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Diffusion and Osmosis Lab

Introduction:

The purpose of this lab was to familiarize the processes of diffusion and osmosis. Diffusion is the movement of particles across a membrane (down the concentration gradient, in the direction of equalizing the concentrations of opposite sides of the membrane) in order to reach a state of equilibrium. Osmosis, like diffusion, is the movement of particles across the membrane in the direction to reach equilibrium, but pertains only to the transport of water. However, depending of the circumstances diffusion and osmosis can have different effects on a cell. In animal cells osmosis can cause a cell to burst (lysis) if too many water molecules enter into the cell if the concentration of solute in the cell is greater than outside it, or osmosis can cause the cell to shrivel up (crenation) when the inverse relationship is true. Plant cells act differently because the cell wall that is located around plant cells can keep the cell from bursting or shriveling, but only to a certain extent, eventually even the cell wall will give way. Water potential, the attractiveness an environment has for water molecules, can be calculated using the water potential formula. Water potential is equal to the solute potential and the pressure potential. The solute potential is normally negative, but distilled water at atmospheric pressure has a water potential equal to zero. Pressure potential is an external force providing pressure to the system, one example being a cell wall in a plant cell. In many cases (when dealing with animal cells) the pressure potential will be equal to zero. The experimenters used the water potential equation and tested the property of diffusion and osmosis by placing various amounts of sucrose into dialysis bags immersed in a beaker of water and looking what particles would travel into the dialysis bags.

Hypothesis:

Dialysis Bag: The higher the concentration of sucrose in the dialysis bag, the greater the % increase in mass will be for the given dialysis bag.
Potato Cores: The white potato cores in < 0.4M sucrose will have a - % change in mass while the white potato cores in ≥ 0.4M sucrose will have a + % change in mass. The sweet potato cores in < 0.6M sucrose will have a - % change in mass while the sweet potato cores in ≥ 0.6M sucrose will have a + % change in mass.

Materials and Methods:

Dialysis Bag:
This experiment was aimed at determining the molecules that can diffuse through the dialysis bags.

1. Add a glucose and starch solution to a dialysis bag after tying off one end and tie off the other end closing the bag
2. Submerge the dialysis bag in a solution of tap water and IKI indicator
3. Record the initial color of the dialysis bag contents and surrounding solution
4. After 30 minutes record the final color of the dialysis bag solution and surroundings

(Note: The authors of this lab report did not design this experiment and wish to give credit to

Carolina Biological Supply Company and Dr. Strong for creating and editing the lab instructions)

Dialysis Bags:
This experiment was designed to test the effect of Sucrose concentration in a dialysis bag on the diffusion of water through the dialysis bag.

1. Obtain 6 soaked dialysis bag tubes
2. Tie off one end of all tubes as closely to the end as possible
3. Use a pipette to add 5mL of varying Sucrose concentrations (and water) to a dialysis bag
4. Tie off last end of all tubes sealing the sucrose solution inside while leaving extra space within the bag
5. Mass each dialysis bag
6. Immerse each dialysis bag under tap water being sure the water level covers the top of the bag
7. record a final mass for each bag after waiting 30 minutes
8. Determine the % change in mass and graph the resulting data

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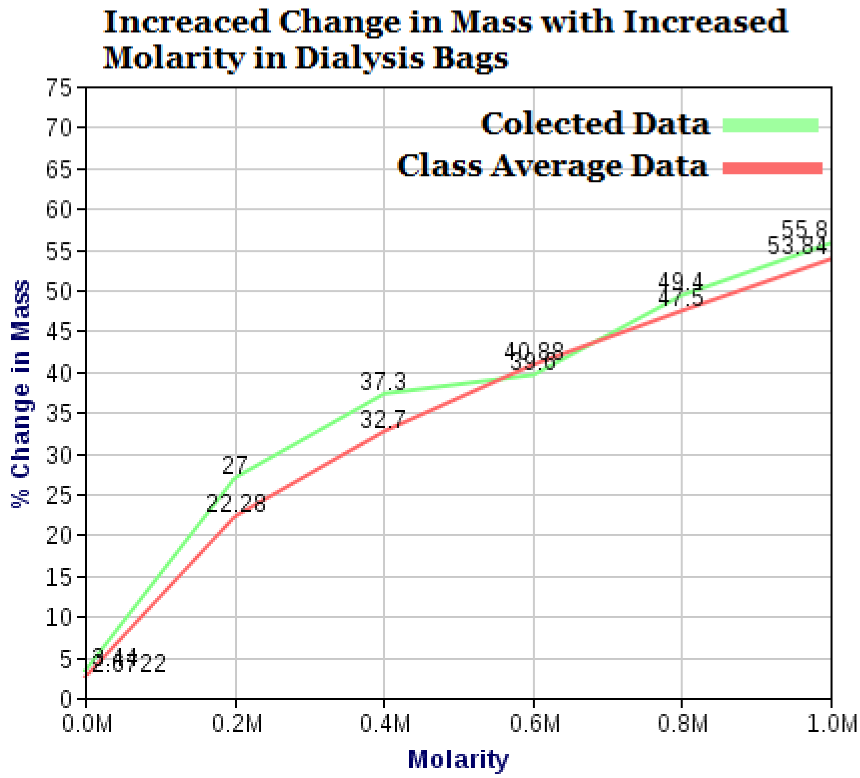
<u>Results:</u>
Dialysis Bag:
Dialysis bag contents has a strong blue tint while the surrounding solution remains colorless.

