Biology coursework.

Investigate the effect of salt concentration on the rate of water loss/gain by potato.

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Plan:

Investigate the effect of salt concentration on the rate of water loss/gain by potato.

Hypothesis:

I predict that the 0 M salt solution will make the potato gain weight because the water is at a higher concentration outside the potato so it moves in by osmosis.
I predict that in the 0.2 M solution the potato will neither gain nor lose weight because I think that the concentrations of water in and out of the potato are the same.
I predict that in the 0.4 M, 0.6 M, 0.8 M and 1.0 M solutions will lose weight because I think that the concentration outside the potato will be less concentrated than inside the potato so the water from inside the potato will move by osmosis.

Background Knowledge:

Osmosis – Osmosis is a special case of diffusion.

Outside the cell in the animation, there is a low concentration of solute molecules and a high concentration of water molecules. Inside the cell, there is a high concentration of solute molecules and a low concentration of water molecules.

The solute molecules can't diffuse out because the plasma membrane won't let them through. The water molecules however can diffuse in - this is osmosis. Osmosis can be defined as the passage of water molecules through a partially permeable membrane, from a region where they are in higher concentration to a region where they are in a lower concentration.

Plasmolysis – Shrinkage of the cytoplasm of a plant cell, so that the cell membrane begins to tear away from the cell wall; caused by loss of water.

Diffusion – The movement of particles of gas, solvent or solute from an area of high concentration to an area of low concentration.

Active Transport - The movement of substances through cell membranes, using energy. The energy is in the form of ATP, which is first made by respiration. The substances are often moved against their concentration gradient.

Plant cell structure - Plant cells have a strong cell wall surrounding them. The shape of the plant cell changes though by when they take up water by osmosis and they start to swell, but the cell wall prevents them from bursting.

Water potential - Water molecules move randomly. When water is enclosed by a membrane, living or artificial, some of the moving water molecules will hit the membrane, exerting pressure on it. This pressure is known as **water potential**.
As the number of water molecules increases, the number of collisions between the molecules and the surrounding membrane increases. This causes the pressure on the surrounding membrane to increase so the water potential will increase.
Water potential is represented by the symbol **Y** (Greek letter, "psi"). It is measured in units of pressure, usually kilopascals (kPa). Pure water has a water potential of zero. A solution will have a lower concentration of water molecules so it will have a negative water potential.

Adding solute - In fact when we add solute to water, the water molecules form a shell around each solute molecule. So this decreases the number of free water molecules that are able to exert a pressure on the membrane. Therefore, the water potential decreases.
There is no solute in pure water. So pure water has the greatest water potential.
Preliminary Study:

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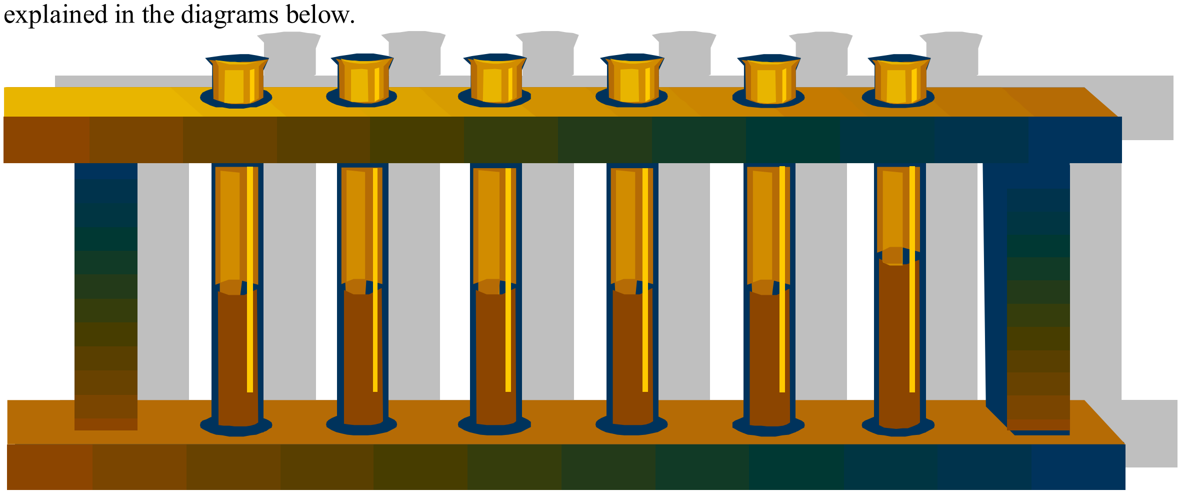
Before starting this particular investigation I have conducted a similar experiment. The aim of the experiment was: To see how the mass of agar jelly affects the absorption of potassium manganate (VIII) solution. In the experiment I found that the potassium absorbed the furthest into the 0.5 cm^3 cube of jelly, next into the 1 cm^3 cube and last into the $2cm^3$ cube.

