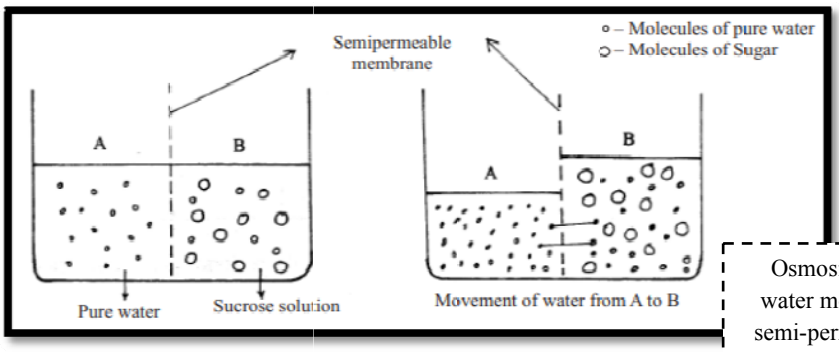
LESSON-8 ABSORPTION, TRANSPORT AND WATER LOSS (TRANSPIRATION) IN PLANTS

Water is the most important component of living cells. It enters the plants through roots and then moves to other parts. It is also lost by transpiration through the aerial parts of plants, mainly through the leaves. There are several phenomena involved in the movement of water about which you will study in this lesson.

- **Permeability** is the property of a membrane to allow the passage of the substances through it. The plant cell wall is permeable because it allows both solvent and solute molecules to pass through it.
- All biological membranes (cell membrane, mitochondrial membrane, nuclear membrane etc.) are selectively permeable as they allow penetration of only solvent molecules but not the solute molecules.
- **Diffusion** is an effective method of transport of matter over short distances. For diffusion to take place no membrane is required.
- **Osmosis** can be regarded as a special kind of diffusion of water molecules from a region of their high concentration to their region of low concentration through a semi-permeable membrane.
- In osmosis, the water molecules move, and the presence of a semi-permeable membrane is essential.



Osmosis - Movement of water molecules through a semi-permeable membrane.

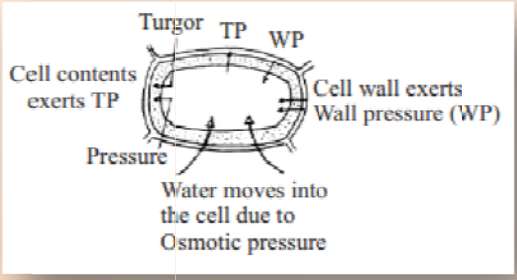
Diffusion	Osmosis
1. Diffusion is the movement of a given substance from the place of its higher concentration to an area of its lesser concentration, irrespective of whether separated or not separated by a semipermeable membrane.	1. Osmosis is a special type of diffusion of solvent molecules such as water from lower concentration of solution to higher concentration of solution when the two are separated by a semi permeable membrane.
2. The diffusion may occur in any medium. The moving particles may be solid, liquid or gas.	2. It occurs in liquid medium and only the solvent molecules such as water move from one place to another.

Importance of Imbibition

- Imbibition is the initial step in the germination of seeds.
- It causes swelling of seeds and breaking of seed coat.
- **Water potential** is the capacity of a solution to give out water. It is represented by the word Psi ψ. It is affected by the solute concentration and external pressure.
  - ψ of pure water = zero. – More solute means low water potential.
  - A solution has lower water potential than pure water.
  - Water potential of a solution is a negative number i.e. less than zero.

Turgor Pressure is the pressure exerted by the protoplasm against the cell wall.

