AP Lab #4 Inquiry

25/9/14

Materials

- Part 1
  - 1M NaCl solution
  - three different size red grapes
  - paper towels
  - (-scalpel)
  - balance + cup
- Part 2
  - 1M glucose
  - alcohol
  - milk
  - 5% ovalbumin
  - 1M NaCl
  - plastic bags
  - cups & balances
- Part 3
  - white and sweet potatoes
  - cork borers/scalpel
  - cups & balances
  - color-coded sucrose solutions, unlabeled

Procedure

Part 1

~~4. Submerge the grapes in salt solution for about 20 minutes.~~

1. Weigh each grape and record.
2. Submerge the grapes in salt solution for about 30 minutes.
3. Remove the grapes and place on a paper towel.
4. Weigh each grape and record.
5. Include any other observations.
6. Think about which grape had the highest increase in weight and why.

Part 2

1. Fill 5 plastic bags with 25ml of the individual solutions.
2. Fill 5 cups/beakers with 100ml of glucose solution.
3. Don't forget to label the bags.
4. Submerge the "cells" in the beakers after weighing each "cell".
5. Wait for 30 minutes and weigh them again.
6. Calculate the percent change in weight : (final-initial)/initial x 100
7. Record results.

Part 3

1. Cut enough same-size sweet and white potato pieces for each given solution.
2. Weigh the potato pieces and record.
3. Submerge the white/sweet potato pieces in each solution.
4. Wait 20-30 (?) minutes.
5. Record the final weight.
6. Use observations to determine the approximate molarity of the potatoes and each solution.
7. Which solutions caused gain or loss in weight? Did any of the potatoes stay the same weight?

Hypothesis

Part 1: If the (fructose-rich) grapes are submerged in salt solution for 20 minutes and the weight is recorded, water should move into the "cells" because salt concentration is lower in the grape.

Part 2: If each liquid is put in a plastic bag & submerged in glucose solution and glucose-in-glucose is the control, then the cells that have less free water concentration should increase in weight and the cells that have higher free water concentration (less solute) should decrease in weight.

Part 3: If sweet/white potato pieces are submerged in each solution and the increase or decrease in weight of these potato pieces is recorded, then the solutions in which the potatoes gain weight should have a lower molarity than the potato pieces and the solutions in which the potatoes lose weight should have higher molarity.

Data

Inquiry 1

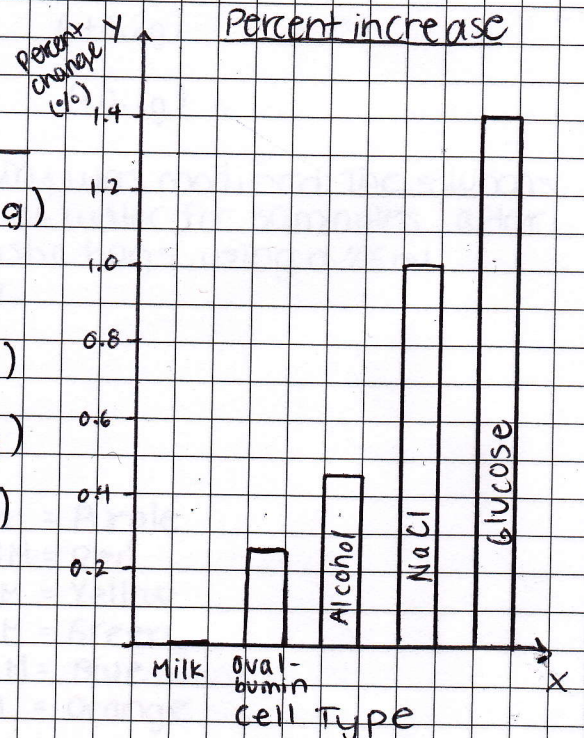
Grape	Initial	Final	Percent change
1	2.3g	1.9g	-17.4% (-0.4g)
2	2.7g	2.3g	-14.81% (-0.4g)
3	3.1g	3.9g	+25.81% (+0.8g)

