



Exercise 1: Plant Cells and Osmosis

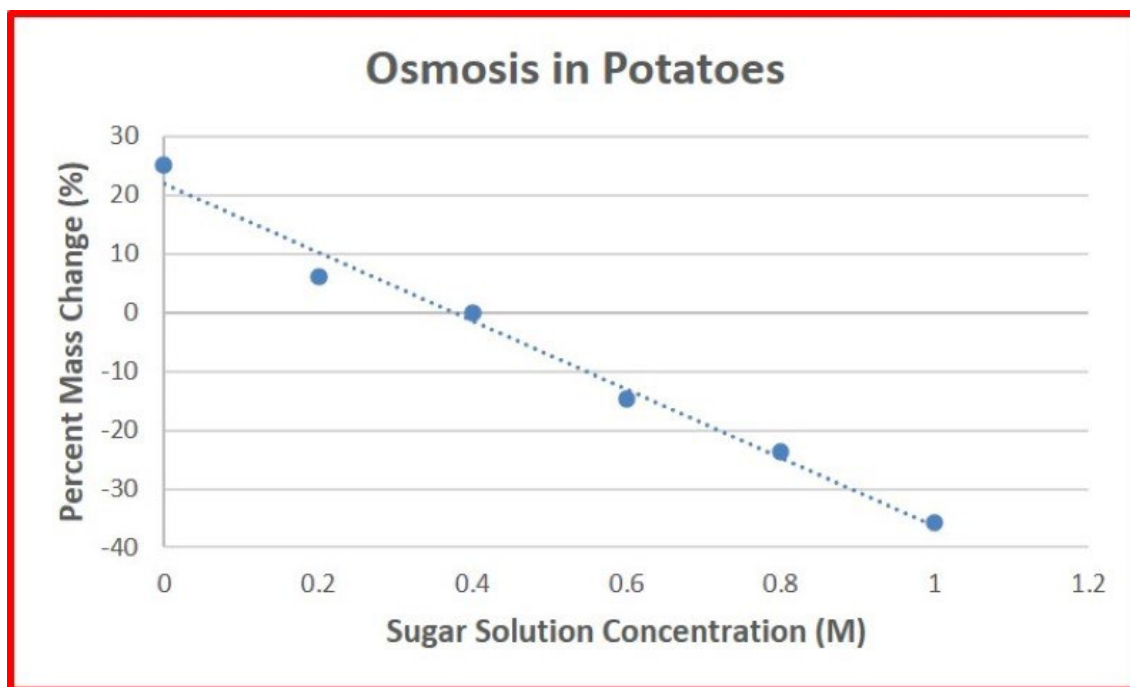
Data Table 1: Potato Masses

Test Tube	Solution	Initial Mass (g)	Final Mass (g)	Percent Change in Mass (%)
A	0.0M Sucrose	1.75	2.19	25.1
B	0.2M Sucrose	1.67	1.77	6
C	0.4M Sucrose	2.08	2.08	0
D	0.6M Sucrose	1.85	1.58	-14.6
E	0.8M Sucrose	2.49	1.92	-23.7
F	1.0 Sucrose	2.01	1.48	-35.8

Panel 1: Potato Mass Prediction

Students should predict that samples will gain mass in distilled water and lose mass in 1.0 M sucrose.

Graph 1: Percent Mass Change vs. Solution Concentration



Question 1

What is osmosis and how was it observed in this exercise? Reference Data Table 1 and Graph 1 in your explanation.

Osmosis is the diffusion of water across a selectively permeable membrane. Osmosis was observed as cells in the potato tissue absorbed water and gained weight or expelled water and lost weight as recorded in Data Table 1 and illustrated in Graph 1.

Question 2

Which of the sucrose solutions were hypertonic, hypotonic, and isotonic to the cells in the potato slices? Explain your answer by referencing Data Table 1 and Graph 1.

The 0.6M, 0.8M, and 1.0M solutions were hypertonic in relation to the cells in the potato slices causing water to leave the cells. This was demonstrated in Data Table 1 and Graph 1 one by the samples exhibiting a net loss of mass after 12 hours exposure to the solutions. The 0.2M and 0.0M solutions were hypotonic in relation to the cells in the potato slices causing water to enter the cells. This was demonstrated in Data Table 1 and Graph 1 by the samples exhibiting a net gain of mass. The 0.4M solution was isotonic in relation to the cells in the potato slices causing no net movement of water into or out of the cells. This was demonstrated in Data Table 1 and Graph 1 by the samples exhibiting no change in mass.

