# Osmosis and Diffusion Lab Activity

**NAME**_____ **Section** _____ **DATE**_____

## Background

Membranes surround cells and cellular organelles. These membranes act as "gateways" between the outside environment and a cell's cytoplasm. Membranes are very important to the function of the cell, and allow only certain molecules to enter and exit the cytoplasm freely. Because the cell's membrane is more permeable to some substances than others, it is said to be selectively permeable.

In 1827, Scottish scientist Robert Brown found that tiny particles suspended in water moved in small, quick movements. This phenomenon is known as Brownian movement or random motion. Molecules exhibit random motion in all liquids and gases; that is, they move in an undirected fashion, bouncing off other molecules.

Diffusion is the movement of molecules from an area of high concentration to an area of low concentration. Since molecules are in constant motion, they will bounce off each other and flow toward an area of fewer molecules (low concentration).

The difference between molecules of high concentration and low concentration is called a concentration gradient. When a concentration gradient exists (a higher concentration exists in one area and a low concentration in another), diffusion will take place and molecules will move until equilibrium of molecules exists across the gradient. For example, when a bottle of hydrogen sulfide (which gives off a smell of rotten eggs) is opened on one side of the room, the smell will quickly be detected on the other side. The bottle has a high concentration of hydrogen sulfide; the room has a low concentration. The hydrogen sulfide will diffuse to the less concentrated area until equilibrium is found.

Osmosis is a process by which water moves through a selectively permeable membrane. The osmotic process is a special case of diffusion involving the diffusion of a solvent, such as water, rather than the diffusion of substances (solutes) dissolved in the solvent.

Osmosis takes place whenever there is an unequal concentration of water on either side of a selectively permeable membrane. Water will continue to move across the concentration gradient until equilibrium occurs.

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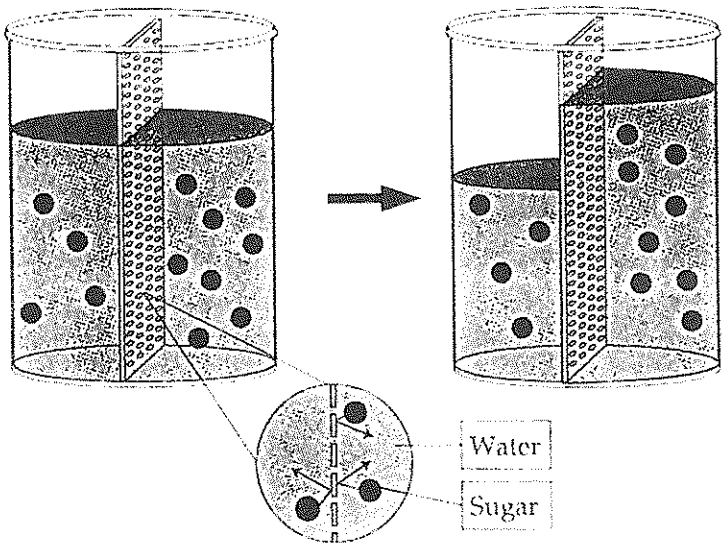
Figure 1




Water molecules are in constant motion, and act in the same manner as other molecules, moving from an area of high concentration through a membrane to an area of low concentration. In some cases, the cell must transport substances in and out of its cell membrane, acting against a concentration gradient. For this process of active transport, the cell uses energy derived from ATP or a protein to move solutes into or out of the cell. Since dialysis tubing is not living and does not produce ATP, this process can not be shown here.

## Objectives

- Demonstrate osmosis and diffusion of molecules through a selectively permeable membrane
- Determine which molecules are able to pass through a membrane and which molecules are not able to pass

## Hypothesis

Form a hypothesis based on the following experiment: A solution of starch and glucose dissolved in water is placed into a dialysis membrane and tied off to resemble a sausage. This sausage is submerged in a cup of water where 1 ml of iodine is placed. Iodine in the presence of starch forms a blue-black color complex. What will happen, form an educated guess (hypothesis) with the information given.

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## Materials

MATERIALS NEEDED PER GROUP

1 Cup
4 Glucose testing strips
1 One-foot section of dialysis tubing
1 Pipet
Graduated cylinder

SHARED MATERIALS

Glucose/starch solution
Iodine potassium iodide (IKI)

## Procedure

*As a general laboratory practice, it is recommended that students wear proper protective equipment such as gloves, safety goggles, and a lab apron to avoid staining any clothing or skin.*

1. Pour 15 ml of prepared glucose/starch solution into a graduated cylinder.
2. Obtain a piece of dialysis tubing from the beaker of water. Tie a tight knot in one end of the tubing, or use a piece of string to tie off the end.

