Date:

TRANSPORT IN PLANTS

Vascular Bundles/Tissues

1. xylem tissue

→ conducting pipes (channels), continuous from roots to leaves

→ meant for transport of water and mineral ions/salts (xylem sap)

→ cells are arranged length wise to form channels/columns

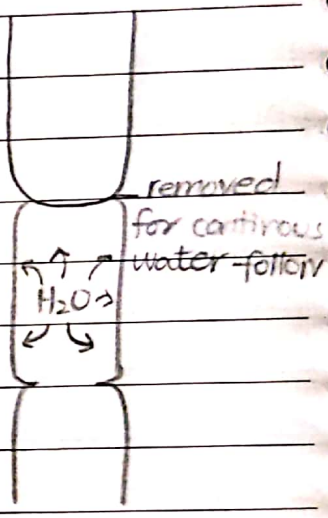
→ there is absence of protoplasm (nucleus+) — hollow cells

→ cross walls between 2 consecutive cells are lost

→ long continuous columns/channels

→ the water exerts pressure and to make xylem resist it has lignified, thick walls

→ moves in one direction only



H_2O : because it is a polar molecule it has a force of attraction when they are together or partial forces of attraction – (loose bonds) Hydrogen Bonding

because of this they tend to stay as one entity :- Cohesion

→ this water clings to the walls and moves — Adhesion

• this gives us continuous water column

→ continuous water column starting from roots till leaves

2. phloem tissue

→ transport of food material (Translocation)

Glucose → Starch → Sucrose (disaccharide) —phloem→ parts of the plant

DALMATIAN

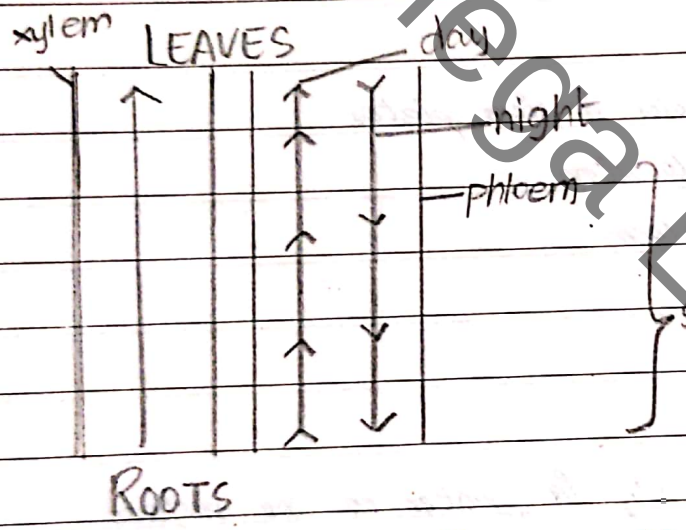
Date:

day —(active p.s)→ sucrose from leaves —(phloem)→ stem, flower, roots

- during the day time leaves become a source of sucrose
- the part where it is used or stored is called sinks. (utilization + storage)

night —(no p.s)→ stem, roots are a source —→ leaves

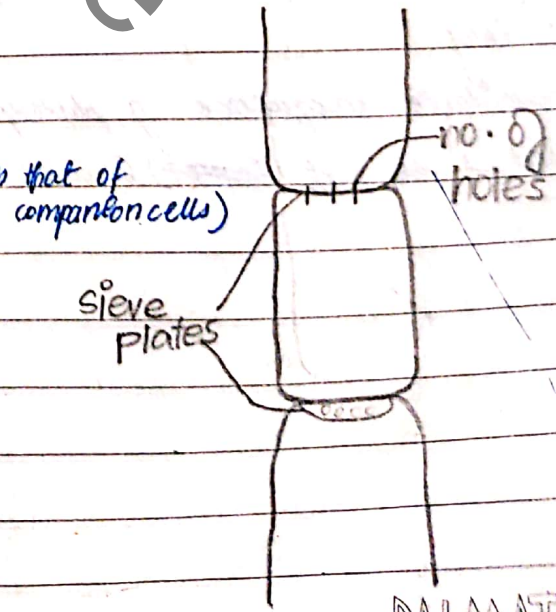
→ Source at night : stem & roots
→ source at day : leaves



