

Biology

STANDARD II: Objective 3

Osmosis Inquiry Labs

Background Knowledge:

Students should have used a microscope before and be familiar with the parts. They should also know how to make a wet mount slide. Students should also be familiar with cell organelles.

Objective:

The purpose of this lab is for students to observe the qualitative effects of osmosis in plant cells and to quantitatively measure the rate of osmosis in potato slices. This should help the students understand how cells maintain homeostasis with the aid of organelles like the cell membrane and cell wall. It will also help students learn to create and design an inquiry lab.

Equipment and Supplies:

Microscope slides, medicine droppers, coverslips, compound microscopes, forceps, salt, tap water, distilled water (1000 ml), paper towel, small white potatoes, 250 ml beakers, balance, pencils, masking tape, single edge razor blade, red onion, Elodea, turnips, food coloring, toothpicks, iodine and any other supplies you or your students can think of to create labs on osmosis.

Safety Issues:

Students should use caution when handling the microscopes. They should also be careful handling the glass slides and coverslips. Extreme caution should be used when using the razor blade to cut the potatoes. You may choose to do this for the students before they arrive in class if you feel it necessary.

Duration: 2 class periods.

Procedures for Teachers:

1. Obtain needed supplies. Print out list of materials and make an overhead of it.
2. If you do not have access to distilled water fill 1000 ml beaker with water and allow the water to sit overnight. Mix up the salt solutions as directed below:
 - 5% = 50 g salt + 1000 ml water
 - 10% = 100 g salt + 1000 ml water
 - 15% = 150 g salt + 1000 ml water

3. You may choose to cut the potatoes ahead of time to save time and help prevent injury with the razor blades
4. Pass out student sheets
5. Have students read the background and purpose.
6. Put up overhead of materials and allow students to look at them.
6. As tables have the students generate 2 hypotheses, one for a qualitative lab and one for a quantitative lab. You may need to go over the definitions of these words with the students again, depending on their prior knowledge.
7. Allow students to complete labs. You may want check their hypotheses and procedures for their qualitative lab before they begin. The best labs should include a wet mount slide and observations under the microscope of cells placed in different solutions of salt water.
8. After students complete the labs allow time for each group to present their lab results and explain the lab design.

Answers to Questions:

1. *The cytoplasm of the cells shrink because water is moving by osmosis from the high concentration in the cell to the lower concentration of water outside the cell. The cell wall remains the same because it is a rigid structure to support the cell.*
2. *It is a little different. In animal cells the cytoplasm shrink but it ends up being the whole cell which shrinks because there is no cell wall to keep the shape of the cell.*
3. *The cell is trying to maintain a constant internal environment (homeostasis) by keeping the concentration of solutes the same inside and outside to the cells.*
4. *There would be no change in the plant cell because solute concentrations are the same when two things are isotonic.*
5. *The cell membrane is responsible to helping the cell maintain homeostasis in this type of environment. Some organisms have cell vacuoles also.*
6. *Answers will vary.*
7. *The distilled water (beaker A) gained the most mass and the 15% sodium chloride solution (beaker D) lost the most mass.*
8. *The distilled water solution was hypotonic to the potato cells, therefore, water was moving into the inside of the potato cells causing them to gain the most mass. The 15 % salt solution was the most hypertonic solution so the most water moved out of the potato cells causing them to lose the most mass.*
9. *The results would be magnified. No. The cells would probably get to a limit where they could not increase or decrease the amount of water any longer.*
10. *You would be surrounded by salt water. You cannot drink salt water because it is hypertonic to your cells. If you drank the water it would cause your cells to shrink in your body and eventually kill you.*
11. *The first part of the lab included written observations and drawings. Data that is not measured using numbers or quantities. The second part of the lab used*

numbers like mass and % change which are quantities therefore it was quantitative.

