

# The Cell in Its Environment

How Do Materials Move Into and Out of Cells?

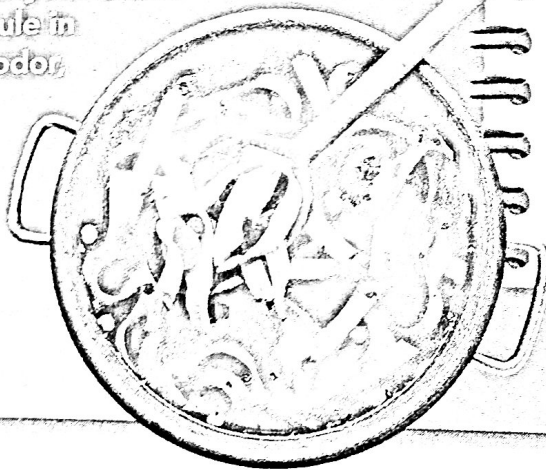


## FUN FACTS

### MY planet DiARY

#### Something Good in the Air

You're in your bedroom studying, and you smell something good. Someone is cooking lunch! How did the smell travel from the kitchen to your nose? During cooking, molecules from soup and many other foods diffuse, or spread farther and farther apart. The molecules are also carried by air currents. Your nose sniffs in the molecules and sends a message to your brain. Even if only one molecule in ten million carries the odor, your nose will send a "smell" message! Amazingly, your brain can identify about ten thousand different smells.



Communicate Discuss this question with a classmate and write your answers below. If the kitchen door is closed, how will that affect your ability to smell cooking odors in your room?

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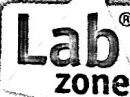


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Go to Planet Diary to learn more about cells in their environments.



Do the Inquiry Warm-Up  
*Diffusion in Action.*

## How Do Materials Move Into and Out of Cells?

Cells have structures that protect their contents from the world outside the cell. To live and function, however, cells must let certain materials enter and leave. Oxygen and water and particles of food must be able to move into a cell, while carbon dioxide and other waste materials must move out. Much as a gatekeeper controls the flow of traffic into and out of a parking lot, the cell membrane controls how materials move into or out of a cell.

### Vocabulary

- selectively permeable
- passive transport
- diffusion
- osmosis
- active transport
- endocytosis
- exocytosis

### Skills

- 🔄 Reading: Relate Cause and Effect
- △ Inquiry: Predict

**Importance of the Cell Membrane** Every cell is surrounded by a cell membrane. In **Figure 1** you can see that the cell membrane consists of a double layer of lipid molecules lined up side by side. Remember that lipids are a group of organic compounds found in living things. Here and there in the double layer of lipid molecules, you can see proteins, some with chains of carbohydrates attached. Other carbohydrate chains sit on the surface of the membrane. All these molecules play important roles in helping materials move through the cell membrane.

Some materials move freely across the cell membrane. Others move less freely or not at all. The cell membrane is **selectively permeable**, which means that some substances can cross the membrane while others cannot. 🚗 **Substances that can move into and out of a cell do so by means of one of two processes: passive transport or active transport.**

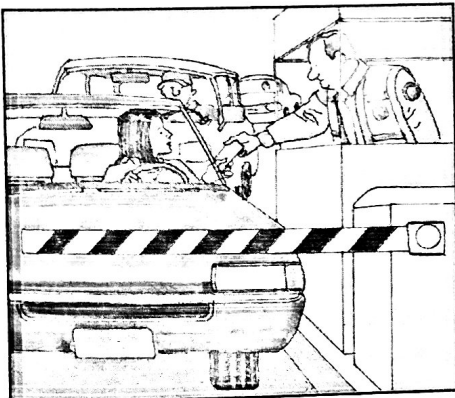


FIGURE 1 .....

