

Ap bio osmosis and diffusion lab essay



**ASSIGN
BUSTER**

1) The relationship between the rate of diffusion, volume and surface area is that the surface area of a subject somewhat correlates with the volume of the object. When the surface area and volume are set up as a ratio, this gives a good idea as to how fast the rate of diffusion will be. The higher surface area to volume ratio, the faster the rate of diffusion. This is because then there is more surfaces to diffuse through and there materials to diffuse, the rate of diffusion is a lot faster. Conversely, when there is a smaller surface area for more molecules to diffuse through, the rate of diffusion will be lower.

2) A few different dialysis tubes, which are semi permeable, will represent a cell's semi permeable membrane. Using different solutes such as egg white, NaCl, glucose, sucrose, and water (as a control) I would create different volumes inside the " cells" as each of these substances has different molarities and densities. By placing the cells into pure water environments, it would represent a cell's external environment whose water potential is 0, allowing maximum water and solute movement. By placing the different " cells" into the same kind of aqueous environment, it would be easy to compare the change of weight in the cells and ultimately the rate of osmosis.

By pre weighing each of the cells before placing them in the environment, this gives us a sense of how dense and concentrated each solution in the cells are. The rate of osmosis can be tested by leaving each cell in for only 30 minutes, then taking them out of the beakers. By weighing the weight of the different cells, it will be easy to compare which cells had the fastest rate of osmosis (the cells which are the lightest) to the cells with the slowest rate of osmosis (the cells which are the heaviest). The direction of osmosis would

automatically be assumed to be out of the cell, as the water potential is higher inside of the cell, due to the various solutes. The reason as to why the resulting lighter cells would have the higher rate of osmosis is because the solutes inside the cells had a higher water potential, which means the molecules would diffuse out into the pure water environment, causing loss of weight.

3) Osmosis in plant cells is the exact force that creates turgor pressure, or resistance to water movement as well as the process of plasmolysis. Turgor pressure is created by the pressure of the water inside the cell, created by water flowing in from the comparatively hypotonic solution environment. When this occurs, the water begins to build up a pressure inside the cell as the water flowing in causes the cell walls to be pressed out. Conversely, osmosis in plant cells can also cause plasmolysis. Plasmolysis is caused when a plant cell is placed in a comparatively hypertonic environment, causing water to flow out of the cell and into the environment.

Because plant cells have cell walls though, the cell does not completely collapse as the cell walls keep the cell's structure, while only pulling a little away from the cell membrane (because there is no incoming water causing pressure to push the walls out). When plasmolysis occurs, all the organelles in the plant cell begin to become concentrated in the center of the cell, as the cell wall moves, in further from the cell membrane.

4) First, we will place potatoes into various concentrated sucrose (which are colored to distinguish the different concentrations as well as the travel in osmosis) environments in which will represent plant cells with their cell walls.

Then, by having the environments of different concentrations of colored sucrose, it will allow the diffuse at different rates. By pre-weighing the potatoes, it will allow us to compare the potatoes later to an unaffected control. After leaving the potatoes in the solutions for a while, allowing for osmosis. Then, by weighing each of the potatoes (after they had been soaked), we will be able to tell where the potato had a higher water potential than the environment and lost weight or had a lower water potential and gained weight.

This is because when a potato's weight changes, it is because of the difference in the water potential between the potato and its concentrated sucrose environment. The control of this lab would be the water potential and molarity of the potatoes, while the independent variable would be the molarity and water potential of the sucrose in the environments and the dependant variable would be the change in ultimate weight of the potatoes (after being placed in the environment). 7) The higher the surface area to volume ratio, the better the rate of diffusion will be for a cell. This is because it allows for the necessary high speed of osmosis to occur (so that necessary cell processes could be carried out). Plasmolysis is a process that occurs when plant cells are put in comparatively hypertonic solutions. This causes the plant cells to “ shrivel” up (due to loss of internal water and Turgor pressure). This pushes all the organelles into the center of the cell, with the exception of the cell wall. In plasmolysis, the cell wall simply peels slightly away from the cell membrane, due to the fact that it lacks the necessary Turgor pressure to hold up against it.

