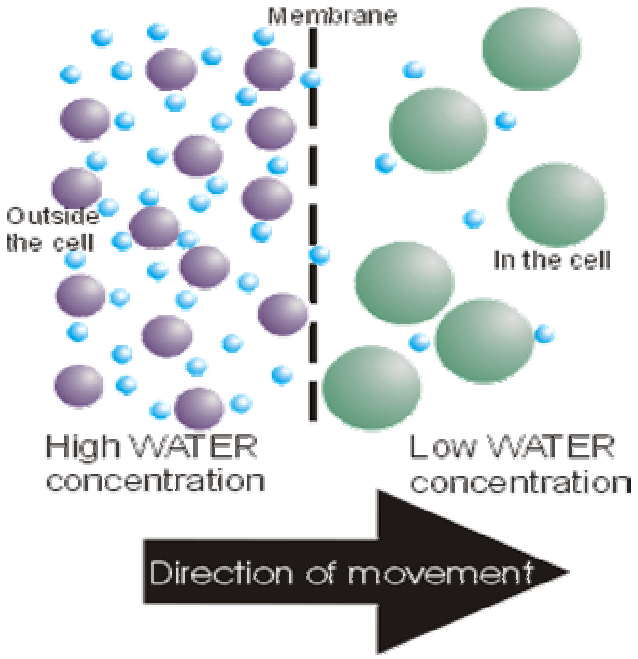
Introduction

Osmosis is the movement of water from a region of high concentration to a region of low concentration.

Osmosis takes place when a solution is separated from another solution of a different concentration via a selectively permeable membrane. In this case water moves from a more dilute (low concentration) area to a more solute (high concentration) area. Water molecules pass across a membrane when they collide with it as shown in the diagram:



When the membranes collide the water exerts a pressure on the membrane. This is called the water potential. Pure water has a water potential of zero so there are maximum collisions taking place which reduce the do not allow any water into the membrane.

When solute is added to the water, the solute particles get in the way of the water reducing the number of collisions and making the water potential lower and therefore allowing water into the

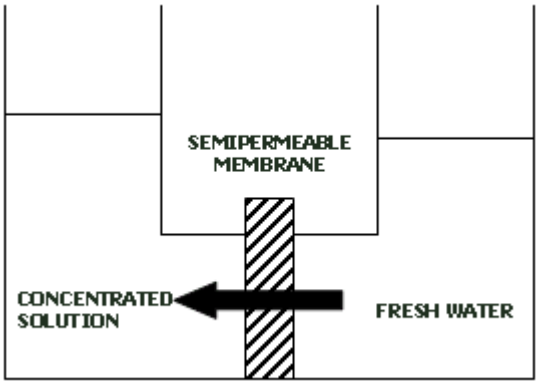
membrane. If the water potential is negative the water will move from an area of high water potential (high water concentration) to an area of low water potential (low water concentration).

Main Experiment

Aim: To investigate the effect of different solutions of varied concentration and discover if they increase or decrease the length of a cut potato chip when kept together in an uncontrolled environment.

Science Theory: Osmosis happens when a solution is separated from it's pure water form or when a selectively permeable membrane separates two solutions. It is very similar to diffusion, but only concerns water. Water moves from a hypotonic (more water, less solute) solution to a hypertonic (less water, more solute) solution when two solutions are separated. A dynamic equilibrium is reached when both solutions become equal after osmosis which is when they are both the same and swap over equally without any total movement occurring. When a dynamic equilibrium is achieved, there is no change in the size or mass of the cells.

Water molecules move across a membrane by colliding with it, in pure water, the maximum number of collisions take place, so it is certain that no water can move in. When colliding with the membrane the water exerts a pressure, this is called the water potential. Pure water has a water potential of zero. When solute is added to the water, the sugar molecules get in the way of the water and reduce the number of collisions taking place, therefore causing a lower water potential. Water then moves from an area of high water potential (high concentration of water) to an area of low water potential (low concentration of water).



