Osmosis and Diffusion Formal Lab Report

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**Introduction**

The purpose of this lab was to investigate the processes of diffusion and osmosis in a model membrane system. They also investigated the effect of solute concentration on water potential as it relates to living plant tissues. The group also discovered the process of diffusion and osmosis.

In this lab, the group hypothesis was that we would see the weight increase due to the fact that the scientific community tells us that the substance will attempt to reach equilibrium by taking in water. They tested their hypothesis because they wanted to find out how a cell membrane worked. The group also based their hypothesis on the prior knowledge that the water is small enough to cross the cellular membrane and will most likely cross the membrane into the cell in order to achieve equilibrium.

Diffusion is the process by which molecules mix as a result of their kinetic energy of random motion. Try to imagine two separate glass boxes that are touching each other on one side and they each hold a different kind of gas. In both of the containers the molecules in each of the gases are in constant motion and collide with the glass. If the glass were removed from the sides that are touching, the gases would mix. After a certain amount of time the amounts of gas “A” and “B” will be equal in both containers. This told the group that diffusion is the passive movement of molecules/particles from a region of higher concentration to one of lower concentration. Osmosis on the other hand is the diffusion of fluid through a semipermeable membrane from a solution that contains a low solute concentration to a solution with a high solute concentration until there is an equal concentration of fluid on both sides of the permeable membrane. In order for the liquid to reach this state of equilibrium the two different solutions must diffuse across the membrane from the less concentrated solution to the higher concentrated solution.

There is also a process known as the concentration gradient. The concentration gradient is the gradual change in the construction of solutes in a solution as a function of distance through a solution. In biology, a gradient is the result from an unequal distribution of ions across a cell membrane. As a result of this, the solutes move along a concentration gradient. This movement is known as diffusion. (Unknown, 2008)

A cell membrane is a very thin, semipermeable membrane that surrounds the cytoplasm of a cell. The cell membrane is mainly composed of a mix of lipids and proteins. Depending on the location of the membrane in the body, the lipids can make up 20 to 80 percent of the cell membrane. The rest of the membrane is composed of proteins. Lipids give the membrane their flexibility while proteins maintain and monitor the cell’s chemical climate. The lipids also assist in the transfer of molecules across the membrane. Cholesterol is also a lipid component of cell membranes. Cholesterol stiffens the membranes. Cholesterol is not found in the membranes of plant cells. There are many different proteins that are found in cell membranes. Structural proteins give a cell support and shape. Receptor proteins help cells communicate with their internal environment by ways of hormones, neurotransmitters, and other signaling molecules. Transport proteins transport molecules across cell membranes through the process of facilitated diffusion. Glycoproteins are embedded in the cell membrane and help the process of cell-to-cell communications and the transport of molecules across the cell membrane. Glycoproteins actually have a carbohydrate chain attached to them. (Bailey, 2012)

Dialysis tubing can be used to model a cell membrane because dialysis tubing is a semi-permeable membrane. This replicates a cell membrane because it can be used for diffusion with solutes or osmosis if it is used with water only. (Unknown, 2012)

In this lab, Group 6 discovered that equilibrium in a cell could be both beneficial and harmful at the same time. Equilibrium is good because it allows good materials to enter into the cell. Equilibrium is bad because it can make the cell shrink. This was proven to them because of the lab that they did called “Observing Cell Plants and Processes”. In this lab they observed how cells can grow/shrink while being exposed to hypertonic and/or hypotonic solutions.

Diffusion and osmosis are vital to cells in order to keep them alive. Without diffusion, the cell could not get the important nutrients that it needs in order to survive. Osmosis is important because, in animals, it influences the distribution of nutrients and the release of waste that is produced in the cell. In plants, osmosis is partially responsible for the absorption of water from soil and for the elevation of the water to the leaves of the plant. (Unknown, Unknown)

**Method**

Our procedure went as follows: First, Group 6 had to obtain six 30-cm strips of presoaked dialysis tubing. Once they did that they had to tie a knot at one end of each piece of dialysis tubing to form six bags. Then they poured approximately 25 milliliters (mL) of each of the following solutions into separate bags: distilled water, 0.2M sucrose, 0.4M sucrose, 0.6M sucrose, 0.8M sucrose, and 1.0M sucrose. After that, they removed most of the air from each of the bags by drawing the dialysis bags between two fingers. They then tied off the other end of each of the bags. They made sure that they left sufficient space for the expansion of the contents in the bag and that the solution filled only about one-third to one-half of the piece of tubing. After that they rinsed off each bag gently with distilled water in order to remove any sucrose spilled during the filling of the tube. They then carefully blotted the outside of each bag and recorded the initial mass of each bag in Table 1.2. They expressed the weight in grams. They then proceeded to fill six 250-mL beakers or cups two-thirds full with distilled water. After that they immersed each bag in one of the beakers of distilled water (H2O) and labeled the beaker/cup to indicate the molarity of the solution that we put in the dialysis bag. They made sure to completely submerge each bag. This can be shown in Diagram 1.0

Diagram 1.0

250-mL Distilled Water

Dialysis Tube

DW 0.2M S. 0.4M S. 0.6M S. 0.8M S. 1.0M S.

