Transport in Plants

Transport tissue

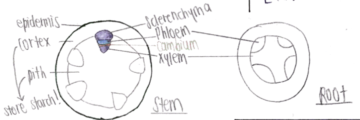
Xylem
- Made of dead cells
- Transport δ & dissolved min-salts from roots → stem & leaves (empty lumen w/o x-walls ↓ resistance to water)
- Provide mechanical support (thickened w/ lignin) may have pits for ↳ lateral flow to another X

Summary: X — Hollow, lignified, bundled, dead, laid end to end

Phloem
- Mainly sieve tube cells & companion cells (living)
- conducts manu. food (sucrose & a-a. glu~~co~~se) from green parts to other parts of plant

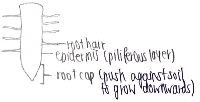
Sieve tube cell
- Thin layer of cytoplasm, vacuole, nucleus (degenerated protoplasm) + Sieve plate
[holes allow rapid flow of manu. food thru sieve tubes]

Companion cell
- Thin-walled w/ cyto., nucleus & many mitochondria
[Provide energy (& ATP) to load sugars from meso. → sieve tubes via A.T.]



- Cambium cells can divide & differentiate into new X. & P. tissues
- Epidermis covered by waxy cuticle to ↓ evap. from stem

Root
- Anchor plant in soil
- Absorb δ & min. salts



Translocation & its studies
transport of manu. food (sucrose & a-a. from leaves → others thru phloem)

[Aphid transloca^n^]
- Insert proboscis into phloem
- Anaesthetised by CO_2
- Liq. comes out of proboscis

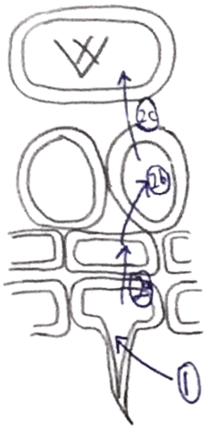
[Ringing exp.]
- Cutting ring of phloem causes region abv. ring to be swollen
- Accumula^n^ of sugars ⊘ → other + roots
- plant dies

[Isotopes of carbon]
- Sugars contain C^{14}
- Darkened on photographic film ↓ Phloem

adaptations
- Long & narrow to ↑ SA:Vol for ↑ rate of absorption of δ & min. salts
- Concentrated cell sap for δ → osmosis, Min salts → A.T.
- Living (+ mitochondria) for energy to be released via cell respira^n^ for A.T.

- Water & min-salts absorbed by roots
- P.p.m. present to allow sugar or starch to pass out of root hair cell → soil
- Ions & min. salts → Diffusion ↘ A.T. (conc. of ions in soil < root hair cell)

MOVEMENT of δ



① Water moves into root hair cell from soil, as cell sap of root hair cell (r-h-c) has lower water potential than soil - via osmosis thru p-p-m-

② Water moves from cell to cell until it enters the xylem vessels & moves up plant.

③ Water moves up the stem into leaves & other parts by ...

a. Root Pressure

- Cortex cells and X pump ions into X by A.T.,
  ↓ δ pot. of X,
  δ moves into X via osmosis
- δ moves ↑wards ⇒ Root pressure

b. Capillary action

- Adhesion & cohesion
  (to surface of thin tubes) (btwn δ-δ)
  pulls a whole, unbroken stream of δ mol. up the stem.

c. Transpiration pull

suction force caused by transpiraⁿ

- Transpiration stream ↗ unbroken column of δ in X from roots to leaves

Transpiraⁿ = loss of δ vap. from aerial parts of plant (esp. stomata)

- lost from inside leaf, surface due to waxy cuticle (cuticular transp.)
- from stomata (stomatal transp.), δ lost as excess water

HOW?

① meso cells —δ→ T-f-o-m-
③ δ from T-f-o-m —evap.→ intercellular air spaces as δ vap.
④ δ vap. —diffuse→ drier air outside thru stomata

① ↓δ pot. of cell sap of meso.,
⑤ & absorb δ from cells deeper w/in leaf by osmosis (X)

⇒ δ moves up from roots to leaves by transpiraⁿ pull from evap. of δ from leaves

WHY?

- Lift δ & min. salts up the plant
  ↳ leaves have suff. δ & min salts for p.s.
- Remove latent heat
  ↳ leaves are cooled to prevent them from being scorched by hot sun.

WHAT?

↑ temp., ↑ transp.

- ↑ rate of evap. from T-f-o-m.
- cause steep conc. grd. btwn leaf atm. & ext. env.

↑ wind, ↑ transp.

- ↑ rate of evap. by blowing away δ vap. at leaf sfc.

↑ Humidity, ↓ transp.

- Less δ vap. diffuses out of leaves, T-f-o-m. evap less, less δ taken from X, ∴ rate of transp ↓.
- Air inside leaf saturated w/ water vap., so when humidity ↓, conc. grd. ↑ & transp. ↑

↑ Light intensity, ↑ size of stomata

- At ↑ light intensity, guard cells become more turgid & stomata open (conc. more, A.T. to uptake K⁺, ↓ water pot., ↑ water enter thru osmo.)
- ↑ water vap. can diffuse out of leaf, ↑ transp. rate.

Wilting

- Rate of transp. > rate of δ absorpⁿ by roots
- cells lose turgor & plasmolyse
- leaf becomes flaccid & wilts

✓
- Leaf folds up to ↓ SA exposed to sunlight (↓ evap. too)
- Guard cells are flaccid & stomata close
- Transp. rate ↓

✗
- δ is L.F. for p.s. (p.s.↓)
- Stomata close so CO_2 entering ↓, CO_2 is L.F. for p.s.

And/Dry/hot env.

- Leaves have thick cuticle
- Upper epi. are many layers thick & lower
- Deep invagination of lower epi. (stomata crypts) have hair to create a more humid micro-env. (↓ transp.), stomata is guarded from strong wind & light

Floating

- Stomata on upper epi- w/ air channels in pali-
- Spongy meso. has large air spaces
- Vascular tissue ↓, esp. in amt. of xylem in branching veins

Submerged

- Narrow linear  to ↓ resistance to currents & damage to tissues
- Sto~~m~~ata on epi. (both)
- Thin  for effi- gaseous exchange + thin cell walls