Additional observations: smooth, regular skin on the grape before, after 20 minutes there is a white layer on the grapes, bubbling throughout the time in salt solution, left in fridge for extended time before experiment

Inquiry 2

Cell	Initial	Final	Percent change
glucose	62.1g	63g	+1.45% (+0.9g)
milk	72.7g	72.7g	———
alcohol	66g	66.3g	+0.455% (+0.3g)
albumin	77.9g	78.1g	+0.257% (+0.2g)
NaCl	66.7g	67.4g	+1.05% (+0.7g)

Additional observations: —



Inquiry 3

Change in weight for white & sweet potatoes in colored solutions

Color	Sweet Potato			White Potato		
	Initial	Final	Percent change	Initial	Final	Percent change
Green	2.2g	2.4g	+9.09% (+0.2g)	2.3g	2.4g	+4.5% (+0.1g)
Red	2.5g	2.5g	no change	2.4g	2.3g	-4.167% (-0.1g)
Purple	2.3g	2.3g	no change	2.2g	2.0g	-9.09% (-0.2g)
Orange	2.5g	2.6g	+4% (+0.1g)	2.4g	2.5g	+4.167% (+0.1g)
Yellow	2.4g	2.5g	+4.167% (+0.1g)	2.5g	2.4g	-4% (-0.1g)
Blue	2.3g	2.4g	+4.35% (+0.1g)	2.4g	2.5g	+4.167% (+0.1g)

Additional observations: White potato sunk to bottom in some solutions

Inquiry 3 (Data) October 1st

Change in weight of the "cells":

Color	Initial	Final	Percent change
Red	29.2g	29.4g	+0.685% (+0.2g)
Orange	25.7g	26g	+1.167% (+0.3g)
Yellow	28.8g	28.9g	+0.347% (+0.1g)
Green	27.4g	27.6g	+0.73% (+0.2g)
Blue	27.7g	28g	+1.083% (+0.3g)
Purple	29.3g	29.5g	+0.683% (+0.2g)
Water	26.8g	26.9g	+0.373% (+0.1g)

Additional observations: This part of the inquiry was modified. The solutions were left in 150ml of water for 30 minutes, after being filled into plastic bags, using a 25ml graduated cylinder.

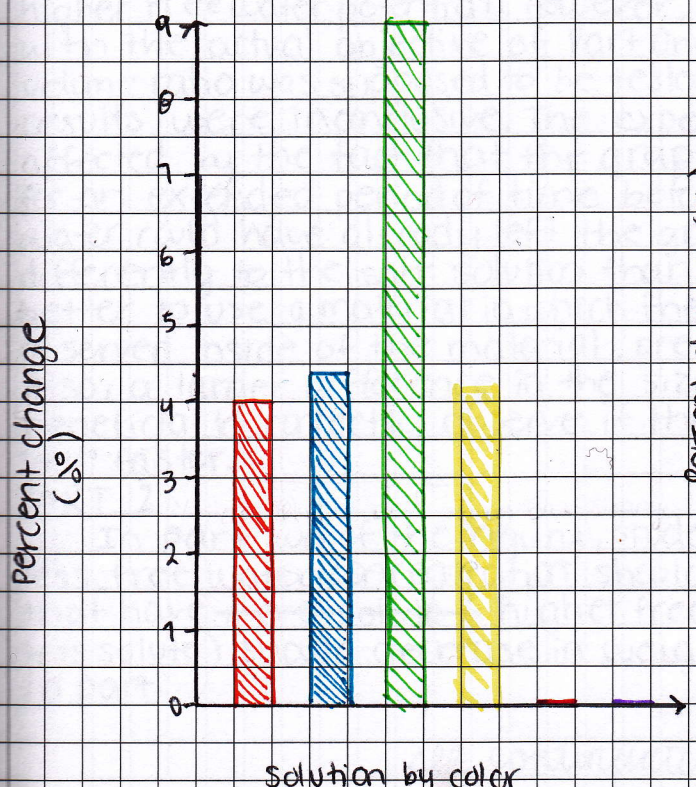
In order from highest percent increase to lowest percent increase (not counting the water cell):

