

B.Sc II Botany Paper III  
**“Taxonomy, Embryology and Plant Physiology”**  
Section II – “Plant Metabolism”

**Unit I – “Plant Water Relationship”**

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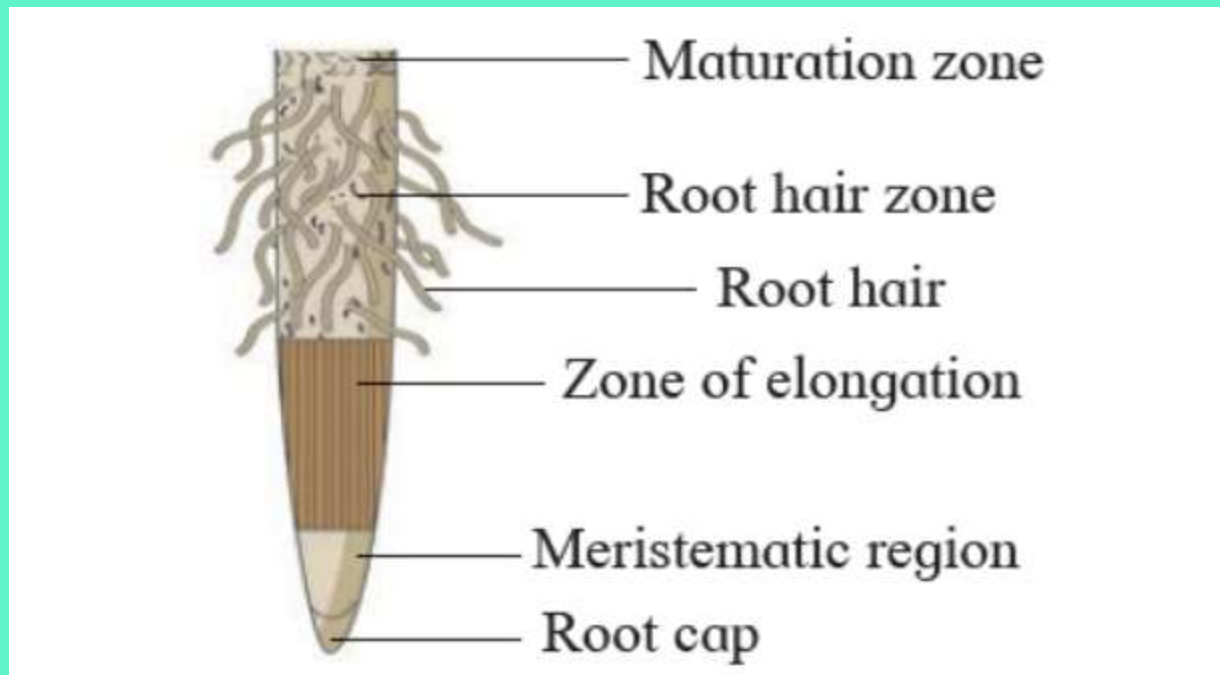
# Plant Water Relation

- Plant Physiology is the study of water in plant system.
- Water is absolutely essential for all living organisms.
- Why water is important for plants ?
  - It is basic medium for all the reactions in different life processes in plants.
  - Living cells are composed of 70-95% water.
  - Life depends on the properties of water.

- Life probably evolved in water.
  - Water covers  $\frac{3}{4}$  of the earth.
  - When organisms go dormant, they loose most of their water.
  - Limiting resource of crop productivity.
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- Water is considered as '**Elixir of life**'.
  
  - Water is important chemical compound in living system.

## ❖ Water absorbing organs in plant – Root

- Root – water and mineral absorption
- Terrestrial plants – absorb water in the form of liquid from the soil.
- Epiphytic plants- Orchids absorbs water vapours from air with the help



Root tip showing root hair zone

## **Terminology**

**Solvent** – A Substance, ordinarily a liquid, in which other materials dissolve to form a solution.

e.g.- Water, Ethanol, Methanol and acetone etc.