Statement of Problem: How do volume, surface area and water potential effect diffusion and osmosis rates? Hypothesis: I predict that the larger the surface area to volume rate, the fast the rate of osmosis/diffusion will be due to the fact that it has more locations in which molecules can diffuse. Having different water potentials will affect osmosis because the higher the potential the water potential is in one location will define which way materials will osmosis in. The higher the water potential in one location compared to another location, will cause the water and molecules to move from the high potential to the low water potential. Lab Design

Control: The cell and its extracellular environment Independent Variable: The cell and its volume, surface area, and the water potential of the internal cell and its environment Dependant Variable: The effects rate of diffusion/and or osmosis Repeated Trials: In procedure one, we tested diffusion on different sized cell models (gelatin with various volume and surface area wise). In procedure two, we tested cell models in different internal environments and similar external environments to find the effects on rate of osmosis. In procedure three, we used potato cells in different concentrated sucrose environments to test the effects on water potential on cells and osmosis.

Conclusion:

1. The relationship between rate of diffusion/ osmosis, volume, and surface area can be easily seen and analyzed through the data that was collected from procedure one: Surface Area and Cell Size. Phenolphthalein is a dye-material in this lab that was used to determine whether a substance was an acid or base. This could be told as the phenolphthalein changed into a

murky. Muddled and clouded color when mixed with acids. When the chemical aid was mixed in with a base, the color evolved into a vivacious purple, almost Barney purple. The use of this dye in the lab was to act as a visual aid to measure the rate of diffusion in different sized blocks of gelatin, consisting of agar.

The first and smallest gelatin block had a surface area of 1.92 cm squared and a volume of 0.18 cm cubed. Our midsized/ medium gelatin specimen had a surface area of 12.612 cm squared and a volume of 2.96 cm cubed. The largest gelatin cube possessed the volume of 5.3 cm cubed and a surface area of 18.4 cm squared. It took 8:04 minutes for the hydrochloric acid to diffuse completely through the smallest gelatin block. This was regulated and measure visually, as the pink color from the gelatin block had began to diffuse out, due to the acid. The midsized gelatin block had a diffusion time of 40 minutes. It took approximately an hour for the largest gelatin block to diffuse completely. The smallest gelatin block's surface area to volume ratio was 10.67 cm.

The medium block had the ratio of 4.3 cm, and the lowest ratio belonged to the largest gelatin block, whose time was 3.5 cm. This data goes to prove the fact that the higher the surface area to volume ratio, the faster the diffusion rate. This lab's data and facts revealed from it explain the phenomenon as to why most cells generally have a relatively high surface area to volume ratio. The reasoning behind this is that cells need a specific amount of diffusion to take place for cells to gain and lose specific material. This is in order to perform specific cellular processes.

2. The self designed experiment used a model system to measure the rate of osmosis, based off of some basic guidelines provided by the directions in Procedure 2: Modeling Diffusion and Osmosis. Dialysis tubing was used as a model for a selectively permeable ‘ membrane’ that allowed for water to diffuse in and out, yet not restricted other substances from osmosis. Each of the four test “ cells” /dialysis tubes was filled with various solutions, 10 mL of a single solution per “ cell”. The solutions that were used in this lab goes as follows: , 1 M NaCl, 5% ovalbumin (protein that comes from the whites of eggs / egg whites), 1 M sucrose, and 1 M glucose. Prior to soaking the “ cells” in the pure water extra cellular environment, each of the “ cells” were weighed, so that it would be possible to compare the amount of water that diffused into the cell.

Each cell was put into water for approximately 20 minutes. This allowed water to diffuse through the model cell . The sucrose solution filled “ cell” gained 3. 03g of water by diffusion from the environment, the glucose solution “ cell” gained 2. 08g of water, the NaCl solution ‘ cell’ gained 0. 73g of water and the ovalbumin solution ‘ cell’ gained 1. 08 gram of water. This data reveals that the sucrose solution filled cell was the most hypertonic, then glucose, ovalbumin, and the most hypotonic was NaCl. Hypertonic means that the dissolved molecules are relatively more concentrated in the cell’s extracellular fluid, rather than the inside of the cell, causing the cell to lose water and molecules that diffuse out, ending often in plasmolysis.

