Research question:

What is the effect of changing the concentration of sucrose solution on the mass of potato cylinders measured by how much mass(in grams) is lost after leaving the cylinders in each solution after 24 hours?

Background information:

Osmosis is the passive movement of water molecules from a region of high water concentration to a region of lower water concentration (lower solute concentration to higher solute concentration), across a partially permeable membrane.[1] The plasma membrane is selectively permeable, and it controls the movement of substances in and out of cells, but water is able to move freely in and out of the cell, allowing osmosis to occur.[2] Potato cells have selectively permeable membranes and therefore can be used to show the process of osmosis.

As plant cells generally have a higher solute concentration than their surroundings (lower water concentration), when immersed in H_20, the potato strips will be surrounded by a region of high water concentration since water has a solute concentration of 0.[3] This would mean that the distilled water is hypotonic whereby it has a higher concentration of water than the potato cells, causing water to flow from the area of higher water concentration (water solution) to the area of lower water concentration (potato cell).

Osmosis is also responsible for the ability of plant roots to draw water from the soil. Roots are adapted for this because of the numerous root hair cells; they increase the surface area to volume ratio, making the absorption highly effective. Animal cells also use osmosis to transport water in and out, but the consequences in this case are different due to the absence of cell walls.

Osmotic pressure is essential for support in plants. Entry of water in the cell raises the turgor pressure exerted against the cell wall, making it turgid and enabling it to stand upright. Plant cells are usually in hypotonic environments, where the fluid in the cell is more concentrated than that outside the cell, so water enters in. This is illustrated below.

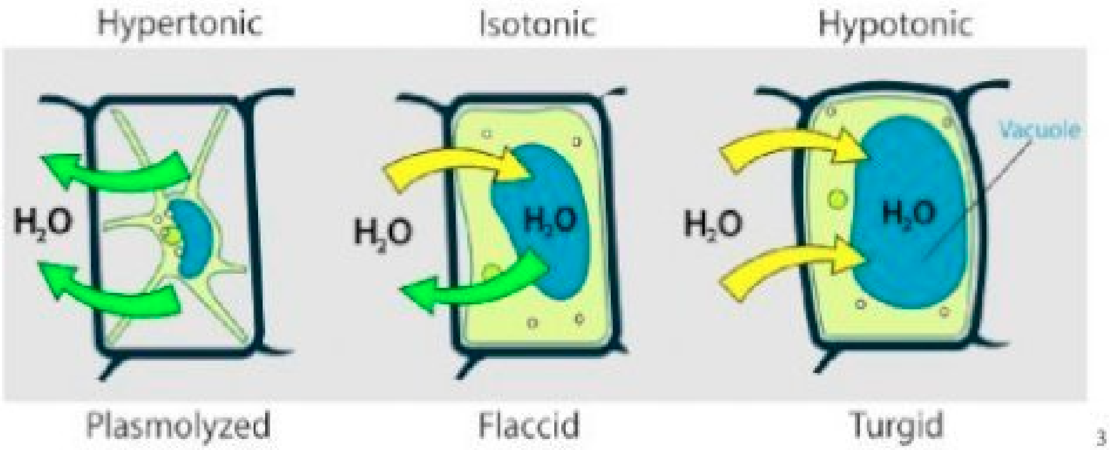

Figure 2: Plant cells in hypertonic, isotonic and hypotonic environments.

Figure 2 also shows that if plant cells are in a hypertonic environment, then all the water will leave the cell, making it plasmolyzed[4]. This causes the cytoplasm to be pinched away from the cell wall, and the cell can no longer function. If plants are in isotonic environment, they are not turgid, but flaccid; they tend to wilt.

In this lab report , we will prepare different concentrations of sucrose solution and we will measure the water uptake or loss by measuring the change in the masses of potatoes using a digital balance after soaking potato cylinders for a fixed period of time .

Hypothesis:

If the concentration of sucrose solution increases, then the change in mass decreases.

This is because of osmosis. In osmosis water moves from a low concentrated region of solute to a higher concentration region of solute. Therefore when the concentration of sucrose solution increases the change in mass will decrease.

Variables :

The independent variable :

Changing the concentration of 100 cm^3 sucrose solution The following concentrations will be prepared as shown in the table below:

Table 1: shows the volumes of water and masses of sucrose that will be used to prepare the different concentrations of sucrose solutions

Mass of Sucrose(g)	Volume of water (cm3)	Concentration of sucrose solution(%)
0g	15cm3	0%
2.5g	15cm3	2.5%
5g	15cm3	5%
7.5g	15cm3	7.5%
10g	15cm3	10%
12.5g	15cm3	12.5%

The masses of sucrose will be measured using a digital balance

- And the volume of water will be measured using a 100 cm3 measuring cylinder
- The uncertainty of the digital balance and the pipette was measured by dividing the smallest increment by 2

Dependent variable :

The dependent variable is the change in mass in percent(%). To measure the percentage change in mass you need to take the final mass, then subtract it by the initial mass and divide that number by the initial mass, then you multiply it by 100%. This is relevant because this is how we know if osmosis occurs. This whole process is testing for osmosis and we need to find the percentage change in mass.

