FREE NOTES · NCERT + NEET LEVEL

Transport in Plants

Extra reading (old NCERT chapter, still useful for basics and some entrance exams): means of transport, water potential, osmosis, plasmolysis, imbibition, long-distance water transport, transpiration, uptake of minerals and phloem transport.

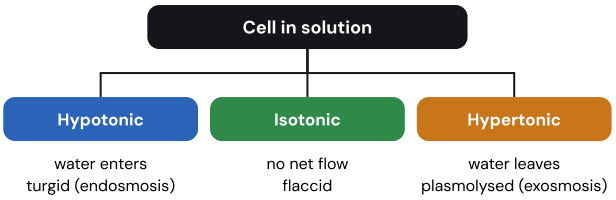
01 Means of transport
02 Water potential and osmosis
03 Water absorption and ascent of sap
04 Transpiration and stomata
05 Uptake of minerals
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01 Means of transport

Process	Energy	Gradient	Notes
Simple diffusion	No	Down	Slow; no membrane protein
Facilitated diffusion	No	Down	Carrier/channel proteins (porins, aquaporins); uniport, symport, antiport
Active transport	ATP	Against (uphill)	Pumps; specific, saturable

- Xylem: unidirectional (water, minerals); phloem: bidirectional (food, source → sink).
- **Imbibition**: absorption of water by solid colloids (seed swelling, wooden door swelling in rain).

02 Water potential and osmosis

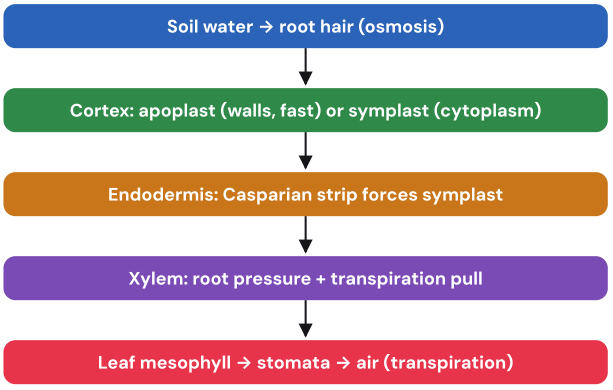


Behaviour of a plant cell in different solutions

- **Ψw = Ψs + Ψp**. Pure water Ψw = 0 (maximum); solute lowers it (Ψs always negative); turgor pressure Ψp usually positive.
- Water moves from higher (less negative) to lower (more negative) water potential.
- **Plasmolysis**: protoplast shrinks away from wall in hypertonic solution; reversible (deplasmolysis).
- Trick: **"Hyper = Hungry for water"**: hypertonic outside pulls water out of the cell.

03 Water absorption and ascent of sap

- Root hairs increase surface area. **Apoplast** (through walls, fast, non-living) and **symplast** (through cytoplasm and plasmodesmata, slower).
- At endodermis the suberised **Casparian strip** blocks apoplast, so water must pass through cytoplasm (selective).
- **Root pressure**: positive pressure from active ion uptake; seen as **guttation** (drops at leaf margins through hydathodes, early morning).
- **Transpiration pull** (cohesion–tension theory): cohesion (water–water), adhesion (water–xylem wall), surface tension; most important for tall trees.
- **Mycorrhiza** helps absorb water and minerals; *Pinus* seeds cannot germinate without it.



Path of water through the plant

04 Transpiration and stomata

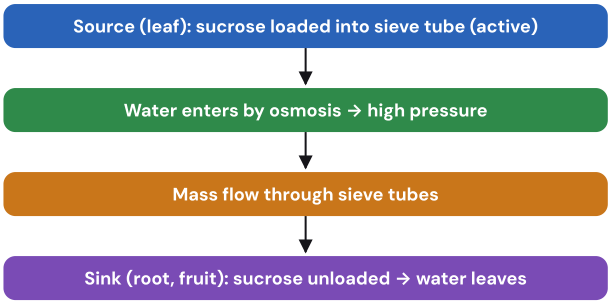
- Loss of water as vapour, mostly through stomata; also cuticle and lenticels. Less than 1% of water reaching leaves is used in photosynthesis.
- Stomata open when guard cells become **turgid** (K^+ and malate enter, water follows; inner wall thick, outer thin so cells bow outward); close when flaccid.
- Dorsiventral (dicot) leaves: more stomata on lower surface; isobilateral (monocot): both surfaces.
- Factors: temperature, light, humidity, wind (external); number and distribution of stomata, water status, canopy (internal).
- Uses: creates pull, supplies water for photosynthesis, cools leaf surface (10–15 °C), maintains shape. C4 plants lose half as much water as C3 for the same CO_2 fixed.

05 Uptake of minerals

- Minerals are in low concentration in soil and charged, so most are absorbed by **active transport** (ATP) through specific membrane proteins of root epidermis.
- Endodermis transport proteins control quantity and type reaching xylem.
- **Remobilisation**: N, P, K, S (readily mobile) move from older to younger leaves, so their deficiency shows first in **older leaves**. Ca (structural, immobile) deficiency appears in **young parts**.

06 Phloem transport

- **Pressure flow / mass flow hypothesis** (Münch): sugar moves from **source** (where made/stored) to **sink** (where used/stored).
- Sucrose is loaded by active transport into companion cells then sieve tubes ⇒ hypertonic ⇒ water from xylem enters ⇒ pressure pushes sap.
- Source and sink can reverse (in spring, stored sugar in roots moves up to buds).
- **Girdling experiment**: removing a ring of bark (phloem) makes the part above swell (sugar collects) and roots die after some time ⇒ phloem carries food downward.



Pressure (mass) flow hypothesis

07 Important Q&A

Q1. Why does Ca deficiency appear first in young leaves but N deficiency in old leaves?

N is mobile and is moved from old to young leaves; Ca is immobile (part of cell wall), so young parts suffer first.

Q2. Calculate Ψw if Ψs = −0.8 MPa and Ψp = 0.3 MPa.

Ψw = −0.8 + 0.3 = −0.5 MPa.

Q3. What is guttation and why does it happen?

Loss of water drops through hydathodes at leaf margins, early morning, due to root pressure when transpiration is low.

08 Common mistakes

- Saying pure water has the lowest water potential (it has the highest, 0).
- Confusing guttation (liquid) with transpiration (vapour).
- Calling phloem transport unidirectional.
- Thinking imbibition needs a membrane.

09 Practice (NEET style)

1. Water channel proteins?
2. Ψw of pure water?
3. Theory for ascent of sap in tall trees?
4. Strip forcing water into symplast?
5. Who gave mass flow hypothesis?

ANSWERS

1) Aquaporins · 2) Zero · 3) Cohesion–tension (transpiration pull) · 4) Casparian strip · 5) Münch

10 Quick revision: 5 minutes before the exam

BASICS

- Diffusion, facilitated, active
- Imbibition: seeds swell

WATER POTENTIAL

- Ψw = Ψs + Ψp
- Pure water 0
- Hypertonic → plasmolysis

WATER MOVEMENT

- Apoplast fast, symplast slow
- Casparian strip
- Transpiration pull

FOOD

- Source → sink
- Münch pressure flow
- Girdling experiment

Have a doubt? Ask the AI Doubt Solver at padhaiadda.netlify.app, or take the mock test on this chapter.