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Biology Notes

On

Transport in Plant

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 Date :- 27/oct/2020

Transport in plants :->

- Short distance Transport.
  - Passive Transport.
    - Simple diffusion.
    - Facilitated diffusion.
  - Active Transport.
- Long distance transport
  - occurs by mass flow
  - In xylem & phloem.

Simple diffusion :-.

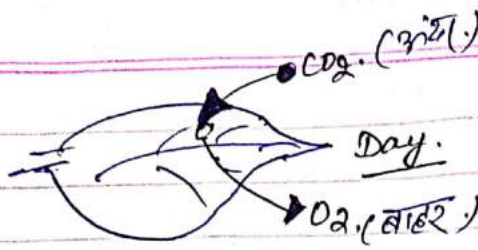
High conc ⟶ Low conc.
[High potential] [Low potential]

→ Simple diffusion may occur through a membrane and without a membrane.

Factor.	Rate of diffusion.
Temp. ↑	↑.
Pressure ↑	↑.
Conc. difference ↑	↑.

(*) If diffusion occurs through membrane than it is also affected by membrane permeability.

(*) => Direct^{n} of diffusion is determined by the Concn of diffusing molecule itself.



* Their are more chances of diffusion in Solid than diffusion of solid.
(Solid में) (Solid का)

eg:→ Diffusion of water through paper.

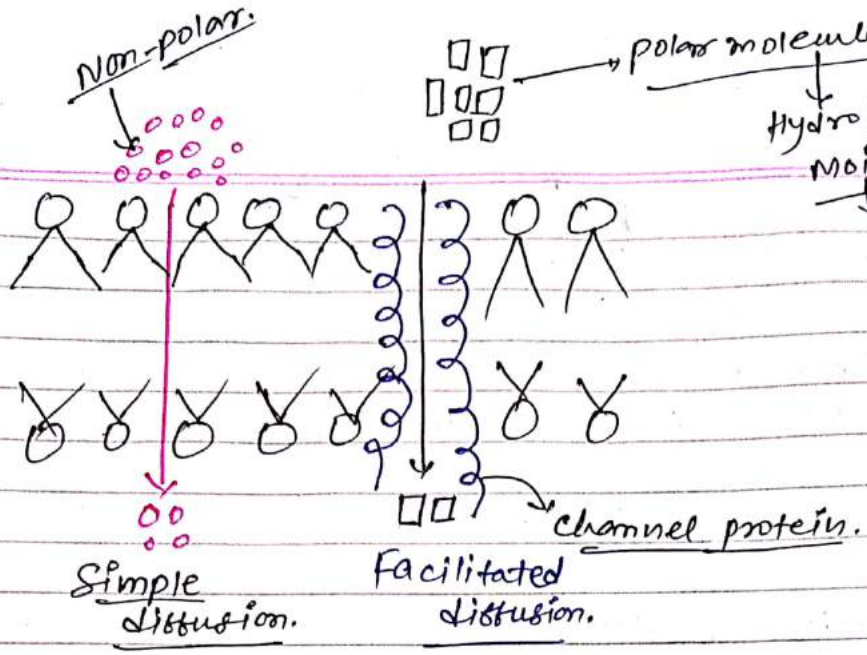
* Diffusing molecules hit any surrounding material and they apply some pressure which is called diffusion pressure.

* Diffusion occurs from high DP to low DP

* Higher is the potential or movement ability of diffusing molecule more is the value of DP.

