4. OSMOSIS

What factors affect the rate of osmosis?

Objectives

- Relate the conditions that drive water movement through a model cell membrane to osmosis in living cells.

Materials and Equipment

- Data collection system
- Pressure sensor
- Connector with 2" piece of tubing attached
- Balance (Readability: 0.01 g)
- Beaker, 400-mL
- Graduated cylinder, 10-mL
- Graduated cylinder, 100-mL
- Funnel
- Ring stand or base and support rod
- Test tube clamp or three-finger clamp
- Dialysis tubing (2), 1" diameter, 15-cm length
- Thread or dental floss (4), 10-cm length
- Syrup (maple or corn), 10 mL
- Distilled water, 650 mL
- Wash bottle filled with distilled water
- Paper towels

Safety

Follow regular lab safety procedures.

Procedure

1. Select Sensor Data in SPARKvue.
2. Connect the pressure sensor to your device.
3. Make sure only the pressure measurement is checked and choose the Graph template.
4. Clamp the pressure sensor to the ring stand. Do not connect the tubing.
5. Wash and dry your hands. Retrieve one piece of soaked dialysis tubing. Tie one end of the tubing with thread to form a bag as shown in Figure 1. Add multiple knots to ensure a tight seal.
6. Rub the tubing between your fingers to open the top of the bag.
7. Use a funnel to fill the dialysis bag with 10 mL of syrup.
8. Rinse the outside of the dialysis bag with distilled water. Make sure no water enters the bag and do not spill any contents of the bag. Carefully blot the bag dry with a clean paper towel.
9. Insert the open half of the plastic tubing into the dialysis bag. Do not allow fluid to enter the tubing for the duration of this investigation. Use thread to tightly seal the bag around the tubing as shown in Figure 1.
10. Record the mass of the bag in Table 1.

Figure 1: Bag setup

11. Inflate the bag by blowing air into the connector end of the tubing.

12. Attach the connector to the pressure sensor. Using an empty 400-mL beaker, adjust the clamp height to set up the materials as shown in Figure 2.

13. Pour 300 mL of distilled water into the beaker. Select Start to begin collecting data. Record the initial pressure in Table 1. Do not disturb the setup while collecting data.

14. Stop collecting data after 15 minutes. Record the final pressure in Table 1. Name the Data run "Syrup".

15. Remove the dialysis bag from the beaker and disconnect the plastic tubing from the sensor.

17. Use a clean paper towel to blot the bag dry. Record the final mass of the bag in Table 1.

18. Dispose of the bag according to your instructor's directions. Rinse the funnel and graduated cylinder thoroughly with tap water, then with distilled water.

19. Repeat Steps 5-18 adding distilled water to the bag instead of syrup.

20. Use the following equation to calculate change in mass and change in pressure. Record the results in Table 1.

    Change = Final value - Initial value

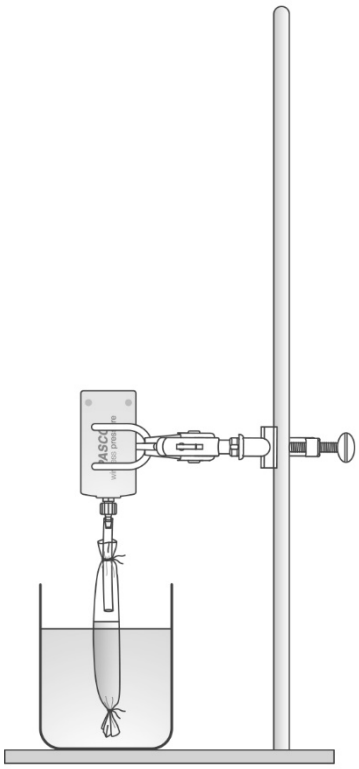


Figure 2: Beaker setup

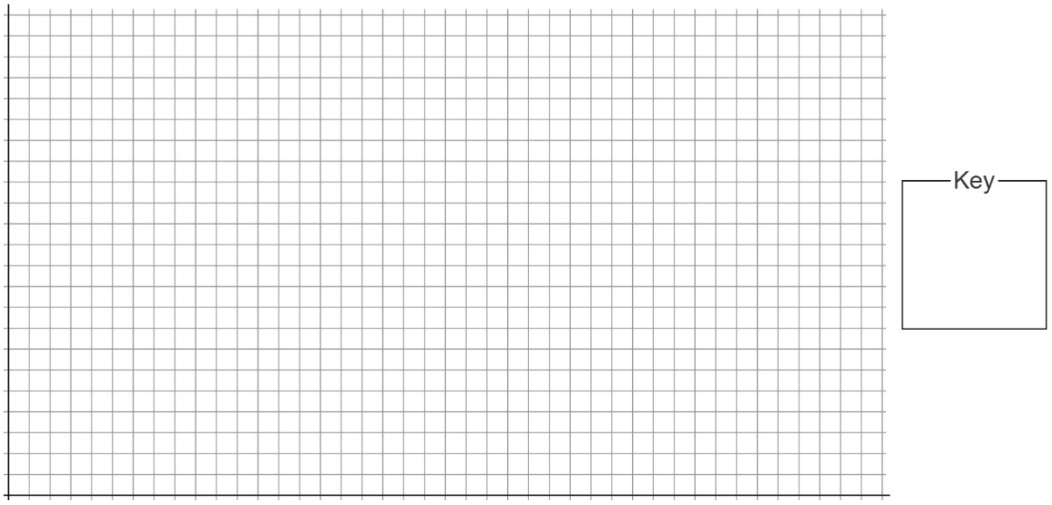
21. Show both runs in SPARKvue and scale the display. Sketch your results in Graph 1. Include numbers, labels, and units on the x- and y-axes. Add a key to identify each run.

Data Collection

Table 1: Mass and pressure data

Bag Contents	Initial Mass (g)	Final Mass (g)	Initial Pressure (kPa)	Final Pressure (kPa)	Change in Mass (g)	Change in Pressure (kPa)
Syrup						
Water						

Graph 1: Pressure versus time for syrup and distilled water



Questions and Analysis

1. In which bag did the pressure increase the most? In which bag did the mass increase the most? What does this indicate about which direction water was moving?

2. Use data to describe what happened to the pressure and mass of the distilled water bag and explain the results.

3. Predict what would happen to the mass of each bag if the beaker contained a solution of 50% syrup and 50% water instead of 100% distilled water.

4. When a person is given fluid intravenously in the hospital, the fluid is typically a saline solution that is isotonic to human body tissues. Explain why this isotonic solution is necessary and predict what would happen if a patient was given distilled water instead of the isotonic saline solution.

5. When roads become icy during the winter months, salt is added to the roads to make them less icy and slippery, but the salt also kills many plants alongside the road. What causes the plants to die? Relate your answer to the observations made during this investigation.