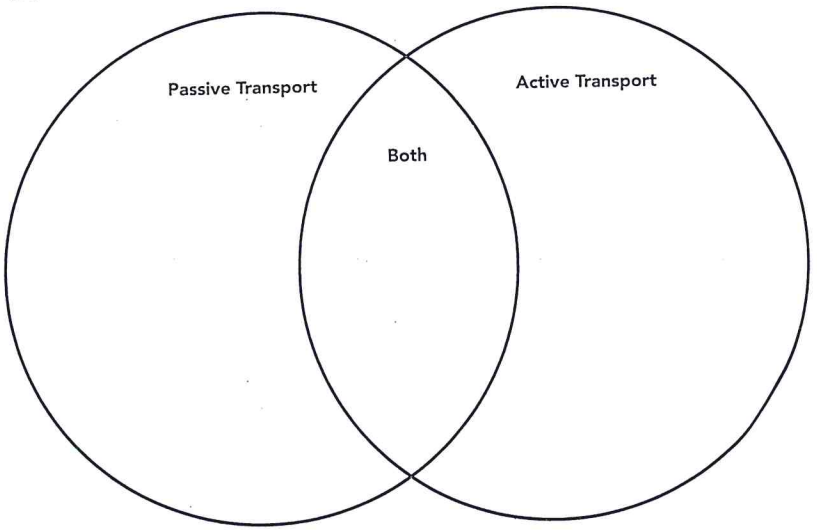
CHAPTER 8 LESSON 3

Cell Transport

READING TOOL **Compare and Contrast** As you read, compare and contrast passive and active transport. Complete the Venn Diagram by filling in the similarities where the two circles overlap, and their differences on either side. Be sure to also include the types of passive transport and active transport.

Do this!



Lesson Summary

Passive Transport

KEY QUESTION *How does passive transport work?*

Living cells must stay in homeostasis, which is a state of relatively constant internal physical and chemical conditions. One way that cells maintain homeostasis is by controlling the movement of molecules across the cell membrane.

As you read, circle the answers to each Key Question. Underline any words you do not understand.

BUILD Vocabulary

homeostasis relatively constant internal physical and chemical conditions that organisms maintain

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READING TOOL

Academic Words

passive *Passive* has multiple meanings. It can mean inactive, and it can also mean that something is unpowered, with no force behind it. ☑ ***Passive transport*** **does not mean that a particle is inactive or not moving. It means that the particle can move without requiring what?**

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BUILD Vocabulary

diffusion process by which particles tend to move from an area where they are more concentrated to an area where they are less concentrated

facilitated diffusion process of diffusion in which molecules pass across the membrane through protein channels in the cell membrane

aquaporin water channel protein in a cell membrane

osmosis diffusion of water through a selectively permeable membrane

isotonic when the concentration of two solutions is the same

hypertonic when comparing two solutions, the solution with the greater concentration of solutes

hypotonic when comparing two solutions, the solution with the lesser concentration of solutes

osmotic pressure pressure that must be applied to prevent osmotic movement across a selectively permeable membrane

Prefixes *Iso-* means "equal." You may have encountered this prefix in the term *isosceles triangle* in a math class. An isosceles triangle has two equal sides. ☑ **What quantity is equal between two solutions that are isotonic?**

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Diffusion In any solution, solute particles constantly move and collide with each other. The particles tend to move from an area where they are more concentrated to an area where they are less concentrated. This process is called diffusion (dih FYOO zhun). Diffusion is why many substances move across the cell membrane. For a substance that can cross the cell membrane, it will move to the side of the membrane where it is less concentrated. Equilibrium is reached when the concentration of the substance is the same on both sides of the membrane. Molecules will continue to move across the membrane, but the concentration will stay the same on both sides. Diffusion depends on molecular movements that do not require the cell to use energy. The movement of molecules across the cell membrane without using cellular energy is called passive transport.

Facilitated Diffusion Molecules that move across the cell membrane most easily are small and uncharged. Such molecules can dissolve in the membrane's lipid bilayer. But charged ions and many large molecules such as the sugar glucose can also cross the cell membrane. This is because proteins in the cell membrane act as carriers or channels for these molecules. In facilitated diffusion, molecules that cannot diffuse through the membrane pass through protein channels. Facilitated diffusion does not require any cellular energy. There are hundreds of different proteins that allow specific substances to cross cell membranes.

