

Assess Your Understanding

Discovering Cells

What Are Cells?

got it?

- I get it! Now I know that a cell is the basic unit of _____

- I need extra help with _____

What Is the Cell Theory?

1a. RELATE CAUSE AND EFFECT Why would Hooke's discovery have been impossible without a microscope?

b. APPLY CONCEPTS Use Virchow's ideas to explain why plastic plants and stuffed animals are not alive.

got it?

- I get it! Now I know that the cell theory describes _____

- I need extra help with _____

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Assess Your Understanding

Discovering Cells

How Do Microscopes Work?

- 2a. **DEFINE** Magnification makes objects look (smaller/larger) than they really are.
- b. **ESTIMATE** The diameter of a microscope's field of view is estimated to be 0.9 mm. About how wide is an object that fills two thirds of the field? Circle your answer.
1.8 mm 0.6 mm 0.3 mm
- c. **COMPARE AND CONTRAST** How are magnification and resolution different?

- d. **EXPLAIN** How do the characteristics of electron microscopes make them useful for studying cells?

got it?

I get it! Now I know that light microscopes work by _____

I need extra help with _____

Place the outside corner, the corner away from the dotted line, in the corner of your copy machine to copy onto letter-size paper.

Key Concept Summaries

Discovering Cells

What Are Cells?

Cells are the basic units of structure and function in living things. Cells form the parts of an organism and carry out all of its functions. Every organism is made out of one or more cells, and each

cell can carry out the basic functions that let it live, grow, and reproduce. Those functions can include obtaining food, water, and oxygen, secreting wastes, and reproducing by division.

What Is the Cell Theory?

The **cell theory** explains the relationship between cells and living things. It was developed about two hundred years after the invention of the **microscope**, an instrument that makes small objects look larger, and the discovery of cells. **The cell theory states the following:**

- **All living things are composed of cells.**
- **Cells are the basic units of structure and function in living things.**
- **All cells are produced from other cells.**

How Do Microscopes Work?

Most cells are too small to be seen by the human eye, so the development of the cell theory depended on observations made through microscopes.

by measuring the width of the circular field visible through the microscope and comparing the size of the object to the width of the field.

Some microscopes focus light through lenses

to produce a magnified image, and other microscopes use beams of electrons. A compound microscope uses two lenses and focuses light from a lamp or reflected from a mirror. This type of microscope is often used in classrooms. You can estimate the true size of an enlarged object

Objects viewed through a microscope are also more detailed than when viewed with the naked eye. Microscopes improve resolution: the ability to distinguish separate structures that are close together. Electron microscopes have better resolution and magnification than light microscopes.

On a separate sheet of paper, explain how microscopes allowed scientists to discover cells and develop the cell theory.

Use the outside corner, the corner away from the dotted line, in the corner of your copy machine to copy onto letter-size paper.

Lesson Quiz

Discovering Cells

Fill in the blank to complete each statement.

1. A cell's functions can include obtaining food and water and getting rid of _____.
2. Compound microscopes focus light through _____ to produce a magnified image.
3. A large organism is made up of many millions of _____.
4. A(n) _____ lens has a center that is thicker than its edge.
5. The _____ describes how cells are related to living things.
6. The ability to distinguish between two nearby objects is called _____.

Write the letter of the correct answer on the line at the left.

- | | |
|--|---|
| <p>7. ____ The scientist who determined that all animals are made out of cells was</p> <p>A Hooke
B Schleiden
C Schwann
D Virchow</p> | <p>8. ____ A compound microscope with a 10x eyepiece and a 40x objective has a magnification of</p> <p>A 10x
B 40x
C 50x
D 400x</p> |
| <p>9. ____ Which of the following statements is NOT part of the cell theory?</p> <p>A All cells are produced from other cells.
B Cells can absorb food and oxygen.
C All living things are composed of cells.
D Cells are the basic units of structure and function in living things.</p> | <p>10. ____ The visible field of a microscope is 10 mm wide. How large is an object that takes up $\frac{1}{4}$ of the field?</p> <p>A 1 mm
B 2.5 mm
C 4 mm
D 5 mm</p> |

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Assess Your Understanding


Looking Inside Cells

How Do the Parts of a Cell Work?

1a. **INTERPRET TABLES** Use the table you completed in Figure 3 to summarize the differences between an animal cell and a plant cell.

b. **MAKE GENERALIZATIONS** How are the functions of the endoplasmic reticulum and the Golgi apparatus related?

c. **CHALLENGE** A solar panel collects sunlight and converts it to heat or electrical energy. How is a solar panel similar to chloroplasts?

d. **ANSWER**  What are cells made of?

got it?

I get it! Now I know that different kinds of organelles in a cell _____

I need extra help with _____

Place the outside corner, the corner away from the dotted line, in the corner of your copy machine to copy onto letter-size paper.

Assess Your Understanding

Looking Inside Cells

How Do Cells Work Together in an Organism?