→ In all case of no active p.s phloem condition will be reversed

Sieve Tube Cells

→ there cells are arranged length wise
→ absence of nucleus & cytoplasm (shares that of companion cells)
→ hollow cells from the centre
→ cross walls contain holes for continuation of phloem sap
→ known as dead cells



PALMATIAN

Date:

XYLEM

- elongated dead cells arranged end to end to form continuous vessels
- cross walls are absent
- no cytoplasm & are impermeable to water
- tough walls containing a woody material called lignin
- transports water & minerals — process is called Transpiration Stream

PHLOEM:

- living cells arranged end to end
- they have cytoplasm which goes through the holes in sieve plates
- transports sucrose & amino acids — Translocation
- pesticides. etc. also move through the phloem

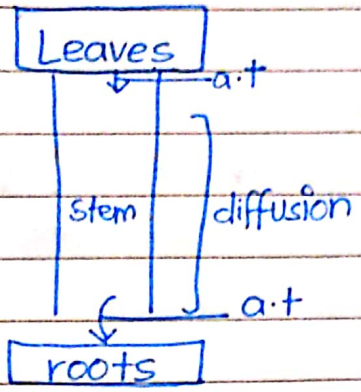
TRANSPIRATION

- when the plant opens its stomata to let CO_2 in, water on the surface of spongy and palaside mesophyll evaporates and diffuses out of the leaf
- unavoidable consequence of photosynthesis (only 5% of water taken up is used - the rest ~~leaves~~) leaves)

Date:

→ for translocation, active transport is needed

* phloem is never empty, it always has presence of Sucrose + H_2O
* if it becomes empty the phloem would collapse.

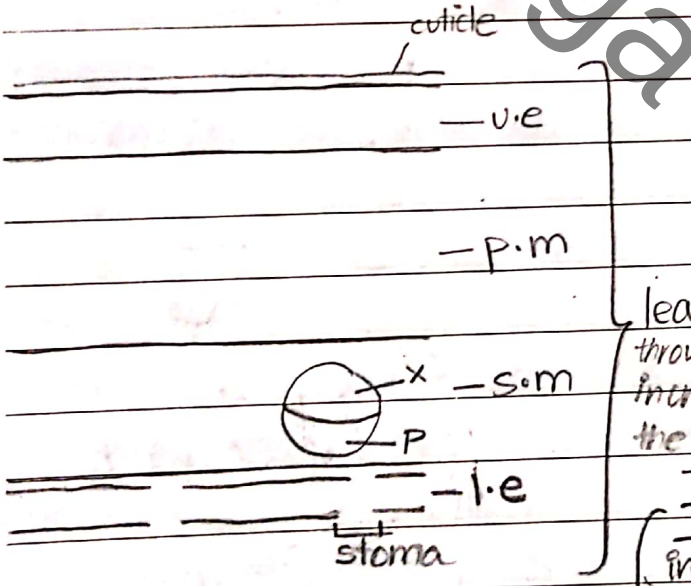


→ in addition to sieve tube cells there are normal plant cells known as

Companion Cells

- to generate energy for active transport during translocation
- present side by side to sieve tube cells, have cytoplasm + mitochondria + nucleus