**Solution** - It is a homogenous mixture of two or more substances. E.g.- Sugar-water, Saltwater.

**Solute** - A solute is a substance that is dissolved in a solvent to form a solution. A solution of salt and water, in this salt acts as a solute and water acts as a solvent.

## **Properties of water**

- Life is totally depends on the properties of water
- Pure water – Colorless and has no smell and taste.
- The hidden qualities of water make it a most interesting.

## **Physicochemical Properties of water**

Physico-chemical properties are the intrinsic physical and chemical characteristics of a substance. These include appearance, boiling point, density Volatility, water solubility and flammability etc.

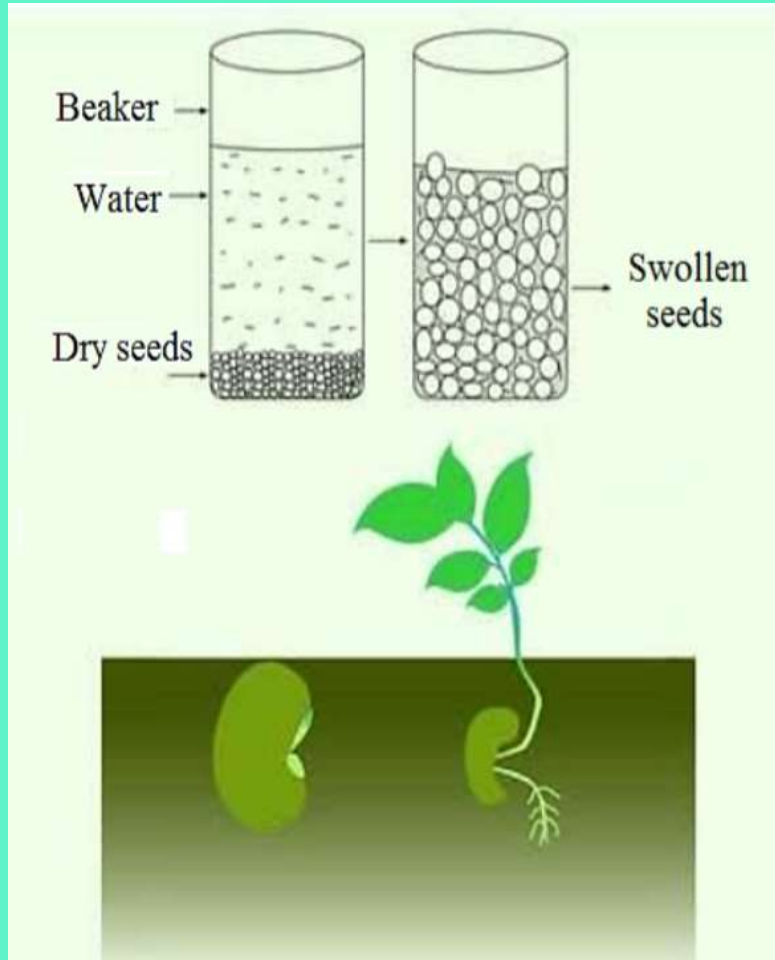
# Universal Solvent

- Dissolves more different kinds of substances than any other solvent.
- Hydrogen bonds make water an excellent solvent.
- Wherever water goes, either through the ground or through plant body, it takes along valuable chemicals, minerals and nutrients.
- Water is a liquid at physiological temperature –
  - High boiling and melting point then other similar sized molecules.
- Life exist between 0 and 100oC
  - > 100oC tends to disrupt bonds
  - < 0oC too low to permit significant chemistry for metabolism.

- Water has unique property due to its simple composition and structure.
- Hydrogen atoms are attached to one side of the oxygen atom.
- Positive and negative charge.
- The separation between negative and positive charges creates a polar molecule.
- Hydrogen bonds- A Weak bond that forms between a hydrogen atom and electronegative atom.
- Water acts as thermal buffer.
- Water molecules have good adhesive and cohesive forces of attraction.



