

Lab-wide Learning Outcomes for Diffusion Explored

Knowledge-Based Outcomes

Upon completion of *Diffusion Explored*, students should be able to:

1. Explain how diffusion arises from the random motion of particles.
2. Define diffusion as the net movement of molecules away from regions of high concentration toward regions of lower concentrations.
3. Understand the difference between movement of individual molecules and net average movement of molecules.

Skills-Based Outcomes

Upon completion of *Diffusion Explored*, students should be able to:

1. Given a concentration difference, predict the net movement of a molecular species and movement of individual molecules.

Diffusion Explored, Part 1: Heat, Random Motion, and Diffusion

Knowledge-Based Outcomes

Upon completion of *Part 1: Heat, Random Motion, and Diffusion*, students should be able to:

1. Explain that the kinetic theory of heat postulates that all molecules, atoms, and ions in a liquid or gaseous solution are in constant random motion, and that this motion speeds up with increased temperature.
2. Define concentration as the relative amount of a given molecular species in a region.
3. Explain why random motion results in molecules spreading out over time.
4. Define diffusive flux as the rate of diffusion.
5. Name a cellular function that depends on random molecular movement.

Skills-Based Outcomes

Upon completion of *Part 1: Heat, Random Motion, and Diffusion*, students should be able to:

1. Predict how changing temperature affects the speed of random motion of molecules.
2. Identify the solvent and the solute in aqueous solutions.
3. Use the equation for diffusive flux to identify circumstances when diffusion will happen more quickly or slowly.

Diffusion Explored, Part 2: Diffusion in Cells

Knowledge-Based Outcomes

Upon completion of *Part 2: Diffusion in Cells*, students should be able to:

1. Explain the mechanism of net movement direction when there is a concentration difference.
2. Understand that diffusion time increases quickly with distance (more quickly than would be predicted by a linear relationship), and that therefore diffusion is slow over long distances but fast over short distances.
3. Explain the difference between "random" and "unpredictable", in the context of molecular movement.

Skills-Based Outcomes

Upon completion of *Part 2: Diffusion in Cells*, students should be able to:

1. Given the average time it takes for a molecule to diffuse a specified distance, predict how long it would take the molecule to diffuse twice or half as far.
2. Assess whether diffusion is a reasonable transport method, given the distance that molecules must diffuse in a biological system.