

CHAPTER 6

A Tour of the Cell

Summary of Key Concepts

Concept 6.1 All organisms are made of cells. (pp. 110–114)

Most cells are so small that they could not be seen until scientists developed the light microscope in the 1600s. In 1665, Robert Hooke observed tiny compartments in cork with a light microscope. He named the compartments “cells.” By 1700, Anton van Leeuwenhoek observed living organisms in pond water with his light microscope. These and other observations led scientists to develop the *cell theory*—all living things are made up of cells, and cells are the basic unit of structure and function in living things. All cells come from other cells.

Electron microscopes are more powerful than light microscopes. By studying *micrographs*, photographs of the view through a microscope, scientists have learned about cell structure and function. Each cell part with a specific job is called an *organelle*. Both animal and plant cells have a thin outer covering called the *plasma membrane*. The plasma membrane defines the cell border and regulates chemicals going into and out of the cell. Each cell also has a *nucleus*, which contains DNA. The area of the cell between the nucleus and the plasma membrane is called the *cytoplasm*. The cytoplasm contains various organelles, many of which are enclosed in their own membranes. Unlike animal cells, many plant cells have chloroplasts, organelles in which photosynthesis occurs. Plant cells also have a strong outer *cell wall* that protects the plant cell and maintains its shape.

There are two basic kinds of cells. *Prokaryotic cells*, such as bacteria, do not have a nucleus and lack most other organelles. *Eukaryotic cells*, such as plant and animal cells, have a nucleus enclosed by a membrane, as well as other organelles with membranes.

1. What are the three main ideas of the cell theory? _____

2. What two cell structures are found in many plant cells but not in animal cells? _____

3. Contrast prokaryotic cells and eukaryotic cells. _____

Concept 6.2 Membranes organize a cell’s activities. (pp. 115–117)

The membranes of a cell are made up mostly of proteins and phospholipids. A phospholipid molecule has a tail of two fatty acids that are hydrophobic (not attracted to water). The head of the phospholipid molecule is a phosphate group (PO_4^{3-}) that is hydrophilic (attracted to water). At a boundary between two watery environments, the phospholipids form a two-layer sandwich of

molecules, called a *phospholipid bilayer*, that surrounds the organelle or cell. The phosphate ends of the phospholipid bilayer face the watery inside and watery outside of the cell. The fatty acid tails are tucked inside. Small nonpolar molecules such as oxygen cross the membrane easily, while polar molecules such as sugars do not. The plasma membrane contains various proteins that drift about in the phospholipid bilayer. The proteins in the plasma membrane perform most of the membrane's functions. Enzymes carry out chemical reactions. Some membrane proteins help cells communicate and recognize each other. Transport proteins help move certain substances across the membrane.

4. Describe the structure of the phospholipid bilayer that surrounds a cell.

5. What is the function of transport proteins in the plasma membrane?

Concept 6.3 Membranes regulate the traffic of molecules. (pp. 118–123)

Molecules in a fluid are constantly in motion, colliding and bouncing as they spread out into the available space. *Diffusion* is the movement of the molecules of a substance from where they are more concentrated to where they are less concentrated. At *equilibrium*, the concentration of the molecules of the substance is the same throughout, and the system is in balance. Cellular membranes are *selectively permeable membranes*, meaning that they let some substances pass through but completely block other substances. In *facilitated diffusion*, transport proteins make a path for certain molecules, such as water and sugars, to pass through the membrane. Both diffusion and facilitated diffusion are forms of *passive transport* because the cell does not use any energy to move the substances.

Another form of passive transport, *osmosis*, is the diffusion of water across a selectively permeable membrane. A *hypertonic* solution has a higher concentration of solute, such as sugar, and a lower concentration of water than another solution. A *hypotonic* solution has a lower concentration of solute (sugar) and a higher concentration of water. As a result of osmosis, water will move from the hypotonic solution on one side of a membrane to the hypertonic solution on the other side until the concentrations of water and solute are the same on both sides of the membrane. The solutions are then *isotonic*, meaning that they have the same concentration of solute.

