

DIFFUSION

Driving Question

- ♦ What is diffusion and which molecules in pickle juice can diffuse across a dialysis membrane?

Materials and Equipment

- Conductivity sensor
- pH sensor
- Colorimeter
- Lint-free tissue
- Disposable pipet (4)
- Cuvettes (2)
- 400-mL beaker or similar-sized cup
- 50-mL beaker or similar-sized cup (2)
- Pickle juice containing FD&C yellow dye # 5, 50 mL
- Soaked dialysis tubing 28 cm
- Squirt bottle of water and cup or beaker
- Paper towels
- Plastic wrap
- Labeling marker
- Distilled water
- Scissors

Background

All living plant cells have permeable membranes that allow them to absorb and secrete ions, thus causing them to uptake minerals and water. The ions cause a negative potential that osmotically passes water to the Xylem. Generally speaking, diffusion is the random movement of molecules from an area of higher concentration of those molecules to an area of lower concentration. Diffusion is driven by the concentration gradient of the molecule, the difference that exists when there is a difference in the concentration of a substance in a given area. Through diffusion, molecules will move down their concentration gradient until a dynamic equilibrium is reached.

Procedure

1. Connect to the pH and Colorimeter sensors.
2. Open the Diffusion lab file.
3. Create a digit display of pH and set the conductivity probe to a measurement range of 0 to 100,000 (the wave button), and connect a 10X probe to the sensor. Create a digit display of conductivity. Set the colorimeter to measure absorbance. Create a digit display of Blue Absorbance.
4. Pour approximately 50 mL of pickle juice into one of your 50-mL beakers. Label this beaker "pickle juice". Fill a clean cuvette with pickle juice using a clean pipet, and screw the cap on the cuvette. Do not dispose of the pickle juice.
5. Fill the other 50-mL beaker with distilled water. Label this beaker "distilled water". Using a clean pipet, fill the second cuvette with distilled water and screw the cap on the cuvette. Do not dispose of the distilled water.
6. Start recording data and use the pH and conductivity probes to measure the pH and conductivity of the pickle juice. Repeat for the pH and conductivity probes to measure the pH and conductivity of the distilled water. Write the results in Table 1.
7. Do not dispose of the pickle juice or the distilled water. Clean the outside of the cuvette with lint free tissue. Calibrate the colorimeter with the cuvette of distilled water.
8. Insert the cuvette into the colorimeter, close the top, measure the absorbance of blue light, and record the data in Table 1. Stop data recording.
9. Obtain a piece of dialysis tubing soaking in water. Tie a half-knot in one end. Open the other end of the dialysis tubing by rubbing it back and forth between your wet fingers. Be patient. Once you get the tube open, hold it open.

10. Using a disposable pipet, fill the dialysis bag with 15 to 20 mL of pickle juice. Be sure to leave enough room in the bag for expansion.
11. Tie off the open end of the bag with another half-knot. If any excess dialysis tubing is exposed above or below your knots, cut it off with scissors. You should have 0.5 cm of dialysis tubing above and below each knot.
12. Place the bag containing pickle juice into the beaker or cup of water, and allow it to soak for 30 to 45 minutes (depending upon your teacher's instructions).
13. What do you think will happen to the pH of the solution in the dialysis bag and the solution in the beaker?
14. Allow the incubation to finish and then remove the dialysis bag from the water. (Do not dispose of the water in the cup.) Hold the dialysis bag over the "pickle juice" beaker, and carefully cut the bag open so the contents empty into the beaker.
15. Using a clean pipet, fill a cuvette with soaking fluid from the cup. Screw on the cap and clean the outside of the cuvette with lint free tissue. Using a clean pipet, fill another cuvette with fluid from the dialysis bag. Screw on the cap and clean the outside of the cuvette with lint free tissue.
16. Start data recording. Insert the cuvette filled with soaking fluid into the colorimeter, close the top, measure the absorbance of blue light. Record the data in Table 1.
17. Insert the cuvette filled with soaking fluid into the colorimeter, close the top, measure the absorbance of blue light. Record the data in Table 1.
18. Remove the cuvette and replace with the cuvette filled with fluid from the dialysis bag. Close the top, measure the absorbance of blue light and record the data in Table 1.
19. Use the pH and conductivity probes to measure the pH and conductivity of the fluid in the beaker labeled "distilled water", and record the data in Table 2.
20. Use the pH and conductivity probes to measure the pH and conductivity of the fluid from the dialysis bag, and record the data in Table 2.
21. Stop data recording.

Analysis & Questions

Table 1: Pre-soak conditions

	pH	Conductivity ($\mu\text{S}/\text{cm}$)	Abs Blue Light (480 nm)
Distilled water			
Pickle juice			

Table 2: Post-soak conditions (30 minutes)

	pH	Conductivity ($\mu\text{S}/\text{cm}$)	Abs Blue Light (480 nm)
Contents of beaker			
Contents of dialysis bag			

1. Calculate the change in pH for the distilled water and the pickle juice. Show your work below and record your results in Table 3. Change = Final – Initial

- Calculate the percent change in pH for the distilled water and the pickle juice. Show your work below and record your results in Table 3. Percent change = $\text{Change in pH} \times 100 / \text{initial pH}$

Table 3 Change in pH & conductivity

	Initial pH	Final pH	Change in pH	(%) Change in pH	Initial Conductivity ($\mu\text{S/cm}$)	Final Conductivity ($\mu\text{S/cm}$)	Change in Conductivity ($\mu\text{S/cm}$)	(%) Change in Conductivity
Distilled Water								
Pickle juice								

Table 4: Change in absorbance of blue light

	Initial Absorbance	Final Absorbance	Change in Absorbance	Change in Absorbance (%)
Distilled Water				
Pickle juice				

- Calculate the change in absorbance of blue light for the distilled water and the pickle juice. Show your work below and record your results in Table 4. Change = Final – initial
- Calculate the percent change in absorbance of blue light for the distilled water and the pickle juice. Show your work below and record your results in Table 4. Percent change = $\text{Change in absorbance} \times 100 / \text{initial absorbance}$
- Which molecules was the dialysis membrane permeable to? Which way did these molecules diffuse: from the bag into the beaker, or from the beaker into the bag? What evidence do you have to support your claims?
- Was the membrane impermeable to any of the molecules? What evidence do you have to support your claims?
- Did osmosis occur during the experiment? What evidence do you have to support your claim?