

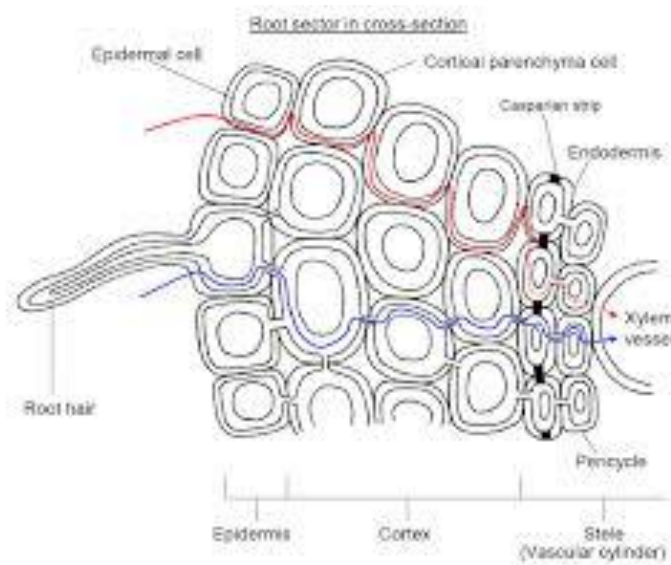
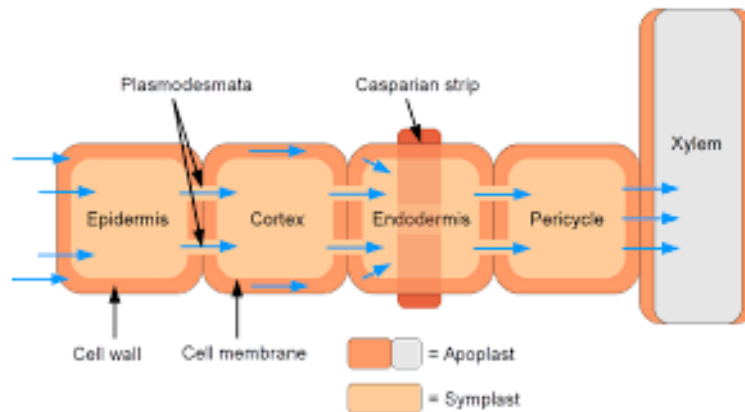
Long distance transport of water

- v Balsam plant experiment demonstrates that water movement in plants occur through vascular bundles namely the xylem tissue.
- v Plants need (require) special long distance transport systems as diffusion or active transport is not sufficient to conduct water and substances to long distance.
- v Water, minerals and food are generally transported by mass or bulk flow, due to pressure difference between the two regions of a plant.
- v The bulk movement of substances through the conducting (vascular) tissues of plants is called **translocation**.
- v Bulk flow is achieved either through a positive hydrostatic pressure (root pressure and pressure developed in sieve elements) or negative hydrostatic pressure (transpiration pull developed in xylem vessels and suction through straw).
- v Hydrostatic pressure called root pressure and pressure due to loading of sucrose and subsequent entry of water into tubes are example of positive pressure.

How do plants absorb water?

- v Plants absorb water by the root hairs which are thin walled extensions of root epidermal cells.
- v Root hairs increase the surface area for absorption and absorbs substances by diffusion.
- v Absorbed substances move into deeper layers from root hairs by two distinct pathways. They are **apoplast** and **symplast**.
- v Majority of lateral conduction upto casparian strips of the endodermis occurs through apoplast pathway by mass flow.
- v Apoplast is the outer space and include intercellular spaces and walls of the cells.
- v In symplast, neighbouring cells are inter-connected through cytoplasmic strands and water is transported through cytoplasm aided by cytoplasmic streaming.
- v Symplastic movement is relatively slower than apoplastic movement.
- v Water and solutes enter into the vascular cylinder through symplastic pathway as suberised endodermal walls are impermeable to water.
- v Xylem tracheids and vessels are non living structures hence considered parts of apoplast.
- v Mycorrhizae are additional structures present in some plants (*Pinus*) and help in water and mineral absorption.

A Mycorrhiza is a symbiotic association of a fungus with root system in which fungus provides minerals and water to roots and roots in turn provide sugars and nitrogen containing compounds to mycorrhizae.



Water movement up a plant :

- v Water absorbed by root hairs is transported to various parts of the plants through xylem against gravity.
- v Positive pressure developed in roots due to active transport of various substances into its vascular tissue from endodermal cells is called **root pressure**.
- v Root pressure pushes water column only to small heights and is also responsible for **guttation** in herbs (water loss in liquid phase).
- v Root pressure is observed at night and also early morning when evaporation is low.
- v Root pressure helps in establishment of continuity of water in the xylem which breaks due to transpiration tension.

Transpiration pull :

- v Most of the plants meet their water requirement by transpiration pull, but not due to root pressure.
- v Upward movement of water occurs through the xylem at high rates and it is under the influence of a pulling force produced due to transpiration.
- v "**Cohesion-tension-transpiration pull model**" was proposed by Dixon.
- v More than 90% of absorbed water in plants is lost from its surface in the form of vapour and this process is called **transpiration**.
- v Ascent of sap is driven by transpiration and it is mainly dependent on cohesion, adhesion and transpiration pull.
- v Water has high tensile strength (ability to resist pulling force) and high capillarity (ability to rise in thin tubes) due to cohesive and adhesive forces.
- v Evaporation of water from the stoma of the leaves sets up a pressure gradient that results in pulling up of water from root to the leaf.