2 The Cell in Action

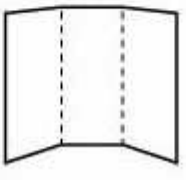
About the PHOTO

This adult katydid is emerging from its last immature, or nymph, stage. As the katydid changed from a nymph to an adult, every structure of its body changed. To grow and change, an organism must produce new cells. When a cell divides, it makes a copy of its genetic material.

PRE-READING ACTIVITY

FOLDNOTES

Tri-Fold Before you read the chapter, create the FoldNote entitled "Tri-Fold" described in the **Study Skills** section of the Appendix. Write what you know about the actions of cells in the column labeled "Know." Then, write what you want to know in the column labeled "Want." As you read the chapter, write what you learn about the actions of cells in the column labeled "Learn."



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START-UP ACTIVITY

Cells in Action

Yeast are single-celled fungi that are an important ingredient in bread. Yeast cells break down sugar molecules to release energy. In the process, carbon dioxide gas is produced, which causes bread dough to rise.

Procedure

1. Add **4 mL of a sugar solution** to **10 mL of a yeast-and-water mixture**. Use a **stirring rod** to thoroughly mix the two liquids.
2. Pour the stirred mixture into a small test tube.
3. Place a slightly **larger test tube** over the **small test tube.** The top of the small test tube should touch the bottom of the larger test tube.
4. Hold the test tubes together, and quickly turn both test tubes over. Place the test tubes in a test-tube rack.
5. Use a **ruler** to measure the height of the fluid in the large test tube. Wait 20 min, and then measure the height of the liquid again.

Analysis

1. What is the difference between the first height measurement and the second height measurement?
2. What do you think caused the change in the fluid's height?

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SECTION 1

Exchange with the Environment

What would happen to a factory if its power were shut off or its supply of raw materials never arrived? What would happen if the factory couldn't get rid of its garbage?

Like a factory, an organism must be able to obtain energy and raw materials and get rid of wastes. An organism's cells perform all of these functions. These functions keep cells healthy so that they can divide. Cell division allows organisms to grow and repair injuries.

The exchange of materials between a cell and its environment takes place at the cell's membrane. To understand how materials move into and out of the cell, you need to know about diffusion.

READING WARM-UP

Objectives

- Explain the process of diffusion.
- Describe how osmosis occurs.
- Compare passive transport with active transport.
- Explain how large particles get into and out of cells.

Terms to Learn

diffusion
osmosis
passive transport
active transport
endocytosis
exocytosis

READING STRATEGY

Reading Organizer As you read this section, make a table comparing active transport and passive transport.

What Is Diffusion?

What happens if you pour dye on top of a layer of gelatin? At first, it is easy to see where the dye ends and the gelatin begins. But over time, the line between the two layers will blur, as shown in **Figure 1.** Why? Everything, including the gelatin and the dye, is made up of tiny moving particles. Particles travel from where they are crowded to where they are less crowded. This movement from areas of high concentration (crowded) to areas of low concentration (less crowded) is called **diffusion** (di FYOO zhuhn). Dye particles diffuse from where they are crowded (near the top of the glass) to where they are less crowded (in the gelatin). Diffusion also happens within and between living cells. Cells do not need to use energy for diffusion.

diffusion the movement of particles from regions of higher density to regions of lower density

Figure 1 *The particles of the dye and the gelatin slowly mix by diffusion.*

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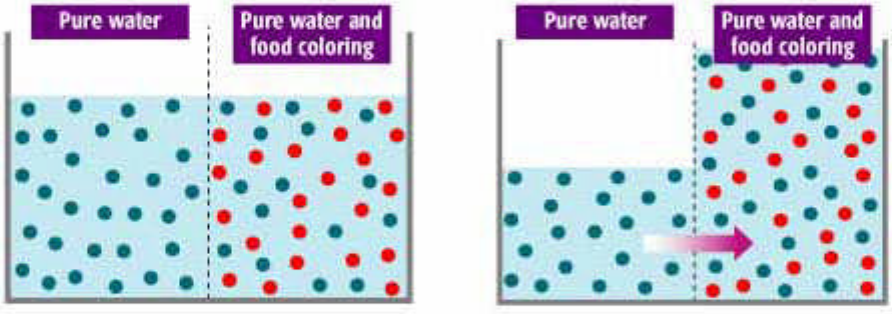
Figure 2 **Osmosis**

1 The side that holds only pure water has the higher concentration of water particles.

2 During osmosis, water particles move to where they are less concentrated.



Diffusion of Water

The cells of organisms are surrounded by and filled with fluids that are made mostly of water. The diffusion of water through cell membranes is so important to life processes that it has been given a special name—**osmosis** (ahs MOH sis).

osmosis the diffusion of water through a semipermeable membrane

Water is made up of particles, called *molecules*. Pure water has the highest concentration of water molecules. When you mix something, such as food coloring, sugar, or salt, with water, you lower the concentration of water molecules. **Figure 2** shows how water molecules move through a membrane that is semipermeable (SEM i PUHR mee uh buhl). *Semipermeable* means that only certain substances can pass through. The picture on the left in **Figure 2** shows liquids that have different concentrations of water. Over time, the water molecules move from the liquid with the high concentration of water molecules to the liquid with the lower concentration of water molecules.

The Cell and Osmosis

Osmosis is important to cell functions. For example, red blood cells are surrounded by plasma. Plasma is made up of water, salts, sugars, and other particles. The concentration of these particles is kept in balance by osmosis. If red blood cells were in pure water, water molecules would flood into the cells and cause them to burst. When red blood cells are put into a salty solution, the concentration of water molecules inside the cell is higher than the concentration of water outside. This difference makes water move out of the cells, and the cells shrivel up. Osmosis also occurs in plant cells. When a wilted plant is watered, osmosis makes the plant firm again.

