Topic: The Cell and Its Environment

Subtopics:

1. **Diffusion – Definition, Process, and Significance**
2. **Osmosis – Process, Examples (Haemolysis, Plasmolysis), and Biological Significance**

Introduction:

Cells constantly interact with their **environment**.
They must take in nutrients, remove waste, and balance water and solute levels.

To achieve this, they use **natural processes** such as:

- **Diffusion**
- **Osmosis**

Both processes happen **without energy** (they are **passive transport mechanisms**).

---

1. Diffusion

Definition of Diffusion:

Diffusion is the **movement of particles (atoms, molecules, ions)** from a region of **higher concentration** to a region of **lower concentration** until they are **evenly distributed**.

How Diffusion Happens:

- Particles are always in **random motion**.
- If a substance is **more concentrated in one place**, its particles naturally move to areas where it is **less concentrated**.
- This movement happens **until equilibrium is reached**, meaning the concentration is the same everywhere.

Biological Examples of Diffusion:

Example	Description
Gaseous exchange in the lungs	Oxygen diffuses from the alveoli (air sacs) into the blood, while carbon dioxide diffuses from the blood into the alveoli to be exhaled.
Respiration in body cells	Oxygen diffuses from the blood into cells for respiration, and carbon dioxide diffuses out of cells into the blood.
Nutrient absorption in the intestines	Digested food molecules like glucose diffuse from the small intestine into the bloodstream.
Removal of waste in plants	Oxygen and carbon dioxide diffuse in and out of plant leaves through stomata.
Scent spreading	The smell of perfume or food spreads in a room because of diffusion (non-living example but helps to understand the concept).

Factors Affecting Diffusion:

1. **Concentration gradient:** The bigger the difference in concentration, the faster the diffusion.
2. **Temperature:** Higher temperatures increase particle movement, speeding up diffusion.
3. **Surface area:** A larger surface area allows faster diffusion.
4. **Size of molecules:** Smaller particles diffuse faster than larger ones.
5. **Membrane permeability:** Some membranes allow particles to pass faster than others.

Biological Importance of Diffusion:

- **Exchange of gases** (oxygen and carbon dioxide) in respiration and photosynthesis
- **Removal of metabolic waste** (e.g., carbon dioxide)
- **Absorption of nutrients** in the digestive system
- **Supply of minerals** to plant cells
- Maintains the **internal environment of cells** by balancing substances

---

2. Osmosis

Definition of Osmosis:

Osmosis is the **movement of water molecules** from a region of **higher water concentration** (or lower solute concentration) to a region of **lower water concentration** (or higher solute concentration), **through a selectively permeable membrane**.

Explanation of Osmosis:

- A **selectively permeable membrane** allows only certain substances (like water) to pass through, but blocks others.
- Water moves into or out of cells depending on the **concentration of solutes** (salts, sugars) inside and outside the cell.
- Osmosis helps balance **water levels** in living organisms.

Examples of Osmosis in Living Systems:

Situation	Description
Plant root absorption	Roots absorb water from the soil by osmosis because the concentration of solutes in root cells is higher than in the surrounding soil water.
Turgidity in plants	When plant cells absorb water, the vacuole swells, making the cell turgid (firm). This helps plants stand upright.
Plasmolysis	When a plant cell is placed in a highly concentrated solution (e.g., saltwater), water leaves the cell. The cytoplasm and cell membrane shrink away from the cell wall. The plant wilts.
Haemolysis	When red blood cells are placed in pure (distilled) water, water enters the cells by osmosis, causing them to swell and burst. This is dangerous in living organisms.
Crenation	When red blood cells are placed in a very salty solution, water leaves the cell, causing it to shrink and wrinkle.

Osmosis in Daily Life:

- Preservation of food using salt or sugar (removes water from microbes by osmosis, killing them)
- Soaking dried food (like beans) in water makes them swell due to osmosis

---

Biological Significance of Osmosis:

- **Maintains cell shape and firmness** (especially in plant cells)
- **Controls water balance** in animal cells (prevents dehydration or swelling)
- **Essential for absorption** of water by roots in plants
- Helps plants to **transport water from roots to leaves**
- Prevents bursting or collapsing of cells by controlling water movement

---

3. Differences Between Diffusion and Osmosis

Feature	**Diffusion**	**Osmosis**
Type of particles	Involves **all types of molecules** (gases, liquids, solids)	Involves **only water molecules**
Membrane	Can happen **with or without a membrane**	Requires a **selectively permeable membrane**
Direction of movement	From **high concentration** to **low concentration**	From **high water concentration** to **low water concentration**
Example	Oxygen entering blood	Water entering plant roots

Diagrams to Draw:

1. **Diffusion through a membrane:** Show molecules moving from high to low concentration.
2. **Osmosis in plant cell:**
    - **Turgid cell** in pure water
    - **Plasmolysed cell** in concentrated salt or sugar solution

3. **Red blood cells in different solutions:**
    - **Normal cell** in balanced solution
    - **Haemolysed cell** in distilled water
    - **Crenated cell** in salty solution

Conclusion:

Diffusion and osmosis are natural processes that do not require energy (passive transport). They help cells and organisms **absorb nutrients, remove waste, balance water, and exchange gases**, which are all essential for life.
Understanding these processes helps explain how cells survive in their environments.