Facilitated diffusion:→

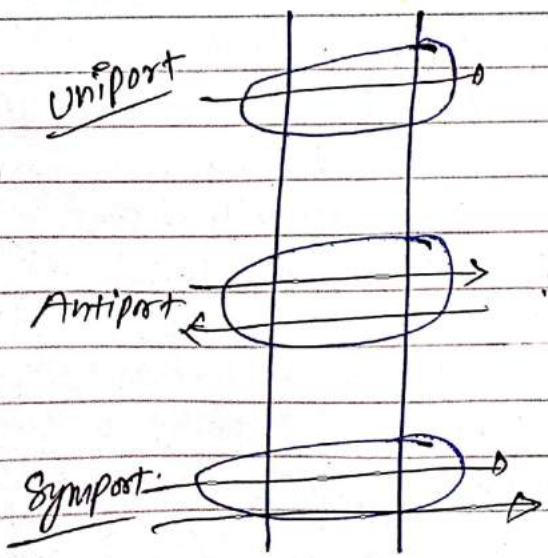
- high concn ⟶ Low concn.
- across membrane
  - Through chanel proteins.
    - eg:→ Porins → in chloroplasts, mitochondria & prokaryotes.
      - act as anion channels.
    - eg:→ Aquaporins.
      - 8 types.
      - water transport.
      - In eukaryotes.



NOTE:- Small amount of polar molecules may pass through membrane without the help of channel protein. when some space is available due to lateral movement of phospholipids.

* facilitated diffusion does not create Concn gradient but gt. utilizes already ext gradient.

* Passive transport does not utilise ATP.



⇒ gn antiport. 2 types of molecule move gn opposite direcn. through a transport protein.

⇒ gn symport 2 types of molecules move gn same direcn through a transport protein.

Concn gradient
↳ Low to high.

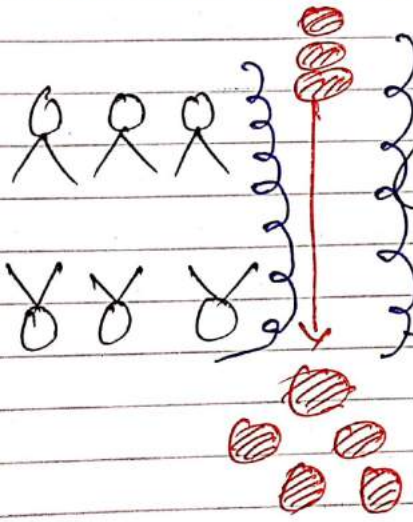
Active Transport.

Low conc^{n} ⟶ High conc^{n}
[Low potential] [High pot.].

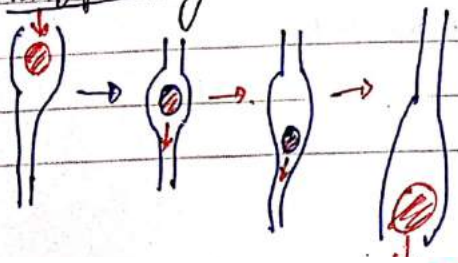
* Energy supply required.
* occurs through pump protein.

(*) Primary active transport :→ ATP is the source of energy.

these ATP are utilised by pump protein.

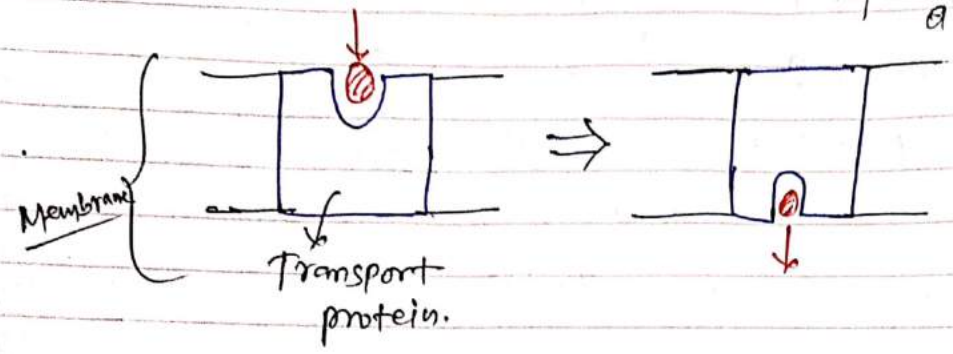


* → conformational changes in pump protein with the help of ATP utilisation are responsible for this active transport. Conformational changes evolve shifting of Binding site of transporting molecule.



Conformational changes.

Simplified method.



