Name: _____

CASE

Activity 4.1.4 Moving Molecules

Purpose

Cells carry out a multitude of functions in animals; such as, production of energy, the movement of oxygen, and the extraction of wastes. Products of cell functions are transported through the body by moving in and out of cells through the cellular membrane. Molecules cross the membrane through osmosis and diffusion. Have you ever smelled cologne from across a room? Diffusion is the movement of molecules from a high concentration to a low concentration. The molecules of the cologne disperse through the air from the high concentration of where the cologne was sprayed to the low concentration of the air across the room.

In cellular functions, diffusion occurs across the cellular membrane to maintain equilibrium. When water diffuses across the membrane, it is called osmosis. The normal state for most cells is isotonic, equal amounts of water on the inside as the outside. When the concentration of water is higher outside of the cell, water moves into the cell causing the cell to expand and the solution to become hypotonic. When the concentration of water is lower outside of the cell, water moves out of the cell causing the cell to shrink and the solution to become hypertonic. How do you determine the state of a cell and its surrounding solution?

Materials

Per student:

- Computer with Internet access
- Pencil
- 3 different colored pencils
- Stopwatch
- *Agriscience Notebook*

Procedure

Using a computer simulation, you will observe molecules moving in and out of a cell. Follow the procedure and fill out the table in *Activity 4.1.4 Student Worksheet*.

Part One – Osmosis and Diffusion Simulation

1. On your computer go to the website **http://phet.colorado.edu/en/simulation/membrane-channels**.
2. Click the green “Run Now” button under the membrane channel graphic. Select Keep, Run, and other options to open the simulation.
3. Place three green gated channels and three blue gated channels equally spaced on the yellow membrane strip in the center of the simulation. These channels signify the semi permeable membrane of the cell in this simulation. The ability to open and close the channels are for simulation purposes only.
4. Observe the right hand side of the simulation; make sure gates are closed. If the boxes on the right hand side say “Open channels” the gates are closed.
5. In this simulation, green will represent a solute, which is the dissolved substance, and blue will represent water. The top of the yellow membrane strip is the inside of the cell; the bottom is the outside of the cell.
6. Use the gold levers on the left hand side of the simulation to choose the desired molecule and press the red button to add the correct colored molecules to the inside of the cell or to the outside of the cell.

7. Add 10 water molecules and 10 solute molecules to the inside of the cell. Add 10 water molecules and 10 solute molecules to the outside of the cell.
8. Open all gates and observe the movement of molecules for 20 seconds. At the end of 20 seconds, press the pause button at the bottom of the simulation to pause the simulation. Count the number of each molecule on either side of the membrane. Record your initial count at the top of Table 1 of *Activity 4.1.4 Student Worksheet*.
9. On the right hand side click “Clear Particles” and close gates.
10. Read the following procedures and use your initial observations to develop a hypothesis of what you expect to happen after you open the gates for the next trial. Record your hypothesis in Table 1 of *Activity 4.1.4 Student Worksheet*.
11. Add 10 solute molecules and 10 water molecules to the inside of the cell.
12. Add 20 water molecules to the outside of the cell. Answer question 1 on *Activity 4.1.4 Student Worksheet.*
13. Open all gates and time for 10sec. At the end of 10sec, press the pause button at the bottom of the simulation to pause the simulation. Count the number of each molecule on either side of the membrane. Record your count in Table 1 of *Activity 4.1.4 Student Worksheet*.
14. Click play on the simulation and time for 10 additional seconds. Record your count in Table 1.
15. Click play on the simulation and time for 10 additional seconds. Record your count in Table 1.
16. On the right hand side click “Clear Particles” and close gates.
17. Add 10 solute molecules and 20 water molecules to the inside of the cell.
18. Add 10 water molecules to the outside of the cell. Answer questions 2 and 3 in Table 1 of *Activity 4.1.4 Student Worksheet*.
19. Repeat Steps 13 – 18.
20. Add 10 solute molecules and 20 water molecules to the inside of the cell.
21. Add 20 water molecules to the outside of the cell. Answer questions 4 and 5 on *Activity 4.1.4 Student Worksheet*.
22. Repeat Steps 13 – 18.

Part Two – Analyzing Data

1. In Table 2 of *Activity 4.1.4 Student Worksheet*, graph the counts from Table 1. Use a different colored pencil to represent each trial.
2. In space provided in *Activity 4.1.4 Student Worksheet*, develop your conclusion of your observations of the movement of water through cell membranes. Consider the questions below Table 2 as your write the conclusion.

