

Name: _____

Date: _____

Student Exploration: Osmosis

Vocabulary: cell membrane, concentration, diffusion, dynamic equilibrium, osmosis, semipermeable membrane, solute, solvent

Prior Knowledge Questions (Do these BEFORE using the Gizmo.)

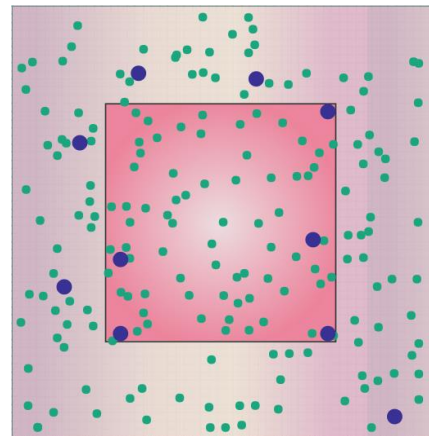
1. Suppose you were trapped on a desert island with no sources of fresh water. Should you drink water from the ocean? Explain why or why not.

2. What do you think would happen if you watered your houseplants with salt water?

Gizmo Warm-up

A **cell membrane** is a thin “skin” that surrounds a cell. It is a **semipermeable membrane**, which means that some particles pass through the membrane easily while others cannot.

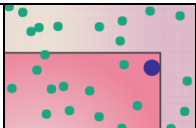
The *Osmosis* Gizmo™ portrays a cell (red square) in a solution of purple **solute** particles dissolved in green **solvent** particles. Press **Play** (▶) and observe.



1. Which particles can pass through the cell membrane?

2. Which particles cannot pass through the cell membrane? _____

3. Click **Reset** (↺), and then click **Play** again. What do you notice about the size of the cell?

Activity A: Observing osmosis	<u>Get the Gizmo ready:</u> <ul style="list-style-type: none"> • Click Reset. Set the Initial cell volume to 40%. • You will need a calculator for this activity. 	
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Question: How do solute concentrations affect the volume of a cell?

1. **Observe:** Use the **Solute outside** slider to change the concentration of solute particles outside the cell. Click **Play**. In each case, focus on whether the cell gets bigger or smaller.

A. In what situation does the cell get larger? _____

B. In what situation does the cell get smaller? _____

2. **Calculate:** The **concentration** of a solute is the amount of solute particles in a given amount of solvent. To calculate percentage concentration, divide the number of solute particles by the total number of particles (solute + solvent), and then multiply by 100:

$$\% \text{ concentration} = (\text{solute} \div \text{total particles}) \times 100$$

Select the DESCRIPTION tab. Click **Reset**. Set the **Solute outside** to 10 and check that the **Initial cell volume** is 40%. (Note: The cell volume is expressed as a percentage of the container size.)

A. How many solute particles are found inside the cell? _____ Outside? _____

B. How many solvent particles are found inside the cell? _____ Outside? _____

C. What is the total number of particles inside the cell? _____ Outside? _____

D. What is the % concentration of solute inside the cell? _____

E. What is the % concentration of solute outside the cell? _____

3. **Observe:** Click **Play**, and observe the numbers shown on the DESCRIPTION pane. How does each number change over time? Write “increases,” “decreases,” or “stays the same” (or “same”) in each space.

• Solute particles inside? _____ • Solute particles outside? _____

• Solvent particles inside? _____ • Solvent particles outside? _____

• Solute concentration inside? _____ • Solute concentration outside? _____

(Activity A continued on next page)



Activity A (continued from previous page)

4. Observe: Wait until the numbers are not changing very much. What do you notice about the solute concentrations inside and outside of the cell? _____

This situation is called **dynamic equilibrium**.

5. Experiment: Click **Reset**. Check that the **Solute outside** is 10 and the **Initial cell volume** is 40%. To calculate the solvent concentration, divide the number of solvent particles by the total number of particles, and then multiply by 100. (Note: The Gizmo only displays the *solute* concentrations.)

A. What is the solvent concentration inside the cell? _____

B. What is the solvent concentration outside the cell? _____

C. Where is there a higher solvent concentration? _____

D. Click **Play**. Do most of the solvent particles move into or out of the cell? (Hint: Does the cell expand or shrink?) _____

6. Experiment: Click **Reset**, and set the **Solute outside** to 1.

A. What is the solvent concentration inside the cell? _____

B. What is the solvent concentration outside the cell? _____

C. Where is there a higher solvent concentration? _____

D. Do you think the cell will get larger or smaller? _____

E. Click **Play** to confirm your predictions. Were you correct? _____

7. Summarize: You have observed examples of **osmosis**—the **diffusion** of a solvent (such as water) across a semipermeable membrane. Summarize what you have observed by filling in the blanks in the following paragraph:

During osmosis, solvent particles move from an area of _____ concentration to an area of _____ concentration. When there is a higher concentration of solvent particles inside the cell, most solvent particles will move _____ the cell and the cell will _____. When there is a higher concentration of solvent particles outside the cell, most solvent particles will move _____ the cell and the cell will _____.



Activity B: Effect of cell volume	<u>Get the Gizmo ready:</u> <ul style="list-style-type: none"> • Click Reset. • Set the Solute outside to 5. • Set the Initial cell volume to 40%. 	
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Question: How does changing the cell volume affect solute concentrations?

1. Experiment: Select the BAR CHART tab, and turn on **Show numerical values**.
 - A. Based on solute concentrations, do you expect the cell to swell or shrink? _____
 - B. Click **Play**, and observe. Was your prediction correct? _____

2. Observe: Click **Reset**. Move the **Initial cell volume** slider back and forth. How does the initial cell volume affect the solute concentrations inside and outside the cell?

3. Experiment: With the **Solute outside** set to 5, predict whether the cell will swell, shrink, or stay the same with each of the following **Initial cell volume** settings. Then use the Gizmo to check each prediction.

Predictions:	20% _____	50% _____	60% _____
Actual results:	20% _____	50% _____	60% _____

4. Analyze: Why do solvent particles flow into the cell when the initial volume is below 50%?

5. Extend your thinking: In the *Osmosis* Gizmo, the cell is placed in a very small chamber. Suppose a cell is placed in a large container of water with a very low solute concentration. What do you think would happen? Explain your answer.
