Diffusion Through Membranes

Cell membranes are selectively-permeable by nature and as such, exert some control over substances passing through them into and out of cells. In the presence of a concentration gradient, substances will diffuse from an area of high concentration to one of low concentration across a selectively permeable membrane. Water, too, will diffuse through membranes in a process called osmosis. The net movement of water is from an area of high [H_2O] (*i.e.*, low [solute]) to one of low [H_2O] (*i.e.,* high [solute]).

In this experiment you will measure diffusion of small molecules through dialysis tubing, a selectively permeable membrane. Small solute molecules and water molecules can move freely through a selectively permeable membrane, but larger molecules will pass through more slowly, or perhaps not at all. In medicine, the movement of a solute through a selectively permeable membrane is called **dialysis.** The size of the minute pores in the dialysis tubing determines which substances can pass through the membrane.

By detecting the presence of particular molecules on each side of the dialysis tubing, we can determine which molecules passed through the tubing and which did not. Starch molecules react with iodine to form a dark blue compound. The presence of starch will be tested with Lugol's solution, (Iodine Potassium-Iodide or IKI). For the Lugol test, a dark blue color is a positive result.

A. Diffusion
Procedure
1. Obtain a 10 cm piece of 2.5-cm dialysis tubing that has been soaking in water. Twist one end of the tubing and fold it over, then tie off that end with string to form a bag. Tie it as low as possible. To open the other end of the bag, rub the end between your thumb and forefinger until the sides separate.
2. Pour starch solution in the tube so that it is about 2/3 full.
3. Twist the top of the tube and tie it securely. Rinse it thoroughly.
4. Place the tube in a 250 mL beaker containing about 150 mL of water and label it 'A' and make sure the names of you and your partner are on it.
5. Add iodine solution to the water slowly while stirring until the water is a **FAINT** yellow color.
6. Let stand 20 min and record your observations.

B. Osmosis
Procedure
1. Prepare another tube as in procedure A.
2. Pour molasses solution into the tube until it is about half full.
3. Twist the top of the tube and tie it securely. Be sure to leave a gap of about 1 cm between the top of the liquid and the thread. Try to squeeze out as much air as possible before tying the bag.
4. Gently rinse the outside of the tube with water.
5. Place the tube in a 250 mL beaker and add about 150 mL of water. Label the beaker 'B' and make sure the names of you and your partner are on it.
6. Let stand overnight and record observations the next day in class.

Questions
1. a) Describe the test results which show the presence of starch.
b) Can the starch molecules pass through a dialysis membrane? Which results support this conclusion?
2. Is the membrane selectively permeable? Explain.
3. Describe any changes that occurred in beaker 'A' and use your results to explain them.   Be sure to specify the direction of movement for each molecule.

4. Describe any changes that occurred in beaker 'B' and use your results to explain them. Be sure to specify the direction of movement for each molecule.

5. Why was the membrane rinsed off after being filled and tied?

6. Suppose that a tube filled with a 5% molasses solution was placed in a beaker filled with a 10% molasses solution. What would happen? Why?

7. A single starch molecule may have thousands of atoms, a glucose molecule has 24, and the ions of dissolved salt are the size of single atoms. Using your knowledge of diffusion across selectively permeable membranes, predict what would happen if each of these was placed into separate dialysis tubes and placed in water.

8. Why is the chemical digestion of starch in your stomach necessary?

9. Does this investigation show that starch molecules cannot move across living cell membranes? Explain.