below to answer questions 8 and 9.



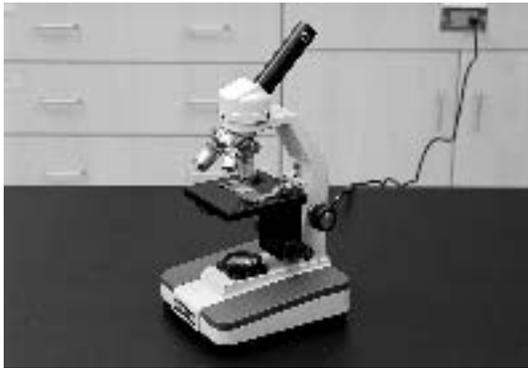
- Where would this organelle likely be found?
 - in your brain
 - in your heart
 - in a leaf
 - in your bone
- What process is taking place in this organelle?
 - cellular respiration
 - photosynthesis
 - food storage
 - cell reproduction
- Which of the following pairs of organisms would have cells that were the most similar?
 - a dog and a cat
 - a turtle and a tree
 - a carrot and a cat
 - a fox and a daisy

Part 2 Short Response/Grid In

Record your answers on the answer sheet provided by your teacher or on a sheet of paper.

11. Cells were not observed until what instrument was invented?
12. The cytoplasm of cells is made mostly of what?
13. If a cell is compared to a bakery, what cell part would be like the manager of the bakery, in charge of the entire operation?
14. When you breathe out, your breath contains the waste products of carbon dioxide and water. What cellular process produces these wastes?
15. What two things produced by plants would be important to help keep astronauts alive on a long journey to Mars?

Use the illustration below to answer questions 16 and 17.



16. This type of microscope is used in most classrooms. What is the name of this type of microscope?
17. The magnification of the eyepiece of the microscope above is $10\times$. A student is looking at a slide of a piece of onion skin. If the magnification of the objective lens used is also $10\times$, how much is the microscope magnifying the image of the cells in the onion skin?

Part 3 Open Ended

Record your answers on a sheet of paper.

18. Name three cellular organelles and describe the role of each.
19. A caterpillar eats the leaves of a milkweed plant. Explain why the caterpillar, like the milkweed plant, uses captured light energy.

Use the photo below to answer questions 20 and 21.



20. The dog could not jump to catch the ring with just its muscle system. What other system must work with muscles and how do the two systems work together?
21. Blood carries oxygen to cells. The dog's muscle cells require energy. Explain why the dog's heart might need to pump faster when the dog jumps.

Test-Taking Tip

Recall Experiences Remember to recall any hands-on experience as you read the question. Base your answer on the information given on the test.

Question 20 Think about what organ systems you use when you jump into the air.