Controlled Variable:

Controlled Variable	**How will you keep this controlled? Stating the values and the equipment that you will be using**	**How could it affect your results if not controlled?**
Temp. of the solutions	We keep them in the same place.	If not controlled the test will be unfair
Volume of water	We measure the water by using a graduated cylinder	If not controlled the test will be unfair
Mass of the potato cylinders	We use the same scale to measure each potato	If not controlled the test will be unfair
Size of potato cylinders	We use a cork borer to make sure each cylinder is the same size.	If not controlled the test will be unfair
Concentration of each sucrose solution	We need to measure the amount of water(by using a measuring cylinder) and the amount of sucrose(by using a digital balance) so each solution has the correct concentration we want.	If not controlled the test will be unfair
Difference in Water Potential	The higher the difference in water potential, the faster the osmosis; for the lesser water molecules are in the region of low concentration, more water molecules from the region of higher concentration can enter faster and easier.	If not controlled the test will be unfair

Table 2: description of the controlled variables

Materials:

Fill in the materials needed for the experiment

INCLUDE THE – Quantity, volume and UNCERTAINTY

- A potato cut into 6 cylinders
- 100cm3 of sucrose solution
- Digital balance,
- Water bath set at 35 c
- Thermometer
- Cork borer with a diameter of 0.6
- 6 beaker
- Digital clock for timer
- Blotting paper
- 6 test tubes
- Water (cm^3)
- Sucrose (g)
- Wash Bottle
- 100cm3 measuring cylinder
- Funnel
- Paper towels
- Ruler
- Forceps
- Pipette

Procedure:

Procedure:

1. Prepare 100 cm3 of sucrose solutions using the information shown in table 1
2. Add each solution into a beaker that is labeled with the corresponding concentration
3. Place all solutions in a thermostatically controlled water bath set at 35°C
4. Using a cork borer with a diameter of 0.6 cut out 6 potato cylinders
5. Using a digital balance (…….) measure the initial masses of each potato cylinder and record these values into a table and label them as initial masses
6. add one cylinder of potato into the beaker labeled 2.5 %
7. repeat step 6 using the other concentrations of sucrose
8. leave all the potatoes soaked for 2 hours monitored using a digital clock
9. after 2 hours remove all the potato cylinder and dry them gently using blotting paper
10. measure the final masses of each potato cylinder and record these values in a table and label them as final masses

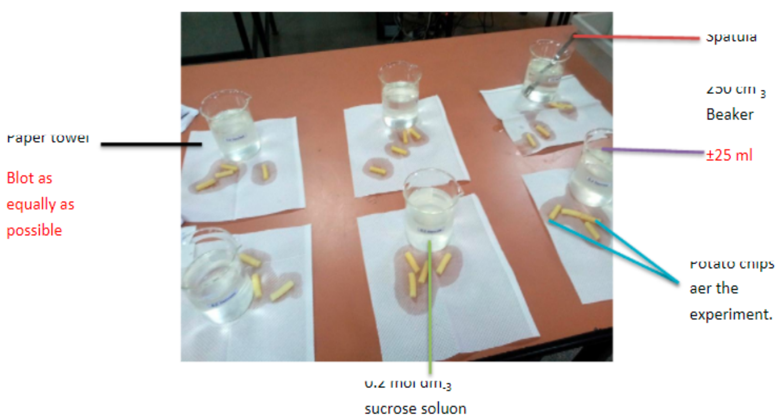

Figure 3.1 and 3.2: Some of the apparatus labeled (these pictures were taken at the end of the experiment)

Safety, ethical and environmental considerations:

Safety : be careful while using scissors to avoid possible cuts in the skin

Ethical : No human or animals subjects are used during the experiment

Environmental : no harmful chemicals that will harm the environment are used , care was taken when selecting the volumes and masses used so as not to over consume the chemicals

The sucrose solutions were safely disposed into the sink after completing the experiment

Construct a table to write your qualitative and quantitative data .

Qualitative :

Concentration of sucrose solution %	Observation
0%	**The water moved from a high water concentration region to a low water concentration region. The potato expands(it becomes turgid). The initial mass was less than the final mass.**
2.5%	**The water moved from a high water concentration region to a low water concentration region. The potato expands(it becomes turgid). The initial mass was less than the final mass.**
5%	**The water moved from a high water concentration region to a low water concentration region. The potato expands(it becomes turgid). The initial mass was less than the final mass.**
7.5%	**Water moved from a region of high water concentration to a region of low water concentration. The potato shrinks in size(it becomes plasmolyzed). The final mass was less than the initial mass.**
10%	**Water moved from a region of high water concentration to a region of low water concentration. The potato shrinks in size(it becomes plasmolyzed). The final mass was less than the initial mass.**
12.5%	**Water moved from a region of high water concentration to a region of low water concentration. The potato shrinks in size(it becomes plasmolyzed). The final mass was less than the initial mass.**

Table 3: Observation

Raw data :

Quantitative :

Concentration of sucrose solution %	Initial mass g (± 0.01)	Final mass g (± 0.01)
0%	2.35g	2.80
2.5%	2.50g	2.81
5%	2.61g	2.73g
7.5%	2.56g	2.69g
10%	2.52g	2.49g
12.5%	2.43g	2.14g

Table 4: Raw data

Processed data :

Concentration of sucrose solution %	Change in mass g	Percentage change %
0%	0.45g	19.14%
2.5%	0.31g	12.4%
5%	0.12g	4.59%
7.5%	0.13g	5.07%
10%	-0.03g	1.19%
12.5%	-0.29g	-15.63%

Table 5: Processed data