# Imbibition

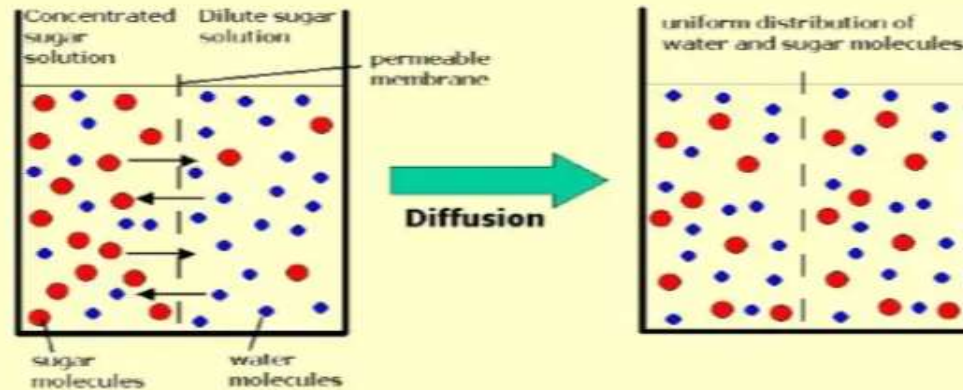


➤ Imbibition is a special type of diffusion when water is absorbed by solids causing an increase in volume.

e.g. – Absorption of water by seeds and dry wood.

➤ It is the first step in germination of seeds. When seeds are soaked in water, they imbibe water and swell. The water is imbibed by the seed coat and then the other tissues of embryo and endosperm. So, the process of imbibition initiates the seed germination.

# Diffusion



- Molecules move until they reach dynamic equilibrium
- At equilibrium the net movement stops
- the molecules continue to move randomly

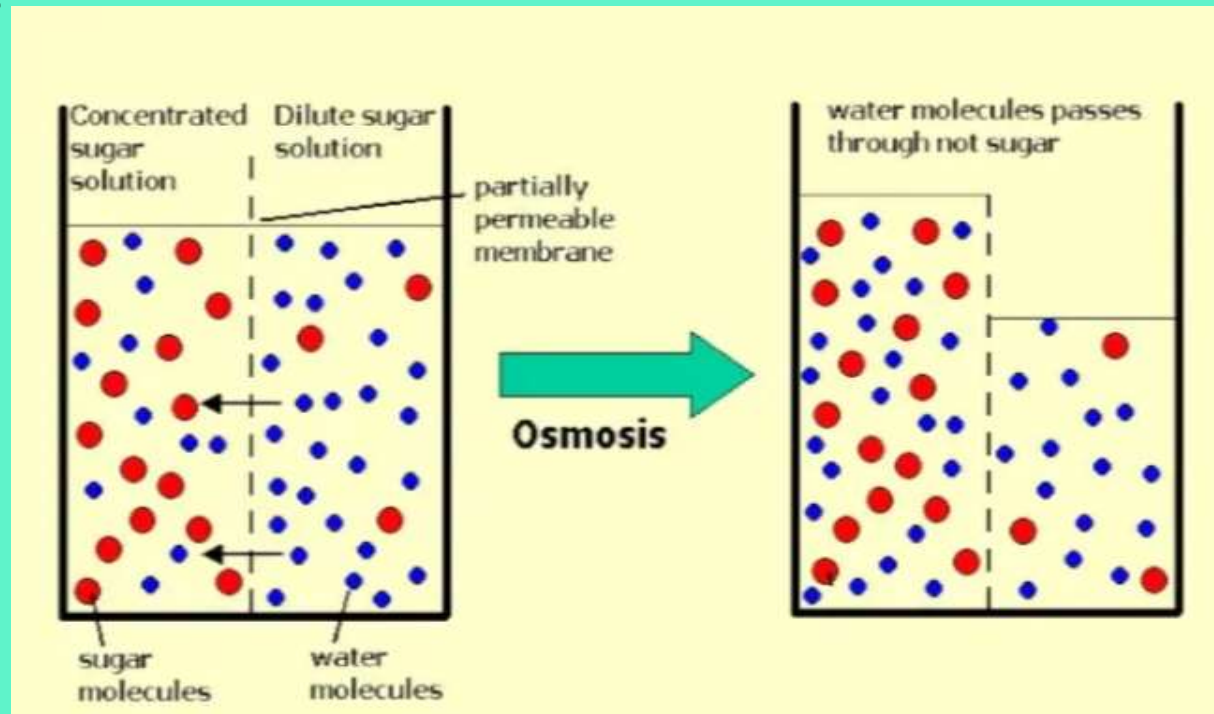
➤ The plants absorb water and minerals from the soil. This water and minerals are taken up by all the part of the plant. These water and minerals are transported through the xylem and vessels by the process of diffusion.

