# Assignment Summary

For this assignment, you will review the experimental design of a laboratory experiment investigating the osmolarity of different types of apples. You will evaluate the experimental design, identify sources of error and suggest improvements. Next, you will propose a new investigation or an extension of the laboratory investigation of osmolarity. Lastly, you will provide a description of a controlled procedure to investigate your proposed area of study.

Background Information

Cells depend on the movement of molecules in and out of the cell to sustain life functions. This movement is regulated because cellular membranes, including the cell membrane and organelle membranes, are selectively permeable. Membranes are phospholipid bilayers containing embedded proteins. Some molecules can pass freely through the bilayer by diffusion, while others depend on transport proteins. Water is able to pass slowly through the bilayer due to having a difficult time passing through the hydrophobic core made of fatty acid tails. Aquaporins, therefore, exist so that water can move quickly across the cell membrane.

Diffusion is the simplest form of transport across membranes, where molecules move from an area of high concentration to an area of low concentration. Diffusion does not require the cell to provide energy, but the molecules are using kinetic energy for their movement.

Like other molecules, water moves down its concentration gradient. Water moves from areas of high potential and low solute concentration to areas of low potential and high solute concentration. In walled cells, osmosis is affected by solute concentration. It is also affected by the resistance to water movement in the cell by the cell wall. This resistance is called turgor pressure. The presence of a cell wall prevents the cells from bursting as water enters; however, pressure builds up inside the cell and affects the rate of osmosis.

Water potential predicts which way water diffuses through plant tissues and is abbreviated by the Greek letter psi (Ψ). When a cell’s cytoplasm is separated from pure water by a selectively permeable membrane, water moves from the surrounding area, where the water potential is higher (Ψ = 0), into the cell, where water potential is lower because of solutes in the cytoplasm (Ψ is negative). The movement of water into the cell causes the cell to swell, and the cell membrane pushes against the cell wall to produce an increase in pressure. This pressure slows the diffusion of water into the cell. Eventually, the water potential of the cell equals the water potential of the pure water outside the cell. At this point, an equilibrium is reached and net water movement ceases.

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, with 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: Review the experimental design.**

1. Read through the procedure for investigating the osmolarity of different types of apples.
2. Consider the independent and dependent variables, and control.
3. Consider the experimental steps and apparatus.
4. Determine measurement techniques and sources of measurement error.

**Step 3: Evaluate the experimental design identifying sources of error.**

1. Evaluate the experimental design for adequate controls and measurement techniques in Question 1 in the Written Analysis section below.
2. Comment on possible sources of error in Question 2 of the Written Analysis section below.
3. Suggest improvements in the experimental design in Question 3 of the Written Analysis section below.

**Step 4: Propose a new or follow-up investigation based on an evaluation of the design and methods of the experiment you have read.**

1. Identify a further area for experimental investigation into transport across membranes. This may be a new investigation, or a further investigation of osmolarity in Question 4 of the Written Analysis section below.
2. Write a description of a controlled procedure for investigating the new aspect of transport across membranes you’ve proposed in Question 5 of the Written Analysis section below.

**Step 5: Evaluate your project using this checklist.**

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

* Did you complete the Written Analysis section, including evaluating the experimental design, identifying sources of error, and suggesting improvements?
* Did you propose a further area for experimental investigation into transport across membranes?
* Did you write a description of a controlled procedure for investigating the new aspect of transport across membranes you’ve proposed?

**Step 6: 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 written analysis to your teacher. Make sure that your name is on it.
3. Congratulations! You have completed your project.

Investigation of Osmolarity in Different Types of Apples

**Read the following experimental design carefully.**

**Purpose:**

The purpose of this lab was to determine the osmolarity of 2 types of apples.

**Materials:**

beakers paper towels cork borer balance

sucrose solutions plastic wrap 2 types of apples thermometer

**Procedure:**

1. Obtain 100 mL of each of the sucrose solutions and pour each solution into a separate, labeled 250 mL beaker.
2. Use a cork borer to cut 24 apple cylinders.
3. Determine the mass of 4 of the cylinders together, and record.
4. Put these 4 cylinders into one of your sucrose solutions.
5. Do the same for 4 other cylinders and place in your second sucrose solution.
6. Do the same for the remaining cylinders (in groups of 4) and place in the third and fourth sucrose solution.
7. Cover the beakers with plastic wrap.
8. Let stand overnight.
9. Repeat steps 1 to 8 for a second apple variety.
10. The next day, record the temperature of the sucrose solutions.
11. Remove the cores from one of the beakers, blot them gently on a paper towel, and determine their combined mass.
12. Do the same for your two other beakers.
13. Record the final masses and calculate percent change. Use the formula:

Percent Change in Mass = (Final Mass) – (Initial Mass) X 100

Initial Mass

1. Repeat steps 10 to 12 for the second apple variety.
2. Record all data of percent change in mass for each apple variety. You will have a data table for each variety.

**Results:**

**Apple Core Results – Variety: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Sucrose Solution (M) | Temperature | Initial Mass | Final Mass | Mass Difference | % Change in Mass |
| 0.0 |  |  |  |  |  |
| 0.3 |  |  |  |  |  |
| 0.6 |  |  |  |  |  |
| 0.9 |  |  |  |  |  |

Written Analysis

Answer the questions below.

1. In a well-structured paragraph, evaluate the experimental design of the investigation into the osmolarity of different types of apples for adequate controls and measurement techniques.
2. Evaluate the experimental design for possible sources of error.
3. Suggest improvements in the experimental design.
4. Identify a further area for experimental investigation into transport across membranes. This may be a new investigation, or a further investigation of osmolarity.
5. In a well-structured paragraph, write a description of a controlled procedure for investigating the new aspect of transport across membranes you’ve proposed.