After this they let them stand for 30 minutes. After the 30 minutes were up, they removed the bags from the water and carefully blotted the bags. They then determined the mass of each bag. Finally, they recorded their group’s data in Table 1.2. Then Group 6 gathered data from the other groups in their class and completed Table 1.3 and Table 1.4. (College Board, 1997). They then compiled all of the percent changes in data into Graph 2.0.

In this lab the dependent variable was the percent change in mass and the independent variable was the molarity of the substance in the dialysis tube. They calculated the dependent variable, the percent change in mass, by measuring each dialysis tube before and after putting it in the distilled water. They then calculated the percent change in mass by dividing the larger mass by the smaller mass. This gave them the percent change in mass.

In this lab, Group 6 performed six trials simultaneously. Each trial consisted of a change in the substance in the dialysis tube. They did this because they wanted a large range of data to work with.

**Results**

Table 1.1

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Initial Contents | Initial Solution Color | Final Solution Color | Initial Presence of Glucose | Final Presence of Glucose |
| Bag | 15% glucose and 1% Starch | Clear | Blue | Positive | Positive |
| Beaker | H20 and IKI | Yellow | Yellow | Negative | Positive |

Table 1.1 describes the experiment that Mrs.Paxhia set up. In that experiment, the topic of diffusion was described. The class found that the starch molecules were too big to pass through the membrane. They found this to be true because the color of the substance in the beaker did not change. The iodine on the other hand was small enough to pass through the membrane. They found this out because the color of the glucose/starch mixture changed from clear to blue. They also found that the glucose was small enough to pass through the membrane because the substance in the beaker did not contain glucose before the experiment, but did contain glucose at the end of the experiment. This lab demonstrated the process of diffusion.

In order to find the percent change in mass we had to use the equation



**Sample Calculation:** *Note: This information was taken from Table 1.2 Distilled Water.*



With this information Group 6 found that as the molarity increased, so did the percent change in mass.

Table 1.2

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Contents in Dialysis Bag | Initial  Mass (Grams) | Final  Mass (Grams) | Mass  Difference | Percent Change  In Mass (to the nearest hundredth) |
| Distilled Water | 24.93g | 25.44g | 0.51g | 2.05 |
| 0.2M | 25.72g | 27.48g | 1.76g | 6.84 |
| 0.4M | 26.05g | 28.42g | 2.37g | 9.10 |
| 0.6M | 26.80g | 30.45g | 3.65g | 13.62 |
| 0.8M | 27.24g | 32.11g | 4.87g | 17.88 |
| 1.0M | 27.82g | 33.05g | 5.23g | 18.80 |

This data table describes the data that Group 6 collected from the lab. They measured the initial mass (in grams), the final mass (in grams), and the percent change in mass (to the nearest hundredth) for each of the solutions in the dialysis tubs.

Table 1.3

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Group 1 | Group 2 | Group 3 | Group 4 | Group 5 | Group 6 | Group 7 | Group 8 | Class A1 Average Percent Change in Mass (to the nearest hundredth) |
| Distilled Water | \*24.06 | 1.09 | 1.76 | 4.76 | 2.22 | 2.05 | 1.46 | 1.009 | 2.05 |
| 0.2M | 6.16 | 8.53 | 6.79 | 7.80 | 4.90 | 6.84 | 5.81 | 2.40 | 6.15 |
| 0.4M | 10.90 | 12.75 | 10.00 | 8.91 | 12.39 | 9.10 | 17.52 | 4.78 | 10.79 |
| 0.6M | 10.11 | 4.14 | 7.90 | 14.20 | 8.90 | 13.62 | 14.18 | 9.62 | 10.33 |
| 0.8M | 22.21 | 11.71 | 13.30 | 15.30 | 12.50 | 17.88 | 14.29 | 1.57 | 13.60 |
| 1.0M | 19.69 | 15.45 | 13.80 | 13.40 | 21.44 | 18.80 | 6.14 | 4.02 | 14.09 |

\*Not included in class average

This data table describes the data that the Biology A1 class collected. Each group in the class plugged in the percent change in mass that they found for each of the substances in each of the dialysis bags. They then added the percent changes in mass together and divided them by the number of groups from which that data was taken from in order to get the class average percent change in mass for each of the substances.