* at the level of nods, branches and buds originate



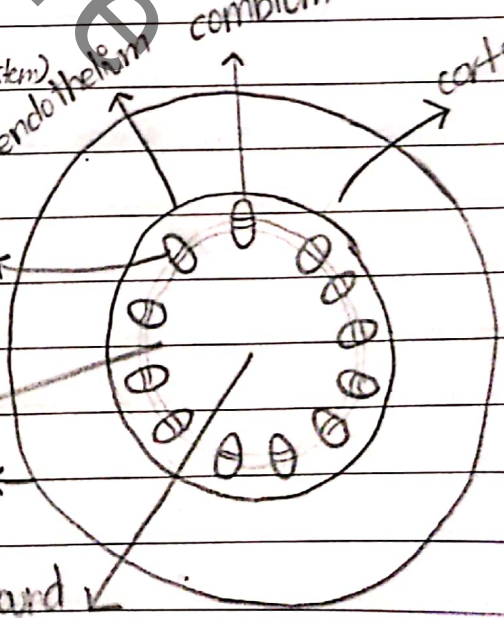
- xylem (double lined + hollow)
- phloem

leaves → capable of reproducing throughout their life, divide and increase the width of the stem

- root tips
- shoot tip (top of stem)
- at intervals in our stem

Nodes (intact)

stem (dicot)



cells : → supports the plant
→ storage

DALMATIAN

Date:

xylem : ascent of sap
(upward transport) (H_2O + salts)

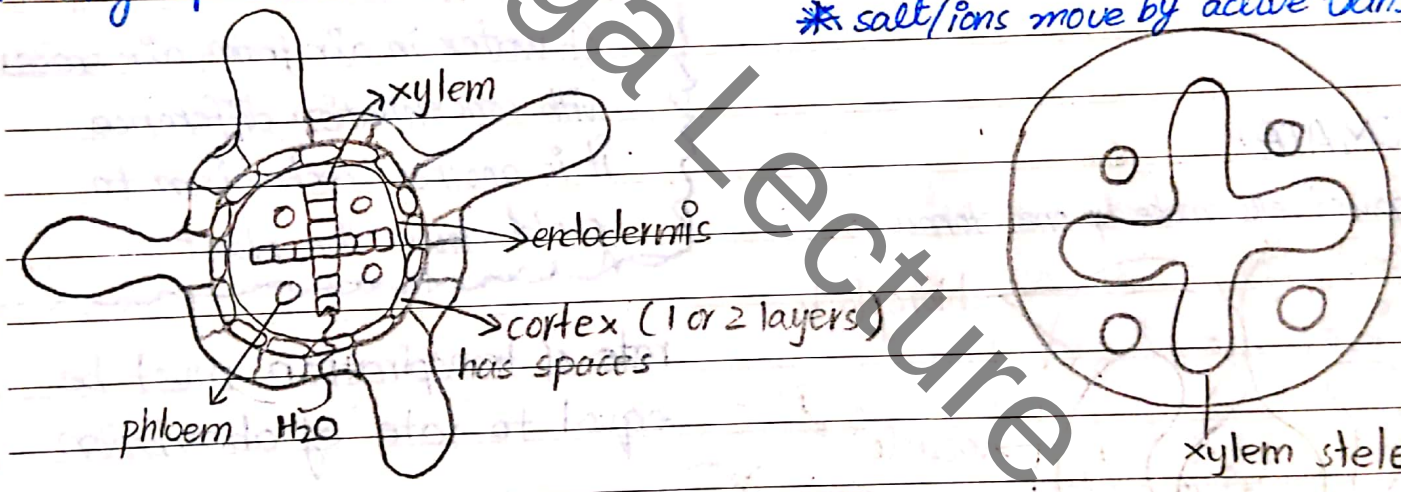
1. **Root pressure**

H_2O absorbed by roots, at the level of roots exerts pressure on the water column in xylem vessels.

decreases the water potential resulting in osmosis of H_2O
- salts → active transport & diffusion

root hair cell sap has ↑ water potential
→ absorption of salts gives us more efficient H_2O osmosis.
→ the pressure on the roots results in the water moving upwards.

* water enter roots by osmosis
* salt/ions move by active transpot



Arrangement of Vescular Bundle in Root Hair cells.

