

Chapter 7 Cell Structure and Function

Summary

7-1 Life Is Cellular

Since the 1600s, scientists have made many discoveries that have showed how important cells are in living things. Such discoveries are summarized in the cell theory. The cell theory states:

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

All cells have two characteristics in common. They are surrounded by a barrier called a cell membrane, and they contain the molecule that carries biological information—DNA.

Cells fall into two broad categories, depending on whether they contain a nucleus. The nucleus is a large membrane-enclosed structure that contains the cell's genetic material in the form of DNA. The nucleus controls many of the cell's activities. Prokaryotic cells have genetic material that is not contained in a nucleus. Bacteria are prokaryotes. Eukaryotic cells contain a nucleus in which their genetic material is separated from the rest of the cell. Plants, animals, fungi, and protists are eukaryotes.

7-2 Eukaryotic Cell Structure

Cell biologists divide the eukaryotic cell into two major parts: the nucleus and the cytoplasm. The cytoplasm is the portion of the cell outside the nucleus. Eukaryotic cells contain structures known as organelles.

The nucleus contains nearly all the cell's DNA and with it the coded instructions for making proteins. The nucleus is surrounded by a nuclear envelope composed of two membranes. Inside the nucleus is granular material called chromatin. Most nuclei also contain a small, dense region known as the nucleolus.

Ribosomes are small particles of RNA and protein found throughout the cytoplasm. Proteins are assembled on ribosomes. Eukaryotic cells contain an internal membrane system known as the endoplasmic reticulum, or ER. The ER is where lipid components of the cell membrane are assembled, along with proteins and other materials that are exported from the cell. The portion of the ER involved in the synthesis of proteins is called rough ER. Smooth ER, which does not contain ribosomes, is involved in the making of lipids. The function of the Golgi apparatus is to modify, sort, and package proteins and other materials from the ER for storage in the cell or secretion outside the cell.

Other organelles include lysosomes, vacuoles, mitochondria, and chloroplasts. Mitochondria are organelles that convert the chemical energy stored in food into compounds that are more convenient for the cell to use. Chloroplasts are organelles that capture the energy from sunlight and convert it into chemical energy.

Eukaryotic cells have a structure called the cytoskeleton that helps support the cell. The cytoskeleton is a network of protein filaments that helps the cell to maintain its shape. The cytoskeleton is also involved in movement.

7-3 Cell Boundaries

All cells are surrounded by a thin, flexible barrier known as the cell membrane. The cell membrane regulates what enters and leaves the cell and also provides protection and support. The composition of nearly all cell membranes is a double-layered sheet called a lipid bilayer. Many cells also produce a strong supporting layer around the membrane known as the cell wall. Cell walls are present in plants, algae, fungi, and many prokaryotes. The main function of the cell wall is to provide support and protection for the cell.

One of the most important functions of the cell membrane is to regulate the movement of dissolved molecules from the liquid on one side of the membrane to the liquid on the other side. The cytoplasm of a cell contains a solution of many different substances in water. The concentration of a solution is the mass of solute in a given volume of solution.

In a solution, particles move constantly. Particles tend to move from an area where they are more concentrated to an area where they are less concentrated, a process called diffusion. When the concentration of a solute is the same throughout a solution, the solution has reached equilibrium. Because diffusion depends upon random particle movements, substances diffuse across membranes without requiring the cell to use energy. Water passes quite easily across most membranes. Osmosis is the diffusion of water through a selectively permeable membrane. Many cell membranes have protein channels that allow certain molecules to cross the membranes. In such cases, the cell membrane protein is said to facilitate, or help, the diffusion of the molecules across the membrane. This process is called facilitated diffusion. It does not require use of the cell's energy.

Active transport does require the cell's energy. In active transport, cells move materials from one side of a membrane to the other side against the concentration difference. Types of active transport include endocytosis, phagocytosis, pinocytosis, and exocytosis.

7-4 The Diversity of Cellular Life

An organism that consists of a single cell is called a unicellular organism. Unicellular organisms carry out all the essential functions of life. Organisms that are made up of many cells are called multicellular organisms. Cells throughout a multicellular organism can develop in different ways to perform different tasks. This process is called cell specialization.

The levels of organization in a multicellular organism are individual cells, tissues, organs, and organ systems. Individual cells are the first level. Similar cells are grouped into units called tissues. A tissue is a group of cells that perform a particular function. Groups of tissues that work together form an organ. A group of organs that work together to perform a specific function is called an organ system.

Chapter 7 Cell Structure and Function

Section 7-1 Life Is Cellular (pages 169-173)



Key Concepts

- What is the cell theory?
- What are the characteristics of prokaryotes and eukaryotes?