Question 3

Was the prediction recorded in Panel 1 supported by your experimental results? Refer to Data Table 1 and Graph 1 in your explanation.

Predictions should be analyzed by referencing Data Table 1 and Graph 1. If students predicted that cells would gain water in dilute solutions and lose water in concentrated solutions, then the predictions will be supported by the results.

Question 4

Did the potato cells expend energy when undergoing osmosis? Explain your answer by comparing passive and active transport across cell membranes.

The potato cells did not expend energy during osmosis. Osmosis and diffusion are forms of passive transport where substances move from areas of high to low concentration without the need for

cellular energy. In active transport, substances move from areas of lower concentration to areas of higher concentration requiring cellular energy in the form of ATP.

Exercise 2: Diffusion Across a Membrane

Table 2: Dialysis Membrane and Starch

Substance	Initial Observations	Final Observations
Solution in Dialysis Tubing	Clear, colorless	Inky black
Solution in Cup 1	Clear, amber, or tea-colored	Clear, amber, or tea-colored

Photo 1: IKI Solution Results

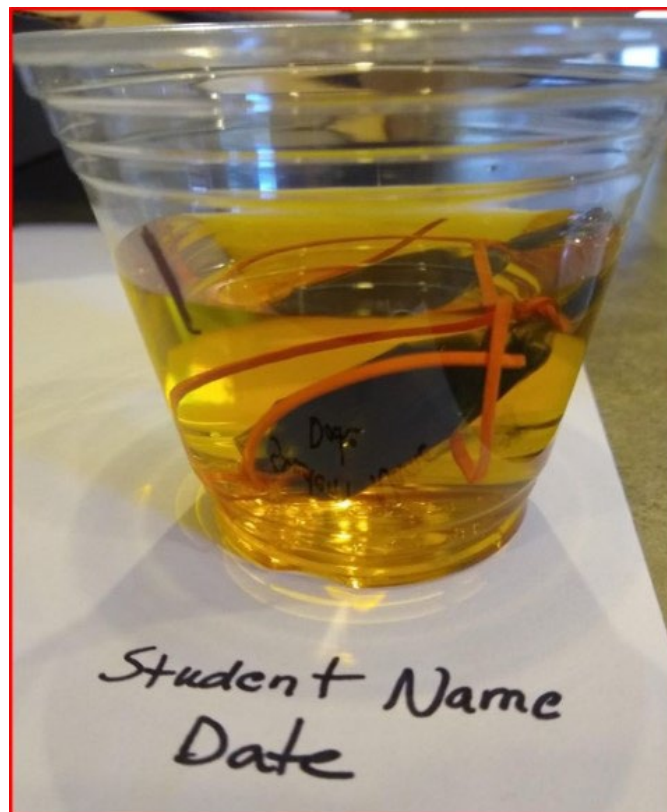
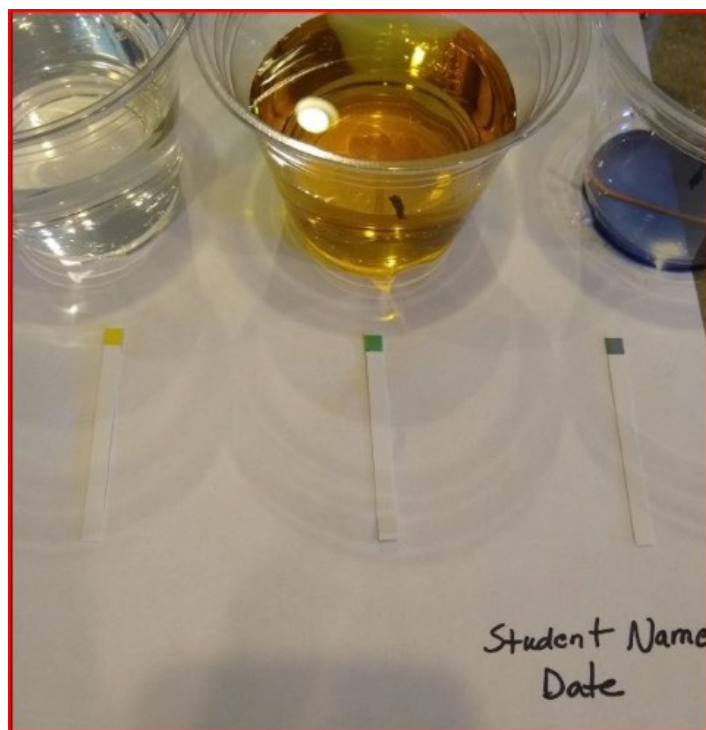