Conclusions: will vary

Sample Scoring Guide:

Hypothesis: 8 points

Procedures: 4 points

Data before: 4 points

Data after: 4 points

Data Table: 4 points

Written observations: 2 points

Analysis Questions: 24 points

Conclusions: 6 points

Total: 50 points

Overhead

Possible Materials List

Microscope slides

Paper towels

Medicine droppers

50 ml beakers

Coverslips

Balance

**Compound
microscopes**

Red onion

Elodea

Forceps

Food coloring

Salt

Toothpicks

Spoons

Iodine

Tap water

Methylene blue

Distilled water

**If you can think of other materials ask
me and I'll see if I can help you!**

Osmosis Inquiry Labs

Name: _____ Period: _____

Background:

Water passes through cell membranes from areas of high water concentration to areas of lower water concentration. This movement of water is called osmosis. If a cell is placed in an environment in which the concentration of water is less than inside the cell, water will flow from the cytoplasm through the membrane into the environment. The cytoplasm of the cell shrinks. In an animal cell the entire cell shrivels. In a plant cell, the cytoplasm shrinks away from the cell wall.

A scientist can observe the effects of water loss by observing the shrinking of a cell's cytoplasm with a microscope. This observation is a qualitative measurement. In measuring the amount of water loss in grams, a scientist makes a quantitative measurement.

Purpose:

The purpose of this activity is for you to create a lab to observe the qualitative effects of osmosis in cells. You will also complete a lab to quantitatively measure the rate of osmosis in cells.

Hypothesis:

Write an if and then statement for your qualitative lab. Make a prediction on how the mass of the potato slices will change when placed in the 4 beakers described in the procedures for the quantitative lab.

Teacher Signature: _____

Materials :

Qualitative Lab (List all materials here which you will be using for your qualitative lab.):

Quantitative Lab: 2 small white potatoes, 4 250 ml beakers, balance, paper towel, pencil, masking tape, 75 ml distilled water, 75 ml each of a 5%, 10%, and 15% sodium chloride solutions, single-edge razor blade

Procedures:

Qualitative Experiment

List all procedures here. You may add extra steps if needed.

- 1.
- 2.
- 3.
- 4.

Write before observations in data section.
Draw before observations in data section.

- 5.
- 6.
- 7.
- 8.

Write after observations in data section.
Draw after observations in data section

Quantitative Experiment

1. Cut a white potato into 8-12 slices. Each piece should be about 1 cm thick.
2. Determine the mass of the potato slices in stacks of three.
3. Record the mass of each stack of three slices in the data table.
4. Put a stack of potatoes into 4 different beakers.
5. Label the beakers, using a pencil and masking tape, A, B, C, and D.
6. To beaker A, add 75 ml of distilled water; to beaker B, add 75 ml of 5% sodium chloride solution; to beaker C, add 75 ml of 10% sodium chloride solution, and to beaker D, add 75 ml of 15% sodium chloride solution.
7. After 20 minutes, remove the potato slices from the beakers.
8. Quickly blot the slides with a paper towel.
9. Mass each stack.
10. In the data table, record the mass of each stack after soaking.
11. In rows 3 and 4 of the table, indicate the amount of increase or decrease in mass of each stack.
12. Calculate the percent change by using the following formula:

$$\frac{\text{Amount of increase or decrease}}{\text{Mass before}} \times 100 = \% \text{ change}$$

13. Observe the appearance of the stacks of potatoes and record a brief description of them in the data section.

Data and Observations:

Qualitative Lab

“Before” Observations:

“Before” Drawings:

“After” Observations:

“After” Drawings:

Quantitative Lab

Data Table

	Beaker A	Beaker B	Beaker C	Beaker D
Mass Before				
Mass After				
Amount of Increase				
Amount of Decrease				
Percent Change				

Observations of Potato Stacks:

Analysis:

1. What happens to the cytoplasm of plant cells when the cells are put in a 15% solution? Why? What happens to the cell wall? Why?
2. Will the same thing happen to animal cells when placed in a 15% solution? Why or why not?
3. What does this movement of water have to do with homeostasis in a cell?
4. What would happen to a plant cell when placed in a solution that matched its internal salt content? Why?
5. What organelles in a cell help maintain homeostasis of water content?
6. Did the results of your qualitative experiment support your hypothesis? Why or why not was this the case?
7. Which potato stack gained the most mass after 20 minutes of immersion? Which potato stack lost the most mass?
8. Explain the reason you got the results you did for question seven.
9. What might have been the results with the potato slices if the immersion time were lengthened? Would this trend continue indefinitely? Why or why not?
10. If you were stranded in the middle of the ocean on a small life raft, explain on a cellular level why you might die of thirst.
11. Why was the first part of this activity considered qualitative and the second part quantitative?

Conclusions: Please explain 3 important concepts you learned in complete sentences.