   NOTE: *The pores in the dialysis tubing are extremely small, and can be easily clogged by any oil or dirt on your fingers and hands. Keep physical contact with the tubing to a minimum. If you choose to tie off the end of the dialysis tubing with string, tie two knots, about ¼" apart, to prevent leaking.*

3. Open the tubing by rubbing the untied end between your fingers. Pour 15 ml of the glucose/starch solution into the tubing.
4. Note the color of the solution in the bag. Record the color in Table 1 in the Analysis section.
5. Determine if glucose is present in the tubing by dipping a glucose indicator strip into the solution. Record the data in Table 1.
6. Carefully tie a knot in the open end to seal the bag. Be sure to leave enough space in the bag for expansion.
7. Fill a plastic cup approximately 2/3 full with distilled water. Add 1 ml of IKI to the water in the cup.

   NOTE: *The IKI solution is an irritant; it affects skin and eyes, and can stain clothing. Handle the solution with caution. Wash off spills and splashes with water.*

8. Note the color of the solution. Record the color in Table 1.

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9. Determine if glucose is present in the IKI solution by dipping a glucose indicator strip into the cup. Record the data in Table 1.
10. Completely immerse the dialysis bag in the solution in the cup.
11. Wait 30 minutes.
12. Remove the dialysis bag from the cup. Record the final color of the solutions in the bag and the cup in Table 1.
13. Determine the glucose content in the cup and in the dialysis bag using glucose indicator strips. To test the solution in the bag, make a small cut in the bag with a pair of scissors, and insert the indicator strip through this hole. Record the data in Table 1.

NOTE: *Clean up all materials and dispose of them according to your teachers instructions. Be sure to wash your hands thoroughly before leaving the laboratory.*

## Analysis

Table 1
Diffusion

| | Color | | Glucose Content | |
|---|---|---|---|---|
| Time | Dialysis Bag | Cup | Dialysis Bag | Cup |
| Start | | | | |
| 30 minutes | | | | |

## Assessment

1. Create a Venn diagram comparing osmosis and diffusion.

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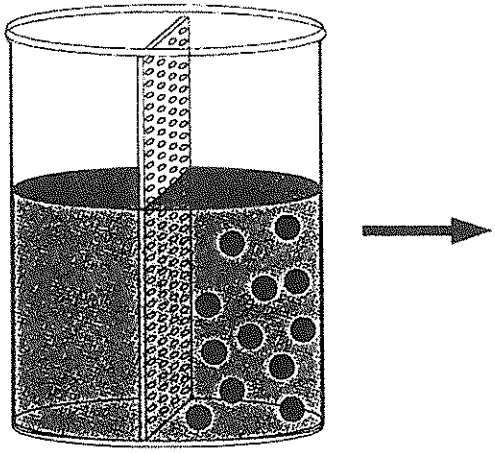
2. Below is a diagram of a chamber separated by a semi-permeable membrane. One side contains a mixture of molecules in water and the other side contains only water. In the space next to the picture, draw what you think the chamber would look like after an extended period of time.



3. IKI (iodine potassium iodide), when mixed with starch, reacts to cause a color change from clear to a blue/black. Glucose test strips are impregnated with a chemical that will change color when exposed to glucose. Given this information, which substance(s) do you believe diffused in or out of the dialysis tubing? Explain.

4. Which, if any, substances(s) do you believe did not diffuse through the membrane? Why?

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5. What is osmosis? Was there any evidence that osmosis occurred through the dialysis tubing?

6. Molecules of a similar substance are about the same size, whereas molecules of different substances are known to have different sizes. By looking at your results, can you determine the relative sizes of molecules that did or did not diffuse across the dialysis membrane?

7. Can it be said that the dialysis membrane is similar to a plasma membrane?

8. Predict what would happen if you allowed the dialysis tubing to sit in the cup overnight.

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9. Give an example of a common object that performs similarly to a selectively permeable membrane.

10. Your lab partner was absent the day the lab was performed. Write a brief description of osmosis and diffusion and describe the protocols performed in the lab and how they relate to osmosis and diffusion.

11. Research two examples of diffusion occurring gin the human body. Be prepared to explain why they represent diffusion, what substances are involved, and how it benefits the body.