2. **Capillari Action**

→ upward movement of water because of adhesion (sticking to) and cohesion (the action or fact of forming a united whole sticking together)
→ only in short plants

Transpiration stream : root → stem → leaves

DALMATIAN

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3. Transpirational Pull

→ after transpiration, to make up water in the water column
→ maximum
→ this pull gets the water up.
→ developing force as a result of transpiration which pulls the whole water column upward.

*. Three of the mechanisms take place side by side. Even though, transpirational pull is the strongest.
*

TRANSPIRATION

→ removal of water from stomata into air (metabolic)

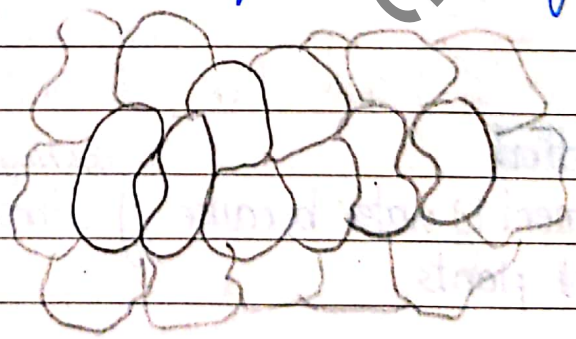
• excretion in plants

→ plant leaves can also be called excretery organ

→ 1. Evaporation
movement of H_2O vapours out of the mesophyll cells into those air spaces, through diffusion

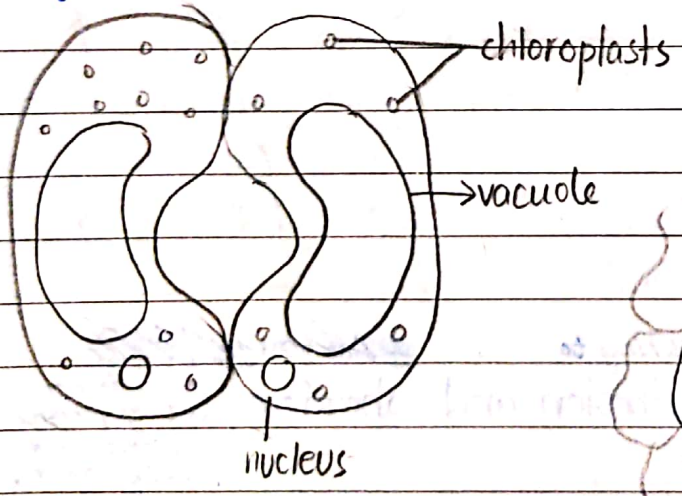
→ 2. Diffusion
of water in air from air spaces with concentration difference
it is another mechanism to cool down the plant

rate of transpiration must be equal to rate of absorbtion



STOMATA:

→ 2 gaurd cells make up one stoma



cross-section

→ when the stomata is open, the light makes it perform p.s
→ Hence, there is presence of glucose

DALMATIAN

Date:

→ turgid guard cells — stoma is open] day
→ flaccid guard cells — stoma is closed] night

Turgid Guard Cells:

→ stoma is open
→ daylight — photosynthesis — carbohydrate presence — low water potential — water from air spaces — guard cells become turgid

Flaccid Guard cells

→ stoma is closed
→ no photosynthesis — low Carbohydrate — ↑ H_2O potenti. in air spaces — exosmosis — flaccid cell — closed stomata.

- at the time of noon plants close their stomata to avoid maximum water loss
  respiration = photosynthesis
- جتنی O_2 release ہوگی اتنی استعمال تو دونوں equilibrium میں آجائیں گے
- This is called the compensation point. when rate of p.s and resp. is equal.
- similiar is the case of sunrise (dawn) and sunset.

photo. is gradually increas. < less light, one point at the time ; sunset ↓ p.s is gradually decreasing.