Reading Check **Why would red blood cells burst if you placed them in pure water?** *(See the Appendix for answers to Reading Checks.)*

QUICK Lab

Bead Diffusion

1. Put three groups of **colored beads** on the bottom of a **plastic bowl.** Each group should be made up of five beads of the same color.
2. Stretch some **clear plastic wrap** tightly over the top of the bowl. Gently shake the bowl for 10 seconds while watching the beads.
3. How is the scattering of the beads like the diffusion of particles? How is it different from the diffusion of particles?

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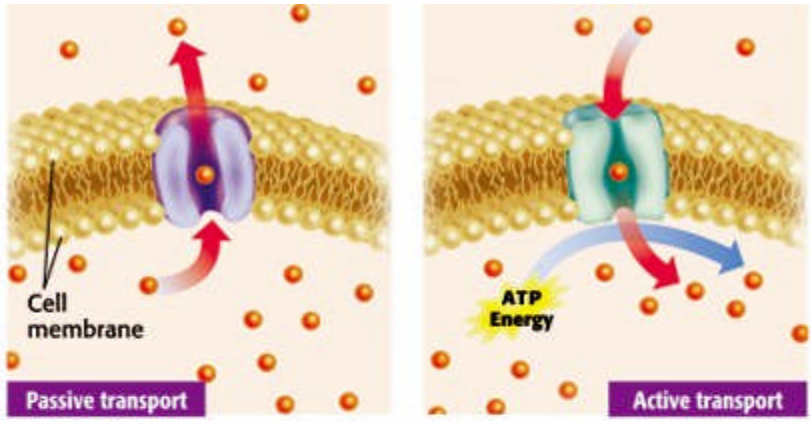

Figure 3 *In passive transport, particles travel through proteins to areas of lower concentration. In active transport, cells use energy to move particles, usually to areas of higher concentration.*

Moving Small Particles

Small particles, such as sugars, cross the cell membrane through passageways called *channels*. These channels are made up of proteins in the cell membrane. Particles travel through these channels by either passive or active transport. The movement of particles across a cell membrane without the use of energy by the cell is called **passive transport**, and is shown in **Figure 3.** During passive transport, particles move from an area of high concentration to an area of low concentration. Diffusion and osmosis are examples of passive transport.

A process of transporting particles that requires the cell to use energy is called **active transport.** Active transport usually involves the movement of particles from an area of low concentration to an area of high concentration.

passive transport the movement of substances across a cell membrane without the use of energy by the cell

active transport the movement of substances across the cell membrane that requires the cell to use energy

endocytosis the process by which a cell membrane surrounds a particle and encloses the particle in a vesicle to bring the particle into the cell

Moving Large Particles

Small particles cross the cell membrane by diffusion, passive transport, and active transport. Large particles move into and out of the cell by processes called *endocytosis* and *exocytosis*.

Endocytosis

The active-transport process by which a cell surrounds a large particle, such as a large protein, and encloses the particle in a vesicle to bring the particle into the cell is called **endocytosis** (EN doh sie TOH sis). *Vesicles* are sacs formed from pieces of cell membrane. **Figure 4** shows endocytosis.

Figure 4 Endocytosis

1. The cell comes into contact with a particle.
2. The cell membrane begins to wrap around the particle.
3. Once the particle is completely surrounded, a vesicle pinches off.

This photo shows the end of *endocytosis*, which means "within the cell."

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Figure 5 Exocytosis

1. Large particles that must leave the cell are packaged in vesicles.
2. The vesicle travels to the cell membrane and fuses with it.
3. The cell releases the particle to the outside of the cell.

Exocytosis means "outside the cell."

Exocytosis

When large particles, such as wastes, leave the cell, the cell uses an active-transport process called **exocytosis** (EK soh sie TOH sis). During exocytosis, a vesicle forms around a large particle within the cell. The vesicle carries the particle to the cell membrane. The vesicle fuses with the cell membrane and releases the particle to the outside of the cell. **Figure 5** shows exocytosis.

exocytosis the process in which a cell releases a particle by enclosing the particle in a vesicle that then moves to the cell surface and fuses with the cell membrane

Reading Check **What is exocytosis?**

SECTION Review

Summary

- Diffusion is the movement of particles from an area of high concentration to an area of low concentration.
- Osmosis is the diffusion of water through a semipermeable membrane.
- Cells move small particles by diffusion, which is an example of passive transport, and by active transport.
- Large particles enter the cell by endocytosis, and exit the cell by exocytosis.

Using Key Terms

For each pair of terms, explain how the meanings of the terms differ.

1. *diffusion* and *osmosis*
2. *active transport* and *passive transport*
3. *endocytosis* and *exocytosis*

Understanding Key Ideas

4. The movement of particles from a less crowded area to a more crowded area requires
   a. sunlight.
   b. energy.
   c. a membrane.
   d. osmosis.
5. What structures allow small particles to cross cell membranes?

Math Skills

6. The area of particle 1 is 2.5 mm^2. The area of particle 2 is 0.5 mm^2. The area of particle 1 is how many times as big as the area of particle 2?

Critical Thinking

7. **Predicting Consequences** What would happen to a cell if its channel proteins were damaged and unable to transport particles? What would happen to the organism if many of its cells were damaged in this way? Explain your answer.
8. **Analyzing Ideas** Why does active transport require energy?

