OSMOSIS COURSEWORK

OSMOSIS

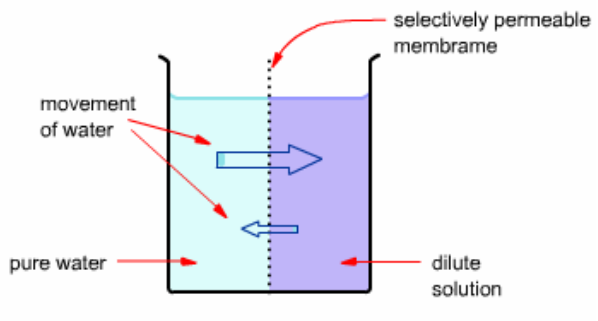
Aim:

To investigate the effect of different concentrations of salt solutions on the mass of potato tissue.

Background Information:

Osmosis

Some membranes allow some particles to pass through them and not others, they are partially permeable. Osmosis is a special type of diffusion - diffusion of water molecules through a partially permeable membrane. More water molecules pass from the water into the dilute solution than pass back the other way, because there is a hig her concentration of water molecules in the pure water than there is in the solution. Eventually the level on the more concentrated side of the membrane will rise, while that on the less concentrated side falls. When the concentration of water is the same on both sides of the membrane, the movement of water will be the same in both directions.



Osmosis in plants Plant cells have a strong cell wall surrounding them. When they take up water by osmosis they start to swell, but the cell wall prevents them from bursting. Plant cells become "turgid" when they are put in dilute solutions. Turgidity is very important to plants because this is what make s stand up into the sunlight. When plant cells are placed in concentrated sugar solutions they lose water by osmosis and they become "flaccid .

Prediction:

I predict the mass of potato will first increase then star t decreasing as the concentration of salt increases. I think this because at first water will enter the potato, because the water outside will have a higher concentration then water in the potato. This means that outside water will start moving into the po tato tissue because of osmosis increasing the mass of the potato. Then when the outside salt solution reaches a certain concentration, water from the potato will go out side decreasing the mass of the potato. In a graph showing the percentage change of potato mass cylinders in different concentrations of salt solutions, I think the graph will show that the mass will be high then slope down as the concentrations of salt solution get higher.

Apparatus:

Method:

1) First of all I will cut 6 pieces of potato using a potato borer. I will use a ruler to make sure that they will all have a diameter of 5 millimetres and will have a length of 3 cm if they were not I would use a knife and cut it to the length needed on a tile. Then I will measure the mass of all of them using a scale and record it.
2) Next I will have six different test tubes with 20 cm^3 of different concentrations of salt (sodium chloride) solution. I will measure 20 cm^3 using a measuring cylinder. The concentrations will be at 0M, 0.2M, 0.4M, 0.6M, 0.8M and 1M.
3) After that at the same time I will put all the potato cylinders in each of the test tubes.
4) I will time all the experiments for 40 minutes and take the potato cylinders out of the salt solution. I then will use a paper towel to take of any excess of salt solution. Then I will measure the mass using a scale.

Safety:

To make this experiment safe I will need to:

1. Be careful when using the borer as it is sharp
2. Do not taste or eat the potato to avoid the ingestion of dangerous chemicals
3. Be careful using a knife

Fair Test:

To make it a fair test I must:

1. Use the same amount of salt solution - 20 cm^3
2. Use the same size of potato - 3cm long and 5mm wide
3. Start and finish the experiment exactly the same time - 30 minutes
4. Keep the concentrations of salt solution as accurate as possible and use the same concentrations thought the three experiments.

Preliminary test:

I did a preliminary test to finalise how I will be doing this experiment.

Concentration of salt solution M	0.0	0.2	0.4	0.6	0.8	1.0
Mass before of potato cylinders (g)	0.41	0.44	0.44	0.42	0.44	0.43
Mass after of potato cylinders (g)	0.47	0.48	0.37	0.31	0.32	0.29
Change in mass of potato cylinders (g)	+0.06	+0.04	-0.07	-0.11	-0.12	-0.14

I have decided to keep my method the same but changing the time to 40 minutes from 30 as I believe will give me better results. I am happy with my results in the preliminary test. The preliminary test helped me inform my plan by giving me an idea how the experiment will be like and give expected results.