Date:

ROLE OF TRANSPIRATION

1. Removal / Excretion of metabolic water
→ out of the plant body
2. Has a cooling effect
→ it regulates internal temperature by removing heat through water vapours that leave from the stomata. It is the same metabolic water produced as a result of photosynthesis.
3. Regulates rate of absorbtion
→ rate of absor. = rate of evaporation
4. Transpirational Pull
→ for the ascent of sap

• Exoretory Product

* water diffuses out of the leaves.

Leaves { excreteory part: Lower epidermis
excretoral openin.: Stomata

WILTING

→ When use no. 3 is disturbed it happens
→ condition brought by flaccid plant cells
→ the turning down of leaf & stem. or plant parts

FACTORS AFFECTING TRANSPIRATION

1. Humidity
→ concentration of water vapours in close envoirnment of our leaves
↑ Humidity — ↓ Transpiration
→ because of loss of concentration gradient for diffusion of wates

2. Temperature
↑ Temperature — ↑ Transpiration

DALMATIAN

Date:

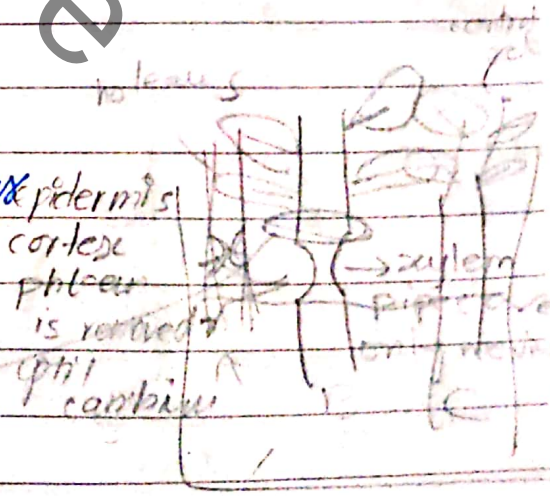
→ increased transpiration regulates the temperature
· Cooling effect
↓ Temperature — ↓ Transpiration
→ temperature is directly proportional to transpiration
→ plants close their stomata in ↓ Temp. to prevent water loss

3. Intensity of Light
↑ Light int. — ↑ Transpiration
(Up till a certain level)
up till the compensation point
after the level the Transp. rate will ↓.
→ as the stomata will be closed

* more light causes the stomata to be open to allow photosynthesis.

4. Wind
→ it takes away humid air from the close environment of the leaves
→ ↑ Wind ∝ ↑ Transpiration

RINGING EXPERIMENT
→ cut a complete ring of bark including the leaves
→ branch is emersed in water
→ when the bark is cut, epidermis, cortex and phloem is removed : uptil cambium
→ Branch B swells above the region is exposed
· because translocation stops at B and it swells. At the level of of a glucose is accumulated.



Date:

2. To demonstrate transpiration (comparison of upper/lower surfaces)

→ use a plant with stomata mainly on the lower surface

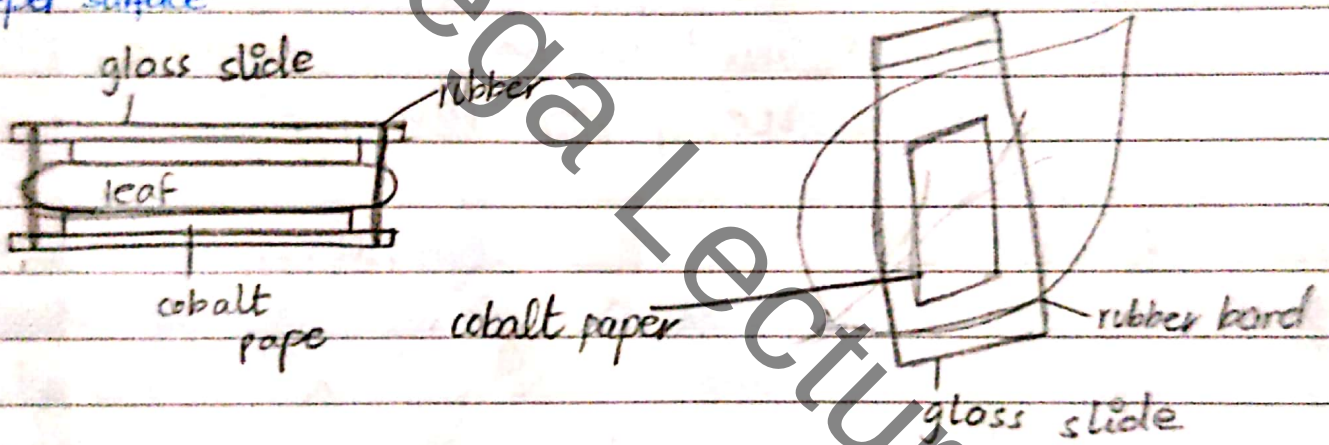
→ cobalt chloride — blue when dry
pink when in contact with water