The adding of the solute particles to alter the water potential is known as the solute potential. It reduces the concentration of water and changes the water potential as pure water has a water potential of zero and as soon as solute is added it becomes negative.

Water exerts a pressure on the cell wall, pushing it outwards. This is the pressure potential. It is positive when the cell is turgid (swollen, hard and standing erect in a plant stem for example) and drops to zero when the cell becomes plasmolysed (flaccid, shrinks with too much sugar/salt solution and cytoplasm peels away from cell wall).

Incipient plasmolysis is and in-between state of turgidity and plasmolysis. Water potential is positive when a cell is turgid and is zero when a cell is plasmolysed as a result of water leaving the cell at incipient plasmolysis, the pressure potential is zero.

Prediction: From looking at the scientific theory behind osmosis, I can make a sound prediction that the potato chips in the hypotonic solution will increase in length and the potato chips in a positive sucrose (hypertonic) solution will decrease in length i.e. anything with a sucrose percentage of 50% and above. I believe my prediction is correct because pure water has a water potential of zero and this becomes negative if sucrose is added to the water the water potential becomes negative. The water will move from an area of high water potential (high concentration of

water) to an area of low water potential (low concentration of water).

Fair Test: To ensure my experiment is as accurate and extracts the most reliable results possible, I will be carrying out the following procedures:

Cut the potato chips very accurately using a corer to get them to a precise 1cm with the same area as well.

Measure the amount of sucrose solution being poured in using a measuring cylinder.

Measure the amount of water being used in each test tube using a measuring cylinder

Make sure that the water being used is distilled

Use the same potato as it may have a different semi-permeable membrane to another potato

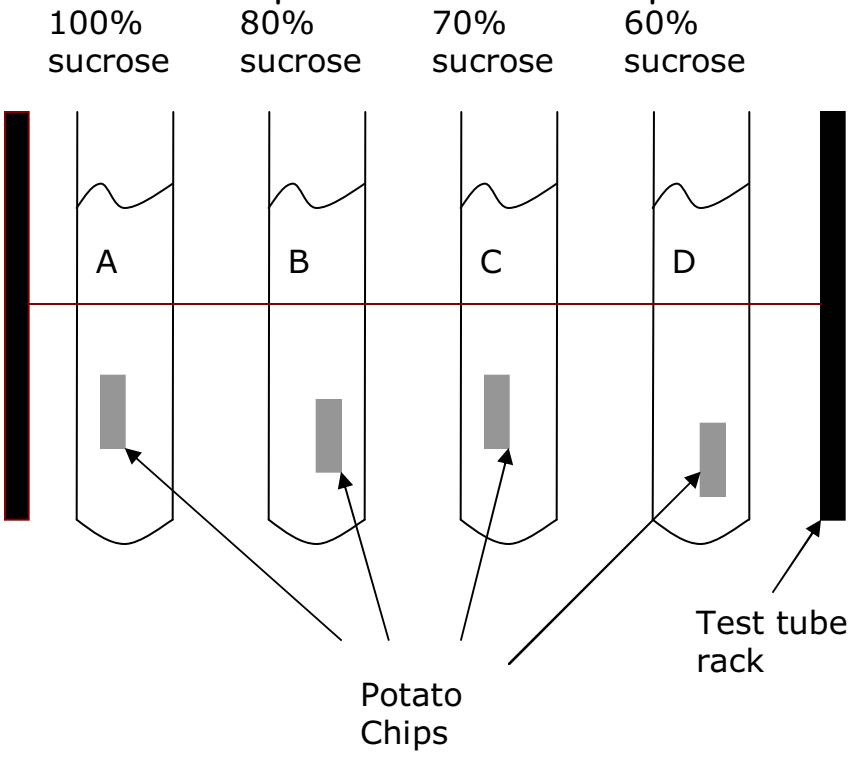
Equipment: 8 Test tubes to put 3 potato chips into each one
One whole potato
Corer to equally split potato pieces into
Knife to cut potato in half
Test tube rack
Measuring Cylinders
1M Sucrose Solution
Distilled water

