Lesson 7.3 • Workbook A • Copyright © by Pearson Education, Inc., or its affiliates. All Rights Reserved.

7.3 Cell Transport

Lesson Objectives

- Describe passive transport.
- Describe active transport.

Lesson Summary

Passive Transport The movement of materials across the cell membrane without using cellular energy is called passive transport.

- **Diffusion** is the process by which particles move from an area of high concentration to an area of lower concentration.
- **Facilitated diffusion** is the process by which molecules that cannot directly diffuse across the membrane pass through special protein channels.
- **Osmosis** is the facilitated diffusion of water through a selectively permeable membrane.
  - *Aquaporins* are water channel proteins that allow water to pass through cell membranes.
  - Two adjacent solutions are **isotonic** if they have the same concentrations of solute.
  - **Hypertonic** solutions have a higher concentration of solute compared to another solution.
  - **Hypotonic** solutions have a lower concentration of solute compared to another solution.
- **Osmotic pressure** is the force caused by the net movement of water by osmosis.

Active Transport The movement of materials against a concentration difference is called active transport. Active transport requires energy.

- Transport proteins that act like pumps use energy to move small molecules and ions across cell membranes.
- The bulk transport of large molecules and clumps of materials into and out of cells occurs by movements of the cell membrane, which require energy.

Passive Transport

For Questions 1–4, write the letter of the correct answer on the line at the left.

1. Which of the following must be true for diffusion to occur?
   - A. Molecules or particles must have different sizes.
   - B. Special protein channels must always be available.
   - C. There must be areas of different concentrations.
   - D. Energy must be available.

   **C**
2. Which term refers to the condition that exists when no net change in concentration results from diffusion?
   A. concentration  
   B. equilibrium  
   C. osmosis  
   D. randomness

3. Air has a higher concentration of oxygen molecules than does the cytoplasm of your lung cells. Where in your lungs will there be a net increase of oxygen?
   A. in the air breathed in  
   B. in the air breathed out  
   C. outside of the lung cells  
   D. inside of the lung cells

4. Which of the following statements tells how facilitated diffusion differs from simple diffusion?
   A. Particles move through cell membranes without the use of energy by cells.  
   B. Particles tend to move from high concentration to lower concentration.  
   C. Particles move within channel proteins that pass through cell membranes.  
   D. Particles tend to move more slowly than they would be expected to move.

For Questions 5–7, match the situation with the result. Write the letter of the correct answer on the line at the left.

<table>
<thead>
<tr>
<th>Situation</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>5. Cells are in an isotonic solution. A. The cells lose water.</td>
</tr>
<tr>
<td>A</td>
<td>6. Cells are in a hypertonic solution. B. The cells gain water.</td>
</tr>
<tr>
<td>B</td>
<td>7. Cells are in a hypotonic solution. C. The cells stay the same.</td>
</tr>
</tbody>
</table>

8. THINK VISUALLY In the table below, draw how each type of cell will look after being placed in a hypertonic solution.

<table>
<thead>
<tr>
<th>Animal Cells</th>
<th>Plant Cells</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students should draw a shrunken red blood cell similar to the one shown in the textbook.</td>
<td>Students should draw a plant cell with shrunken cytoplasm and central vacuole similar to the one shown in the textbook.</td>
</tr>
</tbody>
</table>
Active Transport

9. What is the function of active transport in moving small molecules and ions across cell membranes? Give an example.

Active transport enables cells to move some materials against a concentration gradient. For example, cells can concentrate substances such as sodium and potassium ions in particular locations. This would not happen by diffusion.

10. How does ATP enable transport proteins to move ions across a cell membrane?

Energy from ATP causes a transport protein to change shape, binding substances on one side of the membrane, and releasing them on the other.

11. What are the proteins used in active transport called?

Protein pumps

12. Complete the table to summarize the types of bulk transport.

<table>
<thead>
<tr>
<th>Types of Bulk Transport</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type</strong></td>
</tr>
<tr>
<td>Endocytosis</td>
</tr>
<tr>
<td>Phagocytosis</td>
</tr>
<tr>
<td>Exocytosis</td>
</tr>
</tbody>
</table>

Apply the Big Idea

13. Most sports drinks are isotonic in relation to human body fluids. Explain why athletes should drink solutions that are isotonic to body fluids when they exercise rather than ones that are hypotonic to body fluids (contain a greater proportion of water in comparison to the fluids in and around human body cells).

Sample answer: Athletes lose water and nutrients when they perspire. An isotonic solution restores both the water and the nutrients at levels healthy for the human body. Water alone or a hypotonic solution does not restore the nutrients. In addition, drinking a hypotonic solution might cause excessive water to enter the bloodstream.
7.4 Homeostasis and Cells

Lesson Objectives

- Explain how unicellular organisms maintain homeostasis.
- Explain how multicellular organisms maintain homeostasis.