→ place the leaf between two pieces of cobalt chloride (dry)

→ sandwich the leaf between 2 dry glass slides held in position by rubber bands (it will prevent it from coming in contact with water vapours in the air)

→ after a short while note the colours

→ the lower surface will be darker pink as compared to the upper surface



3. To show transpiration occurs largely through stomata

→ take three leaves of the same size and surface area

Leaf A : cover upper surface with vaseline

Leaf B : cover lower surface with vaseline

Leaf C : cover both surfaces with vaseline

→ weigh each leaf

→ keep the three leafs near a window to provide them sunlight

→ after a few hours check their weight

→

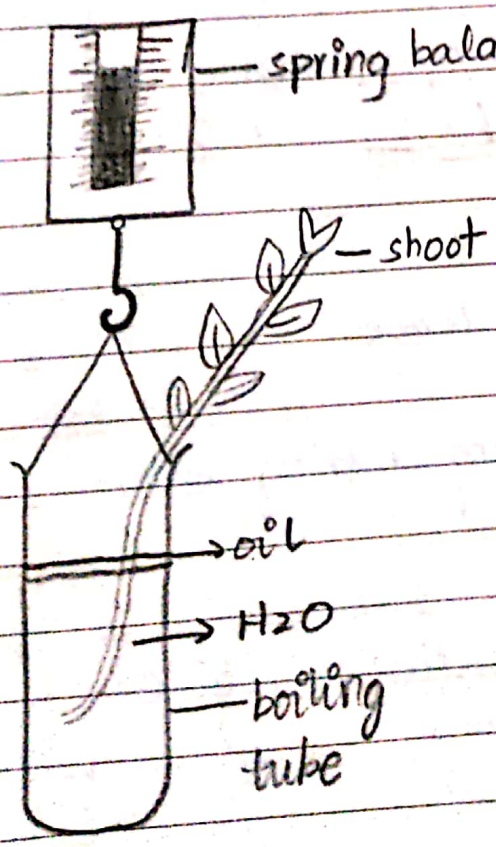
Date:

4. To measure the rate of transpiration of a shoot using spring balance

→ immerse the cut end of a leafy shoot under water
→ add oil to the surface to prevent evaporation
→ tie a spring to the mouth of the test tube and weigh
→ record mass using the spring balance
→ give it light
→ weigh it again
→ there will be loss of weight due to transpiration
→ measure rate