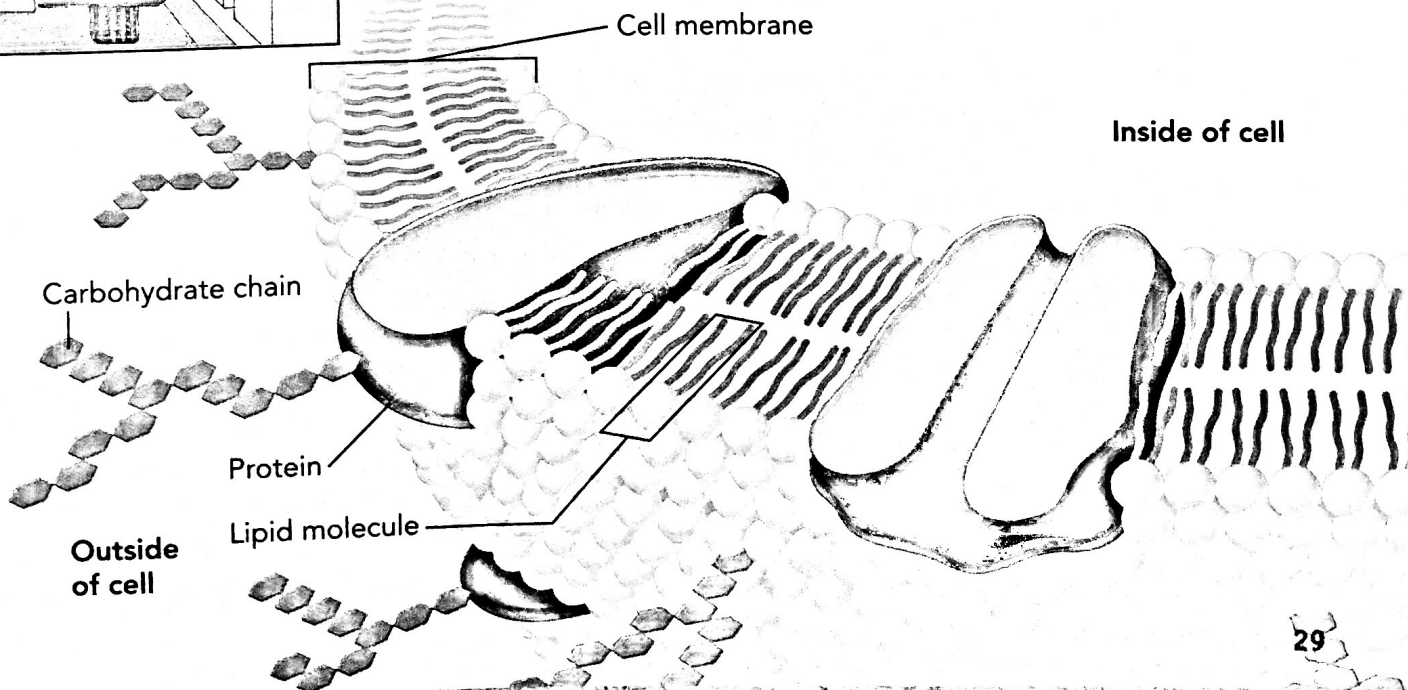
#### A Selective Barrier

✎ **Make Models** In what way is the cell membrane like a gatekeeper?