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For a variety of links related to this chapter, go to www.scilinks.org

Topics: Diffusion; Osmosis

SciLinks code: HSM0406; HSM1090

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SECTION 2

Cell Energy

Why do you get hungry? Feeling hungry is your body's way of telling you that your cells need energy.

All cells need energy to live, grow, and reproduce. Plant cells get their energy from the sun. Many animal cells get the energy they need from food.

READING WARM-UP

Objectives

- Describe photosynthesis and cellular respiration.
- Compare cellular respiration with fermentation.

Terms to Learn

photosynthesis
cellular respiration
fermentation

READING STRATEGY

Discussion Read this section silently. Write down questions that you have about this section. Discuss your questions in a small group.

From Sun to Cell

Nearly all of the energy that fuels life comes from the sun. Plants capture energy from the sun and change it into food through a process called **photosynthesis.** The food that plants make supplies them with energy. This food also becomes a source of energy for the organisms that eat the plants.

Photosynthesis

Plant cells have molecules that absorb light energy. These molecules are called *pigments*. Chlorophyll (KLAWR uh FIL), the main pigment used in photosynthesis, gives plants their green color. Chlorophyll is found in chloroplasts.

Plants use the energy captured by chlorophyll to change carbon dioxide and water into food. The food is in the form of the simple sugar glucose. Glucose is a carbohydrate. When plants make glucose, they convert the sun's energy into a form of energy that can be stored. The energy in glucose is used by the plant's cells. Photosynthesis also produces oxygen. Photosynthesis is summarized in **Figure 1.**

photosynthesis the process by which plants, algae, and some bacteria use sunlight, carbon dioxide, and water to make food

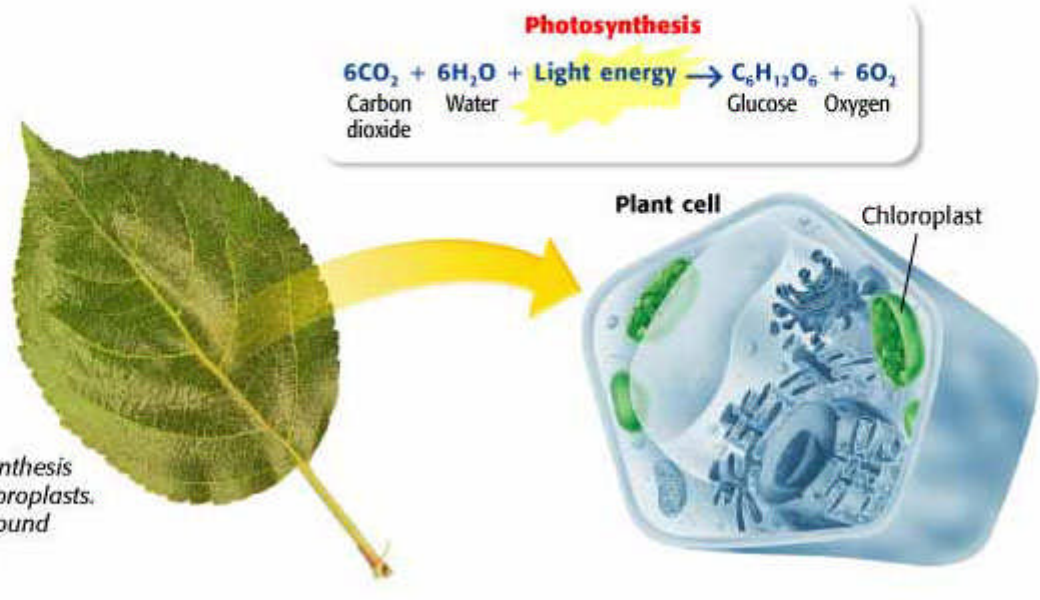

Figure 1 *Photosynthesis takes place in chloroplasts. Chloroplasts are found inside plant cells.*

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Getting Energy from Food

Animal cells have different ways of getting energy from food. One way, called **cellular respiration,** uses oxygen to break down food. Many cells can get energy without using oxygen through a process called **fermentation.** Cellular respiration will release more energy from a given food than fermentation will.

Cellular Respiration

The word *respiration* means "breathing," but cellular respiration is different from breathing. Breathing supplies the oxygen needed for cellular respiration. Breathing also removes carbon dioxide, which is a waste product of cellular respiration. But cellular respiration is a chemical process that occurs in cells.

Most complex organisms, such as the cow in **Figure 2,** obtain energy through cellular respiration. During cellular respiration, food (such as glucose) is broken down into CO_2 and H_2O, and energy is released. Most of the energy released maintains body temperature. Some of the energy is used to form adenosine triphosphate (ATP). ATP supplies energy that fuels cell activities.

Most of the process of cellular respiration takes place in the cell membrane of prokaryotic cells. But in the cells of eukaryotes, cellular respiration takes place mostly in the mitochondria. The process of cellular respiration is summarized in **Figure 2.** Does the equation in the figure remind you of the equation for photosynthesis? **Figure 3** on the next page shows how photosynthesis and respiration are related.