यहाँ माना है कि इसका movement हुआ है लेकिन ऐसा कुछ नहीं है. इसका rotation नहीं बल्कि transportation हुआ है conformational change के कारण।

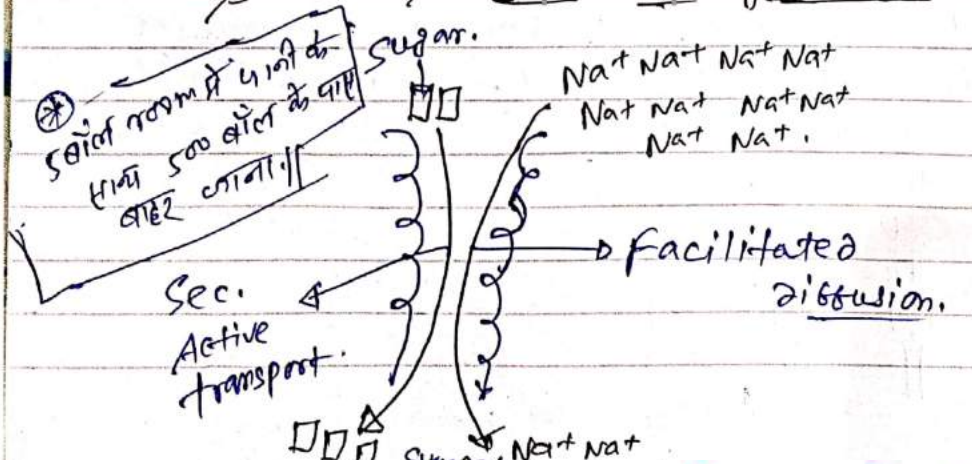
अगोंकि cell में rotation नहीं हो सकता protein का।

* Comparison of initial and final conformation appears like rotation of transport protein but actually transport has occured with the help of Conformational Changes as protein rotation or protein Flip-flop movement is not allowed in membrane.

NOTE:→ Conformational changes in transport protein also occur in facilitated diffusion but ATP not utilized. as diffusing molecules themselves provide energy.

(b.) Secondary Active transport :→

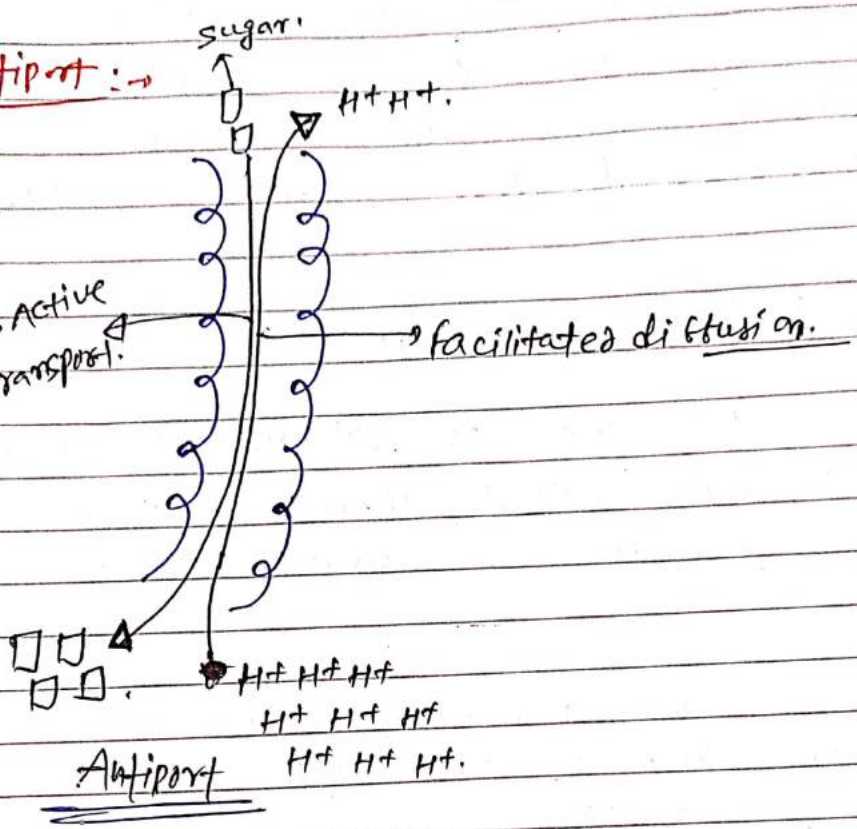
↳ In this type of active transport energy source is some ion gradient.

