Diffusion and Osmosis

Introduction:

In this exercise you will measure diffusion of small molecules through dialysis tubing, an example of a semi-permeable membrane. The movement of a solute through a semi permeable membrane is called **dialysis (as well as diffusion)**. The size of the minute pores in the dialysis tubing determines which substance can pass through the membrane. A solution of glucose and starch will be placed inside a bag of dialysis tubing. Distilled water will be placed in a beaker, outside the dialysis bag. After 30 minutes have passed, the solution inside the dialysis tubing and the solution in the beaker will be tested for glucose and starch. The presence of glucose will be tested with **glucose test strips**. The presence of starch will be tested with **Lugol's solution** (iodine-potassium-iodide).

Procedure:

1. Obtain a 30 cm piece of 2.5-cm dialysis tubing that has been soaking in water. Tie off one end of the tubing to form a bag. To open the other end of the bag, rub the end between your fingers until the edges separate.
2. Place 15 mL of the 15% glucose/1% starch solution in the bag. Tie off the other end of the bag, leaving sufficient space for the expansion of the bag’s contents. Record the color of the solution in your lab notebook.
3. Using about 5 mL of the 15% glucose / 1% starch solution test for the presence of glucose, using glucose test strips, and for the presence of starch by adding about 2 drops of Lugol’s solution. Record the results in your lab notebook.
4. Fill a 250 mL beaker 2/3 full with distilled water. Add approximately 4 mL of Lugol’s solution to the distilled water and record the color in your lab notebook. Test the solution for glucose and record the results in your lab notebook.
5. Immerse the dialysis bag in the beaker of water plus Lugol’s.
6. Allow your set up to stand for approximately 30 minutes or until you see a distinct color change in the bag or the beaker. Record the final color of the solution in the bag and of the solution in the beaker in your lab notebook.
7. Test the liquid in the beaker and in the bag for the presence of glucose. Record the results in your lab notebook.

Analysis of Results:

1. Which substance(s) are entering the bag and which are leaving the bag? What experimental evidence supports your answer?
2. Explain the results you obtained. Include the concentration differences and membrane pore size in your discussion.
3. Quantitative data uses numbers to measure observed changes. How could this experiment be modified so that quantitative data could be collected to show that water diffused into the dialysis bag?
4. Based on your observations, rank the following by relative size, beginning with the smallest: glucose molecules, water molecules, IKI molecules, membrane pores, starch molecules.

5. What results would you expect if the experiment started with glucose and IKI solution inside the bag and only starch and water outside? Why?

**Osmosis:**

In this experiment you will use dialysis tubing to investigate the relationship between solute concentration and the movement of water through a semi-permeable membrane by the process of osmosis. When two solutions have the same concentration of solutes, they are said to be **isotonic** to each other. If the two solutions are separated by a semi permeable membrane, water will move between the two solutions, but there will be no net change in the amount of water in either solution. If two solutions differ in the concentration of solutes that each has, the one with more solute is **hypertonic** to the one with the less solute. The solution that has less solute is **hypotonic** to the one with more solute. These terms can only be used to compare solutions.

**Procedure:**

1. Obtain a 30 cm strip of pre-soaked dialysis tubing
2. Record mass
3. Each lab group will prepare one of the following by pouring approximately 25 mL of the following solutions into each bag.
   - Distilled water
   - 0.2 M sucrose
   - 0.4 M sucrose
   - 0.6 M sucrose
   - 0.8 M sucrose
   - 1.0 M sucrose
4. Remove most of the air from the bags by drawing the dialysis bag between two fingers. Tie off the other end of the bag, leaving sufficient space for the expansion.
5. Rinse each bag gently with distilled water to remove any sucrose spilled during filling.
6. Carefully blot the outside of each bag and record the initial mass of each bag in your lab notebook.
7. Fill six 250 mL beakers 2/3 full with distilled water.
8. Immerse each bag in one of the beakers of distilled water and label the beaker to indicate the molarity of the solution in the dialysis bag. **Be sure to completely submerge each bag.**
9. Let stand for 30 minutes, remove the bags from the water, blot and determine the mass of each bag.
10. Record your group’s results in your lab notebook. Obtain data from the other lab groups
11. Graph the results using LoggerPro.
Analysis of Results

1. Explain the relationship between the change in mass and the molarity of sucrose within the dialysis bag.

2. Predict what would happen to the mass of each bag in this experiment if all the bags were placed in a 0.4 M sucrose solution instead of distilled water. Explain your response.

3. Why did you calculate the percent change in mass rather than using the change in mass?