So, diffusion is the movement of molecules / particles of a medium from the region of higher concentration to the region of lower concentration without expenditure of energy.

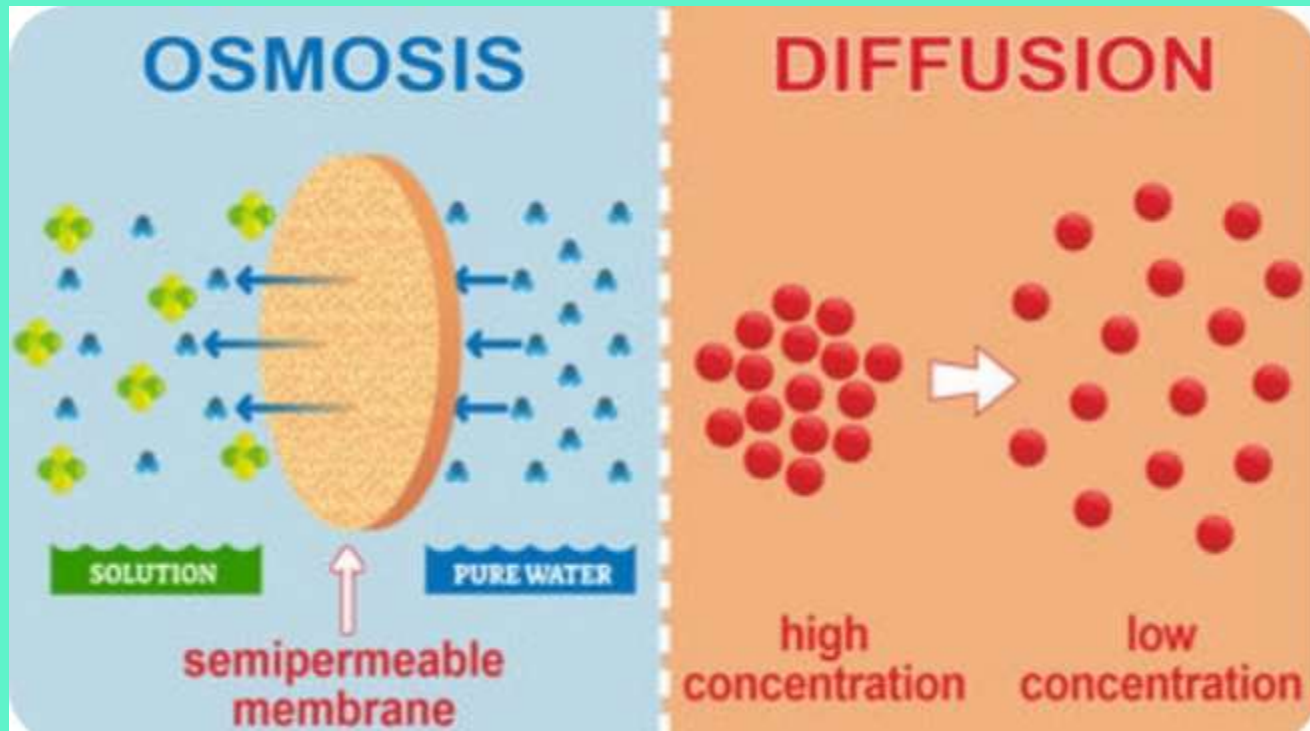
# Importance of Diffusion

1. The movement of water from soil into plant body, occurs by process of diffusion.
2. The loss of large quantity of water, in vapour form, from the aerial organs into surrounding atmosphere is takes place by diffusion process.
3. The movement of nutrients from one region to another, in the plant body is by diffusion.
4. From soil, water molecules with dissolved inorganic salts enter in to the root system by diffusion process, which is essential for uptake of nutrients and water.

# Osmosis



- Water moves from a high concentration of water (less salt or sugar dissolved in it) to a low concentration of water (more salt or sugar dissolved in it). This means that water would cross a selectively permeable membrane from a dilute solution (less dissolved in it) to a concentrated solution (more dissolved in it).



- The net movement of water molecules through the cell membrane from an area of higher to an area of lower water potential is known as Osmosis.

➤ On the basis of concentration and osmotic migration , three types of solutions are recognized.

1. Hypotonic (Weak solution or strong solvent) having low osmotic concentration.
