TRANSPORT IN PLANTS

Transport in Plants

- Short Distance Transport
  - Cytoplasmic Streaming → Intracellular, Cell to cell
  - Active → ATP → Pumps
  - Passive → Simple diffusion, facilitated diffusion → Uni, Anti, Symport
- Plant-Water Relations
  - $\Psi_w = \Psi_s + \Psi_p$
  - Imbition
  - Plasmolysis
  - Osmotic pressure
- Long Distance Transport
  - Xylem → Minerals, Transpirational pull, Root pressure → Guttation
  - Phloem → Mass flow hypothesis

Transport in Plants

- Short Distance
  - Passive
    - Diffusion
    - Facilitated
  - Active
- Long Distance
  - Xylem
  - Phloem

① Diffusion → No energy used.

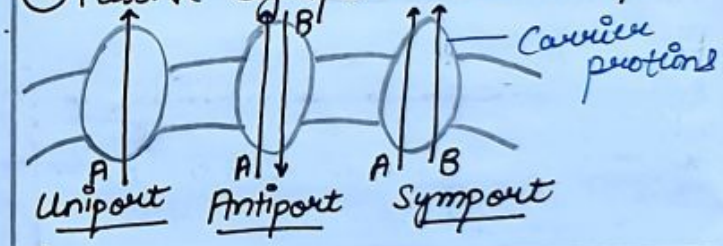
→ from one part of cell to other, or cell to cell or in intracellular spaces.
→ Slow
→ Independent of living system.
→ Substance moves from high conc. to lower conc.
→ Only means of gaseous movement.
→ Diffusion rates affected by →
→ Gradient of Concentration
→ permeability of membrane
→ Temperature
→ Pressure
→ Size of Substance.

② Facilitated Diffusion →

→ Passive diffusion occuring with help of protins.
→ For hydrophilic moities.

→ Some channels are always open, Some can be controlled.
→ Porins → Form large pores in outer membranes of plastids, mitochondria, and some bacteria, allowing even small protins to pass.
→ Water Channels → made up of 8 different aquaporins.

③ Passive Symports and Antiports.



④ Active Transport

→ Use energy / ATP to pump molecules against a conc. gradient.
→ Uphill Transport
→ By protins

⑤ Comparison →

property	Diffusion	facilitated transport	active transport
protins	×	✓	✓
Selective	×	✓	✓
Transport Saturates	×	✓	✓
Uphill transport	×	×	✓
ATP requirement	×	×	✓

(6) Plant Water Relations →

→ Water is essential for all physiological activities of plant.
→ Watermelon → 92% Water
→ Herbaceous plant → 10-15% of fresh wt.
→ Seed → 10-15% water.

(7) Water Potential (Ψ_w) →

→ Kinetic energy of water molecules
→ It decreased as solute is added.
→ Pure Water → Highest Water potential → 0 Pa. (without any external pressure)

(8) Solute Potential (Ψ_s) → Osmotic potential

→ Magnitude of lowering of water potential due to addition of solute.
→ Always negative.
→ for solution at atmospheric pressure.

$$\Psi_w = \Psi_s$$

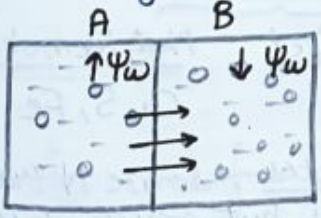
(9) Pressure Potential (Ψ_p) →

→ If pressure greater than atmospheric pressure is applied to pure water/solution, it's water potential increases.
→ Magnitude of it's increase is pressure potential

