**Diffusion & Osmosis Biology Laboratory**

*Adapted from Carolina AP Biology Laboratory I*

**Objectives:**

1. Use dialysis tubing to model diffusion across the cell membrane.
2. Investigate the influence of solute concentration on osmosis.

**Background Information:**

The cell membrane is the cell’s interface, or boundary, with its surroundings. Functions of the cell membrane include cellular communication, protection, support, and transport. Oxygen and water are two essential molecules that need to be able to be transported across the cell membrane. A membrane that allows some molecules to pass through but not others is called semipermeable. Molecules that pass the membrane without the use of cellular energy is called passive transport. Active transport is the passage of molecules that requires energy from the cell.

In these lab activities, you will investigate the passage of molecules through a semipermeable membrane by passive transport. The membrane you will use, dialysis tubing, allows materials through submicroscopic holes, or pores. Molecules are in constant random motion. If a molecule randomly moves towards the membrane, one of three things can occur. 1) If the molecule manages to randomly move toward a pore and is small enough to fit through, it may cross through the membrane. 2) If the molecule randomly moves towards a pore and is too large to fit through, it will be rebounded. 3) if the molecule randomly moves toward the membrane by misses a pore, it will also be rebounded.

If a molecule reaches a pore and is small enough to fit through, the concentration of molecules on each side will determine if the molecule crosses the membrane or not. Molecules will naturally travel from an area of higher concentration to an area of lower concentration. This process is called diffusion. Osmosis is the diffusion of water molecules across a semipermeable membrane.

**Activity A: Diffusion**

**Materials:** dialysis tubing, plastic cup, starch solution, water, IKI solution, pipet, funnel, graduated cylinder

*Caution: IKI solution can irritate the skin, mouth, and eyes, and can stain skin or clothing.*

**Introduction:** In Activity A, you will explore the diffusion of different molecules through dialysis tubing. You will test for the presence of starch by using the IKI solution. When IKI reacts with starch, it turns from a yellow-brown to a dark blue-purple color.

**Procedure:**

1. Put about 160-170 mL of water into a plastic cup. Add approximately 4 mL of IKI solution to the water and mix well. Record the initial color in Table 1 of your data.
2. Obtain a piece of dialysis tubing that has been soaked in water. The tubing should be soft and pliable. Roll the tubing between your thumb and index finger to open it. Close one end of the tube by knotting it or typing it off with string. This will form a bag.
3. Using a small funnel, pour 15 mL of starch solution into the dialysis bag. Smooth out the top of the bag, running it between your thumb and index finger to expel the air. Tie off the open end of the bag. Leave enough room in the bag to allow expansion. Record the initial color of the starch solution in the bag in Table 1 of your data.
4. Immerse the dialysis bag in the plastic cup of water/IKI solution. Make sure that the portion of the bag that contains the starch solution is completely covered by the solution in the cup at all times.
5. Wait ~30 minutes. While waiting, begin Activity B.

**Activity B: Osmosis**

**Materials:** Dialysis tubing, plastic cups, water, funnel, sucrose solution, paper towels, balance

**Introduction:** In Activity B, you will investigate the influence (if any) of solute concentration on the net movement of water molecules through a semipermeable membrane. The solute you will use is sucrose (table sugar) in the following molar concentrations: 0.0 M, 0.2 M. 0.4 M, 0.6 M, 0.8 M, 1.0 M.

**Procedure:**

1. Pour 160-170 mL of distilled water into a plastic cup. Label the cup with the concentration of the sucrose you were assigned.
2. Obtain a piece of dialysis tubing that has been soaked in water. The tubing should be soft and pliable. Roll the tubing between your thumb and index finger to open it. Close one end of the tube by knotting it or typing it off with string. This will form a bag.
3. Using a funnel, pour 25 mL of your assigned sucrose solution into the dialysis bag. Smooth out the top of the bag, running it between your thumb and index finger to expel the air. Tie off the open end of the bag. Leave enough room in the bag to allow expansion.
4. Dry the bag on the paper towels and then determine its mass. Record the initial mass in Table 2 of your data.
5. Immerse the dialysis bag in the plastic cup of water. Make sure that the portion of the bag that contains the sucrose solution is completely covered by the solution in the cup at all times.
6. After ~30 minutes, remove the bag from the cup and dry it on the paper towels. Mass the bag and record the final mass in Table 2 of your data. Finally, determine the change in the mass of the bag and record this data in table 2 of your data.

**Data:**

**Table 1: Diffusion (IKI/Starch Solution)**

|  |  |  |  |
| --- | --- | --- | --- |
| Location | Solution | Starting Color | Final Color |
| Dialysis Bag | Starch Solution |  |  |
| Cup | IKI Solution |  |  |

**Table 2: Osmosis/Sucrose Concentrations**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Concentration of Sucrose | Starting Mass | Final Mass | Change in Mass | Percent Change in Mass |
| 0.0 M |  |  |  |  |
| 0.2 M |  |  |  |  |
| 0.4 M |  |  |  |  |
| 0.6 M |  |  |  |  |
| 0.8 M |  |  |  |  |
| 1.0 M |  |  |  |  |

**Analysis: Activity A**

1. Draw a diagram showing your cup with the dialysis tubing inside it. Label the starting locations of the IKI solution, water, and starch solution. Then draw arrows showing the direction in which the molecules of these solutions moved.
2. Does this activity account for the diffusion of all the molecules that you listed in number 1? If not, what data could be collected to show the net direction of diffusion of this molecule or molecules?
3. What does your data tell you about the sizes of the molecules relative to the pore size of the dialysis tubing?

**Analysis: Activity B**

1. Calculate the percent change in mass. Use the following formula. Record the results in Table 2.

% Change in Mass = (Change in Mass/Starting Mass) X 100%

1. Obtain and record the results for the rest of data table 2 from you classmates.
2. What does the change in mass indicate?
3. Write a hypothesis that this experiment is designed to test.
4. What variable is being tested in this experiment.
5. List at least 3 variables (other than the one listed in your answer to #5) that could influence the outcome of this experiment and why.
6. Graph the percent change in mass for the class data. Title the graph and supply the following information.
   1. The independent variable is:
   2. The dependent variable is:
7. On the basis of your data and graph, has this experiment adequately tested the variable you listed under #5?
8. On the basis of your results, write a statement that expresses the relationship between solute concentrations and the net direction of water molecule movement in osmosis.
9. In which set up, if any, were the concentrations isotonic to each other?