Orange
Blue
Green
Red
Purple
Yellow

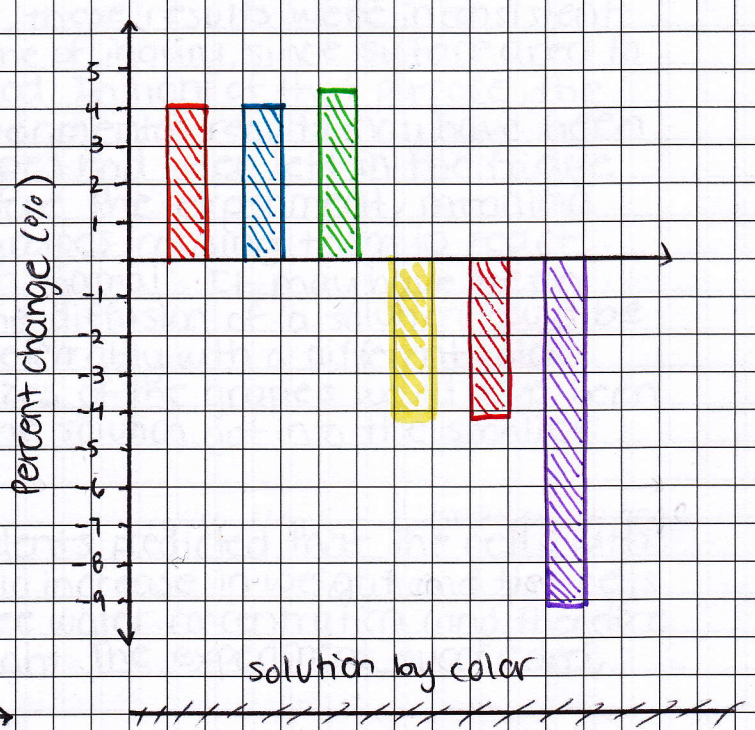
high molarity ↓ low molarity

Correct:
1M = Purple
0.8M = Red
0.6M = Yellow
0.4M = Green
0.2M = Blue
0M = Orange

SWEET POTATO



WHITE POTATO



Error Analysis

In Part 1 of the inquiry, fresh grapes had not been purchased, meaning water could have already left the grapes in substantial amounts during the time they spent in a fridge (over a month). This could have influenced how the grapes reacted to the salt solution.

In Part 2, mistakes in exact measurement of the solutions put into the bags could have been made. Mistakes while weighing the bags could have occured as well.

A number of mistakes could have been made in the third part of the inquiry. Firstly, students had to redo the experiment, because there were too many unknowns in the first try. Secondly, while testing for the molarity of each individual solution, errors while weighing could have been made as well, since the results did not reflect the correct molarities. Also, a better way to test the potatoes would have been to put them individually into a solution in their own beaker, not to put both the white and sweet potatoes in the same solution in the same beaker. Measurement errors were probably minimal.