The opposite of this is hypotonic, which is where the dissolved molecules are relatively more concentrated in the cell’s internal fluid, rather than the outside of the cell. Because the most hypotonic solution, water molecules

that surrounded sucrose let it go, diffused into the 'cell' when water flowed down the relative free molecule concentration gradient, which is what caused the sucrose cell to gain the most weight.

3. Osmosis in plants cells was able to be analyzed by analyzing at the effects that a NaCL solution had on a elodea leaf's plant cells. The specimen provided for this short lab was an Elodea plant. The leaf was placed underneath the light microscope to analyze the structure and location of the plant cell's organelles. The elodea appeared to be distinctly normal, with the chloroplasts spread out in the cell interior, non-concentrated. Applying five droplets of the NaCL solution to the cells caused them to plasmolyze. Plasmolysis the process in which a plant cell is exposed to a comparatively hypertonic solution, causing the cell wall to pull away slightly from the cell membrane as the cell loses water to the environment and the organelles become concentrated.

4. To experiment measuring water potential in plant cells, six various colored and concentrated sucrose solutions were used. Each of these solutions had different molarities, varying from the range of 0- 1 moles (in 0. 2 mole increments). The specific concentrations and molarities of these sucrose solutions were unidentified. If one was able to identify the different specific molarities of each of the colored solutions, the one would be able to define the water potential of the test subject's (potato) plant cells. Six potato cylinders (the average potato weight being 8. 729 grams) and placed each potato into a different colored sucrose solution for 20 minutes.

After the time frame was over, each of the potatoes were weighed (in grams) and had their current mass subtracted from that mass the original average 8.729 g (weight a potato), to get the overall diffusion of water into or out of the cell. The pink potato lost, on average (of 5 lab groups) 2.392g in water weight. The blue potato lost, on average, 2.192 g in water weight. The yellow potato gained 0.13g in water weight. The green potato gained on average .389 g in water weight. The purple potato gained on average 1.29g of water weight. The teal potato gained on average 1.608g in water weight. The reasoning behind this is that when water flows out of the potato, the sucrose solution is hypertonic to the potato. Conversely, if water flows into the potato, the solution is hypotonic to the potato.

Molarity is the measurement of concentration, and it is a known understanding that the lower the concentration of a substance, the lower the molarity of the substance. With this understanding, it was easy to assume that the potato that lost the most water weight was in a solution the most hypertonic (comparatively to the potato), making it a high concentration, and or having a high molarity value. Likewise, the test subject potato that gained the most water weight from the sucrose solution was comparatively hypotonic to the potato, making it a low concentration, and or having a low molarity. Based off the data collected from this procedure and the known information, in order the sucrose solutions from lowest to highest molarity go as follows: teal, purple, green, yellow, blue, pink.

The molarities of the solutions (in that order) go as follows: 0, 0.2, 0.4, 0.6, 0.8 and 1 mole. Water potential also played a role in this lab as it helped determine in which osmosis would occur. If there was a high water potential

in the sucrose solution, the solution will go into the potato (who had a comparatively low water potential) as osmosis will go in the direction of high to low. When the potatoes lost weight in the lab, this was because they were in the solutions that were less concentrated and had lower molarities compared to the potatoes, meaning that the potatoes would lose water in the direction of the lower water potential sucrose solution.

7. After analyzing the data collected from the lab, it was clear to say that the higher the surface area to volume ratio, the better the rate of diffusion would be for a cell because it allows for the necessary optimum speed of osmosis to occur (so that necessary cell processes could be carried out). Water molecules gather around sucrose the most, causing the free water potential drop, making water flow down its concentration gradient and into the hypertonic solution until it can come to a dynamic equilibrium (a situation in which diffusion and or osmosis is still occurring, but the net value of materials lost/gained is 0). Plasmolysis occurs when plant cells are put in comparatively hypertonic solutions.

This causes the plant cells to “ shrivel” up (due to loss of water and Turgor pressure), which concentrates all the organelles into the center of the cell, with the exception of the cell wall. In this situation, the cell wall simply peels slightly away from the cell membrane, due to the fact that it lacks the necessary Turgor pressure to hold up against it. By comparing the net loss/gain of water weight in a plant cell, hypertonic/isotonic/hypotonic solutions can be identifies, and as the relative concentration/molarities can be discovered.