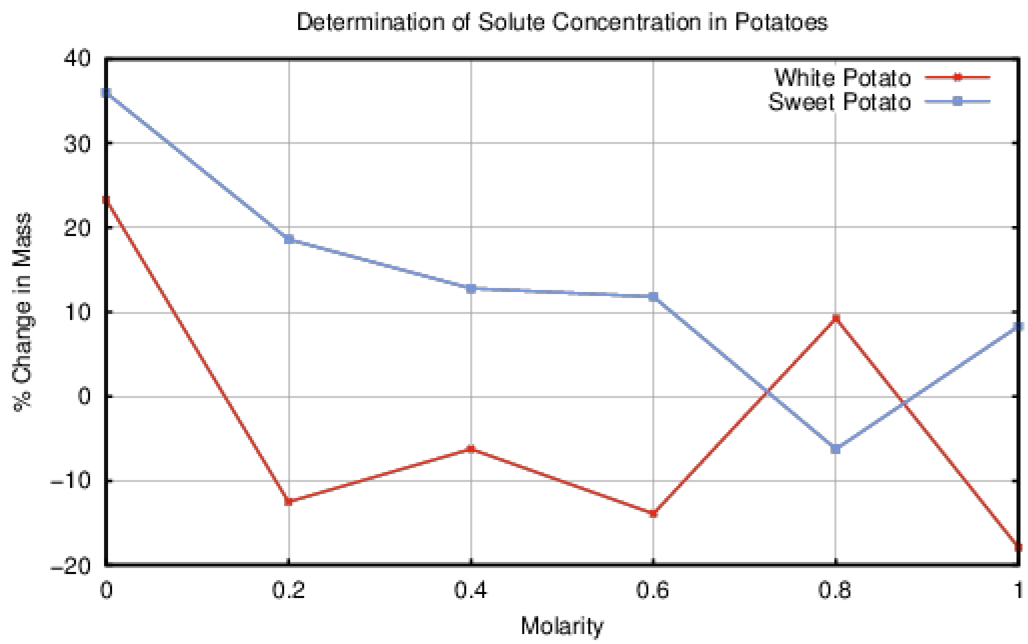
Dialysis Bags (graph by Rohil Parikh):

solution	initial mass (in g)	final mass (in g)	measured % change in mass	average % change in mass
A	5.81	9.26	37.3	32.7
B	6.46	12.76	49.4	47.5
C	5.75	7.88	27	22.28
D	6.68	15.13	55.8	53.84
E	6.46	11.30	39.6	40.88
water	6.09	6.69	3.44	2.6722



Potato Cores (graph by Stephen Clark):

solution (ordered by molar concentration)	% change in mass (sweet potato)	%change in mass (white potato)
water	36	23.3
C	18.6	-12.5
A	12.8	-6.25
E	11.8	-13.9
B	-6.25	9.23
D	8.3	-17.9



Ψw of Potato Cores:

$\Psi w = \Psi s + \Psi p$

$\Psi w = (-i*C*R*T) + \Psi p$

Ψw, sweet potato = $(-i * C * R * T) + \Psi p$

Ψw, sweet potato = (-1 * 0.72 mol/L * 0.0831 (L bars)/(mol °K) * 22 °K) + 0

Ψw, sweet potato = -1.316304 bars

Ψw, white potato = $(-i * C * R * T) + \Psi p$

Ψw, white potato = (-1 * 0.12 mol/L * 0.0831 (L bars)/(mol °K) * 22 °K) + 0

Ψw, white potato = -0.219384 bars

<u>Conclusion:</u>

Results for different molarities of sucrose in dialysis bags, yielded data as expected. The higher the molarity of the solution in the bags the more water transfer into the bag. This conclusion was drawn in all groups that obtained similar data (% change in mass) from the experiment. However, a possible source of error in this experiment is that a dialysis bag may have been allowed to dry after soaking closing up pores available for diffusion across the “membrane.” If this were to happen in single bags, outliers would be produced, but if this was a consistent part of the experiment, the data would be less dramatic because the dialysis bags would have spent some of the first half an hour re-soaking and opening up pores again. The second experiment involving the determination of the molarity of a potato using potato cores did not yield as conclusive results. The percent change in mass of the sweet potatoes was comparable to other groups data with an outlier. This graph showed us that the higher molarity the solution the less solute transferred to the potato until the potato experienced almost no solute transfer (as evident by a near 0 % change in mass). The graph then began to show an increase in solute lost with an increase in molarity after passing the molarity of the potato. The percent change in mass of the white potatoes was less conclusive. It seemed that all of our data was inaccurate, however the data showed the same trend as for the sweet potato, but showed that the white potatoes molarity would be closer to 0.125M. Error could have occurred in this section of the experiment if some potatoes were dry and others more recently cut or because the slices of potato were too small a sample size to get an accurate reading by lowering the effects of human error.