Reading Check **What is the difference between cellular respiration and breathing?** (*See the Appendix for answers to Reading Checks.*)

CONNECTION TO Chemistry

Earth's Early Atmosphere

Scientists think that Earth's early atmosphere lacked oxygen. Because of this lack of oxygen, early organisms used fermentation to get energy from food. When organisms began to photosynthesize, the oxygen they produced entered the atmosphere. How do you think this oxygen changed how other organisms got energy?

cellular respiration the process by which cells use oxygen to produce energy from food

fermentation the breakdown of food without the use of oxygen

Cellular Respiration

$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O +$ energy (ATP)

Glucose Oxygen Carbon dioxide Water

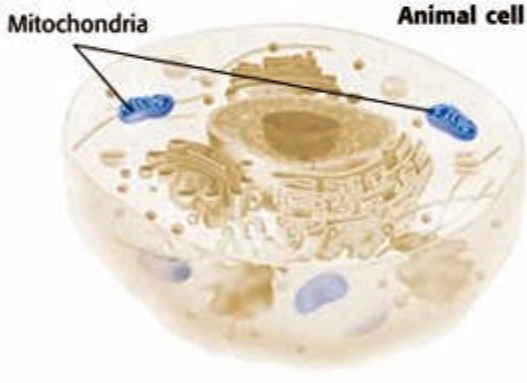

Figure 2 *The mitochondria in the cells of this cow will use cellular respiration to release the energy stored in the grass.*

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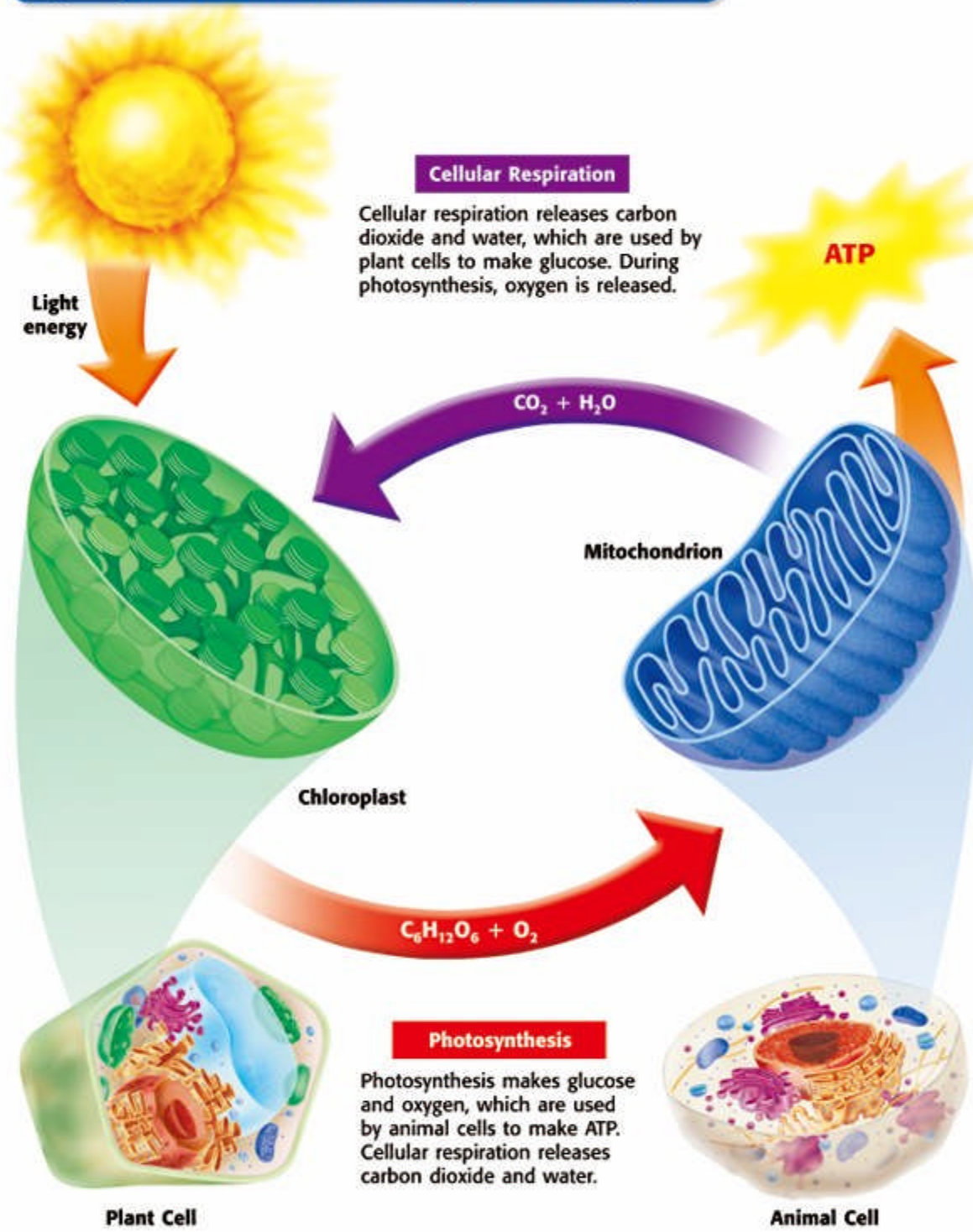
Figure 3 The Connection Between Photosynthesis and Respiration



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Connection Between Photosynthesis and Respiration

As shown in **Figure 3,** photosynthesis transforms energy from the sun into glucose. During photosynthesis, cells use CO_2 to make glucose, and the cells release O_2. During cellular respiration, cells use O_2 to break down glucose and release energy and CO_2. Each process makes the materials that are needed for the other process to occur elsewhere.

