Hot Potato

Diffusion Through a Membrane

Introduction

Do you like to eat raw potato? How is its texture different than a cooked potato? How about its taste? In this experiment you can compare raw and cooked potato in a very different way.

Concepts

- Membrane Permeability
- Diffusion
- Osmosis

Materials

Method A

Potatoes, white, 2
Sugar solution, 50%
Beakers (to fit potatoes), 2
Clamps, 2
Glass tubing
Hot Plate
Large cork borer or apple corer
Modeling clay
One-hole rubber stopper, 2
Ring stand

Method B

Potatoes, white, 2
Table sugar
Large cork borer or apple corer
Scalpel or knife
Shallow pan or bowls

Safety Precautions

Once food grade items are brought into the lab they are considered chemicals and should not be consumed. Exercise caution when inserting glass tubing into rubber stoppers. Fire polish rough ends of the glass tubing, lubricate with glycerin, and protect hands with a towel or leather gloves. Do not exert great force to insert the glass. If it requires great force check the hole size, lubrication, and diameter of the tubing. Try the Flinn Glass-a-Matic Hand Saver (AP4599) or Safety Tips (AP4524) for safer ways to insert glass tubing into a stopper. Wash hands thoroughly with soap and water before leaving the laboratory. Please follow all laboratory safety guidelines.

Preparation

Two alternative methods are described for this lab. Either method can be done as a demonstration or as individual student lab activity. Select the method appropriate for your students, laboratory, and goals. Once the method has been selected, prepare the demonstration and the materials appropriate for the number of student groups participating.

Procedure

Method A

1. Select two white potatoes of similar size and shape.
2. Use a cork borer or other boring device to bore a cylindrical hole into each potato as shown in Figure 1. Leave about 2 cm of tissue at the bottom of the potato. Make sure the hole is large enough for the rubber stopper.
3. Place one potato in boiling water for about 20 minutes. Remove the potato from the boiling water and allow it to cool.
4. Slowly pour a concentrated sugar solution (50%) into the boiled and raw cored potato.
5. Carefully insert a piece of glass tubing into a one-hole rubber stopper. Be sure the tube is entirely through the stopper. *Caution:* Inserting glass tubing into a rubber stopper can be very dangerous. Fire polish rough ends of the glass tubing, lubricate with glycerin, and protect hands with a towel or leather gloves. Never apply great pressure nor force tubing

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into a rubber stopper.

6. Insert the rubber stopper into the top of the cored hole and into the sugar solution.
7. Clamp the entire potato/glass tube setup into a beaker of water as shown in Figure 1.
8. Seal the stopper with modeling clay or melted paraffin.
9. Note the level of the sugar solution in each tube.
10. Let both potatoes sit undisturbed for 24 hours. Examine the liquid levels in the glass tubes and record results. Write an explanation for the results. Be sure to describe some ideas about how the boiling process influenced the results.

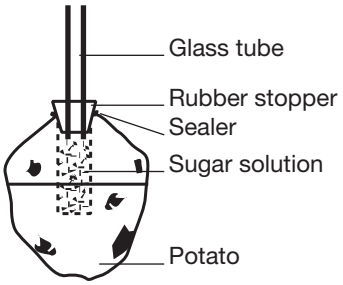

Figure 1. Potato/glass tube setup.

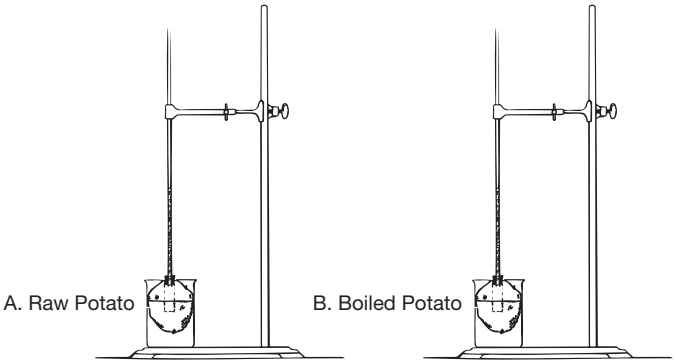

Figure 2. Effect of boiling on potato cell osmosis

Method B

1. Select two white potatoes of similar size and shape for each setup.
2. Place one potato in boiling water for about 20 minutes. Remove the potato from the boiling water and allow it to cool.
3. Slice the top and bottom off of each potato and remove the peel from the lower one-third of each potato as shown in Figure 3.
4. Use a cork borer or other boring device to bore a cylindrical hole in each potato. Leave about 2 cm of tissue at the bottom of the potato.
5. Place a spoonful of table sugar (sucrose) into each hollowed chamber.
6. Fill a shallow pan with water and place each potato in the water as shown in Figure 3.
7. Label the potatoes and leave them in the water undisturbed for 24 hours.
8. After 24 hours, observe the sugar in the chamber in each potato. Write an explanation for your observations. Be sure to include some ideas about how the boiling process influenced the results.

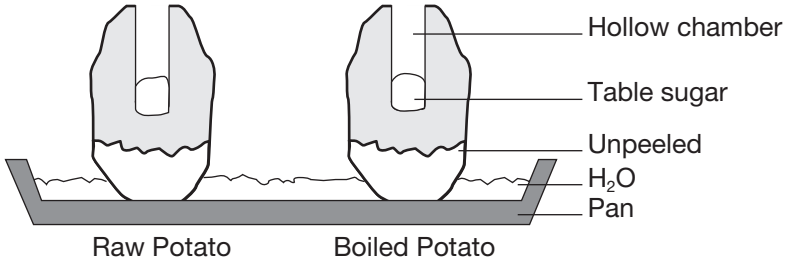

Figure 3. Effect of boiling on diffusion in potato cells

Disposal

Please consult your current *Flinn Scientific Catalog/Reference Manual* for general guidelines and specific procedures, and review all federal, state and local regulations that may apply, before proceeding. All food items that are brought into the lab are con-

sidered laboratory chemicals and may not be removed from the lab after use. Dispose of the potatoes in the trash according to Flinn Suggested Disposal Method #26a.

Discussion

Diffusion principles are significant for living cells. Not all cell membranes, however, react to abiotic influences in the same way. High temperatures such as boiling can affect cells in different ways depending upon the internal contents of the cells. Potato cells are affected by the high temperatures of boiling and become nearly impermeable to the passage of materials. Boiled yeast cells (in contrast to the starch-filled potato cells) react in the opposite way. Boiling yeast cells results in large "holes" in the membrane and they become more permeable.

The "live" potato cells respond to the diffusion gradients and allow water molecules to diffuse through the entire potato from cell to cell. The "dead" potato cells, on the other hand, act as a diffusion barrier and to not allow the free movement of water molecules across the cell membranes.

Connecting to the National Standards

This laboratory activity relates to the following National Science Education Standards (1996):

Unifying Concepts and Processes: Grades K–12
Evidence, models, and explanation
Content Standards: Grades 5–8
Content Standard B: Physical Science, properties and changes of properties in matter
Content Standard C: Life Science, structure and function in living systems
Content Standards: Grades 9–12
Content Standard B: Physical Science, structure and properties of matter, chemical reactions
Content Standard C: Life Science, the cell

Materials for *Hot Potato* from Flinn Scientific, Inc.

Catalog No.	Description
AP8326	Cork Borer Set
AP2301	Rubber Stoppers
GP9020	Glass Tubing
AP4550	Support Stand
AP8354	Clamps
GP1025	Beakers
AB1264	Shallow Pan
AP4599	Glass-a-Matic Hand Saver

Consult your *Flinn Scientific Catalog/Reference Manual* for current prices.