Table 3: Dialysis Membrane and Glucose

Substance	Glucose (Y/N)
Solution outside of dialysis tubing (cup 1)	Y
Solution in dialysis tubing (cup 2)	Y
Distilled water	N

Photo 2: Glucose Test Results



Question 1

Which substances (glucose, IKI indicator, starch) diffused across the dialysis tubing membrane? Explain your answer referencing Data Tables 2-3 and Photos 1-2.

Glucose and IKI indicator diffused across the membrane but starch did not. These results are indicated by the solutions on both sides of the dialysis tubing testing positive for glucose as recorded in Data Table 3 and Photo 2 and by the black color of the solution inside the tubing in Data Table 2 and Photo 1. Starch remained inside the tubing as indicated by the positive starch test for the solution inside the tubing and negative test results of the solution outside the tubing as recorded in Data Table 2 and Photo 1.

Question 2

How would your results have differed if the solutions were tested after 12 hours instead of 1 hour? Explain your answer by including the definition of diffusion.

The results of this exercise would not have changed if the solutions were tested after 12 hours instead of 1 hour. This is because the substances moved across the membrane by diffusion, from areas of higher concentration to areas of lower concentration. Eventually equal amounts of

glucose and IKI indicator would occur on either side of the membrane, however, starch would remain only in the bag as it is unable to cross the membrane.

Question 3

How is a living plasma membrane both similar and different in comparison to the dialysis tubing used in this experiment?

Both living plasma membranes and dialysis tubing are selectively-permeable, allowing the passage of certain substances and preventing the passage of others. Plasma membranes are composed of a phospholipid bilayer with embedded proteins that selectively allow the diffusion of substances based both on particle size and on polarity. Dialysis tubing is composed of a matrix of cellulose fibers and allows diffusion of substances based only on particle size.

Question 4

Did osmosis occur in this exercise? How could procedures be designed to test for this?

Osmosis occurred as water moved from the cup into the dialysis bag. This could be tested by adding only starch solution to the bag, weighing the bag, submerging into a cup of distilled water for at least 1 hour and then weighing the bag a second time. An increase in the weight of the bag would indicate that water moved across the membrane and into the starch solution from an area of low solute concentration to an area of higher solute concentration.

Extension Question

Reverse osmosis is a technique used to generate fresh drinking water (no solutes) from a water source that contains many large molecules and dissolved ions. Reverse osmosis water purification systems use a selectively permeable membrane and a mechanical pump that create pressures against the water source. Explain how reverse osmosis is similar to active transport. Use the principles demonstrated in the exercises to explain why reverse osmosis is an effective method for purifying water.

Active transport requires energy in the form of ATP to move molecules against a concentration gradient. Reverse osmosis also uses energy, supplied from a mechanical pump, to accomplish the task of moving molecules against a gradient.

Osmosis is the diffusion of water through a selectively permeable membrane (down a concentration gradient). When two solutions of different concentrations are separated by a selectively permeable membrane, water molecules move from an area of lesser solute concentration to an area of greater solute concentration. In other words, the water molecules leave the hypotonic solution and cross the membrane into the hypertonic solution.

Reverse osmosis is just the opposite: diffusion of water through a selectively permeable membrane against a concentration gradient. Water molecules are forced to move from an area of greater solute concentration to an area of lesser solute concentration. The water source contains many dissolved molecules and ions. The selectively permeable membrane acts as a physical barrier to filter large molecules and ions, keeping them on one side of the membrane. An outside energy source (mechanical pump) prevents water molecules from moving down a gradient and instead moves them against the gradient. As water is moved across the membrane, the remaining water becomes more and more hypertonic. The collecting freshwater is more and more hypotonic.