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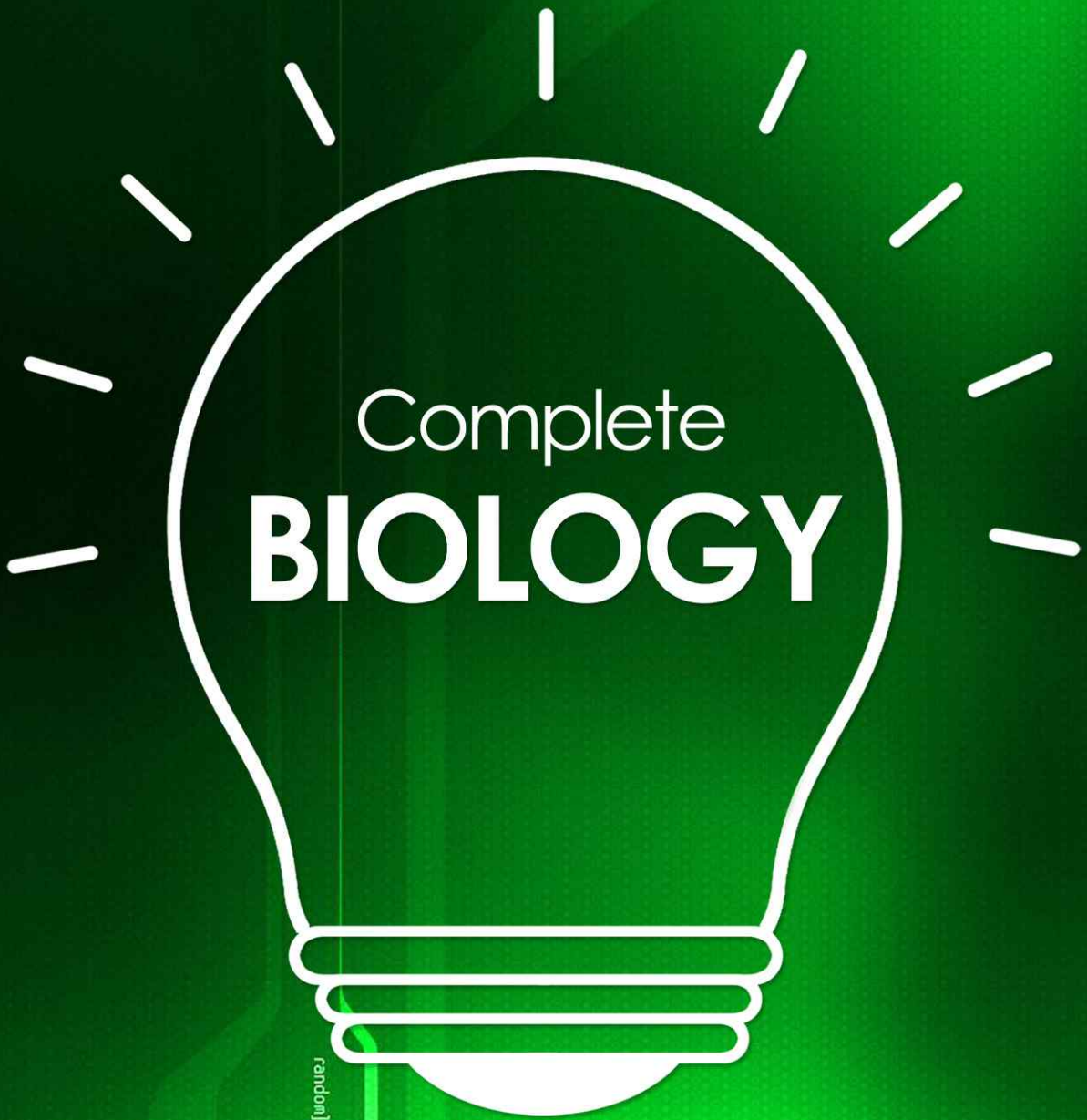

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Transport in Plants

01. Transport in Plants

In plants, transport may start from roots (underground part) or from leaves (aerial part). The substances that would need to be transport in plants are water, mineral nutrients, organic nutrients, enzymes and growth regulators. The specialised tissues involved in the transportation of water and organic solutes are xylem and pholem, respectively.

Means of Transport

The process of transport in a plant takes place at three levels. *These are*

(i) The uptake and release of substances within a cell, i.e. cellular level transport.
(ii) Transport of substances from one cell to another, i.e. short distance transport.
(iii) Transport of water and sugar *via* xylem and phloem, i.e. long distance transport.

Active Transport :

It is the process of transport that requires involvement of energy (ATP). It can allow movement of substances, molecules or ions across a membrane from region of their low concentration to a region of high concentration, i.e. uphill transport. e.g. Na^+ –H^+ transporter protein, GLUT (Glucose Transporter).

Passive Transport :

In this type of transport a molecule is transported along it‘s concentration gradient without the involvement of ATP.
The flow of water in and out of the plant mainly occurs by passive transport.
Passive transport of water and solutes in plants may take place *via* diffusion, osmosis, plasmolysis, etc.

Diffusion

It is the net movement of particles (gases, liquids and solids) from a region of their higher concentration to a region of their lower concentration. This movement continues till an equilibrium is established.
The two main forces that contributes to diffusion of particles are

(i) Kinetic energy present in the particles.
(ii) Differences in areas of concentrations of the particles of a particular substance.