2a. **DESCRIBE** What does the term *division of labor* mean as it is used in this lesson?

b. **INFER** Would a tissue or an organ have more kinds of specialized cells? Explain your answer.

got it?

I **get it!** Now I know that the levels of organization in a multicellular organism include _____

I need extra help with _____

Place the outside corner, the corner away from the dotted line, in the corner of your copy machine to copy onto letter-size paper.

Key Concept Summaries

Looking Inside Cells

How Do the Parts of a Cell Work?

Cells contain a number of smaller structures that divide up the jobs inside the cell. **Each kind of cell structure has a different function within a cell.** Every cell is surrounded by a **cell membrane**, which controls the movement of materials into and out of the cell. Jobs inside the cell are handled by specialized **organelles** suspended in the cell's gel-like **cytoplasm**: the **nucleus** directs the cell's activities, **lysosomes** break down food into smaller particles, **mitochondria** convert the energy stored in food to

energy the cell can use, **ribosomes** produce proteins, and the **endoplasmic reticulum** and **Golgi apparatus** modify proteins and move them around inside the cell. **Vacuoles** are structures where the cell can store water, food, or wastes. Plant cells have two structures that are not found in animal cells: the **cell wall**, which surrounds the cell and helps support it, and **chloroplasts**, which capture the energy in sunlight to power the process the plant uses to make its own food.

How Do Cells Work Together in an Organism?

In a **unicellular** organism, all of the functions of life are carried out by one cell. Each cell in a **multicellular** organism like a plant or an animal also carries out the same basic functions to remain alive, but they may also be specialized to perform specific functions for the organism as a whole.

In multicellular organisms, cells are organized into tissues, organs, and organ systems. A **tissue** is a group of specialized cells that work together to perform a particular function. An **organ** contains different tissues that function together, and an **organ system** is a group of organs that work together to perform a major function.

On a separate sheet of paper, compare the way organelles work inside a cell to the way that cells work inside multicellular organisms.

Lesson Quiz

Looking Inside Cells

Fill in the blank to complete each statement.

1. The _____ controls the materials that enter and leave the cell.
2. Ribosomes make _____.
3. The _____ is a large structure that directs the cell's activities.
4. The storage area of a cell is called a(n) _____.
5. A group of organs that work together to perform a major function is called a(n) _____.
6. _____ are tiny cell structures that carry out specific functions in the cell.

If the statement is true, write *true*. If the statement is false, change the underlined word or words to make the statement true.

7. _____ Plant cells have chloroplasts, but animal cells do not.
8. _____ The cell's nucleus is filled with a substance called protein.
9. _____ The specialized cells in a unicellular organism perform specialized jobs.
10. _____ Ribosomes are made in a special region of the nucleus called the nucleolus.

Assess Your Understanding

Chemical Compounds in Cells

What Are Elements and Compounds?

got it?

- I get it! Now I know that compounds form when _____

- I need extra help with _____

What Compounds do Cells Need?

1a. DESCRIBE An organic compound that contains only the elements carbon, hydrogen, and oxygen is most likely (a carbohydrate/ a protein/DNA). Explain your answer.

b. CLASSIFY Which groups of organic compounds found in living things are NOT energy rich?

c. REVIEW What is the function of DNA?

d. RELATE CAUSE AND EFFECT Describe one way a lack of water could affect cell functions.

got it?

- I get it! Now I know that the important compounds in living things include _____

- I need extra help with _____

Place the outside corner, the corner away from the dotted line, in the corner of your copy machine to copy onto letter-size paper.

Key Concept Summaries

Chemical Compounds in Cells

What Are Elements and Compounds?

Living things contain compounds built out of a small set of **elements**. **An element is any substance that cannot be broken down into simpler substances.** The smallest unit of an element is a

particle called an atom. **Compounds form when two or more elements combine chemically.** When elements combine, they form units called molecules.

What Compounds Do Cells Need?

Many compounds in living things contain the element carbon. Most compounds containing carbon are called organic compounds. **Some important groups of organic compounds that living things need include carbohydrates, lipids, proteins, and nucleic acids.** **Water is a necessary inorganic compound.** About two-thirds of every living thing is water.

Carbohydrates (sugars, starches) and **lipids** (fats, oils, waxes) are energy-rich compounds containing carbon, hydrogen, and oxygen. Carbohydrates are used for energy in living things and are important components in cell walls and on cell membranes. Cells use lipids to store energy for later use, and cell membranes are made of lipid.

Proteins are large organic molecules containing carbon, hydrogen, oxygen, and nitrogen (and in some proteins, sulfur). Proteins make up parts of the cell membrane and organelles. Specialized proteins called **enzymes** speed up chemical reactions inside living things.

Nucleic acids are long molecules containing carbon, hydrogen, oxygen, nitrogen, and phosphorus. They include **DNA**, the molecule that stores the genetic information used to control the cell. The shape of a DNA molecule is called a **double helix**.