Lesson Summary

The Cell as an Organism  Sometimes a single cell is an organism. Single-celled organisms must be able to carry out all the functions necessary for life.

- Unicellular organisms maintain **homeostasis**, relatively constant internal conditions, by growing, responding to the environment, transforming energy, and reproducing.
- Unicellular organisms include both prokaryotes and eukaryotes.
- Unicellular organisms play many important roles in their environments.

Multicellular Life  Cells of multicellular organisms are interdependent and specialized.

- The cells of multicellular organisms become specialized for particular tasks and communicate with one another to maintain homeostasis.
- Specialized cells in multicellular organisms are organized into groups.
  - A **tissue** is a group of similar cells that performs a particular function.
  - An **organ** is a group of tissues working together to perform an essential task.
  - An **organ system** is a group of organs that work together to perform a specific function.
- The cells of multicellular organisms communicate with one another by means of chemical signals that are passed from one cell to another.
  - Certain cells form connections, or cellular junctions, to neighboring cells. Some of these junctions hold cells together firmly.
  - Other cells allow small molecules carrying chemical signals to pass directly from one cell to the next.
  - To respond to a chemical signal, a cell must have a **receptor** to which the signaling molecule can bind.

The Cell as an Organism

For Questions 1–5, complete each statement by writing the correct word or words.

1. The term **homeostasis** refers to the relatively constant internal physical and chemical state of a living cell.

2. Unicellular prokaryotes, called **bacteria**, are adapted to living in a remarkable number of different places.

3. Some unicellular eukaryotes, called **algae**, contain chloroplasts.

4. Yeasts are unicellular **fungi**, which are eukaryotes.

5. Other unicellular eukaryotes include **protozoans** and algae.
6. How do single-celled organisms maintain homeostasis?

They maintain homeostasis by growing, responding to their environment, transforming energy, and reproducing.

7. Why is maintaining homeostasis particularly important to single-celled organisms?

Because they consist of only one cell, loss of homeostasis by a single-celled organism would mean the immediate death of the organism. They do not have any other cells that can perform the activities of life for them.

Multicellular Life

8. How are the cells of a multicellular organism like a baseball team?

A multicellular organism has many different types of cells with different shapes that specialize in one of the functions that keep the organism alive. A baseball team has different players who each specialize in one of the jobs that must be done so the team can function.

9. How does a multicellular organism maintain homeostasis?

A multicellular organism maintains homeostasis by having specialized cells that must maintain their own homeostasis and cooperate with other cells. This requires the cells to communicate with one another. Each cell in a multicellular organism contributes to the overall homeostasis of the organism.

10. Complete the table by describing the functions of the specialized cells.

<table>
<thead>
<tr>
<th>Examples of Specialized Cells</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type of Cell</strong></td>
</tr>
<tr>
<td>cells that line the upper air passages in humans</td>
</tr>
<tr>
<td>pine pollen grains</td>
</tr>
</tbody>
</table>
11. The Venn diagram below consists of four concentric circles. Complete the diagram to show the relationships among four levels of organization of life. Use the terms *cells*, *organ*, *organ system*, and *tissue*.

![Venn Diagram](image)

12. Starting with the outermost circle of the diagram, explain how each level is related to the next level within each circle.

*Organ systems are made of one or more organs. Organs are made up of one or more tissues. Tissues are made up of many cells with similar shapes and functions.*

13. What is the name of the areas that hold adjacent cells together and enable them to communicate?

*Cellular junctions*

14. On the Venn diagram above, where would you add a circle that represents the organism level of life? Where would you add a circle that represents another organ of the same organ system?

*A circle that represents the organism level of life should be drawn outside of the outermost circle for an organ system. A circle that represents another organ of the same organ system would be drawn within the organ system circle but would be separate from the series of circles that represent the organs already shown in the Venn diagram.*
Chapter Vocabulary Review

For Questions 1–4, write True if the statement is true. If the statement is false, change the underlined word or words to make the statement true.

1. All cells are surrounded by a cell wall. **True**
2. The flexible nature of a cell membrane results from its channel proteins. **True**
3. Selectively permeable membranes allow only certain materials to pass through them. **True**
4. Centrioles are found in animal cells.

For Questions 5–11, match the organelle with its description.

