# Lab 2: Experimental Design and Investigating Diffusion and Osmosis

## OBJECTIVES:

- To practice applying hypothesis testing.
- To further your understanding of experimental design.
- To gain a better understanding of diffusion and osmosis.
- To understand these terms: diffusion, osmosis, diffusion or concentration gradient, Brownian movement (or motion), hyposmotic, hyperosmotic, isosmotic, hypotonic, hypertonic, isotonic, hypothesis, selectively permeable, semipermeable, prediction, control, independent variable, dependent variable.

## MATERIALS (per group)

two prepared eggs
two beakers
dropper bottle of 40% NaCl solution
scale or balance
2 weigh boats

## MATERIALS (to share)

dialysis slide filled with starch solution
beaker of water with $I_2KI$ (Lugol's solution) added
bottle of unknown solution A
bottle of unknown solution B
slides and cover slips
*Elodea*
wax pencils

## GENERAL

Work in groups (the size of the groups will be determined by the size of the class and by the amount of equipment available).

## PROCEDURES

**A. <u>Diffusion and Osmosis- Dialysis Slide</u>**

*Diffusion Across a Selectively Permeable Membrane*

1. Your instructor will set-up a demonstration dialysis slide with the following conditions:

| Contents of Dialysis Slide | Contents of Beaker |
|---|---|
| Water | Water |
| Starch | Iodine |

2. What is your (class) hypothesis regarding the movement of water molecules and solute particles if (when) the dialysis slide is placed into the beaker?

3. Record the results of the demonstration experiment

**B. Osmosis- The Egg**

*Determining the Relative Concentration of Two Solutions by Osmosis*

In this portion of the lab, you will be given two solutions. Your job is to determine which is the hypertonic (hyperosmotic) solution. You will be able to do this by using "model cells". We will model cells by using eggs. "Eggs??!!" you exclaim. Yes, eggs! They have been specially prepared to make the egg shell soft by soaking them in vinegar. This makes them permeable to water.

1. Fill out the Hypothesis and Prediction sections of Table 2. We will do this as a class. Remember that we are comparing the solutions, not the eggs!
2. Carefully weigh each egg. Use the weighing dish to prevent the egg from rolling off the balance. Record the data in the Data section of Table 2.
3. Place each egg into a beaker for 30 minutes, keeping track of which egg went in which beaker!

While waiting your 30 minutes, if you have been instructed to do Sections below, do them now!! Then complete this section.

4. After exactly 30 minutes, remove each egg, dry it off, and weigh it again as in #2. Record the data in the Data section of Table 2.
5. Complete Table 2.

**C. Plasmolysis -- Observing Osmosis in a Living System, *Elodea***

If a plant cell is immersed in a solution that has a higher solute concentration than that of the cell, water will leave/enter (circle one) the cell. The loss of water from the cell will cause the cell to lose the pressure exerted by the fluid in the plant cell's vacuole, which is called turgor pressure. Macroscopically, you can see the effects of loss of turgor in wilted house plants or limp lettuce. Microscopically, increased loss of water and loss of turgor become visible as a withdrawal of the protoplast from the cell wall **(plasmolysis)** and as a decrease in the size of the vacuole (Figure 1).

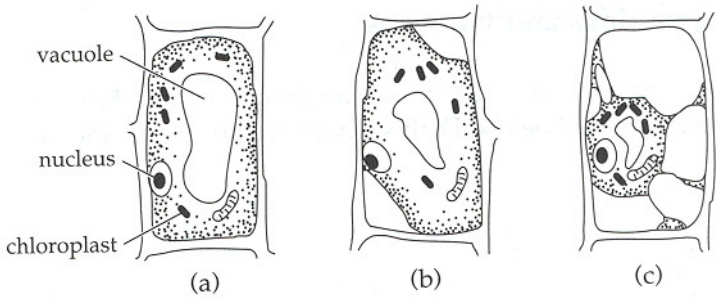


**Figure 1.** *Plasmolysis in an epidermal cell of a leaf. (a) Under normal conditions, the plasma membrane is pressed against the cell walls. A large vacuole occupies the center of the cell, pushing the cytoplasm and nucleus to the periphery. (b) When the cell is placed in a solution with a higher concentration of solutes than that of the cell, water passes out of the cell, and the cell contents contract. (c) In an even more concentrated solution, the cell contents contract still further.*

**Directions:**

1. Obtain a leaf from the tip of an *Elodea* plant. Place it in a drop of water on a slide, cover it with a coverslip, and examine the material first at low power (100X) and then at high power (400X). Locate a region of healthy cells and sketch a few adjacent cells in the left box of Table 2 below. Note especially the location of the chloroplasts. (Don't forget to include magnification.) For the next step, do NOT move the slide.
2. While touching one corner of the coverslip with a piece of Kimwipe to draw off the water, add a drop of concentrated salt solution to the opposite corner of the coverslip. Be sure that the salt solution moves under the coverslip. Wait about 5 minutes, then examine as before. Sketch in the right box one the following pages the same cells you sketched in step 1.

## TO HAND IN, LAB 2

**NAME:** _____

Complete the tables below and answer the questions.

**(A) Dialysis Slide Demonstration:**

Table 1.

| | Dialysis Slide | Beaker |
|---|---|---|
| Pre-experimental color | | |
| Pre-experimental contents | Water,<br>Starch | Water,<br>Iodine |
| Pre-experimental weight | | X |
| Post-experimental color | | |
| Post-experimental weight | | X |

*Is their evidence of the diffusion of starch molecules? If so, in which direction did starch molecules diffuse?*

*Is their evidence of the diffusion of iodine molecules? If so, in which direction did iodine molecules diffuse?*

*Assuming that any weight change is due to osmosis of water, in which direction does water osmose?*

*What can you say about the permeability of the dialysis slide? (What particles could move through and what particles could not?)*

## (B) Egg Experiment

Table 2.

Hypothesis:

Prediction:

**Data:**

| Experimental egg | Pre-soak weight | Post-soak weight |
|---|---|---|
| A | | |
| B | | |

**Interpretation (circle one):** support reject

Reasoning (if supported, why; if rejected, why)

If rejected, a corrected hypothesis:

Reasoning (why you corrected the hypothesis the way you did):

**(C). *Elodea* Leaf Plasmolysis Experiment**

Table 3. Sketch your *Elodea* leaf cells here.

| Water | salt water added |
|---|---|
| | |

**Answer these questions here:**

1. What happened when the water in which the cells were mounted was replaced by the salt solution?

2. Assuming that the cells have not been killed, what should happen if the salt solution were to be replaced by water?

3. Are plant cells normally hypertonic, hypotonic, or isotonic to their environment? Why?

4. Can plant cells burst? Explain.