Table 1.4

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Group 1 | Group 2 | Group 3 | Group 4 | Group 5 | Group 6 | Group 7 | Group 8 | Class A2 Average Percent Change in Mass (to the nearest hundredth) |
| Distilled Water | 3.430 | -4.270 | -2.010 | 14.50 | 3.240 | 9.381 | -0.880 | -2.500 | 2.61 |
| 0.2M | 8.440 | 5.430 | 0.922 | 5.680 | 1.119 | 4.815 | 4.690 | 7.200 | 4.78 |
| 0.4M | 11.54 | 9.650 | 6.230 | 26.95 | 1.797 | 8.715 | 13.29 | 8.100 | 10.78 |
| 0.6M | 17.09 | 20.40 | 10.30 | 17.10 | 12.45 | 16.27 | 14.09 | 5.700 | 14.17 |
| 0.8M | 14.85 | 18.10 | 11.50 | \*55.22 | 11.00 | 10.11 | 21.10 | 15.90 | 14.65 |
| 1.0M | 22.02 | 17.80 | 14.50 | 20.06 | 12.63 | 18.53 | 20.38 | 15.30 | 17.65 |

\*Not included in class average

This data table describes the data that the Biology A2 class collected. Each group in the class plugged in the percent change in mass that they found for each of the substances in each of the dialysis bags. They then added the percent changes in mass together and divided them by the number of groups from which that data was taken from in order to get the class average percent change in mass for each of the substances.

Graph 2.0

This graph shows all of the percent changes on mass from all three of the data tables and their corresponding molarities. They found that the data points on the graph are fairly close to each other. The trend that they found was that as the molarity increased, so did the percent change in mass.

**Discussion and Conclusion**

The purpose of this lab was to investigate the processes of diffusion and osmosis in a model membrane system. The group also investigated the effect of solute concentration on water potential as it relates to living plant tissues. In this lab, the group hypothesis was that we would see the weight increase due to the fact that the scientific community tells us that the substance will attempt to reach equilibrium by taking in water. They determined that as the molarity of the sugar solution increased, so did the percent change in mass.

The data in Table 1.2 shows that the percent changes in mass were as follows: 2.05% for distilled water, 6.84% for 0.2M, 9.10% for 0.4M, 13.62% for 0.6M, 17.88% for 0.8M, and 18.80% for 1.0M. This data proved the group’s hypothesis that as the molarity increases, so does the percent change in mass.

The group’s control for this experiment was the distilled water inside of the dialysis tube placed inside of the distilled water cup/beaker. There were two discrepancies that occurred within our data. One was on Table 1.3, which stated that the percent change in mass was 24.06% for the distilled water. This number was far off from the other percent changes in data, so they decided to exclude it from the class average percent change in mass for distilled water. The second occurred on Table 1.4, which stated that the percent change in mass for a 0.8M solution was 55.22%. This data was extremely off from the data that the other groups found, so they decided to exclude it from the class average for percent change in mass for 0.8M solution. The group believed that these discrepancies occurred because of human error. There is a large possibility that the group whose data was not included in the class average did not blot the bag properly both before and after putting the dialysis tubing into the distilled water. They may also have not weighed the dialysis tubing correctly because the scale was not set at 0 grams when they began weighing.

Group 6 believed that they got the correct results for this lab due to the fact that the scientific community tells us that, due to osmosis and diffusion, the percent change in mass should have increased, which it did. This lab showed the group that since the solutes were so large, they could not pass through the semipermeable membrane of the dialysis tubes. In order for a solution to reach equilibrium, it would have to take on water. Depending on the amount of molarity a solution has, the more or less water it will need to take in. The larger the amount of molarity a solution has, the more water it will need to be diffused across the cell membrane and into the cell in order to reach equilibrium.

If it were not for the cell’s ability to diffuse substances across its semipermeable membrane, it would have no way to reach equilibrium or to get rid of the waste produced inside of a cell. In a human body, osmosis and diffusion are necessary in order to carry out the life functions of a cell.

After this experiment had ended, Group six began to wonder if they could speed up the processes of osmosis and diffusion in order to decrease the amount of time it took for the lab to be completed. All in all this lab was extremely enjoyable and the group would like to have a chance to do it again in order to remove the discrepancies in the data and learn more about the process of osmosis and diffusion.