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, a fundamental concept of biology. 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 and other important molecules. 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. Active transport is when 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 that larger organisms do. 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.
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Vocabulary Review

True or False  Determine whether each statement is true or false.  If it is true, write true in the space provided. If the statement is false, change the underlined word to a term from the list below to make the statement true.

<table>
<thead>
<tr>
<th>cell</th>
<th>exocytosis</th>
<th>osmosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>cell wall</td>
<td>mitochondrion</td>
<td>prokaryote</td>
</tr>
<tr>
<td>chromosome</td>
<td>nucleus</td>
<td>ribosome</td>
</tr>
<tr>
<td>cytoplasm</td>
<td>organ</td>
<td>tissue</td>
</tr>
</tbody>
</table>

1. The basic unit of life is the cell.
2. A(An) mitochondrion is a unicellular organism that lacks a nucleus.
3. The support structure found outside the cell membrane is the tissue.
4. A(An) chromosome is the threadlike nuclear structure that contains genetic information.
5. An organelle that releases energy from food molecules is a(an) ribosome.
6. The material inside the cell membrane that surrounds the nucleus is the cytoplasm.
7. The diffusion of water through a selectively permeable membrane is osmosis.
8. Cytoplasm is a group of similar cells that work together to perform a specific function.
9. Proteins are made on a(an) ribosome.
10. A group of tissues that work together to perform a similar function is called a(an) cell.
11. The cell wall is the structure in eukaryotic cells that controls cell activities and contains genetic material.
12. Endocytosis is the process by which a vacuole fuses with the cell membrane and releases its contents out of the cell.
Concept Map

Using information from the chapter, complete the concept map below. If there is not enough room in the concept map to write your answers, write them on a separate sheet of paper.

Cells

include

1.

Animal cells

include

2.

3.

Nucleus

4.

5.

function in

functions in

stores

function in

function in

function in

Photosynthesis

Support and protection

6.

Releasing usable energy for the cell

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

12. mitochondrion  a. site where lipid components of cell membrane are assembled
13. ribosome  b. captures energy from sunlight and converts it into chemical energy
14. endoplasmic reticulum  c. modifies, sorts, and packages proteins
15. Golgi apparatus  d. site where proteins are assembled
16. lysosome  e. converts chemical energy in food into compounds the cell can use
17. chloroplast  f. acts as the cell’s cleanup crew

Completion  Fill in the blanks with terms from Chapter 7.

18. In the process of _____________, a protein channel helps the diffusion of glucose across a membrane.

19. The diffusion of water through a selectively permeable membrane is called _____________.

20. The process that moves materials through a membrane against a concentration difference is known as ___________.

Vocabulary Review

Labeling Diagrams  Use the words listed below to label the parts of these cells. Some words will be used twice. On the line below each cell, identify the cell as either a prokaryote or a eukaryote.

- cell membrane
- cell wall
- cytoplasm
- nucleus
- nuclear envelope
- nucleolus
- chromosome

1. ____________
2. ____________
3. ____________
4. ____________
5. ____________
6. ____________
7. ____________
8. ____________
9. ____________
10. ____________
11. ____________

Name______________________________  Class __________________  Date ______________

Chapter 7  Cell Structure and Function

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Matching  On the lines provided, match the term with its definition.

1. cell  a. organism whose cells contain a nucleus
2. cell membrane  b. granular material visible within the nucleus
3. cell wall  c. the basic unit of life
4. nucleus  d. specialized structures within a cell that perform important cell functions
5. cytoplasm  e. organism whose cells do not contain a nucleus
6. prokaryote  f. strong layer around the cell membrane that protects the cell
7. eukaryote  g. process by which extensions of cytoplasm engulf large particles
8. organelle  h. large structure that contains the cell’s genetic information
9. chromatin  i. thin, double-layered sheet around the cell
10. phagocytosis  j. portion of the cell outside the nucleus

Multiple Choice  On the lines provided, write the letter that best completes the sentence or answers the question.

11. The small dense region in the nucleus where the assembly of ribosomes begins is called the
   a. nucleolus.   b. nuclear envelope.
   c. chloroplast.   d. vacuole.

12. The hollow tubes of protein that help maintain the shape of the cell are called
   a. microfilaments.   b. mitochondrion.
   c. microtubules.   d. ribosomes.

13. Which organelles can use energy from sunlight to create energy-rich food molecules?
   a. lysosomes   b. Golgi apparati
   c. vacuoles   d. chloropasts

14. What is the process by which material is taken into the cell by infoldings of the cell membrane?
   a. diffusion   b. endocytosis
   c. osmosis   d. exocytosis

15. The fourth, and highest, level of organization in a multicellular organism is
   a. cell specialization.   b. a tissue.
   c. an organ system.   d. an organ.
Labeling Diagrams  On the lines provided, label the structures found in an animal cell that correspond with the numbers in the diagram.

16. _____________________________
17. _____________________________
18. _____________________________
19. _____________________________

Completion  On the lines provided, complete the following sentences.

20. The distinct, threadlike structures that contain the genetic information of the cell are called ____________________.
21. Particles tend to move from an area of high concentration to an area of low concentration in a process known as ____________________.
22. When some substances can pass across them but others cannot, biological membranes are said to have ____________________.
23. The process in which water diffuses through a selectively permeable membrane is called ____________________.
24. The process by which a protein channel allows molecules to cross the cell membrane is called ____________________.
25. The process that requires an input of energy to help material move from an area of lower concentration to an area of greater concentration is called ____________________.