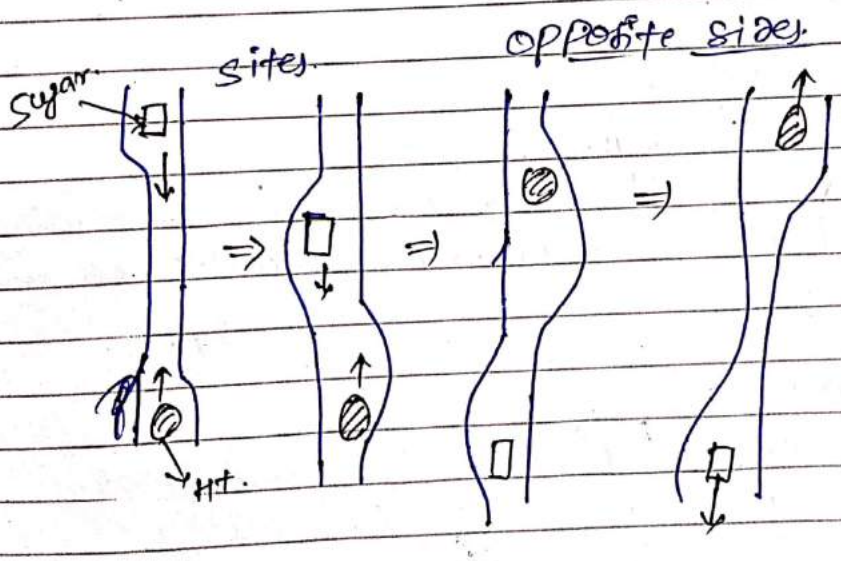


* सोडियम रूम में पानी के साथ sugar को पानी के बाहर लाना।

⇒ In this case sodium ion conc provides energy for conformational changes in transport proteins

* Antiport :→





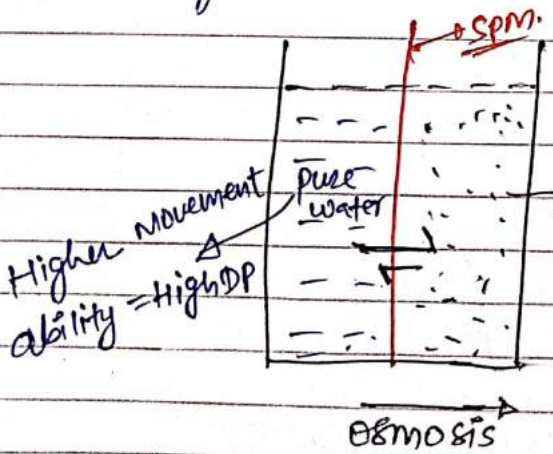
(*) For Antiport initial binding sites of energy providing ion gradient and actively transported molecule must be +nt at opposite sides of transport protein across the membrane. and then they are shifted in opposite direct^{n}.

OSMOSIS :-

- term by Nollet.
- Movement of solvent molecules from their high conc^{n} to their low conc^{n} through Semi-permeable membrane. (SPM)

OR

Movement of water from ~~to~~ Lower Solute to higher solute conc^{n} through SPM.



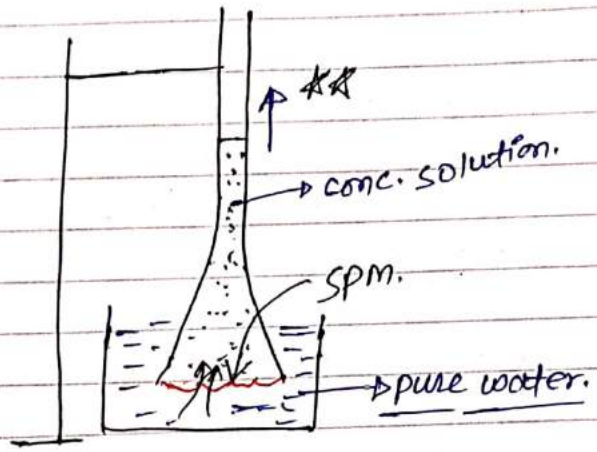
Solution में Lower movement ability of water molecules of soln = Lower DP.

