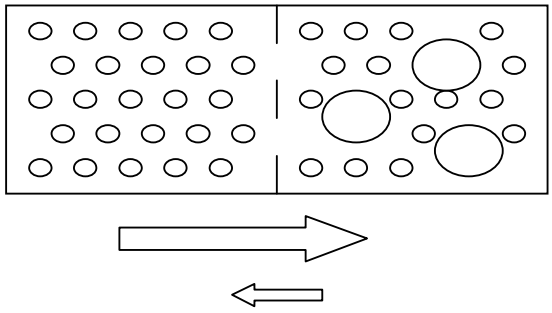
Liam Tai-Hogan Biology Coursework

Osmosis Experiment

Osmosis: is when a substance such as sugar dissolves in water, the sugar dissolves in water, and the sugar molecules attract some of water molecules and stop them moving freely. This, in effect, reduces the concentration of water molecules. There are more free water molecules on the left of the membrane than on the right, so water will diffuse more rapidly from left to right across the membrane than from right to left. Osmosis is water passing from a region where it is highly concentrated to a region where its concentration is lower, through a partially permeable membrane.
Below is a basic diagram of Osmosis.



Definitions: (from www.studentcentral.com)
A Partially Permeable Membrane allows the free passage of some particles but is not freely permeable to others. Biological membranes are freely permeable to water but have restricted permeability to solutes such as glucose molecules, i.e. they are selectively permeable.

Hypotonic Solution
A Hypotonic solution is where there is a lower concentration on the outside off the cell than on the inside of the cell.

Isotonic Solution
An Isotonic solution is when the concentration on the inside is exactly the same as the concentration on the outside.

Turgidity
A plant is said to be turgid when they become too big but they still continue to take in water, as the concentration inside the cell is lower than the

concentration on the outside of the cell. The vacuole of the cell is pushing on the cell wall and it is said to be exerting turgid pressure on the cell wall. However plant cells don't explode when they become turgid as the have a cell wall that protects the cell.

Flaccid
A flaccid cell is when the cells vacuole looses water and the cells will be limp. This is basically when the cell looses most of its water.

Plasmolysis
Plasmolysis is where the cells have lost so much water due to the solution outside the cell being more concentrated. The water then diffuses out of the vacuole and the vacuole shrinks pulling the cytoplasm away from the cell wall leaving the cell flaccid.

Aim: To investigate how different concentrations of sugar solution affect the size of plant tissue (namely potato pieces) though osmosis or diffusion.

Method: The first thing I will do is to make the sugar solutions; I will make 6 different concentrations of sugar solution.

- 5 parts water : 0 part sugar 1 part = 10ml cm3
- 4 parts water : 1 part sugar
- 3 parts water : 2 parts sugar
- 2 parts water : 3 parts sugar
- 1 part water : 4 parts sugar
- 0 part water : 5 parts sugar

To next thing I will do is to make 12 pieces of potato as equally shaped as possible? I will make them using a cork borer and then use a razor blade/scalpel to cut each piece to exactly 5cm long.
Then 2 pieces will be placed in each of the petri dishes and left for 24 hours. When I return to take the results each piece will be measured and the lengths recorded in a table. I will also check if the potato feels firmer, as this is another sign of osmosis.

Prediction and Hypothesis: If the potato cells were not fully turgid at the beginning of the experiment, then the ones in which the concentration of water surrounding the potato cells were greater than the concentration of water in the potato cells, will be longer and firmer. This is because the water molecules pass from a high concentration, i.e. in the water itself, to a low concentration, i.e. in the potato chip. Therefore, the chips in higher water concentrations will have a larger mass than in higher sugar concentrations.

1. Since there is effectively a lower concentration of water in the cell sap
2. Water diffuses into the vacuole
3. And makes it push out against the cell wall

If however the concentration of the solution around the potato cell had less water then the opposite would happen. The potato cell would happen. The potato cell would become flabby and shorter because the cell wall loses their turgor.

1. The solution outside the cell is more concentrated with sucrose than the inside the cell.
2. Water diffuses out of the vacuole.
3. The vacuole shrinks, pulling the cytoplasm away from the cell wall, leaving the cell flaccid.

To find the percentage change in my results I will use this equation.

$$\textbf{Percentage Change} = \frac{\textbf{Change}}{\textbf{Initial}} \textbf{ X 100}$$

Results:

Note: The original average weight' was after made 10 the pieces were weighed and an average was made.