Introduction (page 169)

1. What is the structure that makes up every living thing? _____

The Discovery of the Cell (pages 169-170)

2. What was Anton van Leeuwenhoek one of the first to see in the 1600s? _____

3. What did a thin slice of cork seem like to Robert Hooke when he observed it through a microscope? _____

4. What did the German botanist Matthias Schleiden conclude? _____

5. What did the German biologist Theodor Schwann conclude? _____

6. How did Rudolph Virchow summarize his years of work? _____

7. What are the three concepts that make up the cell theory?

a. _____

b. _____

c. _____

Exploring the Cell (pages 170-172)

8. Why are electron microscopes capable of revealing details much smaller than those seen through light microscopes? _____

Prokaryotes and Eukaryotes (pages 172–173)

9. Circle the letter of each sentence that is true about prokaryotes.
- a. They grow and reproduce.
 - b. Many are large, multicellular organisms.
 - c. They are more complex than cells of eukaryotes.
 - d. They have cell membranes and cytoplasm.
10. Are all eukaryotes large, multicellular organisms? _____

11. Complete the table about the two categories of cells.

TWO CATEGORIES OF CELLS

Category	Definition	Examples
	Organisms whose cells lack nuclei	
	Organisms whose cells contain nuclei	

Section 7-2 Eukaryotic Cell Structure

(pages 174-181)

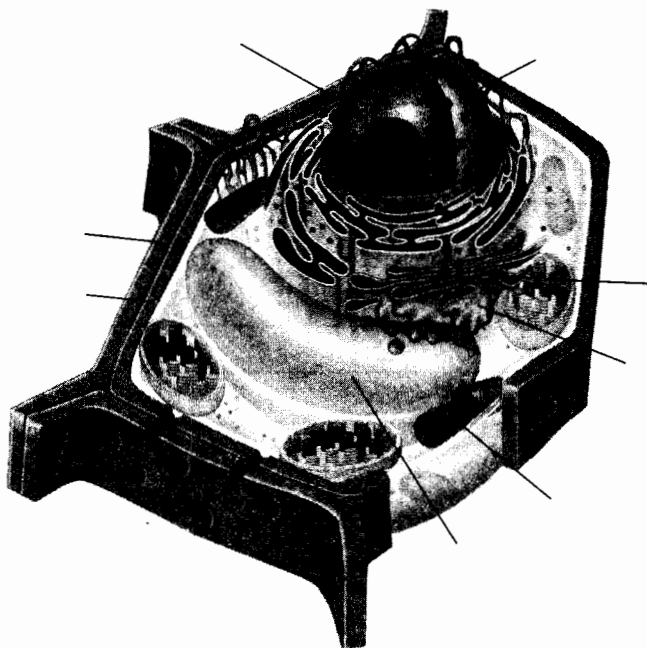
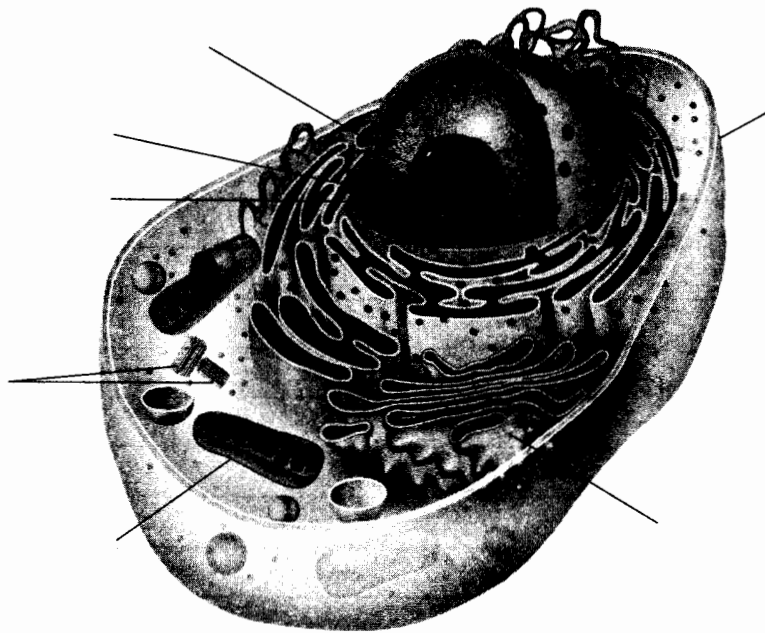
Key Concept

- What are the functions of the major cell structures?

