# Assignment Summary

For this assignment, you will calculate and graph the solute potential of increasing molar concentrations of a sucrose solution and describe how the change in molarity of the solution affects potato cubes submerged in the solution.

Background Information

Water moves across membranes based on water potential, which is the physical property that predicts the direction water will flow. Water potential is based on a solution’s solute concentration and physical pressure. The higher the solute concentration, the lower the water potential. Water flows from areas with high water potential (low solute concentration) to areas with low water potential (high solute concentration). Water potential is abbreviated by the Greek letter **ψ** (psi) and is measured in megapascals (MPa). At room temperature in an open container, the water potential of pure water is 0 MPa.

To calculate water potential, add solute potential and pressure potential. Solute potential is equal to 0 for pure water, and decreases as solute concentration increases. So, the solute potential of a solution is always negative. Pressure potential is the physical pressure on a solution, and can be positive, neutral, or negative relative to atmospheric pressure. In plants, turgor pressure is the pressure of the cell interior against the cell wall. Turgor pressure is positive and helps plants function by maintaining the stiffness of the plant’s structures.

Materials

* Writing and drawing supplies (colored pencils, paper, etc.)
* Access to the Internet, lesson, student edition, and other reference materials

# Assignment Instructions

For this project, you are expected to submit:

1. A completed version of this guide, featuring your calculations, graphs, and written analysis.

**Step 1: Prepare for the project.**

1. Read through the guide before you begin so you know the expectations for this project.
2. If there is anything that is not clear to you, be sure to ask your teacher.

**Step 2: Calculate how increasing the molar concentration of a sucrose solution affects the solution’s solute potential.**

1. The equation for solute potential is: **ψ**S = −iCRT, where *i* = the ionization constant (1 for sucrose), *C* = the molar concentration (in moles/liter), *R* = the pressure constant [*R* = 0.0831 (liter MPa)/(mole), and *T* = temperature in Kelvin (273 + °C).
   1. Calculate **ψ**S for a sucrose solution with C = 0.07, C = 0.09, and C = 0.11 at room temperature (*T* = 23 °C).

**Step 3: Draw a line graph showing the solute potential vs. molarity that you calculated in Step 2.**

1. In the section below, draw a line graph that shows your calculations about how the solute potential of the sucrose solution changed by increasing the molarity of the solution.
2. Make sure to create a key for the graph, title the graph, and label the axes and include units.

**Step 4: Calculate water potential (ψ).**

1. Calculate the water potential for each of the scenarios you calculated in Step 1.
2. Describe the relationship between solute potential and water potential by answering Question 1 in the Written Analysis section below.

**Step 5: Potatoes are a plant tuber that contains sucrose. Submerge potato cubes in the sucrose solutions of *C* = 0.07, *C* = 0.09, and *C* = 0.11.**

1. Make an inference about how the mass of the potato cubes will change as the sucrose solutions increase in molarity by answering Question 2 in the Written Analysis section below.
2. Draw a line graph that shows the trend of how the mass of the potato cubes changes as the molarity of the sucrose solution increases.
3. Identify the conditions necessary for the pressure potential to no longer equal 0 by answering Question 3 in the Written Analysis section below.

**Step 6: Evaluate your project using this checklist.**

If you can put a check in each box below, you are ready to submit your project.

* Did you calculate the solute potential for the three different molarities of the sucrose solution?
* Did you graph the molarities of the sucrose solution versus the solute potential you calculated in Step 2?
* Did you complete the Written Analysis section, including descriptions of the relationship between solute potential and water potential, describing how the mass of the potato cubes will change based on the molarity of the sucrose solution, and identifying the conditions necessary for the pressure potential to no longer equal 0?
* Did you draw a line graph with the trend line that shows the relationship between the mass of the potato cubes and the changes in molarity of the sucrose solution?

**Step 7: Revise and submit your project.**

1. If you were unable to check off all of the requirements on the checklist, go back and make sure that your project is complete. Be sure to save your project before submitting it.
2. Turn in your graphs and written analysis to your teacher. Make sure that your name is on it.
3. Congratulations! You have completed your project.

Solute Potential vs. Molarity

In the box below, graph your calculations from Step 2. Make sure to create a key, labels with units, and a title.

Written Analysis

Answer the questions below.

1. Describe the relationship between solute potential and water potential in this scenario.
2. Describe how the mass of potato cubes will change as the sucrose solution increases in molarity.

Potato Cube Mass vs. Molarity

In the box below, draw a trend line on a graph that shows your description of how potato cube mass will change based on increasing the molarity of the sucrose solution. Make sure to create a key, labels with units, and a title.

1. Identify the conditions necessary for the pressure potential to no longer equal zero.