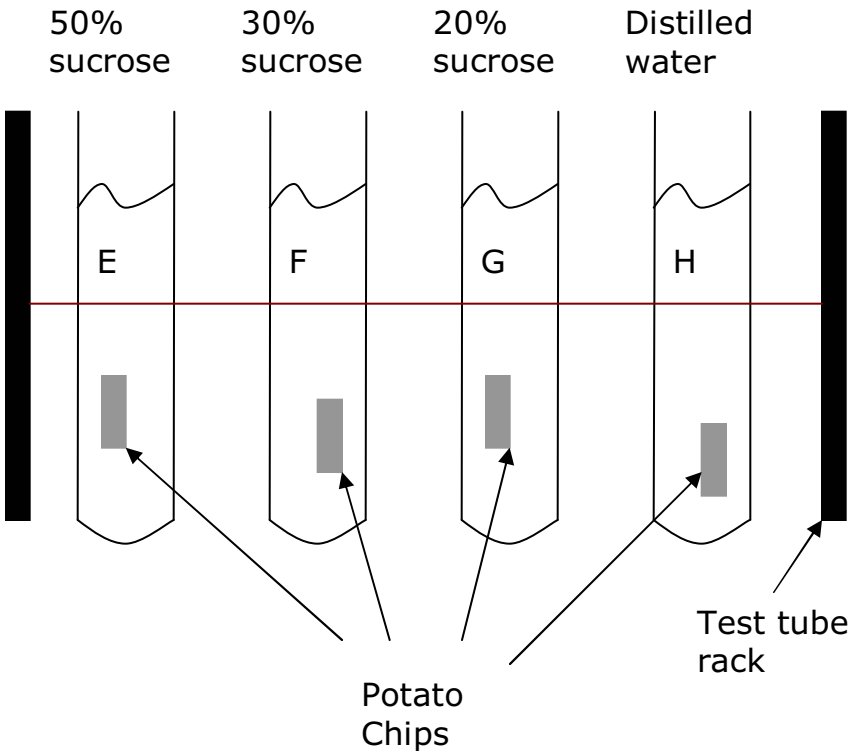
Method: Using a corer I will cut 24 equal pieces of potato to go into each one of my eight test tubes.

I will then pour different combinations of water and sucrose solution to make a certain concentration:
I will firstly pour 10ml of sucrose solution and 0ml of water, which is 100% sucrose concentration until I get to 10ml of water and 0ml of sucrose solution, which is 0% of sucrose concentration.

I will do this at intervals of 0.2 molarity because this way I get a fair and accurate reading by testing at even intervals. I will put 3 chips in each test tube to represent three different experiments.

I will label each test tube with its percentage of sucrose concentration and carefully cover each test tube with cling film to stop evaporation taking place.
This is how the experiment will be set up:





Results: Test one:

Test Tube	Amount of sucrose solution (ml)	Amount of H_20 (ml)	Concentration of sugar solution (%)	Length of potato chip before (mm)	Length of potato chip after (mm)
A	10	0	100	10	8
B	8	2	80	10	7
C	7	3	70	10	7
D	6	4	60	10	7
E	5	5	50	10	9
F	3	7	30	10	10
G	2	8	20	10	12
H	0	10	0	10	14

