

Lab-wide Learning Outcomes for Membranes and Osmosis Explored

Knowledge-Based Outcomes

Upon completion of *Membranes and Osmosis Explored*, students should be able to:

1. Explain the difference between movement of individual molecules and net average movement of molecules.
2. Understand that cell membranes are semipermeable, allowing only certain molecules to cross.

Skills-Based Outcomes

Upon completion of *Membranes and Osmosis Explored*, students should be able to:

1. Given a concentration difference, predict the direction of average net movement and contrast with individual molecule movement.
2. Given concentrations of a type of molecule (including water) inside and outside of a cell, predict whether a cell could use passive transport to move molecules in a particular direction, or if active transport must be used.

Membranes and Osmosis Explored, Part 1: Cell Membranes

Knowledge-Based Outcomes

Upon completion of *Part 1: Cell Membranes*, students should be able to:

1. Describe the cell membrane as a lipid bilayer that includes proteins and other molecules.
2. Explain the basic functions of a cell membrane.
3. Define membrane permeability as how easily molecules of a particular type can cross a membrane.
4. Explain mechanisms for how the permeability of a cell membrane can be different for different types of molecules.
5. Explain the difference between saturated and unsaturated fatty acids, and explain why membranes with higher unsaturated fatty acid content are generally more permeable.
6. Describe the role of transport proteins in cell membranes.
7. Clarify the difference between passive and active transport across cell membranes, indicating that active transport requires energy input while passive transport does not.

Skills-Based Outcomes

Upon completion of *Part 1: Cell Membranes*, students should be able to:

1. Predict how changing the temperature of a membrane will affect its permeability.
2. Predict how changing the ratio of saturated to unsaturated lipids in a cell membrane will affect its permeability.
3. Predict the direction of net movement of molecules under passive transport across a membrane, and test the prediction with a simulation.

Membranes and Osmosis Explored, Part 2: Osmosis

Knowledge-Based Outcomes

Upon completion of *Part 2: Osmosis*, students should be able to:

1. Define osmotic concentration as the total concentration of all solute particles in solution.
2. Define osmosis as net water movement across a water-permeable membrane towards the compartment with higher osmotic concentration.
3. Explain that osmosis depends on total osmotic concentration and not on the type(s) of solutes, nor on the concentration of a single type of solute.
4. Define isotonic, hypotonic, and hypertonic solutions, and explain how tonicity of an extracellular solution is a measure of total solute concentration relative to that in a cell.
5. Understand that osmosis can change the pressure in a cell.
6. List examples of how osmosis plays a role in biology and/or medicine.

Skills-Based Outcomes

Upon completion of *Part 2: Osmosis*, students should be able to:

1. Given an osmotic concentration difference and a membrane permeable only to water, predict whether the cell volume will increase, decrease, or remain the same, and test the prediction with a simulation.
2. Calculate what changes to concentration in an extracellular fluid are needed to avoid cell volume changes.
3. Given a cell that is changing volume (shrinking or expanding), determine whether the cell is in a hypotonic or hypertonic environment, and propose a strategy to reverse the change.