Using energy to move molecules across a membrane is called *active transport*. A specific transport protein pumps a solute across the membrane, usually in the opposite direction of the way it travels in diffusion. This action requires energy.

Large particles move through the plasma membrane differently than water and small solute particles. Large particles are packaged in *vesicles*, which are small membrane sacs specialized in moving products into, out of, and within a cell. In *exocytosis*, a vesicle fuses with the plasma membrane and spills its contents outside the cell. In the reverse process, *endocytosis*, vesicles bud inward from the plasma membrane and carry materials into the cell.

Name _____ Class _____ Date _____

6. Describe three forms of passive transport. _____

7. Explain how hypertonic, hypotonic, and isotonic solutions differ. _____

8. How does passive transport differ from active transport? _____

9. How do large molecules move across the plasma membrane? _____

Concept 6.4 The cell builds a diversity of products. (pp. 124–127)

A pair of membranes called the *nuclear envelope* surrounds the cell nucleus. Substances made in the nucleus move out through tiny holes in the nuclear envelope. The nucleus contains DNA, which directs the cell's activities. The nucleus also contains a ball-like mass called the *nucleolus*. The nucleolus contains the parts that make up organelles called ribosomes. *Ribosomes* are clusters of proteins and nucleic acids that build new proteins. Ribosomes in the cytoplasm make proteins that remain in the cytoplasm. Ribosomes attached to the endoplasmic reticulum make proteins that move out of the cell. The *endoplasmic reticulum (ER)* is a continuous network of membranes throughout the cell. There are two distinct regions: rough ER and smooth ER. Rough ER has ribosomes attached to it. Smooth ER does not have ribosomes. Enzymes built into the smooth ER perform many different functions, such as building lipid molecules and producing hormones.

Some products made in the ER travel in vesicles to the *Golgi apparatus*, an organelle that modifies, stores, and sends proteins and other chemicals to their next destinations. The finished products move by vesicles to specific targets within the cell or leave the cell by exocytosis.

The cytoplasm contains large, membrane-bound sacs called *vacuoles*, which are storage places for undigested nutrients, colorful pigments, or self-defense poisons. The cytoplasm also contains *lysosomes*, membrane-bound sacs that contain digestive enzymes that break down large molecules. Lysosomes destroy harmful bacteria and break down damaged organelles.

10. What is the function of the nucleus? _____

11. Relate the functions of the ribosomes, endoplasmic reticulum, and Golgi apparatus. _____

12. Contrast vacuoles and lysosomes. _____

Concept 6.5 Chloroplasts and mitochondria energize cells. (pp. 128–129)

Photosynthesis is the process in which light energy from the sun is changed to the chemical energy stored in sugars. *Chloroplasts* are the organelles found in some plant cells where photosynthesis takes place.

Cells access stored energy through the process of cellular respiration. *Mitochondria* are the organelles where cellular respiration takes place. Cellular respiration releases energy from sugars and other organic molecules and stores it in a molecule called ATP. *ATP (adenosine triphosphate)* is the main energy source for cells. Mitochondria are found in almost all eukaryotic cells. The many folds of the mitochondrion’s inner membrane are the sites of ATP production.

13. Compare the functions of chloroplasts and mitochondria. _____

14. What is ATP? _____

Concept 6.6 An internal skeleton supports the cell and enables movement. (pp. 130–131)

The cytoskeleton is a network of fibers that supports organelles and maintains the shape of a cell. Different kinds of fibers make up the cytoskeleton. *Microtubules* are straight, hollow tubes of protein that make a cell rigid and give it shape and organization. Microtubules provide “tracks” along which other organelles can move. *Microfilaments* are thinner, solid rods of protein that enable a cell to move or change shape.

Many cells move as a result of the action of structures that project from the cell. *Flagella* are long, thin, whip-like structures with a core of microtubules. A flagellum usually waves with an “S”-shaped motion that moves a cell. *Cilia* are generally shorter and more numerous than flagella. Cilia also have a core of microtubules, but move with a back-and-forth motion. Cilia or flagella can also extend from nonmoving cells, such as those lining the windpipe. Here, their motion moves fluid over the surface of tissues.