Fermentation

Have you ever felt a burning sensation in your leg muscles while you were running? When muscle cells can't get the oxygen needed for cellular respiration, they use the process of fermentation to get energy. One kind of fermentation happens in your muscles and produces lactic acid. The buildup of lactic acid contributes to muscle fatigue and causes a burning sensation. This kind of fermentation also happens in the muscle cells of other animals and in some fungi and bacteria. Another type of fermentation occurs in some types of bacteria and in yeast as described in **Figure 4.**

Reading Check **What are two kinds of fermentation?**

Figure 4 *Yeast forms carbon dioxide during fermentation. The bubbles of CO_2 gas cause the dough to rise and leave small holes in bread after it is baked.*

SECTION Review

Summary

- Most of the energy that fuels life processes comes from the sun.
- The sun's energy is converted into food by the process of photosynthesis.
- Cellular respiration breaks down glucose into water, carbon dioxide, and energy.
- Fermentation is a way that cells get energy from their food without using oxygen.

Using Key Terms

1. In your own words, write a definition for the term *fermentation.*

Understanding Key Ideas

2. O_2 is released during
   a. cellular respiration.
   b. photosynthesis.
   c. breathing.
   d. fermentation.
3. How are photosynthesis and cellular respiration related?
4. How are respiration and fermentation similar? How are they different?

Math Skills

5. Cells of plant A make 120 molecules of glucose an hour. Cells of plant B make half as much glucose as plant A does. How much glucose does plant B make every minute?

Critical Thinking

6. **Analyzing Relationships** Why are plants important to the survival of all other organisms?
7. **Applying Concepts** You have been given the job of restoring life to a barren island. What types of organisms would you put on the island? If you want to have animals on the island, what other organisms must you bring? Explain your answer.

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Topic: Cell Energy; Photosynthesis
SciLinks code: HSM0237; HSM1140

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SECTION 3

The Cell Cycle

In the time that it takes you to read this sentence, your body will have made millions of new cells! Making new cells allows you to grow and replace cells that have died.

The environment in your stomach is so acidic that the cells lining your stomach must be replaced every few days. Other cells are replaced less often, but your body is constantly making new cells.

READING WARM-UP

Objectives

- Explain how cells produce more cells.
- Describe the process of mitosis.
- Explain how cell division differs in animals and plants.

Terms to Learn

cell cycle
chromosome
homologous chromosomes
mitosis
cytokinesis

READING STRATEGY

Paired Summarizing Read this section silently. In pairs, take turns summarizing the material. Stop to discuss ideas that seem confusing.

The Life of a Cell

As you grow, you pass through different stages in life. Your cells also pass through different stages in their life cycle. The life cycle of a cell is called the **cell cycle.**

The cell cycle begins when the cell is formed and ends when the cell divides and forms new cells. Before a cell divides, it must make a copy of its deoxyribonucleic acid (DNA). DNA is the hereditary material that controls all cell activities, including the making of new cells. The DNA of a cell is organized into structures called **chromosomes.** Copying chromosomes ensures that each new cell will be an exact copy of its parent cell. How does a cell make more cells? It depends on whether the cell is prokaryotic (with no nucleus) or eukaryotic (with a nucleus).

cell cycle the life cycle of a cell

chromosome in a eukaryotic cell, one of the structures in the nucleus that are made up of DNA and protein; in a prokaryotic cell, the main ring of DNA

Making More Prokaryotic Cells

Prokaryotic cells are less complex than eukaryotic cells are. Bacteria, which are prokaryotes, have ribosomes and a single, circular DNA molecule but don't have membrane-enclosed organelles. Cell division in bacteria is called *binary fission,* which means "splitting into two parts." Binary fission results in two cells that each contain one copy of the circle of DNA. A few of the bacteria in **Figure 1** are undergoing binary fission.

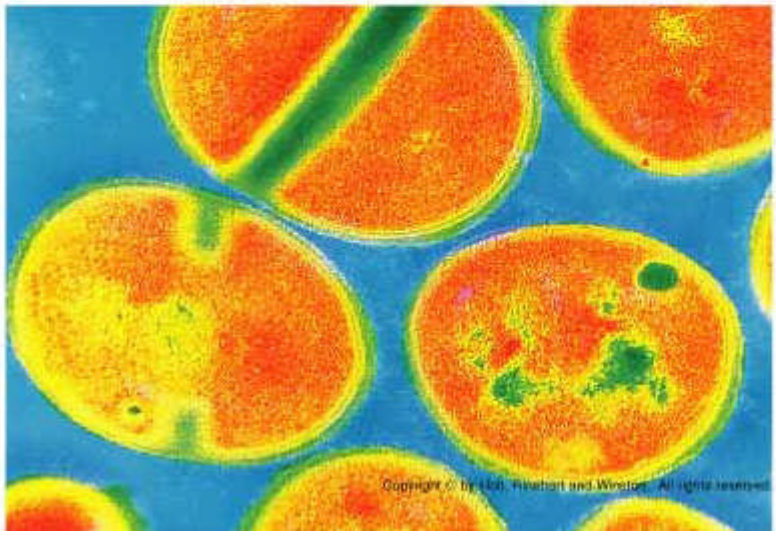


Figure 1 *Bacteria reproduce by binary fission.*

Eukaryotic Cells and Their DNA

Eukaryotic cells are more complex than prokaryotic cells are. The chromosomes of eukaryotic cells contain more DNA than those of prokaryotic cells do. Different kinds of eukaryotes have different numbers of chromosomes. More-complex eukaryotes do not necessarily have more chromosomes than simpler eukaryotes do. For example, fruit flies have 8 chromosomes, potatoes have 48, and humans have 46. **Figure 2** shows the 46 chromosomes of a human body cell lined up in pairs. These pairs are made up of similar chromosomes known as **homologous chromosomes** (hoh MAHL uh guhs KROH muh SOHMZ).

