Experimental Design Lab: Modeling Diffusion & Osmosis

SC.912.N.1.1, SC.912.L.14.2; SC.912.L.14.3

Objective:

Distinguish between diffusion and osmosis. Explain how equilibrium is established as a result of diffusion. Evaluate the experimental process and determine if the process is active or passive transport.

Introduction:

Cell membranes allow some molecules to pass through, but not others. If a molecule can pass through a cell membrane, it will **diffuse** from an area of higher concentration on one side of the membrane to an area of lower concentration on the other side until it reaches equilibrium. The difference in concentration of the molecules across a distance is called the **concentration gradient**. The process by which water molecules diffuse across a cell membrane from an area of high concentration to an area of lower concentration (like an object moving down hill) is called **osmosis**. Since water is moving from an area of high concentration to an area of lower concentration it does not require cells to expend energy and therefore is an example of *passive transport*. The net direction in which a solution moves is determined by the solute concentration inside and outside the cell; hypotonic, hypertonic, and isotonic.

Purpose:

Students will visualize through hands-on learning the process of diffusion and osmosis. Students are to determine which process is taking place based on information gathered through experimental design.

Materials: Safety equipment and…

Part 1	**Part 2**
• Iodine (IKI)/Lugol's solution • 10% starch solution • Dialysis tubing • String • Fresh water • Pipette • 200 ml beaker **During 15 min. wait time begin part 2**	• Polymer fish/insect • Metric scale • Ruler • Fresh water / Saltwater solution • Beaker • Ziplock bag • Permanent marker

Procedure

Students work in cooperative groups at lab tables. Analyze and record all observations for part 1 and 2. After experiment is completed, **clean** lab station and dispose of any materials that are not reusable.

Part 1: Pour 100 mL water into 200mL beaker. Add at least 20 drops of IKI/Lugol's solution to the water. Open the dialysis tubing and tie one end tightly with a piece of string to form a bag. Use a pipette to pour 10mL of starch solution into dialysis bag, approximately 2/3 full (leaving room at top). Tie off top of bag well with a second piece of string. Gently rinse the outside of the bag. Mass the dialysis bag and record your results. Place dialysis bag into beaker with IKI/Lugol's solution and wait about 15 minutes. Record all results; color changes, mass changes, etc. Begin part 2 immediately.

Part 2: Create a data table to document and record your results. Measure and record original length and mass of polymer specimen (metric units) in your data table. Trace outline of specimen onto graph paper and record the surface area. With permanent marker, write your name and period on a Ziploc bag. Place your specimen in Ziploc bag partially filled with approximately 200 mL water solution. Seal and store in location reserved for your class. Observe any changes and record data over 24 hour period.
Alternative: take home and make observations after 24 hour period. Bring back to school to get final mass of polymer.

- Day 2: Remove specimen from ziplock bag. Dry off with paper towel before taking measurements. Calculate raw data and % change in mass and surface area. Graph all data.

Discussion questions:

1) State your hypothesis.
    a) Did your hypothesis support your conclusion? Why or why not?
2) List observations, measurements, estimations and predictions based on current knowledge.
3) What happened to the color in the dialysis tubing?
4) What happened to the color of the water around the dialysis tubing?
5) Did any substance enter the beaker from the dialysis bag?
    a) If so, to which substance is the dialysis bag permeable? Why? Explain.
6) How is the dialysis bag like the cell membrane?
7) What happened to the polymer sample? Explain.
8) Explain which part of the experiment demonstrated *osmosis* and which demonstrated *diffusion*.
9) With regard to the osmosis experiment, explain the direction of the net movement of water (ie. Hypotonic, hypertonic or isotonic).
10) List any sources of error during the lab process and explain how they affected your experiment.