chapter 7 Cellular Structure and Function

section 4 Cellular Transport

MAIN Idea

Cellular transport moves substances in and out of a cell.

What You'll Learn

- the processes of diffusion, facilitated diffusion, and active transport
- effect of hypotonic, hypertonic, or isotonic solutions on a cell
- how large particles enter and exit a cell

Before You Read

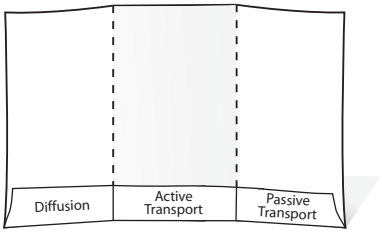
Describe on the lines below how you would move a large box that weighs more than you do. Then read the section to learn how large particles move in and out of cells.

Mark the Text

Create a Quiz As you read this section, write quiz questions based on what you have learned. After you write the questions, answer them.

FOLDABLES™

Record Information Make a three-pocket Foldable from an 11 × 17 sheet of paper. As you read, record information about cellular transport on quarter sheets of notebook paper and store them in the appropriate pocket.



Read to Learn

Diffusion

Substances dissolved in water move constantly and randomly. Imagine you place a drop of red ink on the left side and a drop of blue ink on the right side of a dish of water. The ink moves randomly through the water and turns the water purple as the colors mix. The ink has diffused in the water. **Diffusion** is the net movement of particles from an area where there are more particles of the substance to an area where there are fewer particles. Diffusion does not require additional energy because the particles are already in motion.

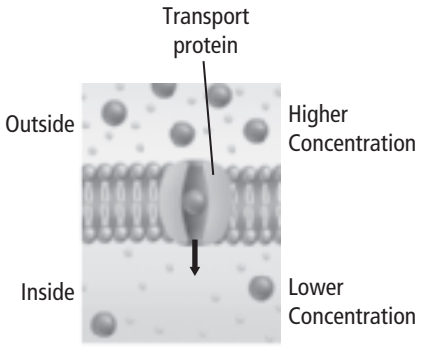
Concentration is the amount of a substance in an area. Diffusion continues until the concentrations are the same in all areas of the water. The dish of water has reached **dynamic equilibrium,** in which the particles continue to move randomly, but the overall concentration does not change.

What affects the rate of diffusion?

Concentration, temperature, and pressure affect the rate of diffusion. Diffusion occurs more quickly when the concentration, temperature, or pressure are high because the particles collide more often. The size and charge of a substance also affects the rate of diffusion.

What is facilitated diffusion?

Water can diffuse across the plasma membrane. However, other ions and molecules that cells need to function cannot diffuse across the plasma membrane. Molecules such as sugars and chlorine need help to move from outside the cell's environment to inside the cell. **Facilitated diffusion** uses transport proteins to help move some ions and small molecules across the plasma membrane. One type of facilitated diffusion is shown in the figure below.



Diffusion of water and facilitated diffusion of ions and small molecules occur without additional energy because the particles are already moving. When no energy is added, the transport is referred to as passive transport.

Osmosis: Diffusion of Water

Water passes in and out of the cell through the plasma membrane. The diffusion of water across a selectively permeable membrane is called **osmosis** (ahs MOH sus). Osmosis helps the cell maintain homeostasis.

What is the result of osmosis?

Most cells undergo osmosis because they are surrounded by watery solutions. These solutions have different concentrations than the inside environment of the cell. Before osmosis, the concentration inside and outside the cell have not reached dynamic equilibrium. After osmosis, the concentrations are the same on both sides of the membrane, and dynamic equilibrium has been reached.

What happens to a cell in an isotonic solution?

A cell in an **isotonic solution** has the same concentration in its cytoplasm as its surrounding watery environment. Water continues to move through the plasma membrane, but water enters and leaves the cell at the same rate. The cell is at equilibrium with its surrounding environment.

Picture This

1. Explain Use this figure to explain facilitated diffusion to a partner.

Reading Check

2. Explain Why is the cell at equilibrium in an isotonic solution?

How do hypotonic solutions and hypertonic solutions differ?

If a cell is placed in a solution that has a lower concentration of dissolved substances, the cell is in a **hypotonic solution.** There is more water outside the cell than inside the cell. Osmosis moves water into the cell.

Reading Check

3. Analyze Why does water move into a cell placed in a hypotonic solution?

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As water moves into an animal cell, the plasma membrane swells. If the solution is too hypotonic, pressure builds inside the cell, and it might burst.

In a plant cell, the cell wall keeps it from bursting. As the central vacuole fills with water, the plasma membrane pushes against the cell wall. The plant cell becomes firmer.

In a **hypertonic solution,** the concentration of dissolved substances outside the cell is higher than inside. There is more water inside the cell. During osmosis, more water moves out of the cell than into it. Animal cells shrink in hypertonic solutions. The loss of water in plant cells causes wilting.

Active Transport

Substances might need to move from an area of lower concentration to an area of higher concentration. Transport proteins help move substances across the plasma membrane against the normal flow. This movement against the normal flow requires energy and is called **active transport.**

Transport of Large Particles

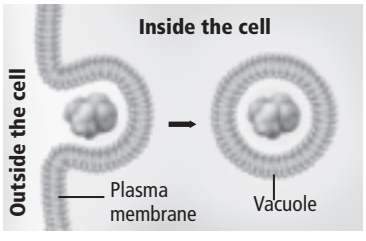
Some substances are too large to move by diffusion or active transport. **Endocytosis** is the process by which a cell surrounds a substance in the outside environment with a portion of the plasma membrane, then pinches off the membrane, bringing the substance inside the cell.

Exocytosis is the reverse process by which large substances exit the cell. Both processes, as shown in the figure below, require energy. As with other forms of transport, endocytosis and exocytosis help cells maintain homeostasis.

Picture This

4. Label the cell structure through which substances pass as they leave the cell during exocytosis.

Endocytosis



Exocytosis