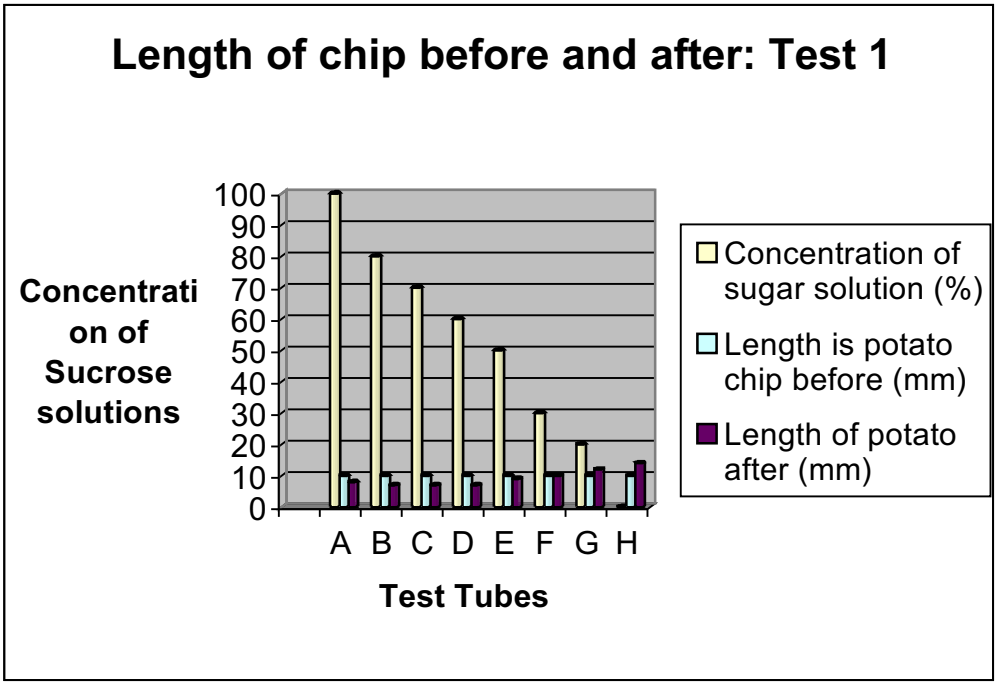
Test two:

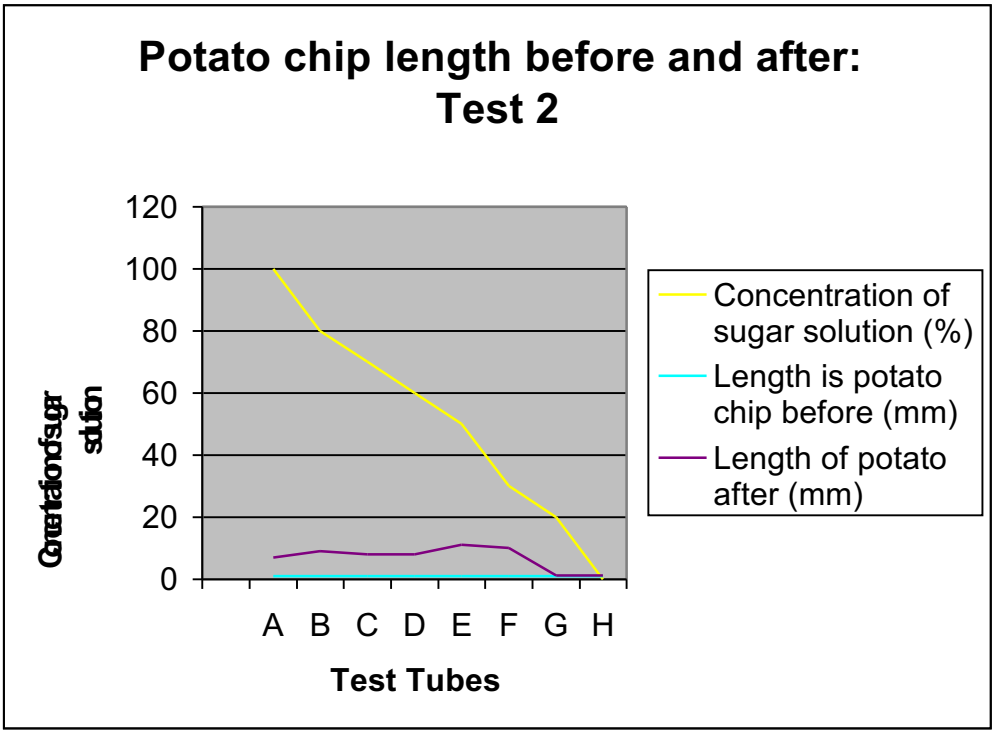
Test Tube	Amount of sucrose solution (ml)	Amount of H_20 (ml)	Concentration of sugar solution (%)	Length of potato chip before (mm)	Length of potato chip after (mm)
A	10	0	100	1	7
B	8	2	80	1	9
C	7	3	70	1	8
D	6	4	60	1	8
E	***5***	***5***	***50***	***1***	***11***
F	3	7	30	1	10
G	2	8	20	1	1.1
H	0	10	0	1	1.2