Diffusion Pressure (DP)

The pressure exerted by particles of a substance, when they move from their higher concentration to lower concentration is called as diffusion pressure.
Diffusion pressure of pure water is found to be maximum. Its value at 20°C is 1336.40 atm.
DP decreases as more solute is added in a solution.

Facilitated Diffusion

It is the movement of particles from a region of their higher concentration to a region of their lower concentration with the help of a membrane transport protein and without the involvement of energy.

Transport proteins involved in facilitated diffusion are of two types.

(i) **Carrier Protein** They bind to the substance and carry it to the other side.

(ii) **Channel Protein** They allow diffusion of solutes of appropriate size only. *Some examples of channel proteins are as follows* :

(a) **Porins** These are β-barrel proteins that form a pore-like structure in mitochondrial, chloroplast and bacterial membranes. Through this pore only specific molecules are transported.

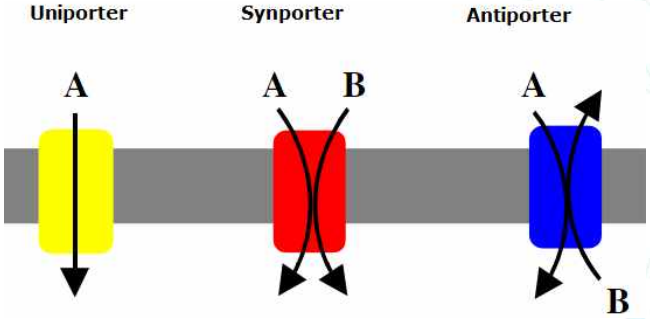
(b) **Aquaporins** These are membrane proteins with 8 units that unite to form a water channel. It allows transport of water.

Types of Facilitated Diffusion

(i) **Uniport System** It allows diffusion of one molecule only.

(ii) **Symport System** It allows diffusion of two types of molecules in a single direction only.

(iii) **Antiport System** It allows diffusion of two types of molecules in opposite directions.



Role of Diffusion in Plants

The following roles are played by diffusion in plants

(i) Diffusion keeps the cell wall moist.

(ii) It helps in gaseous exchange during photosynthesis and respiration, transpiration and translocation of food materials.

(iii) It is involved in short-distance transport of gases, liquids and some food materials.

Permeability

The term 'Permeability' refers to the degree tow which a membrane permits movement of gases, liquids and dissolved substances across it. *On the basis of permeability, membranes may be of following types*

(i) **Permeable membranes** These allow diffusion of both solvent and solute molecues, e.g. cellulosic cell wall, lignified cell walls.

(ii) **Impermeable membranes** These prohibit the diffusion of both solvents and solute particles, e.g. cutinised or suberised cell walls.

(iii) **Semplermeable membranes** These allow diffusion of solvent molecules, but do not allow the passage of solute molecules. Such membranes from perfect partition between two osmometers, e.g. membranes of parchment paper and copper ferrocyanide, etc.

(iv) **Differentially permeable membranes** These allow only certain specific substances to pass through them. They are also called as differentially permeable or selectively permeable membrane, e.g. all biological membranes.

Osmosis

The phenomenon of osmosis was discovered by Nollet in 1748. It is a kind of diffusion that plays a role in the movement of water into and within the plants.

It is defined as the diffusion of water molecules from a less concentrated solution to a more concentrated solution through semipermeable membrane.

The net direction and rate of osmosis depends on both the pressure gradient and concentration gradient.

Osmosis Concentrations

Solutions can be of three types based on osmotic concentration.

(i) **Hypertonic Solution** Having osmotic concentration higher than that of another solution or cell sap in vicinity.

(ii) Hypotonic Solution Having osmotic concentration lower than that of another solution or cell sap in vicinity.

(iii) **Isotonic Solution** Having osmotic concentration equal to another solution of cell spa in vicinity.

Types of Osmosis

Osmosis is of two types depending upon the movment of water in or out of a living tissue or cell.

The two types are

(i) **Exosmosis** When a cell is placed in hypertonic solution water come out of the cell. As a result of this cell becomes flaccid. This is called as exosmosis.

(ii) **Endosmosis** When a cell is placed in hypotonic solution cell it gain water dueto osmosis and becomes turgid. This is known as edosmosis.

Osmotic Pressure (π)

It was proposed by Pfeffer. It can be defined as the actual pressure, that develops in a solution, when it is separated from its pure solvent (water) by means of a semipermeable membrane.

Plant cells exhibit a considerable range or variation in Osmotic Pressure (OP). The osmotic pressure of plant cell usually varies from 4–5 atmosphere.

Significance of Osmosis for Plants

(i) It helps in maintaining the turgidity of cells such as guard cells thus, aididng in opening and closing of stomata.

(ii) It plays a role in providing resistance to cold stress.

(iii) Absorption of water through root hairs take place by osmosis.

(iv) Movement of plants and plant parts, e.g. movement of leaflet of Indian telegraph plant.

Plasmolysis

When a plant cell is placed in hypertonic solution, exosmosis take place. The water moves out of the cells and thus the cell wall is no longer under tension. Due to this loss of water the protoplast shrinks and move away from the cell wall.

This process of shrinkage of protoplast away from the cell wall is called as plasmolysis.