Variables:

VARY	CONSTANT
Salt concentration	Control
Amount of water	Size of potato (length)
	Time (25 minutes)
	Temperature
	Type of potato
	Freshness of potato
	Apparatus

Observations:

I will make three repeats, recording the gain/loss in mass and length of the potato cylinders at the end and beginning of the experiment in six different salt concentrations. How I made up these concentrations is explained in the diagrams below.



	0 M	0.2M	0.4M	0.6M	0.8M	1M
Water (cm^3)=	20	16	12	8	4	0
Salt solution (cm^3) =	0	4	8	12	16	20

Apparatus:

- Potato/cork borer.
- 6 boiling tubes.
- 1 test tube rack.
- 1 $10cm^3$ measuring pipette.
- 1 knife/blade.

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- 1 one molar salt solution.
- 1 set of scales.
- 1 tile/cutting board.
- 1 stop clock.
- 1 Potato.
- 1distilled water bottle.

Make sure to always use the same diameter cork borers.

Method:

- Use a cork borer to cut out six cylinders of potato. The cork borer makes it easy too cut pieces of the same diameter.
- Measure six cylinders the same length (see results for details) using a ruler and cut to length with knife.
- Recorded mass before and length of each cylinder.
- Measured out our solutions using a $10cm^3$ pipette. These solutions were:

MOLES	SALT	WATER
0	0	20
0.2	4	16
0.4	8	12
0.6	12	8
0.8	16	4
1	20	0

- We placed a potato cylinder in each boiling tube.
- We waited 25minutes and recorded the results.
- This experiment was repeated three times to improve accuracy.

Safety:

This experiment is quite 'low risk' the only things you could really do is wound yourself with the knife, stab the borer into your hand if you are not using it properly on the tile and you could break the delicate glass pipette.

Results:

1st set of results:

Salt concentration.	Mass @ start of experiment (g).	Mass after (g).	Mass gain/loss (g).	Start length (cm).	End length (cm).	Length gain loss (cm).
0	2.48	2.63	0.15	4.1	4.2	0.1
0.2	2.43	2.36	-0.07	4.1	4.1	0
0.4	2.58	2.25	-0.33	4.1	4.1	0
0.6	2.61	2.14	-0.47	4.1	4	-0.1
0.8	2.66	2.09	-0.57	4.1	4	-0.1
1	2.52	2.06	-0.46	4.1	3.9	-0.2

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2nd set of results:

Salt concentration.	Mass @ start of experiment (g).	Mass after (g).	Mass gain/loss (g).	Start length (cm).	End length (cm).	Length gain loss (cm).
0	2.3	2.5	0.2	3.3	3.4	0.1
0.2	2.4	2.3	-0.1	3.5	3.5	0
0.4	2.6	2.4	-0.2	3.5	3.5	0
0.6	2.4	2.1	-0.3	3.4	3.2	-0.2
0.8	2.4	2	-0.4	3.3	3.1	-0.2
1	2.2	0.7	-0.5	3.3	3	-0.3

3rd set of results:

Salt concentration.	Mass @ start of experiment (g).	Mass after (g).	Mass gain/loss (g).	Start length (cm).	End length (cm).	Length gain loss (cm).
0	2.8	3	0.2	4.8	4.9	0.1
0.2	3.2	3.1	-0.1	4.7	4.7	0
0.4	2.8	2.5	-0.3	4.5	4.5	0
0.6	2.9	2.6	-0.3	4.7	4.6	-0.1
0.8	3	2.6	-0.4	4.7	4.6	-0.1
1	2.7	2.2	-0.5	4.8	4.6	-0.2

Average of results:

Salt concentration.	Mass gained/lost (g).	Length gained/lost (cm).
0	0.183	0.1
0.2	-0.09	0
0.4	-0.243	0
0.6	-0.357	-0.133
0.8	-0.757	-0.133
1	-0.0497	-0.233

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Analysis:

From my two graphs of results I found very similar patterns, they both seem to lose length and mass mainly after the 0.2 M solution. At the first point 0 M they both gain in mass and length.
They gain in mass because

Evaluation:

I only had one anomalous result

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