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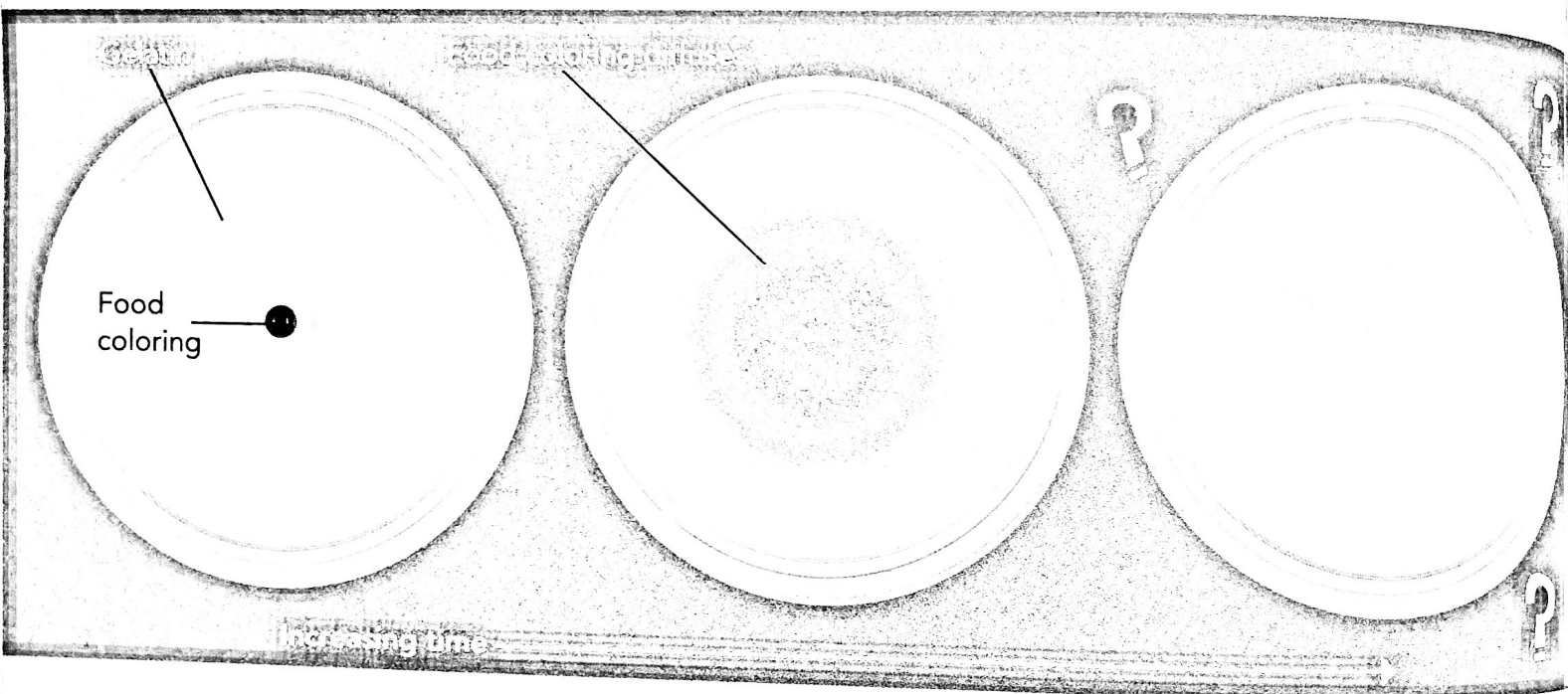



**Diffusion and Osmosis: Forms of Passive Transport** If you have ever ridden a bicycle down a hill, you know that it takes hardly any of your energy to go fast. But you do have to use energy to pedal back up the hill. Moving materials across the cell membrane sometimes requires the cell to use its own energy. At other times, the cell uses no energy. The movement of dissolved materials across a cell membrane without using the cell's energy is called passive transport.

FIGURE 2 .....

**Diffusion**

A drop of food coloring in a plate of gelatin gradually spreads as molecules of the dye diffuse.  **Predict** In the third plate, draw how you think the plate would look if diffusion continues.



 .....  
 ☞ **Relate Cause and Effect**  
 Diffusion causes molecules to move from areas of \_\_\_\_\_ concentration to areas of \_\_\_\_\_ concentration.

**Diffusion** Molecules are always moving. As they move, they bump into one another. The more molecules there are in a space, the more they are said to be concentrated in that space. So they collide more often. Collisions cause molecules to push away from one another. Over time, as molecules continue colliding and moving apart, they become less concentrated. Eventually, they spread evenly throughout the space. **Diffusion** (dih FYOO zhun) is the process by which molecules move from an area of higher concentration to an area of lower concentration. See **Figure 2**.

Consider a unicellular organism that lives in pond water. It gets oxygen from that water. Many more molecules of oxygen are dissolved in the water outside the cell than inside the cell. In other words, the concentration of oxygen is higher outside the cell. What happens? Oxygen moves easily into the cell. The diffusion of oxygen into the cell does not require the cell to use any of its energy. Diffusion is one form of passive transport.

**Osmosis** Like oxygen, water passes easily into and out of a cell across the cell membrane. **Osmosis** is the diffusion of water molecules across a selectively permeable membrane. Because cells cannot function properly without adequate water, many cellular processes depend on osmosis. Osmosis is a form of passive transport.

Osmosis can have important effects on cells and entire organisms. The plant cells in the top photo of **Figure 3** have a healthy flow of water both into and out of each cell. Under certain conditions, osmosis can cause water to move out of the cells more quickly than it moves in. When that happens, the cytoplasm shrinks and the cell membrane pulls away from the cell wall, as shown in the bottom photo. If conditions do not change, the cells can die.