(10) $\Psi_w = \Psi_s + \Psi_p$

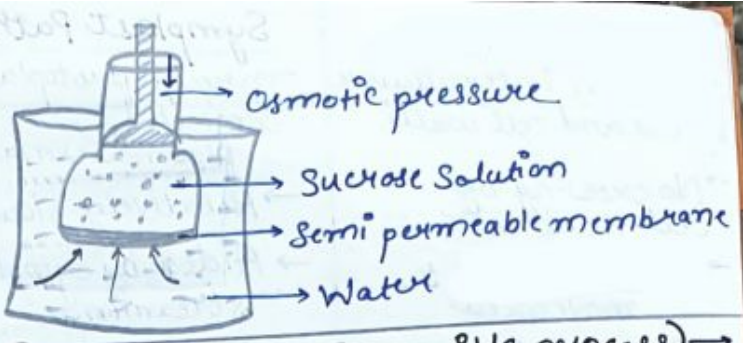
(11) Osmosis →

→ Diffusion of water across a selectively permeable membrane.
→ Water moves from region of higher water potential to lower water potential.
→ At equilibrium both chambers will have nearly same Ψ_w.



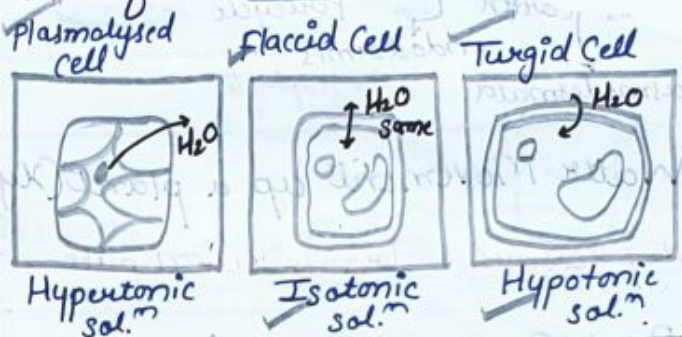
(12) Osmotic Pressure →

→ pressure applied to stop diffusion of water across a semipermeable membrane.
→ It is function of solute concentration.
→ Osmotic pressure = Osmotic potential, just sign is opposite



(13) Plasmolysis (Reversible process) →

→ Occur when H_2O moves out of cell and cell membrane shrinks away from it's cell wall.
→ Water moves first from cytoplasm, then from Vacuole.



(14) Turgor Pressure → pressure of protoplast against cell wall due to entry of water.

(15) Imbition → Special type of diffusion where water is adsorbed on solids.

e.g. → Adsorption of water by wood.
→ Swelling of seeds after absorbing water.

(16) Long Distance Transport of Water

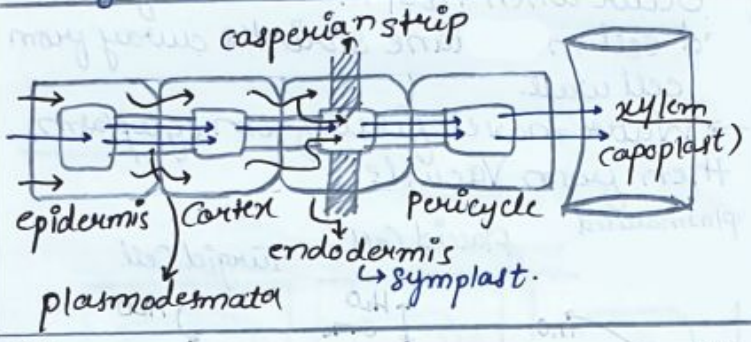
→ Water, minerals and food are generally moved by mass/bulk flow.
→ Mass flow is movement of substances as a result of pressure differences btw 2 points.
→ Bulk movement of substances through the vascular tissues of plant is called Translocation.

(17) How do plants absorb water?

→ Apoplast pathway
→ Symplast pathway

Apoplast Pathway
Through intercellular spaces and cell walls.
- → No crossing of cell membrane.
- → No resistance to movement
- → Dependent on gradient.

Symplast Pathway
Through protoplasts connected by plasmodesmata.
- → Relatively slower
- → Aided by cytoplasmic streaming.
- → Dependent on gradient



(18) Water Movement up a plant (Xylem)
Root pressure ⫽ Transpiration pull (major)

(19) Root Pressure. → (minor Cause)
(1) Various ions are actively transported in xylem.
(2) Water follows the ions.
(3) A positive pressure is built called root pressure
(4) Guttation is due to root pressure
↓
water loss in liquid phase from special openings of veins near tip of grass blades.
(5) Do not play major role in water movement. Just provide a modest push.

