Further Reading

Topic Diffusion / Osmosis

What is Diffusion?

Diffusion is the passive movement of molecules from a region of higher concentration to lower concentration until equilibrium is reached.

How Does It Work?

- Molecules move randomly due to kinetic energy (natural motion).
- They spread out evenly until there is no concentration gradient.
- No energy (ATP) is needed since the process happens naturally.

Examples of Diffusion

In Living Organisms

- Gas exchange in the lungs: Oxygen diffuses from the air sacs (alveoli) into the blood, and carbon dioxide diffuses out.
- Perfume spreading in a room: Fragrance particles move from an area of high concentration (bottle) to low concentration (air).

Factors Affecting Diffusion

1. Concentration Gradient – The bigger the difference, the faster diffusion happens.
2. Temperature – Higher temperature increases the speed of molecules.
3. Surface Area – A larger surface allows more diffusion (e.g., alveoli in lungs).

2. Osmosis

What is Osmosis?

Osmosis is a special type of diffusion where water molecules move from a region of higher water concentration to lower water concentration across a partially permeable membrane.

How Does It Work?

- A partially permeable membrane allows only water to pass through but not solute molecules (like salt or sugar).
- Water moves to balance concentrations on both sides of the membrane.

Examples of Osmosis

In Living Organisms

- Plants absorb water from the soil: The root cells have a higher solute concentration than the soil, so water moves in by osmosis.
- Red blood cells in different solutions:
- In pure water (hypotonic solution), water enters the cell, and it may burst.
- In a salty solution (hypertonic solution), water leaves the cell, and it shrinks.
- In a balanced solution (isotonic solution), water moves in and out equally.

Topic

Importance of Osmosis

- Helps plants stay firm (turgid).
- Maintains water balance in animal cells.

3. Active Transport

What is Active Transport?

Active transport is the movement of molecules or ions from a region of lower concentration to a higher concentration using energy (ATP) and carrier proteins in the cell membrane.

How Does It Work?

- Carrier proteins in the cell membrane grab molecules and push them against the concentration gradient.
- This process requires ATP (energy) since molecules are moving in the opposite direction of diffusion.

Examples of Active Transport

In Living Organisms

◊ Plants absorb minerals from soil:
◊ Soil has a low concentration of minerals (e.g., nitrates, potassium).
◊ The plant actively pumps minerals into its roots using ATP.
◊ Sodium-Potassium Pump in Nerve Cells:
◊ Nerve cells pump sodium ions (Na^+) out and potassium ions (K^+) in to maintain the right charge balance for nerve signals.

Why Is Active Transport Important?

- Allows cells to absorb essential nutrients that diffusion cannot provide.
- Helps nerve signals and muscle contractions.

Comparison Table of Transport Methods

Feature	Diffusion	Osmosis	Active Transport
Definition	Movement of molecules from high to low concentration.	Movement of water across a membrane from high to low water concentration.	Movement of molecules from low to high concentration using energy.
Type of Transport	Passive (no energy required)	Passive (no energy required)	Active (requires ATP energy)
Molecules Involved	Gases (O_2, CO_2), small molecules	Water molecules only	Ions (Na^+, K^+, nutrients like glucose)
Requires a Membrane	No	Yes (partially permeable)	Yes (with carrier proteins)
Examples	Oxygen into blood, perfume spreading	Water absorption in roots, red blood cells in different solutions	Mineral uptake in roots, sodium-potassium pump in nerves

Further Reading

Topic

Summary

- Diffusion = Passive, high to low, no energy needed.
- Osmosis = Water diffusion through a membrane.
- Active Transport = Requires energy, low to high concentration.