The 'length after experiment' and 'weight after experiment' were made by making an average out of the two pieces of potato.

Length				
Concentration (ml)	Original Length (cm)	Weight after experiment (cm)	Percentage Change%	Turgid?
50 water/ 0 sucrose	5	5.55	11	Very
40 water/ 10 sucrose	5	5.05	1	Same
30 water/ 20 sucrose	5	4.5	-10	Loss of turgidity
20 water/ 10 sucrose	5	4.25	-15	Thinner and loss of turgidity
10 water/ 40 sucrose	5	4.08	-18.4	Very Thin and more loss of turgidity
0 water/ 50 sucrose	5	3.95	-21	Even thinner and greater loss of turgidity

Weight				
Concentration (ml)	Original Weight (g)	Weight after experiment (g)	Percentage Change%	Turgid?
50 water/ 0 sucrose	1.80	2.15	19.4	Very
40 water/ 10 sucrose	1.80	1.85	2.7	Same
30 water/ 20 sucrose	1.80	1.61	-10.6	Loss of turgidity
20 water/ 10 sucrose	1.80	1.23	-31.6	Thinner and loss of turgidity
10 water/ 40 sucrose	1.80	0.92	-48.9	Very Thin and more loss of turgidity
0 water/ 50 sucrose	1.80	0.78	-56.7	Even thinner and greater loss of turgidity

Conclusion and Evaluation:

Looking at my results tables and graphs, it is obvious that as the concentration of sucrose increases, the turgidity of the potato pieces decreases. This is because there is a higher concentration of water inside the potato cells than outside. Basically, as long as my results are accurate, which I think they are as I have tried to make the test as fair as possible, my prediction and hypothesis is correct.

It is also apparent from the way the lines of best fit on my graph start to level out at the end that the cells have become **flaccid** because of **Plasmolysis.** Plasmolysis is where the cells have lost so much water due to the solution outside the cell being more concentrated. The water then diffuses out of the vacuole and the vacuole shrinks pulling the cytoplasm away from the cell wall leaving the cell flaccid.

When you put a plant cell into a liquid containing a water and sucrose solution one of three things will happen.

1. If the medium surrounding the cell has a higher water concentration than the cell (a very dilute solution) the cell will gain water by osmosis.
   Water molecules are free to pass across the cell membrane in both directions, but more water will come into the cell than will leave. The net (overall) result is that water enters the cell. The cell is likely to swell up.
2. If the solution is exactly the same water concentration as the cell, there will be no real movement of water across the cell membrane.
   Water crosses the cell membrane in both directions, but the amount going in is the same as the amount going out, so there is no overall movement of water. The cell will stay the same size.
3. If the solution has a lower concentration of water than the cell (a very concentrated solution) the cell will lose water by osmosis.
   Again, water crosses the cell membrane in both directions, but this time more water leaves the cell than enters it. Therefore the cell will shrink.

These points are proven in my experiment e.g.

1.b. When the concentration was 50ml water and 0ml sucrose, it became very turgid. This is where the water concentration was higher.

2.b. When the concentration was 40ml water and 10ml sucrose, it stayed the same this is where the concentration of water inside and outside the cell was the same.

3.b. When the concentration was 30ml water and 20ml sucrose or contained more sucrose, it became less turgid, this is where the concentration of water was higher inside the cell than outside the cell.

Plant cells always have a strong cell wall surrounding them. When the 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. Turgid means swollen and hard. The pressure inside the cell rises, eventually the internal pressure of the cell is so high that no more water can enter the cell. This liquid or hydrostatic pressure works against osmosis. Turgidity is very important to plants because this is what make the green parts of the plant "stand up" into the sunlight. Although this is not a necessary feature in potatoes, they are still plant cells and they have basically the same properties as a plant cell from the leaf of a regular plant.

Although I think my experiment went well I would like to make the following changes if I were to do it again.

If I were to do the experiment again, I would like to create over three sets of results, each one in a different container. I would also like to leave the solution for longer to see whether it affected the percentage change and the difference between the percentage changes. The other thing I would like to do would be to use at least double the number of types of concentration, I would like to see whether than graph completely levels out at the end, this would mean the cells were completely flaccid and Plasmolysis had occurred.

One point in my results that I think is wrong is the measurement of weight for the concentration- 20ml water/30ml sucrose. This can clearly be seen on my graph, as it does not fit in along the line of best fit. By doing the corrections to my experiment as above, I believe the line of best fit would be a better curve. Possibly