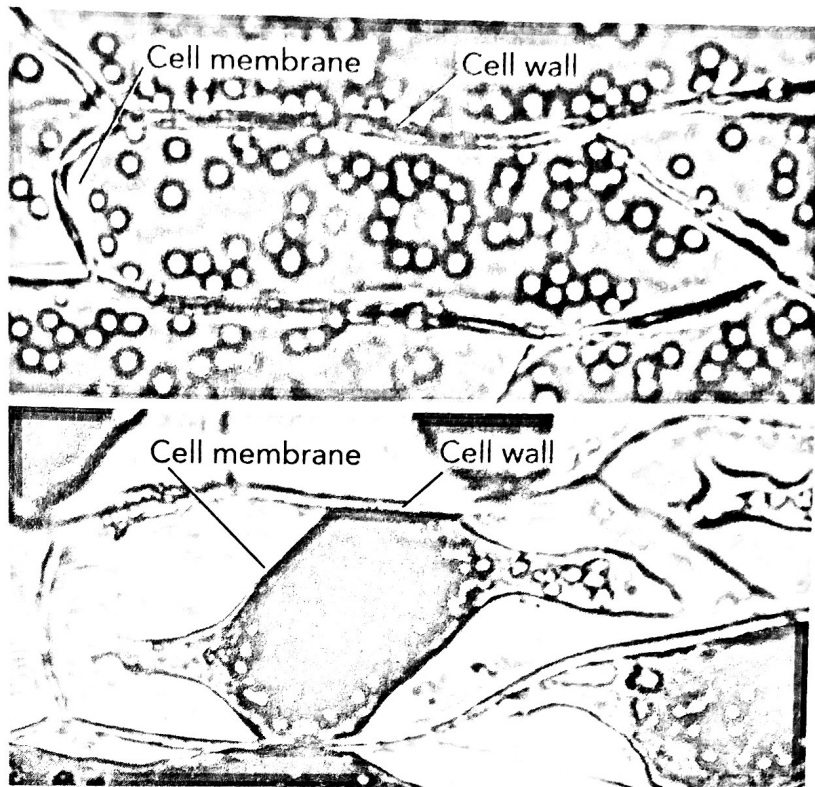



FIGURE 3 .....

**Effects of Osmosis**

Cells shrink and die when they lose too much water.

 **Infer** Using a colored pencil, shade the cells in the bottom photo to show how they would change if the flow of water was reversed.

**apply it!**

Most cells are too small to be seen without a microscope. What does cell size have to do with moving materials into and out of a cell? Suppose the diagrams at the right represent two cells. One cell is three times the width of the other cell. Think about how this difference could affect processes in the cells.

**1 Infer** Cytoplasm streams within a cell, moving materials somewhat as ocean currents move a raft. In which cell will materials move faster from the cell membrane to the center of the cell? Why?

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**2 Predict** Wastes are poisonous to a cell and must be removed from the cytoplasm. Predict how cell size could affect the removal process and the survival of a cell.

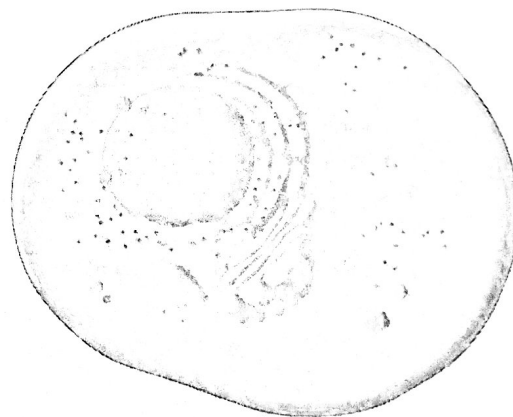
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Large cell



Small cell

**Facilitated Diffusion** Oxygen and carbon dioxide diffuse freely across a cell membrane. Other molecules, such as sugar, do not. Sugars cannot cross easily through the membrane's lipid molecules. In a process called facilitated diffusion, proteins in the cell membrane form channels through which the sugars can pass. The word *facilitate* means "to make easier." As shown in **Figure 4**, these proteins provide a pathway for the sugars to diffuse. The proteins function much the way downspouts guide water that flows from the roof of a house to the ground. Facilitated diffusion uses no cell energy and is another form of passive transport.

**Active Transport** Molecules in cells must often move in the opposite direction from the way they would naturally move due to diffusion. That is, the molecules move from a place of *lower* concentration to a place of *higher* concentration. Cells have to supply the energy to do this work—just as you would supply the energy to pedal a bike uphill. **Active transport** is the movement of materials across a cell membrane using cellular energy.