The coordinated actions of the structures and organelles of a cell enable it to perform a specific function, such as moving toward and destroying bacteria.

15. Describe the kinds of fibers that make up the cytoskeleton. _____

16. How are flagella similar to cilia in structure and function? _____

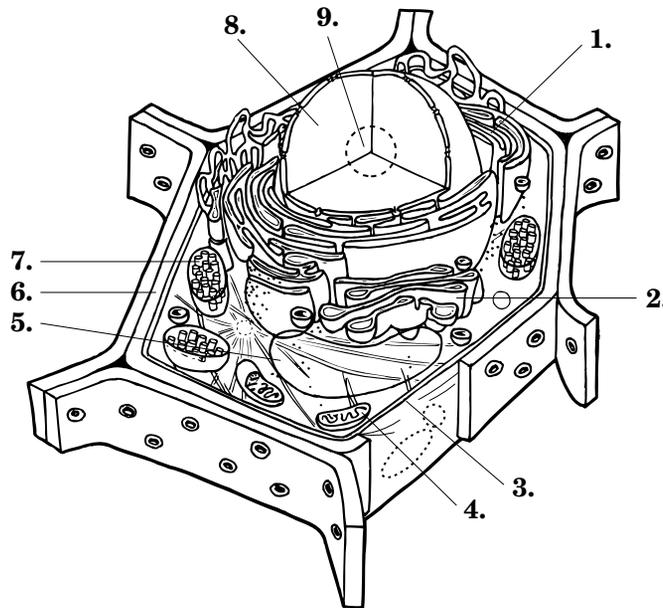
Reading Skills Practice

Creating a table Construct a table that organizes the structures and functions of the parts of a cell. Use column headings such as *Cell Part*, *Structure*, *Function*, and *Found in Plant and/or Animal Cells*. Give your table a title.

Vocabulary Review and Reinforcement

In 1–13, study the diagram. Then fill in the blanks with the appropriate terms from the chapter.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____



10. The cell in the diagram above is a(n) _____ cell because it has chloroplasts and a cell wall.
11. The region of the cell between the nucleus and the plasma membrane is called the _____.
12. Each part of a cell with a specific job to do is called a(n) _____.
13. This cell is a(n) _____ cell because it has a nucleus surrounded by its own membrane and other internal cell parts bounded by membranes.

In 14–20, write true if the statement is true. If the statement is false, replace the underlined term with a term that makes the statement true.

- _____ 14. The nucleolus is a pair of membranes that surround the nucleus.
- _____ 15. In the process of exocytosis, materials are taken into a cell.
- _____ 16. A selectively permeable membrane allows some substances to cross more easily than others.
- _____ 17. A vacuole is a small membrane-enclosed sac that specializes in moving products into, out of, and within a cell.
- _____ 18. A photograph of the view through a microscope is a micrograph.
- _____ 19. Equilibrium is the state in which a system is in balance.
- _____ 20. The plasma membrane is a network of fibers that supports organelles and maintains the shape of a cell.

WordWise

Answer the questions by writing the Key Terms in the blanks. Then put the numbered letters in order to find the hidden Key Term. Write a definition for the hidden Key Term.

1. What kind of cell lacks a nucleus and most organelles?

1

2. What membrane-bound sac in the cytoplasm contains digestive enzymes that can break down large molecules?

2

3. What cytoskeleton fiber is a straight, hollow tube of protein?

3

4. What term describes a solution that has a lower solute concentration and a higher water concentration than another solution?

4

5. What motion is the net movement of particles of a substance from areas of high concentration to areas of low concentration?

5

6. What are short, thin, numerous projections from a cell that wave in a back-and-forth motion?

6

7. What kind of transport across a membrane does not require energy?

7

Key Term: _____
1 2 3 4 5 6 7

Definition: _____