Results:

Test 1

Concentration of salt solution M	0	0.2	0.4	0.6	0.8	1.0
Mass before of potato cylinders (g)	0.99	1.02	0.98	1.01	1.01	1.01
Mass after of potato cylinders (g)	1.01	0.81	0.71	0.67	0.65	0.64
Change in mass of potato cylinders (g)	+0.02	-0.21	-0.27	-0.34	-0.36	-0.37

Test 2

Concentration of salt solution M	0	0.2	0.4	0.6	0.8	1.0
Mass before of potato cylinders (g)	0.98	0.96	1.00	0.98	1.03	0.97
Mass after of potato cylinders (g)	1.05	0.85	0.76	0.66	0.62	0.61
Change in mass of potato cylinders (g)	+0.07	-0.11	-0.24	-0.32	-0.41	-0.36

Test 3

Concentration of salt solution M	0	0.2	0.4	0.6	0.8	1.0
Mass before of potato cylinders (g)	1.04	0.93	1.05	0.99	0.99	0.98
Mass after of potato cylinders (g)	1.06	0.82	0.77	0.66	0.62	0.64
Change in mass of potato cylinders	+0.02	-0.11	-0.28	-0.33	-0.37	-0.34

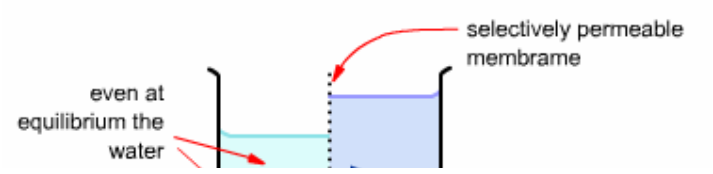
(g)						

Average results:

Concentration of salt solution M	Average mass before of potato cylinders (g)	Average change in mass of potato cylinders (g)	Average percentage change of mass (%)
0	(0.99+0.98+1.04) ÷ 3 = 1.00	(0.02+0.07+0.02) ÷ 3 = +0.04	(0.04÷1.00)×100= +4.00
0.2	0.97	-0.14	-14.43
0.4	1.01	-0.26	-25.74
0.6	0.99	-0.33	-33.33
0.8	1.01	-0.38	-37.62
1	0.99	-0.36	-36.36

Analysis of graph:

The graph shows me that at the point (0.04, 0) the concentration of the surrounding solution is the same concentration as the concentration of the cell sap. This means that the concentration of the cell sap is 0.04M. This is the point when the line crosses the x-axis. At this point, the salt solution that surrounds the potato cylinder is isotonic. This means that water diffuses into the potato and out of the potato at the same rate.



The general pattern shown by the graph is that as the concentration of the salt solution increased the average percentage change of mass decreased. The section above the x-axis shows that at first the mass of the potato increases as the first point is above zero percentage change. For the section below the y-axis, the points start to decrease as the rest of the points fall below zero .

At the concentration of 0M of salt solution, the mass increased. This is because the solute (salt) in the potato was at a higher concentration then the salt solution surrounding the potato cylinder. This means that the water diffuses into the cell, causing the cell to swell and become turgid. We can also say that water will enter the potato because the water outside will have a higher concentration then water in the potato. This means that outside water will start moving into the potato tissue because of osmosis increasing the mass of the potato. We can see this in the graph by looking at the first point that has increased in its percentage mass change.

Then at 0.2M of salt solution, the mass decreased. This is because the solute (salt) in the potato was at a lower concentration then the salt solution surrounding the potato cylinder. This means that the water diffuses out of the cell, causing the cell to shrivel and become flaccid. We can also say that the salt solution has a higher concentration then the potato so the water from the potato will go outside because of osmosis and decrease the mass of the potato. This happens for the next two points as each time the concentration gets higher the average percentage change of mass decreases. For example at the point at 0.4M of salt solution, the average percentage mass change was -25.74%. We can see this in the graph by looking at all the points below the x -axis as all those points have decreased in average percentage change of mass. This matches my prediction of the experiment exactly and the prediction of the graph.

Evaluation:

I believe that my results are reliable. I think this because my three experiments have results that all have similar values. Also all the points fit into the line of best fit. I believe that my method is as reliable as it could have been with the time and equipment available. If I would have to comment on any anomalies it would be for the point on my graph which was at 1M of salt solution. This would be because it increases in mass from the last point that was at a lower concentration . I think my results are still valid because I believe that it is a very small fluctuation in the graph. To increase accuracy I could do the experiment few more times and find the average of the results also I rounded my values up which would make my results less accurate. I can see from looking back to my method that some of my equipment could be improved to increase accuracy. For example I could have used burettes as they are a very accurate way to measure. Also I could use more accurate scales to measure the weight of the potato cylinders. The reliability of evidence for my work is very valid and I believe it is sufficient to support my conclusion. The preliminary test was very strange that its results where very different from all my other results. I think it could be to do with the potato or the equipment, as we did the preliminary test and the other tests on different days using different equipment. If I could take this investigation further, it would be to investigate active transport in plants. Active transport is the process by which dissolved molecules move across a cell membrane from a lower to a higher concentration. In active transport, it requires an input of energy from the cell.

Bibliography:

I used these two websites as my source for background information and the diagrams that I have used in my coursework.

http://www.bbc.co.uk/schools/gcsebitesize/biology/cellprocesses/2diffusionandosmosisrev1.shtml

http://www.tvdsb.on.ca/westmin/science/sbi3a1/Cells/Osmosis.htm