initial mass = a
mass after 5 hours = b

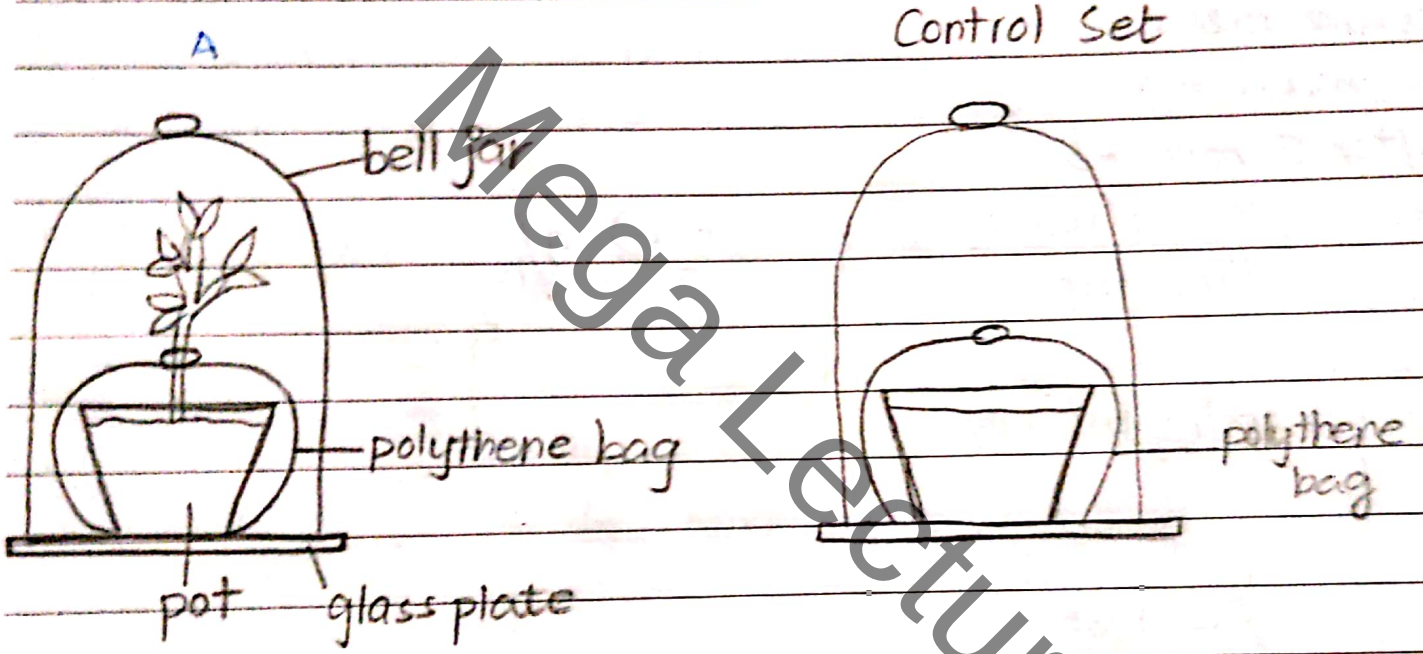
$$\text{rate} = \frac{\text{loss in mass}}{\text{time taken}} = \frac{(a-b)}{5}\ g/h$$



Date:

5. To show transpiration in a potted plant

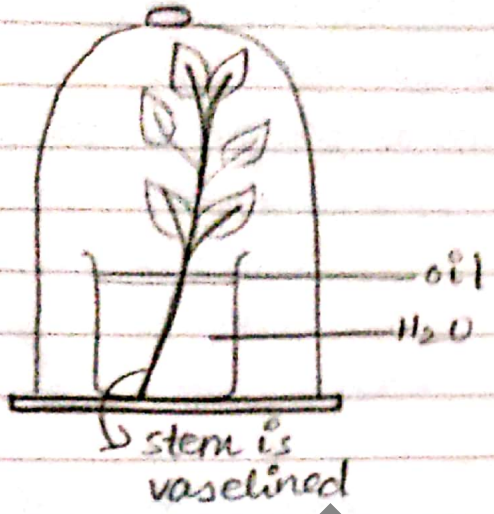
→ take a potted plant and wrap it in a polythene bag (stem + pot)
→ place the pot on a glass plate
→ cover with a dry bell jar
→ set up control apparatus but x plant
→ provide it light for two hours
→ in apparatus A there will be presence water vapours)