2. Hypertonic (Strong solution or weak solvent) having high osmotic concentration.
3. Isotonic having such a concentration of solution where there is neither gain nor loss of water in an osmotic system. (i.e concentration in outside and inside the cell is same).

Osmosis having two types, endosmosis and exosmosis.

➤ **Endosmosis-**

- It is a type of osmosis in which the flow of the solvent is towards the inside of a vessel or cell.
- It occurs when cells are placed in hypotonic solutions. Cells are swell as a result of endosmosis.

e.g.-1. Entrance of water in the xylem vessel.

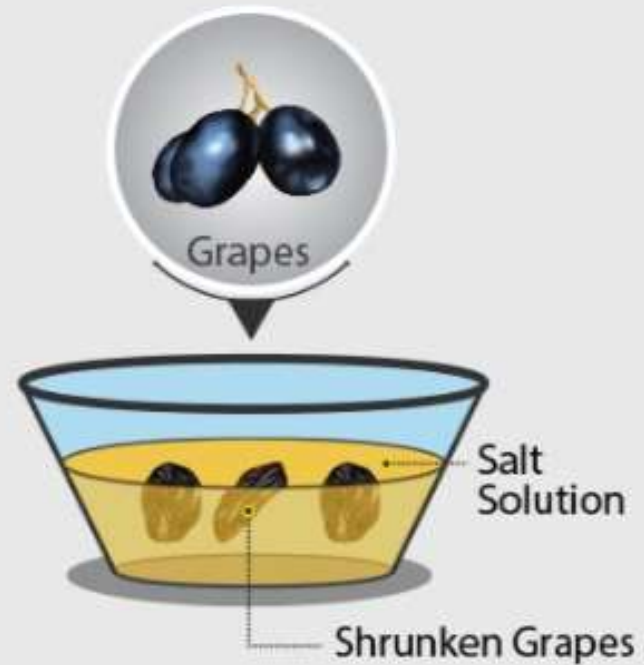
2. Raisins swell when placed in normal water





## ENDOSMOSIS

THE INFLOW OF SOLVENT (WATER) INTO A CELL FROM OUTSIDE WHEN CELL IS PLACED IN DISTILLED WATER. CELL SWELLS UP IN THIS CASE.



## EXOSMOSIS

THE OUTWARD FLOW OF WATER FROM THE CELL WHEN PLACED IN MORE CONCENTRATED SOLUTION LIKE SUGAR SOLUTION (HYPERTONIC). CELL SHRINKS IN THIS CASE.



## ➤ **Exosmosis**

- Is the movement of water out of the cell. It occurs when cells are placed in hypertonic solutions. Cells shrink as a result of exosmosis.

e.g.- 1. Movement of water from the root hair cells to the cortical cells of the root.

2. Raisins shrivel when placed in a concentrated salt solution.

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