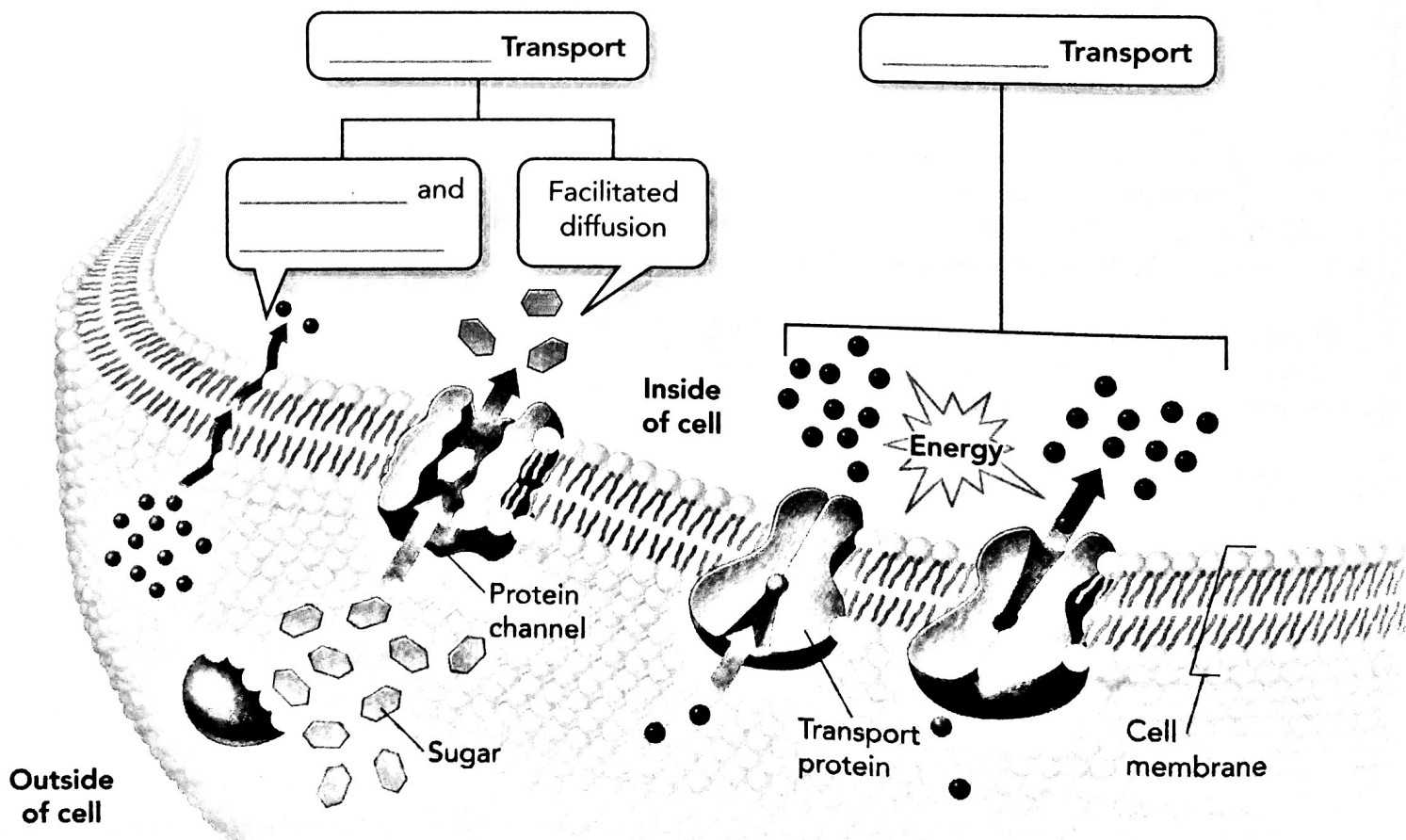
As in facilitated diffusion, proteins within the cell membrane play a key role in active transport. Using the cell's energy, transport proteins "pick up" specific molecules and carry them across the membrane. Substances that are carried into and out of cells by this process include calcium, potassium, and sodium.

FIGURE 4 .....

**ART IN MOTION** Crossing the Cell Membrane

Molecules move into and out of a cell by means of passive or active transport.