(Pure water से soln की ओर जायेगा b/z pure water से Low Solute से soln (High Solute)

Addition of solute always decreases the potential or movement ability of water molecules.

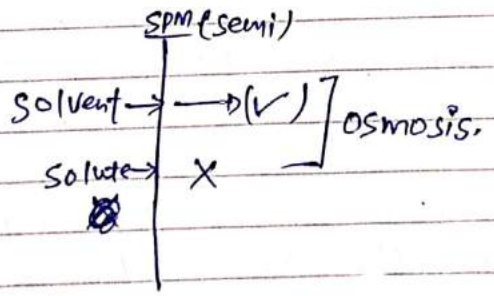
Osmosis is a special case of diffusion.

=| Osmosis can be demonstrated by using a thistle funnel experiment.

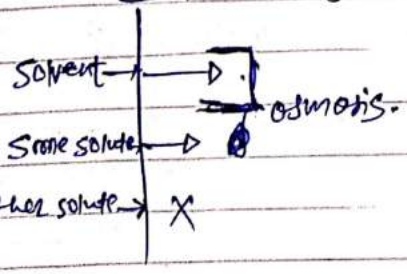


Osmosis ⊖
pure water → Conc^n soln.

* (1)



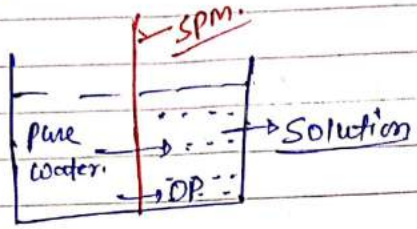
(2.) SPM (selectively permeable membrane)
↳ Biomembrane.



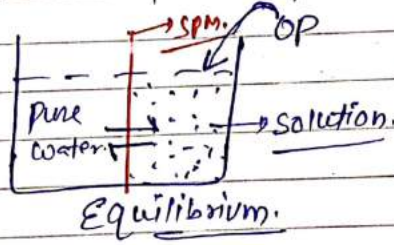
21/11/2019.

Osmotic pressure :- (OP)

(1.) It is the pressure with which osmosis occurs from pure water to a solution.



(2.) It is the amount of pressure applied over soln to just prevent osmotic entry of water into solution from pure water.



Equilibrium.

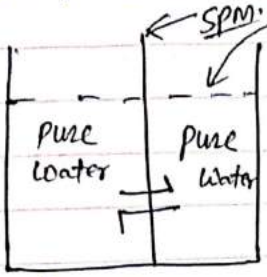
(3.) OP is the dif of DP b/w pure water and solution.

*** Application of pressure increases movement ability or potential of water molecules.

* higher is the Concn of a solution, more is the O.P of solution.

Soln के ऊपर लगाया जाने वाला pressure.

* O.P of pure water is 0.

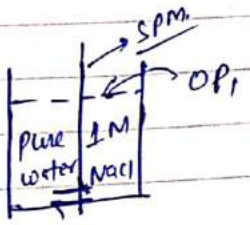


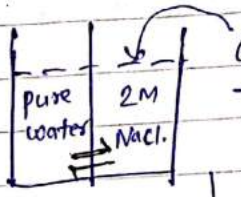
* OP is always measured w.r.t pure water.