Comparing a Cell to a Factory (page 174)

1. What is an organelle? _____

2. Label the structures on the illustrations of the plant and animal cells.



3. Circle the letter of each structure that animal cells contain.

- a. chloroplasts
- b. lysosomes
- c. mitochondria
- d. ER

4. Circle the letter of each structure that plant cells contain.

- a. cell wall
- b. ER
- c. lysosomes
- d. chloroplast

Nucleus (page 176)

5. What is the function of the nucleus? _____

6. What important molecules does the nucleus contain? _____

7. The granular material visible within the nucleus is called _____.

8. What does chromatin consist of? _____

9. What are chromosomes? _____

10. Most nuclei contain a small, dense region known as the _____.

11. What occurs in the nucleolus? _____

12. What is the nuclear envelope? _____

Ribosomes (page 177)

13. What are ribosomes? _____

Endoplasmic Reticulum (pages 177–178)

14. What is the difference between rough ER and smooth ER? _____

Golgi Apparatus (page 178)

15. Using the cell as a factory analogy, describe the role of the Golgi apparatus in the cell.

Lysosomes (page 179)

16. Circle the letter of each sentence that is true about lysosomes.
- a. They contain enzymes that help synthesize lipids.
 - b. They break down organelles that have outlived their usefulness.
 - c. They produce proteins that are modified by the ER.
 - d. They contain enzymes that break down lipids, carbohydrates, and proteins.

Vacuoles (page 179)

17. What are vacuoles? _____

18. What is the role of the central vacuole in plants? _____

19. How does the contractile vacuole in a paramecium help maintain homeostasis?

Mitochondria and Chloroplasts (pages 179–180)

20. Is the following sentence true or false? Both chloroplasts and mitochondria are enclosed by two membranes. _____
21. Chloroplasts and mitochondria contain their own genetic information in the form of _____

22. What are mitochondria? _____

23. Are mitochondria found in plant cells, animal cells, or both? _____
24. Where are chloroplasts found? _____

25. Biologist Lynn Margulis has suggested that mitochondria and chloroplasts are descendants of what kind of organisms? _____

Cytoskeleton (page 181)

26. What is the cytoskeleton? _____

27. Complete the table about structures that make up the cytoskeleton.

STRUCTURES OF THE CYTOSKELETON

Structure	Description	Functions
		Maintain cell shape, help build cilia and flagella, form centrioles in cell division
		Support the cell, help cells move

Match the organelle with its description.

Organelle	Description
_____ 28. Ribosome	a. Uses energy from sunlight to make energy-rich food
_____ 29. Endoplasmic reticulum	b. Stack of membranes in which enzymes attach carbohydrates and lipids to proteins
_____ 30. Golgi apparatus	c. Uses energy from food to make high-energy compounds
_____ 31. Lysosome	d. An internal membrane system in which components of cell membrane and some proteins are constructed
_____ 32. Vacuole	e. Saclike structure that stores materials
_____ 33. Chloroplast	f. Small particle of RNA and protein that produces protein following instructions from nucleus
_____ 34. Mitochondrion	g. Filled with enzymes used to break down food into particles that can be used

Reading Skill Practice

A flowchart can help you remember the order in which events occur. On a separate sheet of paper, create a flowchart that describes how proteins are made in the cell. You will find that the steps of this process are explained on pages 176–178. For more information about flowcharts, see Organizing Information in Appendix A in your textbook.

Section 7-3 Cell Boundaries (pages 182-189)

Key Concepts

- What are the main functions of the cell membrane and the cell wall?
- What happens during diffusion?
- What is osmosis?

Cell Membrane (page 182)

1. What are the functions of the cell membrane? _____

2. The core of nearly all cell membranes is a double-layered sheet called a(an) _____.
3. What is the difference in the function of the proteins and the carbohydrates attached to a cell membrane? _____

Cell Walls (page 183)

4. In what organisms are cell walls found? _____

5. Is the following sentence true or false? The cell wall lies inside the cell membrane.

6. What is the main function of the cell wall? _____

7. What are plant cell walls mostly made of? _____

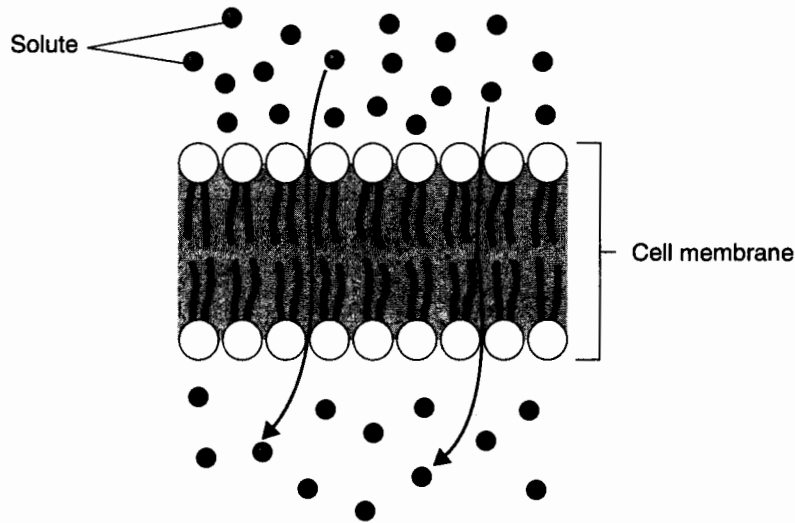
Diffusion Through Cell Boundaries (pages 183-184)

8. What is the concentration of a solution? _____

9. What is diffusion? _____

10. What is meant when a system has reached equilibrium? _____

11. The molecules of solute in the illustration are moving through the cell membrane from top to bottom. Indicate with labels which side of the membrane has a high concentration of solute and which has a low concentration.