- 1. Name** Fill in the words missing in the boxes.
- 2. CHALLENGE** On the diagram, write an "H" where the concentration of each substance is high and an "L" where the concentration is low.




## Moving Large Particles

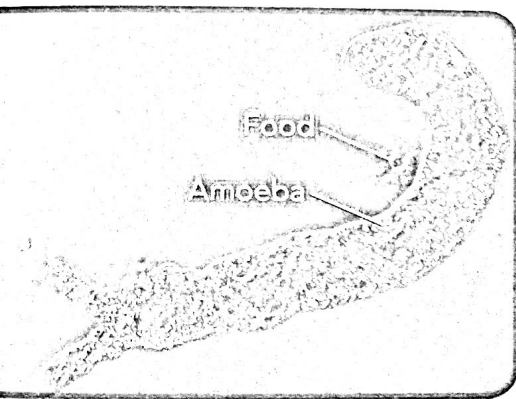
Some materials, such as food particles, are too large to cross the cell membrane. In a process called **endocytosis** (ehn doh sigh TOH sihs), the cell membrane changes shape and engulfs the particle. You can see this process happening in **Figure 5**. Once the food particle is engulfed, the cell membrane fuses, pinching off a vacuole within the cell. The reverse process, called **exocytosis** (ehk soh sigh TOH sihs), allows large particles to leave a cell. During exocytosis, a vacuole first fuses with the cell membrane. Then the cell membrane forms an opening to the outside and spills out the contents of the vacuole. Both endocytosis and exocytosis require energy from the cell.

FIGURE 5 .....

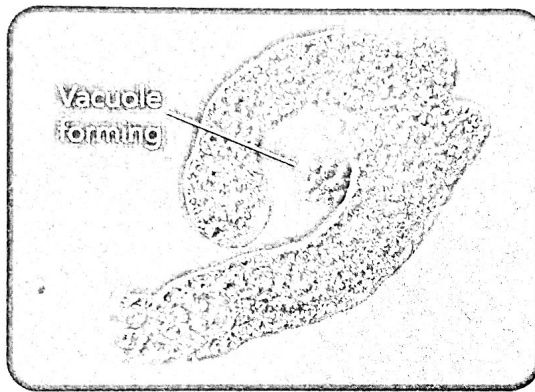
### Amoeba Engulfing Food

A single-celled amoeba slowly surrounds bits of food.

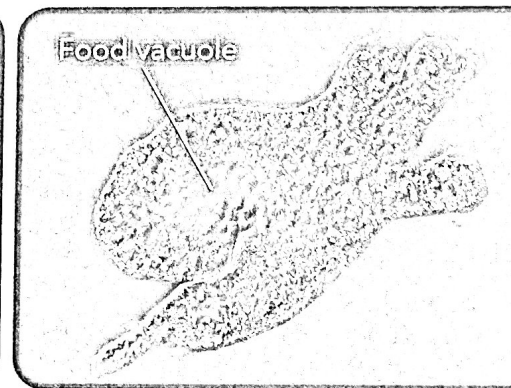
 **Observe** Look at these photographs. They show (endocytosis/exocytosis).



1 Amoeba's cytoplasm streams toward food particles.



2 Cytoplasm surrounds food particles as vacuole begins to form.



3 Cell membrane fuses, trapping food particles in new vacuole.

**Lab**<sup>®</sup>  
**zone**

Do the Quick Lab *Effect of Concentration on Diffusion*.

## Assess Your Understanding

**1a. Review** Use diffusion to tell what happens when you drop a sugar cube into water.

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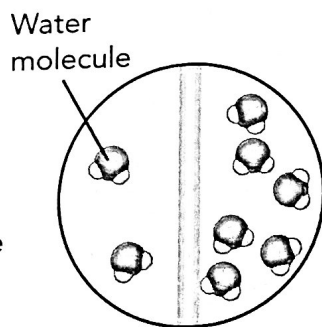


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**b. Predict** Draw an arrow to show the overall direction water will travel as a result of osmosis. (The yellow line is the cell membrane.)



**c. Identify** Active transport depends on (sugars/proteins) to move molecules across the cell membrane.

**d. Compare and Contrast** How does active transport differ from passive transport?

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**got it?** .....

I get it! Now I know that a key function of the cell membrane is to \_\_\_\_\_

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I need extra help with \_\_\_\_\_

Go to **MY SCIENCE COACH** online for help with this subject.