Conclusion

1. When there is more water outside of the cell is the solution isotonic, hypotonic, or hypertonic? Explain your determination.

2. Describe what the cell would look like in a hypertonic solution.

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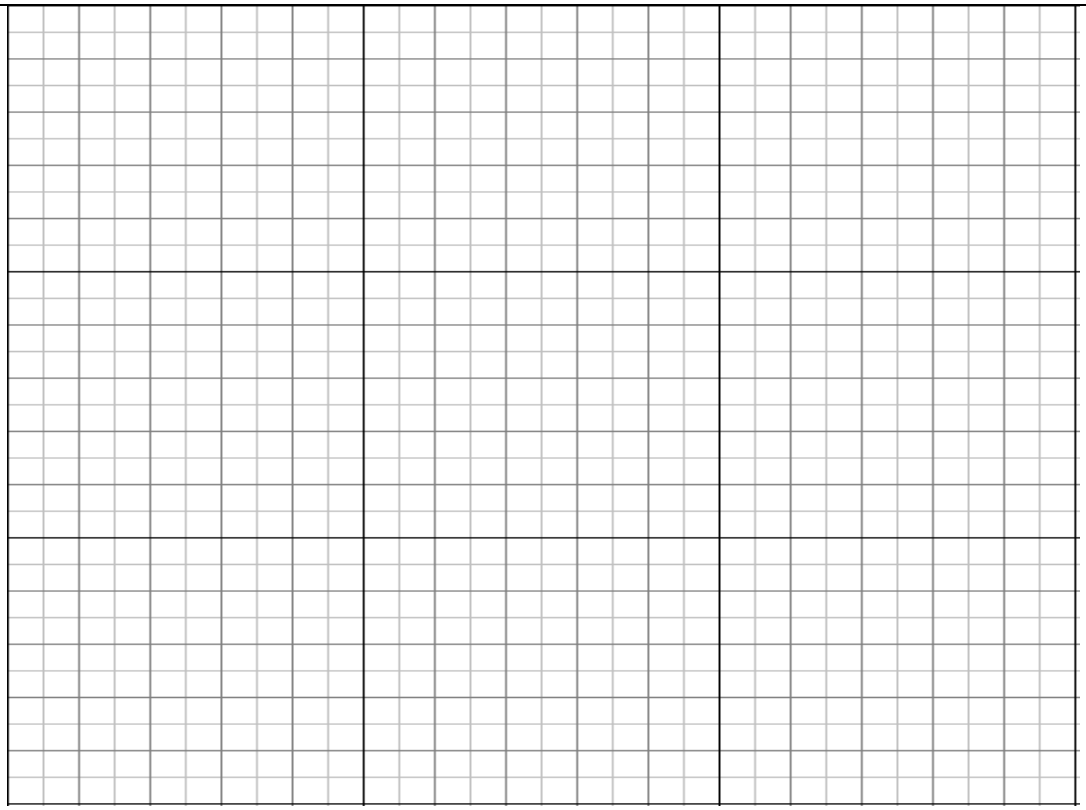
Activity 4.1.4 Student Worksheet

Table 1. *Simulation Data*

Initial count: _____				
Hypothesis:				
Question 1: Describe whether the cell is isotonic, hypotonic, or hypertonic in Trial 1. Explain.				
	Inside of Cell		**Outside of Cell**	
	Solute	**Water Molecules**	**Solute**	**Water Molecules**
Trial 1				
0 seconds				
10 Seconds				
20 Seconds				
30 Seconds				
Average				
Question 2: Describe whether the cell is isotonic, hypotonic, or hypertonic in Trial 2. Explain. **Question 3: Develop a hypothesis of what you expect to happen after you open the gates.**				
Trial 2				
0 seconds				
10 Seconds				
20 Seconds				
30 Seconds				
Average				
Question 4: Describe whether the cell is isotonic, hypotonic, or hypertonic in Trial 3. Explain. **Question 5: Develop a hypothesis of what you expect to happen after you open the gates.**				
Trial 3				
0 seconds				
10 Seconds				
20 Seconds				
30 Seconds				
Average				

Directions: Label the x axis (the bottom line) "time" and the y axis (the left line) "molecules". Determine proper units for your data and include them on each axis. Provide a key to show which line corresponds with which molecule.

Table 2. ***Graphing Molecular Movement***



In the space below, develop your conclusion of *Activity 4.1.4 Moving Molecules*.

- Were your hypotheses in Table 1 supported or unsupported for each trial? Why?
- How were the molecules inside the cell affected by molecules outside of the cell?
- What other observations did you make?