Osmosis (pages 185–186)

12. What does it mean that biological membranes are selectively permeable?

13. What is osmosis?

14. Is the following sentence true or false? Water tends to diffuse from a region where it is less concentrated to a region where it is highly concentrated. _____

15. When will water stop moving across a membrane? _____

Match the situation to the description.

Situation	Description
_____ 16. Two solutions are isotonic.	a. The solution is above strength in solute.
_____ 17. A solution is hypertonic.	b. The solutions are the same strength.
_____ 18. A solution is hypotonic.	c. The solution is below strength in solute.

19. On which side of a selectively permeable membrane does osmosis exert a pressure?

Facilitated Diffusion (page 187)

20. What happens during the process of facilitated diffusion? _____

21. What is the role of protein channels in the cell membrane? _____

22. Is the following sentence true or false? Facilitated diffusion does not require the cell to use energy. _____

Active Transport (pages 188–189)

23. The energy-requiring process that moves material across a cell membrane against a concentration difference is called _____.
24. Is the following sentence true or false? Active transport always requires transport proteins during the process. _____
25. Complete the table about types of active transport.

TYPES OF ACTIVE TRANSPORT

Type	Description
Endocytosis	
Phagocytosis	
Exocytosis	

26. During endocytosis, what happens to the pocket in the cell membrane when it breaks loose from the membrane? _____

Section 7-4 The Diversity of Cellular Life (pages 190-193)

Key Concepts

- What is cell specialization?
- What are the four levels of organization in multicellular organisms?

Unicellular Organisms (page 190)

1. A single-celled organism is also called a(an) _____ organism.

Multicellular Organisms (pages 190-192)

2. What is cell specialization in a multicellular organism? _____

3. Circle the letter of each sentence that is true about cell specialization.
 - a. Specialized cells perform particular functions within the organism.
 - b. Only unicellular organisms have specialized cells.
 - c. The human body contains many different cell types.
 - d. Some cells are specialized to enable movement.

Levels of Organization (pages 192-193)

4. What are four levels of organization in a multicellular organism?
 - a. _____
 - b. _____
 - c. _____
 - d. _____
5. What is a tissue? _____

6. What are the four main types of tissue in most animals?
 - a. _____
 - b. _____
 - c. _____
 - d. _____
7. Groups of tissues that work together to perform a specific function are called a(an) _____.
8. What kinds of tissues can be found within a muscle in your body? _____

9. What is an organ system? _____

Chapter 7 Cell Structure and Function

Vocabulary Review

Matching *In the space provided, write the letter of the function that best matches each organelle.*

- | | |
|--------------------------------|---|
| _____ 1. mitochondrion | a. site where lipid components of the cell membrane are assembled |
| _____ 2. ribosome | b. captures energy from sunlight and converts it into chemical energy |
| _____ 3. endoplasmic reticulum | c. modifies, sorts, and packages proteins |
| _____ 4. Golgi apparatus | d. site where proteins are assembled |
| _____ 5. lysosome | e. converts chemical energy in food into compounds the cell can use |
| _____ 6. chloroplast | f. acts as the cell's cleanup crew |

Completion *Fill in the blanks with terms from Chapter 7.*

7. Bacteria are examples of _____.
8. Cells that are larger and more complex than prokaryotes are _____ cells.
9. The _____ is the portion of the cell outside of the nucleus.
10. The supporting structure of the cell that is also involved in movement is the _____.
11. All cells are surrounded by a flexible barrier known as the _____.
12. The movement of particles from an area of greater concentration to an area of lower concentration is called _____.
13. When comparing two solutions, the solution with the greater concentration of solutes is called _____, while the solution with the lower concentration of solutes is called _____.
14. The process of taking material into the cell by means of infoldings of the cell membrane is called _____.
15. Amoebas use the process of _____ to take in food and other materials.
16. _____ is the process by which cells in an organization develop in different ways to perform different tasks.
17. In the process of _____, a protein channel helps the diffusion of glucose across a membrane.
18. The diffusion of water through a selectively permeable membrane is called _____.
19. The process that moves materials through a membrane against a concentration difference is known as _____.