(20) Transpiration Pull → (major Cause)
→ Negative pressure, pull
Cohension – Tension – transpiration pull model.
→ Water evaporates from stomata, causing a pull on water column in xylem vessels.
→ Transpiration is affected by →

external factors:
- → Temperature
- → Light
- → Humidity
- → Wind speed

internal factors:
- → No. and distribution of stomata.
- → % of open stomata
- → Canopy structure

→ Transpiration driven ascent of xylem sap depends on physical properties of water.
→ Cohension → Mutual attraction between water molecules
→ adhesion → attraction of H_2O with polar surface.
→ Surface Tension → H_2O molecules more attracted to each other in more liquid phase than H_2O molecule in gas phase.
→ This property give water →
(1) High tensile strength → Ability to resist a pulling force.
(2) High capillarity → Ability to rise in thin tubes.

(21) C_4 plants are twice efficient than C_3 plants in terms of fixing CO_2.
→ C_4 plants loose only half H_2O than C_3 plants. ☆☆

(22) Uptake of mineral Ions (Xylem)
→ Some minerals are passively absorbed while most minerals are actively absorbed.
→ Transport proteins in endodermal cells are control points for adjusting quality and quantity of solutes.

(23) Translocation of Mineral Ions.
→ Chief Sinks : Growing regions.
→ Unloading of ions occur by diffusion and active uptake
→ Remobilisation

Actively remobilised	Not Remobilised
P, S, N, K, Mg	Ca, S, Fe

→ Xylem exudates → Some N travel as inorganic ions, but much of it's is carried in organic forms.
i.e. → Amino acids, Ureids, Amides
→ Small amount of exchange between xylem and phloem.
→ So, it is wrong to say that, xylem transports only inorganic nutrients while phloem transports only organic molecules.

(24) Phloem Transport →

→ Bidirectional

→ Source is leaf, sink can be leaves, fruit as root.

→ Water, Sucrose, Hormones, amino acids are translocated.

(25) Pressure Flow / Mass flow Hypothesis.

→ phloem sap moves by positive pressure.

→ Sucrose moves → in companion cells (at source)

↓

Sieve tubes (by active transport)

→ Water follows (creating high pressure)

→ At sink

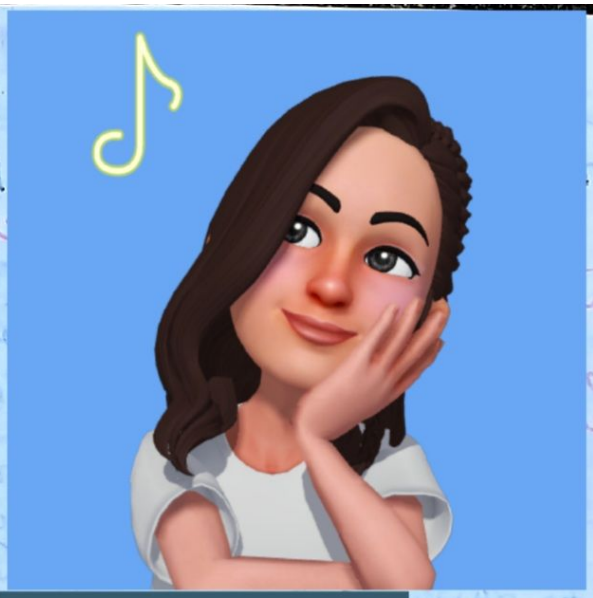
Sucrose out of sieve tubes into cells (active transport)

↓

water follows (decreased pressure)

→ Girdling → Used to identify tissues through which food is transported.

→ Removal of bask upto phloem depth



NEET SLAYER