<table>
<thead>
<tr>
<th>Organelle</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>F 5. Ribosomes</td>
<td>A. Convert energy from sunlight into chemical energy that is stored in food</td>
</tr>
<tr>
<td>D 6. Endoplasmic reticulum</td>
<td>B. Stack of membranes that modifies, sorts, and packages proteins and other materials for storage or release</td>
</tr>
<tr>
<td>B 7. Golgi apparatus</td>
<td>C. Convert chemical energy stored in food into a form that can be easily used by the cell</td>
</tr>
<tr>
<td>G 8. Lysosomes</td>
<td>D. An internal membrane system where lipid components of cell membranes are made</td>
</tr>
<tr>
<td>E 9. Vacuoles</td>
<td>E. Saclike structures that store materials</td>
</tr>
<tr>
<td>A 10. Chloroplasts</td>
<td>F. Small particles of RNA and protein on which proteins are assembled using instructions from DNA</td>
</tr>
<tr>
<td>C 11. Mitochondria</td>
<td>G. Filled with enzymes used to break down carbohydrates into smaller molecules</td>
</tr>
</tbody>
</table>

For Questions 12–15, complete each statement by writing the correct word or words.

12. Osmosis occurs through water channel proteins called **aquaporins**.
13. The force created by the net movement of water through a cell membrane is called **osmotic** pressure.
14. Red blood cells are able to maintain homeostasis because they are bathed in blood, which is **isotonic** to the fluid in the cells themselves.
15. To respond to a chemical signal, a cell must have a **receptor** to which the signaling molecule can bind.
Preparation for, Completing, and Recovering From a Race

Marathon running poses some challenges to cellular homeostasis. Dehydration can occur due to sweating. Exercising muscles demand more oxygen and produce excess heat. But if participants take precautions, marathon running is generally a safe activity. The plan below explains some of the things that runners should do.

**Six Weeks Before the Race**
Do not try any new training techniques. Limit your strength training to exercises with minimal external resistance (that means no weights).

**Three Weeks Before the Race**
Reduce the length of long training runs by 25%.

**Two Weeks Before the Race**
Reduce the length of long training runs by another 25%.

**The Week Before the Race**
Stop all long training runs—just do light ones. Stop strength training. Do not try any unfamiliar foods, and that means ordinary meals as well as training foods. If you plan to use any new electrolyte drinks, nutrition bars, gel supplements, etc. during the race, start consuming them now. Get extra sleep every night.

**The Day Before the Race**
Stay off your feet. Take it easy. Eat lots of complex carbohydrates. Do not eat much fiber. Drink a lot of water. Do not drink any caffeine. Do not eat anything late at night.

**The Day of the Race**
Get up early. Eat a light breakfast. Drink a large glass of water two hours before the race. Do not drink again until after the race starts.

**During the Race**
Start slowly—you can pick up speed later in the race. Drink at every water station. Drink electrolyte drinks as well as water.

**Within Two Hours of the End of the Race**
Drink water or electrolyte drinks. Walk for 60 of the 120 minutes (not necessarily all at once, though). Eat something with carbohydrates and a little protein. Do not eat anything high in fat or sugar.

**After That**
Put ice on any sore muscles. Get lots of sleep. Do not run for the next week. Do not do any strength training for two weeks.

In the Chapter Mystery, you learned how the body’s salt balance can be disrupted during periods of exertion, in this case a marathon. Running a marathon can disrupt other aspects of the body’s homeostasis.
21st Century Themes

Science and Health Literacy

1. When should a runner stop doing long training runs?
   *One week before the race*

2. What should an athlete do after a marathon?
   *Put ice on sore muscles, get lots of sleep; avoid running and strength training*

3. What should a runner do six weeks before a race? Why do you think that is advisable?
   *Avoid new training techniques and high-resistance techniques like weight training;*  
   *Sample answer: to prevent injuries*

4. Should a runner eat nothing, a light, meal, or a heavy meal before the race? Why do you think this advice is given?
   *A light meal. Sample answer: You need to eat something in order to have the energy to start the race, but eating too much could lead to an upset stomach while running.*

5. What advice does the article give about eating the week before the race? Why might that advice be appropriate?
   *Do not eat any unfamiliar foods, but eat or drink any new supplements you plan to use during the race. Sample answer: Unfamiliar foods might cause stomach problems or allergies, so they should be avoided. The same is true for unfamiliar supplements, so try them in advance to make sure they won't cause any problems during the race.*

21st Century Skills

Race for a Cause

The skills used in this activity include problem identification, formulation, and solution; interpersonal and collaborative skills; accountability and adaptability; and social responsibility.

Use library and Internet resources to research different ideas about what an athlete should do the week prior to a race, the day of the race, and the day after. Combine the tips you find with the ones presented here, and then write them up in the form of a calendar or schedule for prospective athletes.

Working with a group, choose a charity or non-profit organization in your community. Plan, organize, and stage a race to benefit that organization.

Have a sports physician and a gym teacher review your training calendar. Make any changes they suggest, and then mail a copy to each entrant.

Things you will need to do include determining the length of the race, planning the course, getting permits for the race, and finding sponsors. You will need to publicize the event twice—first to attract entrants, and later to attract spectators.

*You will also need to check that entrants do not have any physical conditions that rule out their participation.*

Evaluate students’ schedules based on how each activity on the schedule will benefit a runner’s health as he or she prepares for a long-distance race.