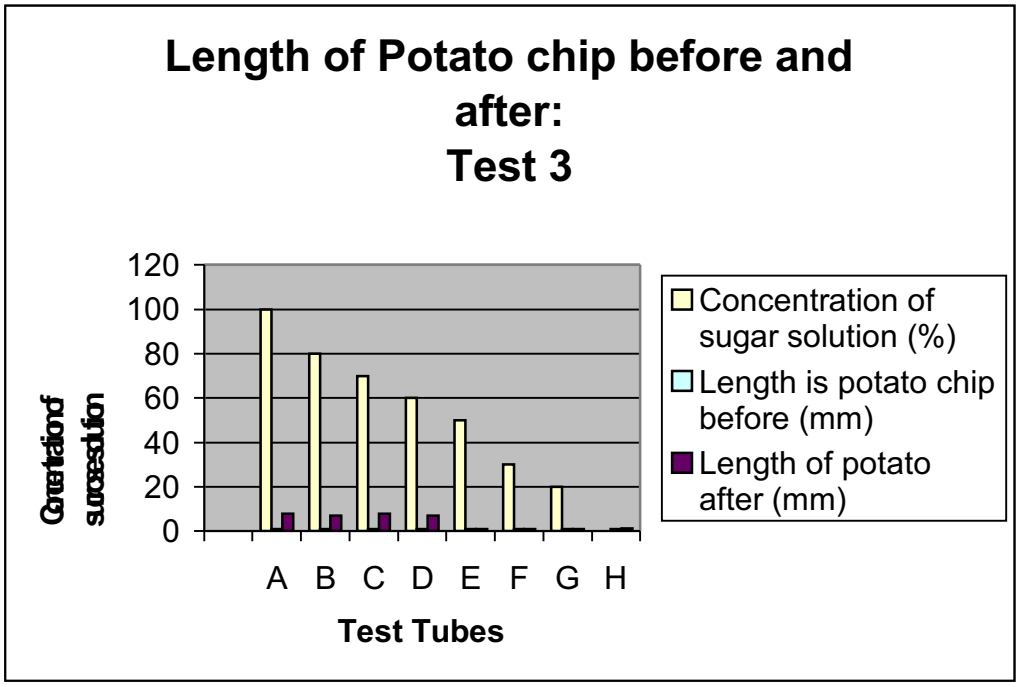
Test Three:

Test Tube	Amount of sucrose solution (ml)	Amount of H_20 (ml)	Concentration of sugar solution (%)	Length of potato chip before (mm)	Length of potato chip after (mm)
A	10	0	100	1	8
B	8	2	80	1	7
C	7	3	70	1	8
D	6	4	60	1	7
E	5	5	50	1	1
F	3	7	30	1	1
G	2	8	20	1	1
H	0	10	0	1	1.2

Sunny Gill 10B







Conclusion: My results are fairly accurate and show clear evidence of osmosis affecting the size of the potato chips. My results support my prediction.

The graph for test 2 shows that as the concentration of the solution went up, the length of the chip after decreased. This is because the higher the concentration of the sucrose solution, the lower the water potential. The lower the concentration of sucrose solution, the higher the water potential. This makes the potato chips increase/decrease in size because they move from the area of a high concentration of water (distilled water) to the area of a low concentration of water (potato chip) when the potato chips grow and when the potato chips decrease the water also moves from an area of high water concentration (potato chip, although it has less concentration of water than pure water, it has a higher concentration of water than a sucrose solution) to an area of low water concentration (sucrose solution).