Reading Check **Do more-complex organisms always have more chromosomes than simpler organisms do?** *(See the Appendix for answers to Reading Checks.)*

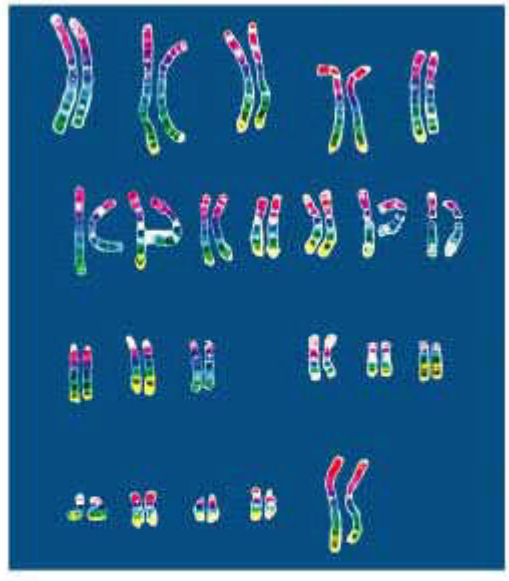


Figure 2 *Human body cells have 46 chromosomes, or 23 pairs of chromosomes.*

Making More Eukaryotic Cells

The eukaryotic cell cycle includes three stages. In the first stage, called *interphase*, the cell grows and copies its organelles and chromosomes. After each chromosome is duplicated, the two copies are called *chromatids*. Chromatids are held together at a region called the *centromere*. The joined chromatids twist and coil and condense into an X shape, as shown in **Figure 3.** After this step, the cell enters the second stage of the cell cycle.

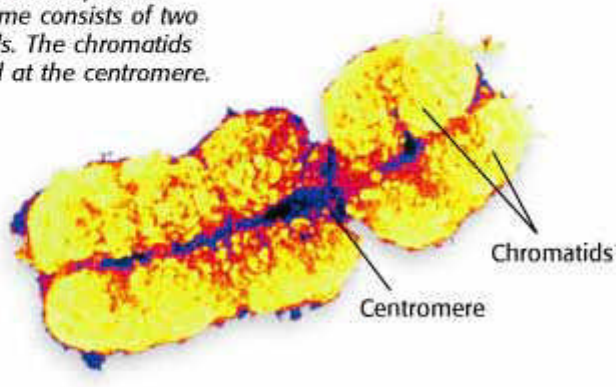
In the second stage, the chromatids separate. The complicated process of chromosome separation is called **mitosis.** Mitosis ensures that each new cell receives a copy of each chromosome. Mitosis is divided into four phases, as shown on the following pages.

In the third stage, the cell splits into two cells. These cells are identical to each other and to the original cell.

homologous chromosomes chromosomes that have the same sequence of genes and the same structure

mitosis in eukaryotic cells, a process of cell division that forms two new nuclei, each of which has the same number of chromosomes

Figure 3 *This duplicated chromosome consists of two chromatids. The chromatids are joined at the centromere.*



CONNECTION TO Language Arts

Picking Apart Vocabulary

Brainstorm what words are similar to the parts of the term *homologous chromosome.* What can you guess about the meaning of the term's root words? Look up the roots of the words, and explain how they help describe the concept.

ACTIVITY

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Figure 4 The Cell Cycle

Copying DNA (Interphase)

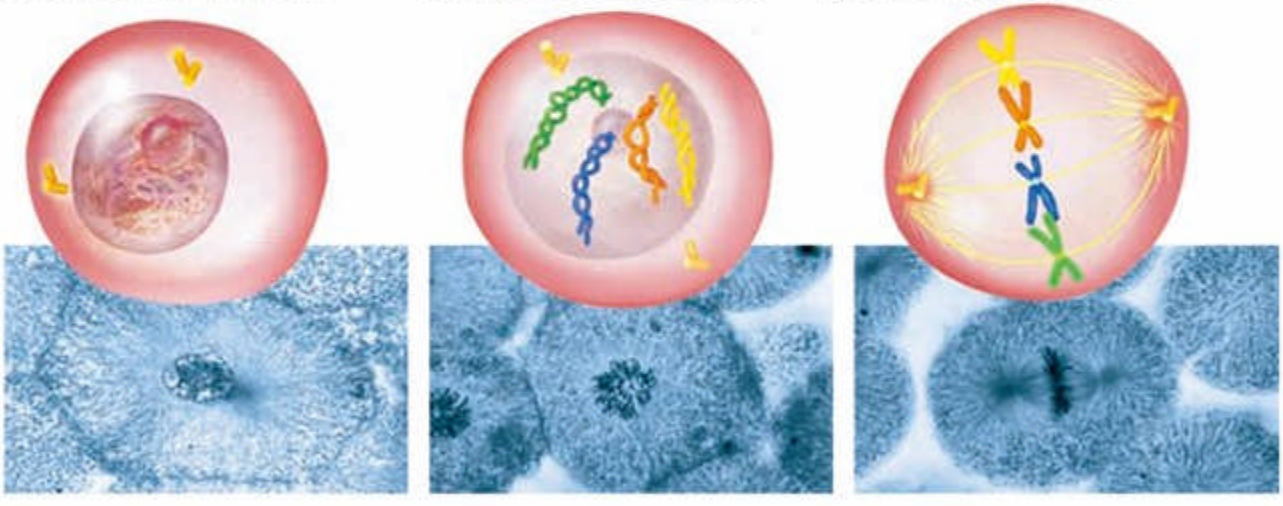
Before mitosis begins, chromosomes are copied. Each chromosome is then two chromatids.