Osmosis: An Example of Facilitated Diffusion

Water molecules cannot diffuse through the cell membrane because the interior of the membrane is hydrophobic. Water enters cells by facilitated diffusion. Many cells contain proteins called aquaporins (ak wuh PAW rinz) that allow water to pass through them. Osmosis is the diffusion of water through a selectively permeable membrane, such as the cell membrane.

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How Osmosis Works Think about two solutions of sugar in water separated by a membrane that is permeable to water, but not sugar. One solution has a higher concentration of sugar, which means there is a lower concentration of water. Water moves both ways across the membrane, but more water molecules will move from the side with more water and less sugar to the side with less water and more sugar until equilibrium is reached. Equilibrium is when the water and sugar concentrations are the same in both solutions. At equilibrium, the solutions are **isotonic**, meaning "same strength." Before equilibrium was reached, the solution with more sugar was **hypertonic**, or "above strength," and the solution with less sugar was **hypotonic**, or "below strength." The terms *isotonic, hypertonic,* and *hypotonic* refer the "strength," or concentration, of the sugar solute, not the water.

Osmotic Pressure The net movement of water into or out of a cell produces a force called **osmotic pressure**. Because cells contain salts, sugars, proteins and other dissolved molecules; they are almost always hypertonic to fresh water. As a result, water tends to move into a cell, increasing the osmotic pressure inside the cell and causing it to swell. This could cause the cell to burst. Most cells in large organisms are bathed in blood or other isotonic fluids, not water, so they are not in danger of bursting.

Visual Reading Tool: Passive Transport

Diffusion is the movement of particles from an area of high concentration to an area of low concentration. Osmosis is the diffusion of water through a selectively permeable membrane. Study the beakers at the right. Note changes in water levels and solute particles.

1. For both scenarios, label each of the solutions on each side of the membrane as either hypertonic, hypotonic, or isotonic.
2. Which of the two scenarios can cause cells to burst when they are placed in a hypotonic solution?

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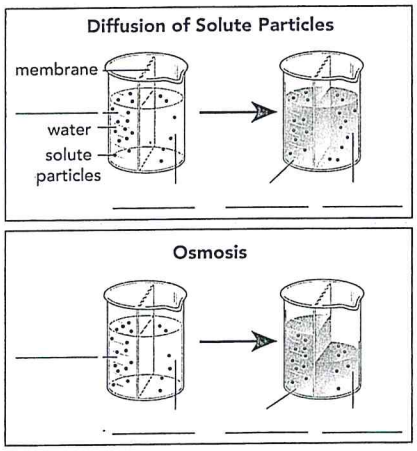

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Active Transport

As you read, circle the answers to each Key Question. Underline any words you do not understand.

READING TOOL

Cause and Effect Small molecules have the ability to move across the cell membrane by dissolving through the lipid bilayer. This is called diffusion and it happens without any energy input.

☑ **Why do some molecules need help moving across a cell membrane in the form of energy?**

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KEY QUESTION *How does active transport work?*

Sometimes cells transport materials against a concentration gradient, from an area of low concentration to an area of higher concentration. The movement of materials against a concentration difference is known as active transport, and it requires energy. The active transport of small molecules or ions across a cell membrane is usually carried out by membrane proteins called protein pumps. Larger molecules can be actively transported by processes known as endocytosis and exocytosis.

Molecular Transport Many cells use protein pumps and cellular energy to move ions such as calcium, potassium, and sodium across membranes. This allows cells to store substances in a particular location even when diffusion would tend to move these substances in the opposite direction.

Bulk Transport Large molecules and even clumps of material can be moved across the cell membrane by bulk transport.

Endocytosis Endocytosis (en doh sy TOH sis) is the process of bringing material into a cell by means of parts of the membrane folding in, or forming pockets. The resulting pocket breaks away from the cytoplasmic side of the cell membrane, forming a vesicle or vacuole in the cytoplasm. Large molecules, clumps of food, and even whole cells can be taken up in this way.

Phagocytosis (fag oh sy TOH sis) is a kind of endocytosis in which extensions of the cell surround a particle and package it within a food vacuole. White blood cells use phagocytosis to destroy damaged or foreign cells. Amoebas use this method to take in food. Phagocytosis requires a lot of cellular energy.

Many cells take up liquid from the environment in a similar process called pinocytosis (py nuh sy TOH sis). Tiny pockets form along the cell membrane, fill with liquid, and pinch off to form vacuoles.

Exocytosis Cells can also release material using the process of exocytosis (ek soh sy TOH sis). In exocytosis, the membrane of a vesicle or vacuole fuses with the cell membrane, forcing the contents of the vacuole out of the cell. Cells remove water by means of a contractile vacuole and exocytosis.

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