On a separate sheet of paper, tell which three elements are found in all the organic compounds that living things need. Which of these elements are also found in water?

Lesson Quiz

Chemical Compounds in Cells

Match each term with its definition by writing the letter of the correct definition in the right column on the line beside the term in the left column.

- | | |
|---------------------|---|
| 1. ___ carbohydrate | a. inorganic compound |
| 2. ___ carbon | b. element found in water |
| 3. ___ water | c. energy-rich organic compound |
| 4. ___ oxygen | d. element that is part of most organic compounds |

If the statement is true, write *true*. If the statement is false, change the underlined word or words to make the statement true.

- _____ Sugars and starches are examples of lipids.
- _____ Proteins are part of cell membranes and store energy.
- _____ A(n) enzyme helps speed a chemical reaction.
- _____ Carbohydrates direct cell functions.
- _____ Water makes up one-third of the human body.
- _____ Meat, dairy products, fish, nuts, and beans are all foods that are high in protein.

Assess Your Understanding

The Cell in Its Environment

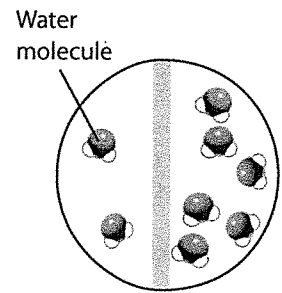
How Do Materials Move Into and Out of Cells?

1a. REVIEW Use diffusion to tell what happens when you drop a sugar cube into water.

b. PREDICT Draw an arrow to show the overall direction water will travel as a result of osmosis. (The vertical line is a cell membrane.)

c. IDENTIFY Active transport depends on (sugars/proteins) to move molecules across the cell membrane.

d. COMPARE AND CONTRAST Give an example of how active transport differs from passive transport.



got it?

I get it! Now I know that a key function of the cell membrane is to _____

I need extra help with _____

Use the bottom corner, the corner away from the dotted line, in the corner of your copy machine to copy onto letter-size paper.

Key Concept Summary

The Cell in Its Environment

How Do Materials Move Into and Out of Cells?

All of the materials that cells need—such as food, water, and oxygen—as well as the wastes that they must get rid of, move through the cell membrane.

Cell membranes are **selectively permeable**: a double layer of lipid molecules prevents some substances from passing through the membrane but lets other molecules move through. Molecules that cannot freely pass through the membrane must cross through one of the proteins embedded in it.

Substances that can move into and out of a cell do so by means of one of two processes: passive transport or active transport.

Passive transport is the movement of materials through the membrane without the use of cellular energy. There are several forms of passive transport. Small molecules that can freely cross the cell membrane move by **diffusion**, moving from areas of high concentration to areas of lower concentration.

Oxygen and carbon dioxide enter and leave the cell by diffusion. Water also crosses the cell membrane easily, by a passive process called **osmosis**. Molecules that cannot move through the cell membrane can diffuse through specialized protein channels in a process called facilitated diffusion.

Active transport uses cellular energy to move materials through the cell membrane. Some of the proteins in the cell membrane can move small molecules in the opposite direction than diffusion would take them: from an area of lower concentration to a region of higher concentration. These proteins are called transport proteins.

Materials that are too large to pass through transport proteins are also moved by active transport: during **endocytosis** the cell membrane changes shape to engulf particles, during **exocytosis** vacuoles fuse with the membrane to expel large particles.

On a separate sheet of paper, explain how the cell membrane controls the movement of materials into and out of the cell.

Place the outside corner, the corner away from the dotted line, in the corner of your copy machine to copy onto letter-size paper.

Lesson Quiz

The Cell in Its Environment

Fill in the blank to complete each statement.

1. Water diffusing through a semipermeable membrane is called _____.
2. _____ occurs when a cell engulfs large food particles.
3. The cell membrane is built of a double layer of _____.
4. Facilitated diffusion moves large molecules through _____.
5. The _____ controls the materials that move into and out of a cell.
6. The _____ use energy to pick up specific molecules and carry them across the cell membrane.

Write the letter that best describes the type of transport on the line at the left.

- | | |
|--|---|
| <p>7. ___ Glucose enters a liver cell through a protein channel.</p> <p>A diffusion
B facilitated diffusion
C osmosis
D active transport</p> | <p>8. ___ Oxygen moves into a contracting heart muscle cell.</p> <p>A diffusion
B facilitated diffusion
C osmosis
D active transport</p> |
| <p>9. ___ A nerve cell uses energy to pump sodium out of its cytoplasm into a sodium-rich environment.</p> <p>A diffusion
B facilitated diffusion
C osmosis
D active transport</p> | <p>10. ___ Water moves out of the skin cells of a person swimming in a freshwater pond.</p> <p>A diffusion
B facilitated diffusion
C osmosis
D active transport</p> |

Use the perforated corners, the cutter away from the dotted line, in the corner or your copy machine to copy onto letter-size paper.