Conclusion

PART 1

The first part of the inquiry for lab #4 was supposed to show the relationship between surface area to volume. The prediction was that water would move into the grapes if submerged in salt solution. The experimental results did not support this hypothesis, nor does it make all that much sense, since the assumption can be made that there is less solute (NaCl) inside the grapes than in the 1M NaCl solution. In the experiment, three different-sized grapes were submerged in salt solution for 20 minutes. Throughout this time, a white layer appeared on the surface of the grapes and bubbles appeared as well. Once their final weight was recorded, the results showed that only the largest grape increased in weight by 25% and the two smaller grapes lost weight by 14.81% and 17.4%. This could mean that the largest grape had higher solute concentration than the NaCl solution, which had higher free water potential. Since both smaller grapes decreased in weight, their solute concentration in relation to the solution must have been lower, meaning there was higher free water potential. However, these results were inconsistent with the actual objective of Part One of inquiry, since surface area to volume ratio was supposed to be tested. In light of that purpose, the results were inconclusive. The experimental results may have been affected by the fact that the grapes had been left in the fridge for an extended period of time before the experiment, meaning water could have already left the grapes, causing them to react differently to the salt solution than "normal". It may have been better to use a material in which the diffusion of a solution could be observed inside of the material, preferrably with a different color. Also, a larger difference in the sizes of the grapes would have been beneficial to correctly observe if the solution got into the smaller "cell" faster.

PART 2

In part two of the inquiry, students predicted that the cells with less free water concentration should increase in weight and the cells that have ~~more solute~~ higher free water concentration (and therefore less solute) should decrease in weight. The experiment succeeded, in part.

see continuation on page 20

Conclusion continued

Each cell experienced an increase in weight, except the cell that was filled with milk. In order from highest percent increase to lowest percent increase: glucose cell, NaCl cell, alcohol cell, and ovalbumin cell. The weight of the milk cell did not change. These results could mean that each cell that gained weight had less free water concentration and more solute than the 1M glucose solution that they were submerged in for 30 minutes. However, this is questionable, since the control of glucose-in-glucose experienced the highest increase in weight, which was not expected. The glucose solution inside and outside the semi-permeable membrane (plastic bag) was of the same molarity, which makes the rest of the results unreliable. In cells, water diffuses from an area of high water potential (less solute) to an area of lower water potential (more solute). This could show that each of the cells that gained weight had a higher concentration of solute than outside the cell. If the molarity of the solutions could have been tested after the cells had been submerged, the conclusions may have been different and more reliable or easily interpretable. Also, students used milk and alcohol, two solutions of which the molarity was unknown, which may have made it more difficult to understand the concept of water potential within cells. Lastly, students could have made mistakes in exact measurement and weighing of the solutions before and after the experiment. The permeability of the plastic bags could have played a role as well.

PART 3

In Part Three of the inquiry, that had to be redone after a first try, students predicted that the solutions in which the potatoes gained weight would have to be of lower molarity than the potatoes and the solutions in which they lost weight would have to be of higher molarity. This is quite plausible, since water moves from areas of higher water potential and less solute to areas of lower water potential and more solute. First, students used plastic bags filled with each of the six color-coded solutions in beakers of water to determine the molarity of each solution. Measurement errors and weighing errors could have caused the incorrect results that were obtained for the molarity of the solutions after being left in water for 30 minutes. The correct order of molarity from highest to lowest is purple (1M), red (0.8M), yellow (0.6M), green (0.4M), blue (0.2M), and orange (0M → water). Second, sweet and white potato pieces were cut with cork borers into a cylinder form and all weighed ~~2.5~~ 2.2-2.5 grams. Two potato pieces (one white, one sweet) were submerged in each solution for about 30 minutes, which may have affected the rate of diffusion, since they should have been put into each solution seperately to maintain accuracy of results. The sweet potato gained weight in the orange, yellow, and blue solutions of about 4% increase and gained about 9% weight in the green solution, which means each of those solutions had less solute than the sweet potato. The sweet potato's weight did not change in the red and purple solutions, meaning its molarity can be estimated at about 0.9M (between the molarities of the red and purple solutions). The white potato experienced a percent increase in weight of about 4% in the three solutions of lower molarity: blue, orange, and green. This means that water moved out of these solutions and into the white potato, meaning they were hypotonic to the potato. The white potato experienced a decrease in weight in the yellow, red, and purple solutions, meaning that water moved from an area of ~~higher~~ higher water potential to an area of lower water potential (the solutions). It can be inferred that these solutions were hypertonic to the cell and the white potato's molarity is about 0.5M, right in the middle of the molarities of the solutions.