Mitosis Phase 1 (Prophase)

Mitosis begins. The nuclear membrane dissolves. Chromosomes condense into rodlike structures.

Mitosis Phase 2 (Metaphase)

The chromosomes line up along the equator of the cell. Homologous chromosomes pair up.



cytokinesis the division of the cytoplasm of a cell

Mitosis and the Cell Cycle

Figure 4 shows the cell cycle and the phases of mitosis in an animal cell. Mitosis has four phases that are shown and described above. This diagram shows only four chromosomes to make it easy to see what's happening inside the cell.

Cytokinesis

In animal cells and other eukaryotes that do not have cell walls, division of the cytoplasm begins at the cell membrane. The cell membrane begins to pinch inward to form a groove, which eventually pinches all the way through the cell, and two daughter cells form. The division of cytoplasm is called **cytokinesis** and is shown at the last step of **Figure 4.**

Eukaryotic cells that have a cell wall, such as the cells of plants, algae, and fungi, reproduce differently. In these cells, a *cell plate* forms in the middle of the cell. The cell plate contains the materials for the new cell membranes and the new cell walls that will separate the new cells. After the cell splits into two, a new cell wall forms where the cell plate was. The cell plate and a late stage of cytokinesis in a plant cell are shown in **Figure 5.**

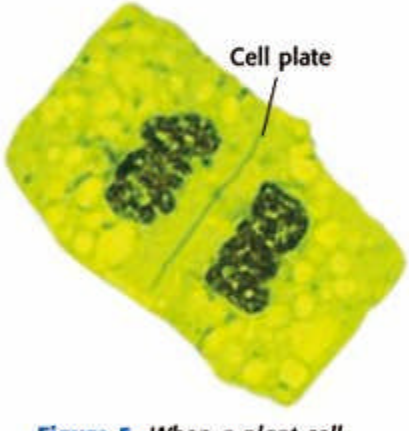


Figure 5 *When a plant cell divides, a cell plate forms and the cell splits into two cells.*

Reading Check **What is the difference between cytokinesis in an animal cell and cytokinesis in a plant cell?**

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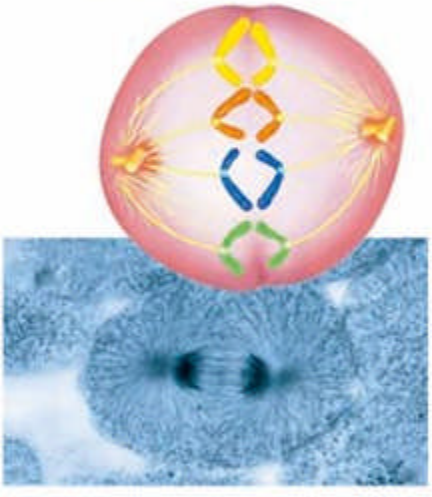
Mitosis Phase 3 (Anaphase)

The chromatids separate and move to opposite sides of the cell.

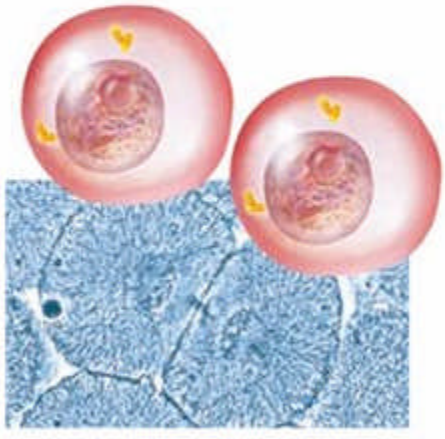


Mitosis Phase 4 (Telophase)

A nuclear membrane forms around each set of chromosomes, and the chromosomes unwind. Mitosis is complete.

Cytokinesis

In cells that lack a cell wall, the cell pinches in two. In cells that have a cell wall, a cell plate forms between the two new cells.



SECTION Review

Summary

- A cell produces more cells by first copying its DNA.
- Eukaryotic cells produce more cells through the four phases of mitosis.
- Mitosis produces two cells that have the same number of chromosomes as the parent cell.
- At the end of mitosis, a cell divides the cytoplasm by cytokinesis.
- In plant cells, a cell plate forms between the two new cells during cytokinesis.

Using Key Terms

1. In your own words, write a definition for each of the following terms: *cell cycle* and *cytokinesis*.

Understanding Key Ideas

2. Eukaryotic cells
   a. do not divide.
   b. undergo binary fission.
   c. undergo mitosis.
   d. have cell walls.
3. Why is it important for chromosomes to be copied before cell division?
4. Describe mitosis.

Math Skills

5. Cell A takes 6 h to complete division. Cell B takes 8 h to complete division. After 24 h, how many more copies of cell A would there be than cell B?

Critical Thinking

6. **Predicting Consequences** What would happen if cytokinesis occurred without mitosis?
7. **Applying Concepts** How does mitosis ensure that a new cell is just like its parent cell?
8. **Making Comparisons** Compare the processes that animal cells and plant cells use to make new cells. How are the processes different?

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Topic: Cell Cycle
SciLinks code: HSM0235

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Using Scientific Methods

Inquiry Lab

The Perfect Taters Mystery

You are the chief food detective at Perfect Taters Food Company. The boss, Mr. Fries, wants you to find a way to keep his potatoes fresh and crisp before they are cooked. His workers have tried several methods, but these methods have not worked. Workers in Group A put the potatoes in very salty water, and something unexpected happened to the potatoes. Workers in Group B put the potatoes in water that did not contain any salt, and something else happened! Workers in Group C didn't put the potatoes in any water, and that didn't work either. Now, you must design an experiment to find out what can be done to make the potatoes stay crisp and fresh.