Evaluation: I believe my method was reasonably well planned, as I tried to the best of my ability to keep things constant and make it a fair test. My method could be changed so that instead of measuring with a measuring cylinder similar to what we were given, a more precise method of measuring could have been used such as a 10ml-measuring cylinder so that we do not exceed the limit. I would also change the way the potatoes were cut as a corer is not accurate enough and can produce potatoes that are different to one another. I would try to use an electronic potato cutter, which would produce more reliable results, as the potatoes would be the same size and length.

If there was one test tube available for each potato chip the experiment results would be more accurate as there would be a whole 10ml of solution to diffuse in/out of the potato, whereas in this experiment, 3 potato chips had to share the 10ml solution. These results may possibly be inaccurate as if the potato chips were allowed more time, there may have been a considerable change in the length of the potatoes, as some chips did not change length. If I were to repeat the experiment, I would leave them all for approximately 24 hours in order to achieve satisfactory results.

Preliminary Evidence

Visking Tubing Experiment:

Aim: To investigate how osmosis works when a selectively permeable membrane separates two solutions.

Prediction: I predict that the visking tubing containing sugar will gain weight and the visking tubing containing water will lose weight, as the sugar particles are too thick to move enter the visking tubing.

Apparatus: Beakers
2 ViskingTubes
Sucrose Solution
Distilled Water
Measuring cylinders
String (to tie tubing with)

Fair Test: In order to make the experiment as fair a test as possible, I will ensure the following:

- ✓ Accurate measuring of the sucrose solution and water to go into the visking tubing and the surrounding solution into the beaker in which the visking tubing will be placed.
- ✓ Visking tubes are both of the same size
- ✓ Beakers are both the same size

Method: I ill cut 2 pieces of visking tubing each 12cm long.

I will then label two beakers marked cell A and cell B.
I will fill cell A with 1molar sucrose solution and Cell B with distilled water.

I will then weigh each Cell before placing them in the beakers.

Lastly, I will put cell A in a beaker of water and cell B in a beaker of 1molar sucrose solution.

After 30 mins, I will re-weigh the cells and check for an increase or decrease in mass.

	Weight before (g)	Weight after (g)
Cell A	6.2g	8.3g
Cell B	5.5g	4.5g

Results:

Conclusion: My results prove that my prediction was correct as the tube full of water lost weight and the tube full of sucrose gained weight. The water diffused into the visking tubing in cell A and diffused out of cell B. The water moved from the solution which was low concentration solution to the highly concentrated solution because two solution were being separated by a selectively permeable membrane.

Preliminary potato experiment:

Aim: To investigate the effect of various concentrations on potato cells.

Prediction: I predict that the test tube full of distilled water will increase the chip and the two other test tubes full of sucrose solution will decrease the chip length.

Apparatus: Half a potato
3 Test tubes
Labels (a,b,c)
Distilled water
0.5M sucrose solution
1M sucrose solution

Method:

Cut 3 potato chips the same size (1cm)

Label 3 test tubes (a, b, c)

Fill test tube A with distilled water, test tube B with 0.5M sucrose solution and test tube C with 1M sucrose solution.

(All measurements of solutions and potato chip lengths are approximations only)

Leave potato chip to soak in test tube for 30 mins, take out all three chips and record the length.

Results:

Test Tube	***Length of potato chip before experiment (mm)***	***Length of potato chip after experiment (mm)***	***Increase in size (mm)***
A – Distilled water.	***40***	***44***	***4***
B – 0.5m of sucrose solution	***40***	***38***	***-2***
C – 1m of sucrose solution.	***40***	***35***	***-5***

Conclusion: My results support my prediction. The potato placed in pure water increased and the potato placed in sucrose decreased. This is because the water is moving from where there is a lot of water (pure water in beaker) to where there is less water (potato chip).