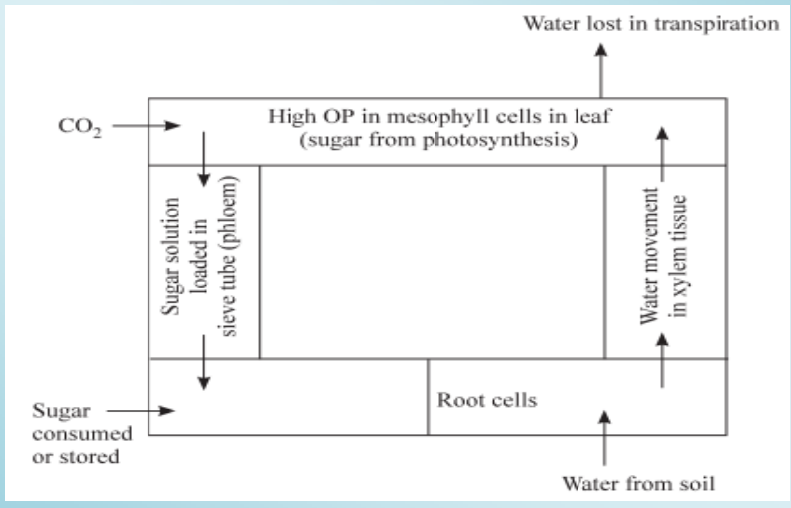
- Plants absorb water by their roots (mainly by root hair) from the soil through osmosis. The increased water content inside the protoplasm exerts a turgor pressure on the cell wall.



- The equal and opposite force exerted by the cell wall onto the cell contents is termed as wall pressure.
- Water is present in the soil as gravitational water, hygroscopic water (least available to the plant) and capillary water (most readily available to the plant). The water absorbed by root hairs flows to the xylem vessels mainly by the **apoplast pathway**.
- The water moves up through the xylem vessels to the leaf along the water potential gradient as explained by the cohesion- tension theory (most acceptable).

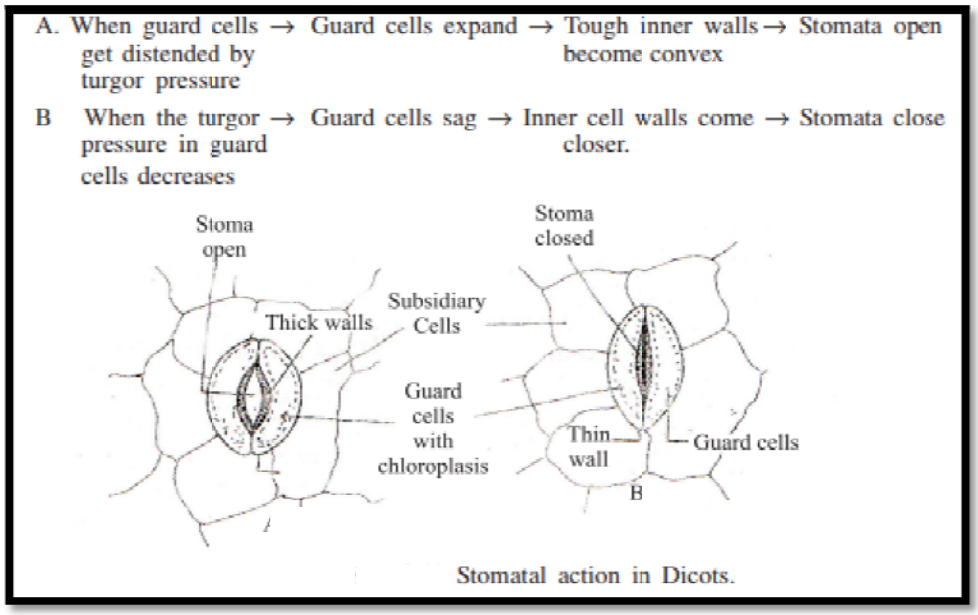
TRANSLOCATION OF ORGANIC SOLUTES

Movement of organic and inorganic solutes from one part of the plant to another is known as translocation, e.g. transport of sugar in sieve tubes of leaves to stem or fruit.