OBJECTIVES

Examine osmosis in potato cells.

Design a procedure that will give the best results.

MATERIALS

- cups, clear plastic, small
- potato pieces, freshly cut
- potato samples (A, B, and C)
- salt
- water, distilled

SAFETY

- Before you plan your experiment, review what you know. You know that potatoes are made of cells. Plant cells contain a large amount of water. Cells have membranes that hold water and other materials inside and keep some things out. Water and other materials must travel across cell membranes to get into and out of the cell.
- Mr. Fries has told you that you can obtain as many samples as you need from the workers in Groups A, B, and C. Your teacher will have these samples ready for you to observe.
- Make a data table like the one below. List your observations in the data table. Make as many observations as you can about the potatoes tested by workers in Groups A, B, and C.

Observations	
Group A	
Group B	
Group C	

Ask a Question

1. Now that you have made your observations, state Mr. Fries's problem in the form of a question that can be answered by your experiment.

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Form a Hypothesis

2. Form a hypothesis based on your observations and your questions. The hypothesis should be a statement about what causes the potatoes not to be crisp and fresh. Based on your hypothesis, make a prediction about the outcome of your experiment. State your prediction in an if-then format.

Test the Hypothesis

3. Once you have made a prediction, design your investigation. Check your experimental design with your teacher before you begin. Mr. Fries will give you potato pieces, water, salt, and no more than six containers.

4. Keep very accurate records. Write your plan and procedure. Make data tables. To be sure your data is accurate, measure all materials carefully and make drawings of the potato pieces before and after the experiment.

Analyze the Results

1. **Explaining Events** Explain what happened to the potato cells in Groups A, B, and C in your experiment. Include a discussion of the cell membrane and the process of osmosis.

Draw Conclusions

2. **Analyzing Results** Write a letter to Mr. Fries that explains your experimental method, results, and conclusion. Then, make a recommendation about how he should handle the potatoes so that they will stay fresh and crisp.

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Chapter Review

USING KEY TERMS

1. Use the following terms in the same sentence: *diffusion* and *osmosis*.

2. In your own words, write a definition for each of the following terms: *exocytosis* and *endocytosis*.

Complete each of the following sentences by choosing the correct term from the word bank.

cellular respiration
photosynthesis
fermentation

3. Plants use ___ to make glucose.

4. During ___, oxygen is used to break down food molecules releasing large amounts of energy.

For each pair of terms, explain how the meanings of the terms differ.

5. *cytokinesis* and *mitosis*

6. *active transport* and *passive transport*

7. *cellular respiration* and *fermentation*

UNDERSTANDING KEY IDEAS

Multiple Choice

8. The process in which particles move through a membrane from a region of low concentration to a region of high concentration is
   a. diffusion.
   b. passive transport.
   c. active transport.
   d. fermentation.

9. What is the result of mitosis and cytokinesis?
   a. two identical cells
   b. two nuclei
   c. chloroplasts
   d. two different cells

10. Before the energy in food can be used by a cell, the energy must first be transferred to molecules of
    a. proteins.
    b. carbohydrates.
    c. DNA.
    d. ATP.

11. Which of the following cells would form a cell plate during the cell cycle?
    a. a human cell
    b. a prokaryotic cell
    c. a plant cell
    d. All of the above

Short Answer

12. Are exocytosis and endocytosis examples of active or passive transport? Explain your answer.

13. Name the cell structures that are needed for photosynthesis and the cell structures that are needed for cellular respiration.

14. Describe the three stages of the cell cycle of a eukaryotic cell.

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CRITICAL THINKING

15 Concept Mapping Use the following terms to create a concept map: *chromosome duplication, cytokinesis, prokaryote, mitosis, cell cycle, binary fission,* and *eukaryote*.

16 Making Inferences Which one of the plants pictured below was given water mixed with salt, and which one was given pure water? Explain how you know, and be sure to use the word *osmosis* in your answer.

17 Identifying Relationships Why would your muscle cells need to be supplied with more food when there is a lack of oxygen than when there is plenty of oxygen present?

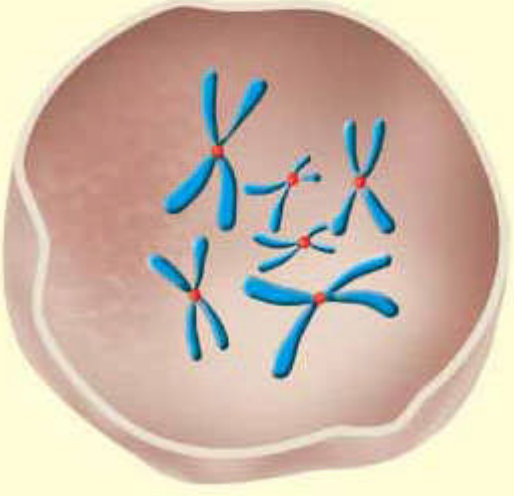
18 Applying Concepts A parent cell has 10 chromosomes.

a. Will the cell go through binary fission or mitosis and cytokinesis to produce new cells?

b. How many chromosomes will each new cell have after the parent cell divides?

INTERPRETING GRAPHICS

The picture below shows a cell. Use the picture below to answer the questions that follow.



19 Is the cell prokaryotic or eukaryotic?

20 Which stage of the cell cycle is this cell in?

21 How many chromatids are present? How many pairs of homologous chromosomes are present?

22 How many chromosomes will be present in each of the new cells after the cell divides?

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