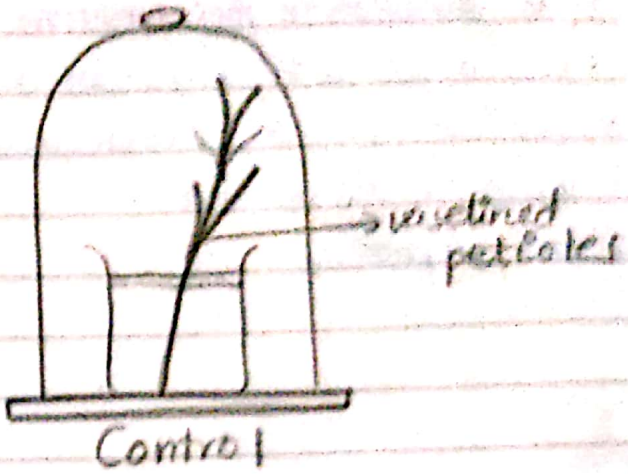


6. To show transpiration occurs mainly through leaves

→ take 2 leafy twigs
→ cut their ends under the water to prevent air from entering xylem (it could interfere with the absorption)
→ place in a beaker & add oil
→ strip of all the leaves from one and put vaseline on petioles
→ also put vaseline on the leafy twig (on stem)
→ allow sunlight
→ only water vapours in A

Date:





7. To measure rate using potometer

∴ Potometer is used to measure rate of absorption

→ rate of absorption ∝ rate of transpiration

→ insert shoot through the hole in the cork (in contact with cork)

→ smear vaseline round the region to make it air tight

→ open the tap of reservoir to fill the graduated tube

→ close the tap when the tube is full

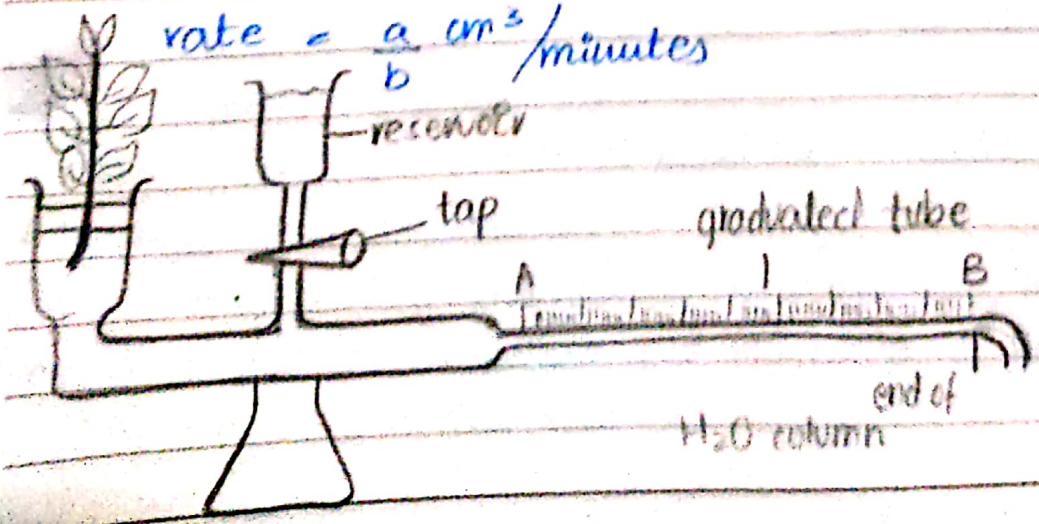
→ as the shoot transpires it will absorb water

→ water column moves from B to A

→ rate of movement = rate of absorption

• volume of water column from B to A : a cm³
time taken = b minutes

rate = $\frac{a}{b}$ cm³/minutes



Date:

8. To demonstrate root pressure

→ take a pot with only stem in it (5cm) (with roots)

→ provide it with water

→ invert a glass tube

→ cork lagaen.