Topic 1: Scientific Method or Cell Structure – 1f. Osmosis/Diffusion Challenge

Resources:	Miller, K., Levine J. (2004). *Biology.* Boston, MA: Pearson Prentice Hall. Yale team claims forward-osmosis success [Internet]. 13 Jan. 2009. Cited 23 July 2009. Available from: http://www.desalination.biz/news/news_story.asp?id=4685
Building on:	This lab can be used as a review of *scientific method*, during a discussion of biochemistry and *particle size*, or in a unit on *cell structure* with particular emphasis on *cell membranes*. The use of dialysis tubing brings up the topic of kidney dialysis, which is a very good entry into the discussion of *semipermeable versus selectively permeable membranes*. The lab is inquiry-based and leaves the procedure to the discresion of the student/scientist. They must design their procedure and predict their outcome. While the math is not difficult, the student must decide what measurements are needed and how to set up the math problems to determine % composition. The lab also had the element of a contest: who can cause their dialysis bag to have the greatest % change in mass. This provides a bit of fun and the potential to earn a little extra credit provides additional motivation.
Links to Chemistry:	Molecular size Compounds and molecules Molecular motion (Brownian motion) Solubility Ionic and covalent bonds Equilibrium
Links to Physics:	Equilibrium Atomic size Liquid pressure Pascal's principle
Stories:	http://tweetmeme.com/bar/114074768 The above is a link to a funny photo of a cat and is used to define osmosis and equilibrium.

There is a lot of information about the use of osmosis to desalinate salt water thus providing more fresh water for people. Most plans use reverse osmosis, which uses a membrane that water molecules can get through, but solutes like salt cannot. Pressure is used to push the water out of the salt water, through the membrane where the water can be collected on the other side leaving the salt behind. This requires energy to produce the pressure needed to push the water. A group working at Yale University is testing a system to desalinate water using negative pressure osmosis they call "Forward Osmosis." They would place the salt water in dialysis tubing that is permeable to water and not to salt, similar to reverse osmosis except they would not apply pressure to push the water out. The Yale group would place the bag in a solution that is more hypertonic than the salt water and will literally pull the water out, leaving the salt behind. The problem with this system is that the water is now in a new solution; therefore, it is not pure water. The Yale team claims to have found a chemical solution that is very easy to remove from the water, rendering it pure fresh water without the need for the large energy expenditure needed with reverse osmosis. You can connect to an article explaining the Yale procedure at: http://www.desalination.biz/news/news_story.asp?id=4685

Materials Needed for the Lab:

- Table salt
- Table sugar
- Dialysis tubing
- Plastic reusable cups or beakers
- Digital balance
- String to tie the dialysis tubing (optional as you can also just tie the tubing as you would a balloon)

Diffusion and Osmosis Lab

Introduction: Cells must be able to pass substances back and forth across their membranes in order to adjust to their surroundings and maintain the homeostasis necessary for life. The cells use different methods of transport, depending on the nature of the substance transported. This lab will examine the process of diffusion and osmosis using a semipermeable membrane.

Vocabulary: (You should understand the meaning of each of the following words):
Semipermeable membrane
Impermeable membrane
Differentially (selectively) permeable
Diffusion
Facilitated diffusion
Osmosis
Active transport

Objective: You will design and execute a procedure to demonstrate diffusion and osmosis while trying to achieve the greatest % change in the mass of your dialysis tubing bag. This % change can be **either** positive or negative. The lab group with the maximum % change in the mass of their dialysis tube will receive 2 points extra credit on this lab.

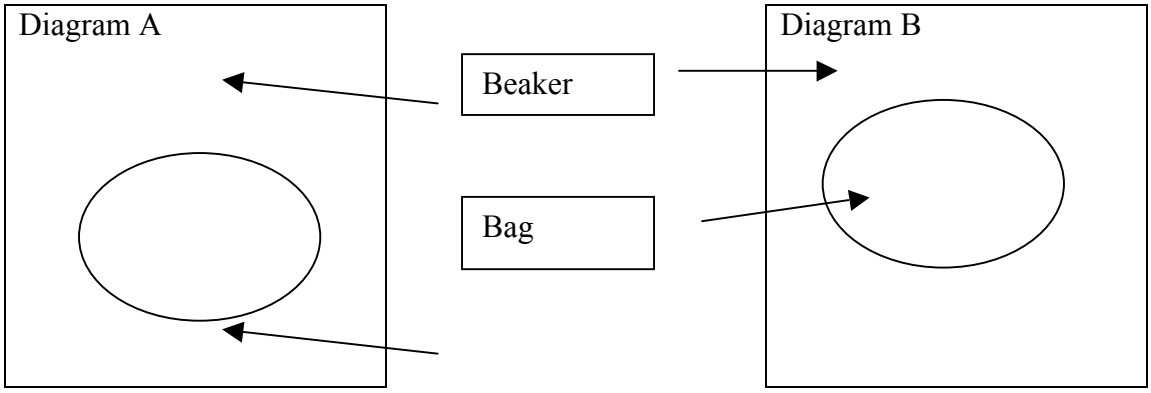
Procedure:

1. In this lab you are going to design your own procedure. You will be provided with the following equipment:
   Dialysis tubing
   Water
   Salt
   Sugar
   Beaker
   Graduated cylinder
   Mass balance
2. You may use all or some of the materials provided to set up and run your lab. Your only restriction is that you may only use one beaker.
3. The lab will run overnight and results will be gathered and submitted the following day.
4. You must use the official form to detail your procedure and show your results. Be sure to include the exact amounts of material used.

****** <u>All mass measurements must be taken and certified by the teacher</u>. ******

Diffusion and Osmosis Lab – Official Entry Form
Complete the drawings below. Include the components and quantities used both in the bag and in the beaker.

Day 1:



Total mass of bag = _____ _____(initials)
Type of solution (in beaker) = _____

A. In Diagram A, write in the components and amounts used in both the beaker and the bag.
B. In Diagram B, write in the percents of sugar, salt, starch, and water in both the beaker and the bag. Use this space to show your calculations.

- Add arrows to show which directions you think the substances will move.
- The mass of the bag will _____. (Hypothesis)

Day 2:

Total mass of bag = _____ _____(initials)

Change in mass = _____

% change in mass = _____

Use this space to show your calculations.

Analysis:

1. Explain specifically what you *think* happened to cause the change in the bag's mass. Does this support the hypothesis from Day 1?

2. How would you change the procedure to get a larger % change? Why?