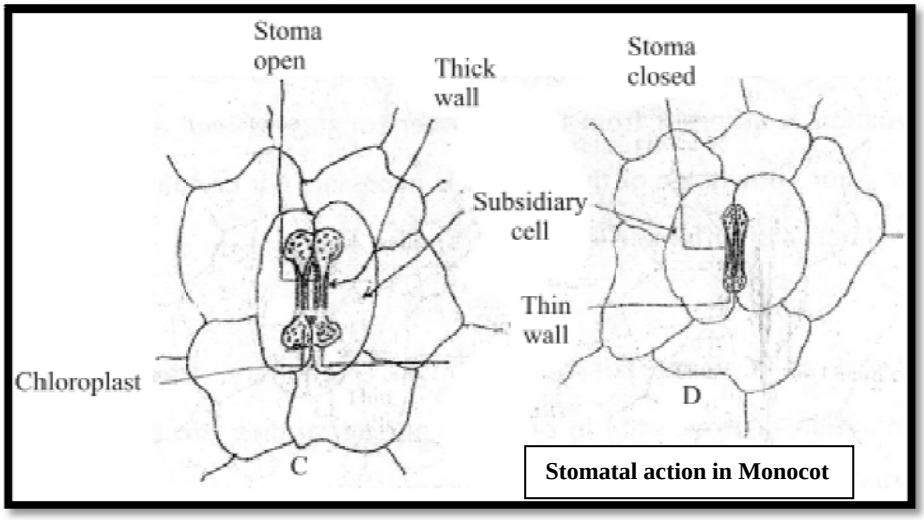


Transpiration	Guttation
(i) Water is lost in the form of water vapor.	(i) Water is lost in the form of water drops.
(ii) Occurs through stomata, cuticle and lenticels.	(ii) Occurs through special pores, called hydathodes.
(iii) Occurs during day time and at high temperature.	(iii) Occurs at night and early in the mornings at low temperature.
(iv) Water vapour lost is pure water and does not contain minerals.	(iv) Water lost has substances dissolved in water. It contains sugars, salts and amino acids.
(v) Increased transpiration is physical process (see cohesion physical force theory)	(v) It is due to increased root pressure that develops in the aerial shoot system when water absorption by roots is more and transpiration by aerial plant parts is low.

- The loss of water from aerial parts of the plant in the form of water vapour is termed transpiration and, when transpiration is low and absorption of water by roots is high, loss of water from leaves in the form of liquid is termed **guttation.**
- **Transpiration** or evaporation of water from the plant through stomata causes a pull and water moves up like a water column due to the force of cohesion and tension created by transpiration.
- Certain plants show guttation due to high root pressure and low transpiration. Turgidity of guard cells is explained by the increased conversion of starch into sugar and by the accumulation of K+ ions.
- Various environment factors like temperature, light, wind, humidity and internal Plants and animals factors like structure of leaf and root-shoot ratio affect the transpiration.
- **The opening and closing of stomata** depends upon the turgidity and flaccidity alternately in the guard cells and subsidiary cells. When the guard cells are turgid, and subsidiary cells are flaccid, the stoma opens, and, when guard cells lose water into subsidiary cells so that guard cells become flaccid and subsidiary cells become turgid, the stoma closes.



Stomatal action in Dicots.



Stomatal action in Monocot

A. When the guard cells become turgid → The region with thin walls bulges and gets inflated → The thick walls move apart → Stoma opens

B. When the guard cells lose water → The inflated part sags → The thick walls collapse → Stoma close

- Transpiration not only brings about ascent of sap but also has a cooling effect and saves the plant from heat injury.
- When the transpiration rate exceeds the water absorption rate, it leads to **temporary wilting of the plant.**
- When a plant undergoes wilting due to water deficit in the soil, it is called **Permanent Wilting.**

TEST YOURSELF

1. Define Translocation. How does translocation occur in plants?
2. Mention any two factors that affect transpiration in plants.
3. State five points of difference between transpiration and guttation.