Absorption by Roots

- **Morphology**
  - It is the branch of biology which deals with the study of external structures of plants and animals.
  - A plant consists of a root system (underground part) and a shoot system (above the ground parts).
  - Roots are the parts of the root system; and stem, leaves, flowers, and fruits are parts of the shoot system.
- **Roots**
  - It helps in anchoring plant and absorbing water and minerals.
  - Developed from the radicle part of a cotyledon
  - It consists of a region of meristematic activity covered by a root cap, a region of elongation, and a region of maturation having root hairs.
- **Types of roots system:**

  1. Tap root system
  - It consists of a primary root that grows deep inside the soil.
  - It also bears lateral roots referred to as secondary and tertiary roots.
  - Example- Dicotyledons (mustard)
- **2.Fibrous root system**
  - Primary root is short-lived and is replaced by a large number of secondary roots.
  - Example- Monocotyledons (wheat)
- **3. Adventitious roots**
  - Roots arise from parts other than the radicle.
  - Example- Banyan tree

- **Root modifications**
  - **Prop roots –** Example: banyan tree
  - **Stilt roots –** Example: maize and sugarcane
  - **Pneumatophores** (that helps in respiration) – Example: Rhizophora
- **Characteristics of Root for Absorbing Water**
  - Enormous surface area
  - Root hairs containing cell sap at higher concentration
  - Thin walled root hairs

- **Translocation**
  - It is a biological process that involves the transport of dissolved material within a plant.
  - It mainly occurs with the help of xylem and phloem.
  - The transport of food from leaves to other parts of plant occurs by phloem. Movement of food in phloem is bidirectional.
  - The conduction of water and minerals from soil to the rest of the plant occurs by xylem. Movement of water in xylem is unidirectional.
- **Need of Water and Minerals for Plants**
  - **Need of Water**
    - For photosynthesis
    - For transpiration
    - For transportation
    - For mechanical stiffness
  - **Need of Minerals**
    - Needed as nutrients for the plants
    - For the synthesis of a variety of compounds and enzymes

- **Means of Transport**
- **Diffusion**
  - It is the spontaneous movement of molecules from a region of high concentration to a region of low concentration.
  - It is a slow process and does not require any energy expenditure.
  - It does not require a semi-permeable membrane and can take place through any membrane along concentration gradient.
  - Rate of diffusion is affected by
    - a. concentration gradient
    - b. membrane permeability
    - c. temperature
    - d. pressure
- **Facilitated diffusion**
  - It involves the movement of molecule from the region of higher concentration to lower concentration, mediated by a carrier (mainly protein) molecule.
  - Movement of molecules across membrane occurs without expenditure of energy.
  - **Porins –** They are large protein molecules that form pores in membranes of plastids, mitochondria, and some bacteria
  - Porins allow the movement of small-sized proteins across membrane. Aquaporins are proteins, which form a water-permeable channel.
  - Some protein molecules allow diffusion only if two molecules are present. Based upon the direction which is followed by both molecules, the path can be of three types.
  - **Symport –** when both molecules cross the membrane in same direction
  - **Antiport –** when both the molecules move in the opposite directions
  - **Uniport –** when single molecule moves across a membrane independent of other molecule
- **Active transport**
  - It involves the transport of molecules from a region of low concentration to a region of high concentration with an expenditure of energy.
  - It is carried out by membrane proteins.

- **Osmosis**
  - Osmosis is a special type of diffusion which involves the movement of water molecules from the region of high concentration to the region of low concentration through a semi-permeable membrane.
  - Semi-permeable membrane = Selectively permeable membrane.
  - Types of Osmosis:
    - Endosmois
    - Exosmosis
  - Rate of osmosis is affected by
    (i) pressure gradient
    (ii) concentration gradient
  - Osmotic pressure is the hydrostatic pressure produced by a difference in concentration between solutions on the two sides of a semi-permeable membrane.
  - **Tonicity** : Relative concentration of solution and its surroundings.
  - **Isotonic solution:** Solution that has the same salt concentration as the normal cells
  - **Hypotonic solution:** Solution that has lower salt concentration than the normal cells
  - **Hypertonic solution:** Solution that has higher salt concentration than the normal cells
  - **Important terms : Flaccidity, Turgidity, Plasmolysis, Deplasmolysis,Wall Pressure.**
- **Plasmolysis**
  - It is the contraction of cells within plants due to the loss of water through osmosis.
  - When cells are placed in hypertonic solution, a cell tends to lose water to the surrounding solution due to exosmosis. The plasma membrane shrinks and the cell is said to be plasmolysed.
  - When cells are placed in hypotonic solution, cells get deplasmolysed (turgid) due to movement of water into the cell from surrounding as a result of endosmosis.

- **Deplasmolysis**
  - The opposite of plasmolysis.
  - If not dead, the protoplasm absorbs water
  - The cell swells up
- **Difference between Diffusion and Osmosis**
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Diffusion	**Osmosis**
1 Movement of substances from higher concentration to lower concentration.	Movement of selective substances thr membrane.
2 It occurs in any medium	It occurs in liquid medium.
3 It helps in equalising the concentration in the available space.	It does not equalise the concentration
4 It does not depend on solute potential	It depends on the solute potential.

- **Imbibition:** It is a special type of diffusion which involves water absorption through colloids causing tremendous increase in volume. For example: absorption of water by seeds and dry wood

- **Water movement**
- **Root pressure**
  - It is the positive pressure that develops in the roots of plants by active absorption of nutrients from soil.
  - It pushes the water up to small heights.
  - Root pressure is linked to the phenomenon of guttation.
  - Guttation: It involves the loss of water in the form of liquid droplets through the vein endings of the leaves.
  - Guttation occurs early in the morning and late in the evening when evaporation is low and root pressure is high.
- **Transpiration Pull**
  - Water transport in tall trees occurs by transpiration pull.
  - Transpiration pull is generated by transpiration. It is also called cohesion - tension - transpiration pull model of water transport.
  - The ascent of xylem sap is dependent on three physical properties of water:
    - Cohesion
    - Surface tension
    - Adhesion