# Lab report osmosis

Science, Biology

**Abstract**

In this study, we tested the validity of osmosis in artificial animal cells. Osmosis is the diffusion of free water across a membrane. The purpose of the study was to calculate the rate of osmosis in artificial cells containing different concentrations of sucrose and water. We studied the rate of osmosis in artificial cells by creating five different dialysis bags with different concentrations of both sucrose and water and calculating the cumulative change in weight ever 10 minutes for 90 minutes. Our results for the artificial cells showed different concentrations moved from high to low concentrations- through hypotonic movement or hypertonic movement.

Introduction The main purpose of this paper is to assess the rate of change with osmosis for different concentrations of sucrose in artificial cells.

Since the human body is composed of trillions of cells that contain roughly 85% of water, makes osmosis a very important concept. The forces that affect osmosis are the concentrations of solutes surrounding the cell or inside of the cell. Water will then move across the cell membrane and create a balance of water between the cell and itsenvironment. In order to calculate the average rate of change for our artificial cells, we must understand tonicity as the ability of a nearby solution to cause a cell to lose or gain water, depending on its concentration of non-penetrating solutes relative to solutes inside the cell. The dialysis bags used in this experiment have membranes that are selectively permeable, which only allows particles specifically small enough to pass through.

In a hypotonic solution, water goes into the cell because the solute is more concentrated inside the cell, while in a hypertonic solution, water moves out of the seller because the solute is more concentrated outside of the cell. We are testing the effect of osmosis on different concentrations of artificial cells by calculating the cumulative change in weight and the corrected cumulative changes in weight and by determining whether a solution is hypertonic, hypotonic, or isotonic. We predicted that a dialysis bag holding tap water in a beaker also containing tap water is in an isotonic solution. While 20% sucrose, 40% sucrose, and 60% sucrose in beakers containing tap water is considered hypotonic solutions. Lastly, the dialysis bag holding tap water in a beaker containing 40% sucrose is a hypertonic solution. This will result in isotonic solutions remaining at the same weight, hypotonic solutions gaining weight, and hypertonic solutions losing weight. We tested this by creating the five different dialysis bags with different concentrations of sucrose in order to measure the weight change in grams of the bag after nine 10 minute increments. Methods and Materials

This experiment took place on Monday, February 6th, 2011. During this time, we tested the effects of different sucrose concentrations on the rate of osmosis in artificial cells we made with dialysis tubing. We studied five different dialysis bags containing 10mL of different concentrations of tap water and sucrose. Two contained tap water while three contained different concentrations of sucrose, varying from 20% to 60%. Each bag was placed in a beaker surrounded by either tap water or 40% sucrose. We began the experiment by soaking the dialysis tubes to prepare them for the sucrose concentrations they would be filled with. Taking each bag, two were filled with 10mL of tap water, one filled with 10mL of 20% sucrose, one with 10mL of 40% sucrose, and another with 10mL of 60% sucrose. Each bag was clamped closed. All the bags were weighed before being placed in their corresponding beakers in order to record their initial weight in grams. The bags were put in their corresponding beakers, all of which contained tap water, except beaker #5 (tap water bag #5 was placed in beaker #5 which instead of holding water, was filled with 40% sucrose) concurrently, recording the time.

In the same manner in which the bags were placed in the beakers simultaneously, remove the bags every 10 minutes, and record the weight of each bag. This process should be repeated for at least 90 minutes in total. This data was analyzed by calculating the cumulative change in weight for each dialysis bag. This was done from subtracting the weight of each bag from the initial weight of the bag. Doing so, allows the weight of each bag to be initially zero. For that, we must calculate the corrected cumulative change in weight. For each time interval of 10 minutes, we subtracted the change in weigh of bag #1 (tap water) from the weight of each bag at the specific time measure- this corrected any oscillations. Results in The corrected cumulative change in weight due to osmosis from different concentrations of sucrose and tap water are shown in Figure One. This figure shows the weight change in grams for every interval of 10 minutes. Using the corrected cumulative change in weight eliminates bag #1 because its average rate of change will always be zero.

The purpose of this experiment was to determine the relationship between concentration gradients and the rates of osmosis. Using the corrected cumulative change, we can monitor the rate of change for each bag, and correlate the rate of change to the rate of osmosis. For bag #2, the slope, or the rate of osmosis was y = 0. 1193x - 1. 7293, displaying a slow but obvious increase in weight or a hypotonic solution, when the solute was more concentrated inside the cell and water moved into the cell. Bag #3 continues to show this trend with a quicker rate of y = 1. 295x - 2. 4807, which water enters this bag as a hypotonic solution. Bag #4, which a rate of y = -1. 0586x + 1. 9043, shows a hypertonic solution in which the low concentration solute, causing the water inside the dialysis bag, to move out.

Although it was expected for bag #5, which was tap water submerged in 40% sucrose, to be hypertonic, the rate of osmosis was y = 1. 3536x - 0. 1679, which demonstrates a hypotonic solution, or water entering the cell, or moving from a high concentration of the solute to a low concentration. These results prove that the direction of osmosis does directly affect the rate of osmosis. If the slope begins with a negative x value, the solution is indeed a hypertonic solution, that when surrounding a cell will cause the cell to lose water, moving from a high concentration to a lower concentration. The slopes which begin with a positive x value demonstrate a hypotonic solution, which causes a cell to take in water. This shows that the direction of osmosis is directed related to the rate of osmosis, or vice versa. The rate of osmosis ultimately determines the direction of osmosis. Depending on which direction osmosis is going- hypertonic, isotonic or hypotonic, determines the rate of osmosis, or the rate of change for each dialysis bag. Or by the means of our experiment, the direction of osmosis was determined by the rate of change in each bag, or the rate of osmosis.

Discussion

Throughout the study, it was concluded that different concentrations of sucrose are allowed at different rates and directions of osmosis. The results show that the rate of osmosis is directly related to the direction of osmosis, or vice versa. This proposal does not match with our quantitative prediction. Our results for the artificial cells showed different concentrations moved from high to low concentrations- through hypotonic movement or hypertonic movement; however, bag #3 with 40% sucrose was expected to be a hypotonic solution, while it was a hypertonic solution. This falsified hypothesis could be due to the explanation that in an animal cell, when a hypertonic solution, the cell experiences crenation. The dialysis tubing creates a theoretical flaw in our experiment because the tubing has a molecular weight cut off of a maximum of 14 kilodaltons, while the average human cell may have a larger or smaller molecular weight cut off, allowing the cell to experience different tonicities. In order to obtain more accurate results, modifications should be made. More drastic concentrations of sucrose in the dialysis tubing should be tested in order to find the extremes of the rate of change for osmosis.

The study enhances the presentscholarshipin this area by exposing osmosis along a free energy gradient. However, other experiments could increase our knowledge about the relationship between concentration gradients and rates. An experiment that includes the idea that the selectively permeable membrane moves, might allow for more accurate results (Patlak and Watters). The qualified location mirrors the volume of each side of the membrane, which affects the total number of particles on each side (Patlak and Watters). Our experiment exposes the ideal notion that there is no net movement of a solvent and the water is what diffuses across the membrane.

# Reference

1. Carmichael, Jeff, Mark Grabe, and Jonathan Wenger. Biology 150 Laboratory Review. The University of North Dakota, n. d. Web. 7 Oct. 2011.
2. Patlak, Joseph, and Chris Watters. Diffusion and Osmosis. University of Vermont and Middlebury College, 1997. Web. 8 Oct. 2011.
3. Reece, Jane B., et al. Campbell Biology. San Francisco: PearsonEducationInc., 2005. Print.