* water moves from Low O.P to high O.P

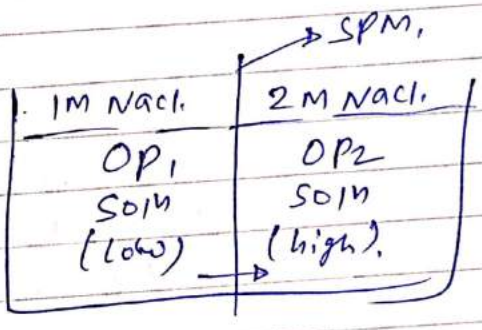
(pressure) → pressure

Solute ↑



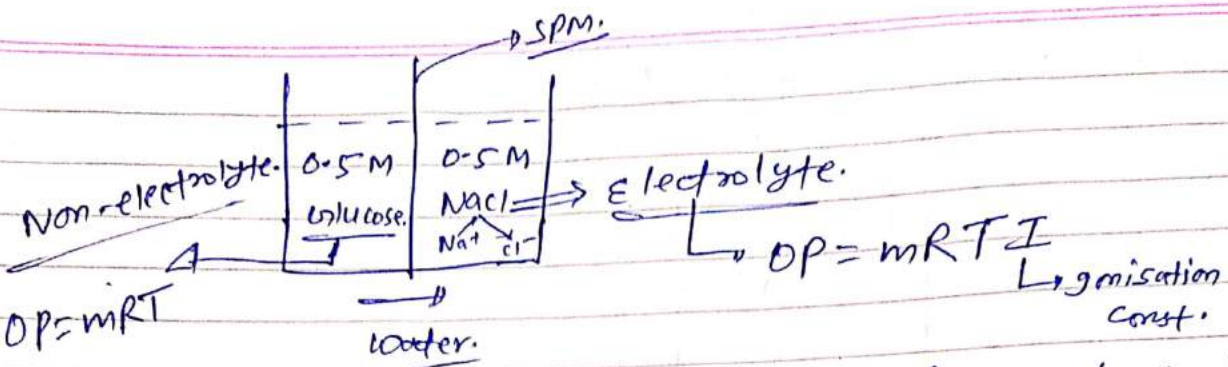


$OP_2 > OP_1$



* Lower is the O.P, higher is the movement ability or higher is the D.P.

* O.P is also affected by ionisation of solute.



ionisation increases the actual number of available solute particles due to which movement ability of more solvent molecules is decreased.

* → Haloplytes grow in saline area and thus they maintain high solute conc^n or high OP in their roots to prevent water loss.

Turgor pressure [T.P].

* It is the pressure applied by cell content towards outerside or pressure applied by water int in cell, towards outerside.

* T.P develops in a closed system like a cell.

* T.P is +ve for turgid cell and their is net +ve pressure towards outerside.

* +ve value of T.P supports cell growth or cell expansion.

* when T.P is +ve it opposes entry of

(13) Cell

more water into cell.

→ T·P is zero for a flaccid cell.

T·P is -ve for plasmolysed cell. and it results in shrinking of cell-membrane.

* Wall pressure :→ (WP) :→ It is the pressure applied by rigid cell wall against TP.

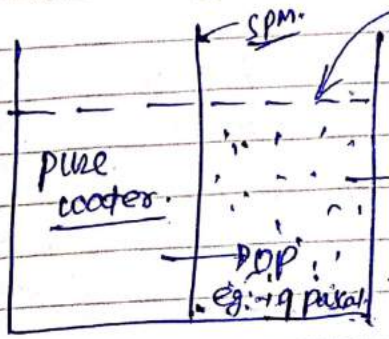
↳ W·P prevents cell expansion beyond a certain limit.

↳ It also helps to prevent rupturing of plant cell when placed in hypotonic soln.

↳ When further expansion is not possible than (WP = TP.)

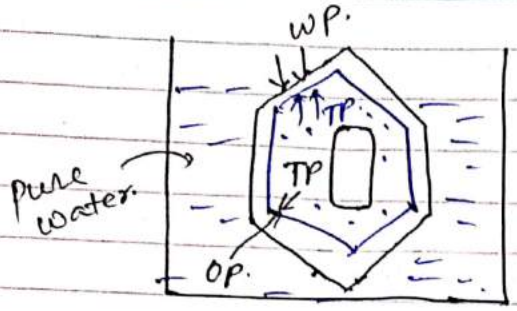
Diffusion pressure Deficit [DPD]

↳ It is the net Deficit or Loss in movement ability or DP of water in a cell or in a soln w.r.t pure water.



↳ DPD = OP - Artificial press

Plant cell :→ DPD = OP − TP.



1# When TP = 0, cell flaccid.
↳ DPD = OP.

2# When TP = OP (max TP.) cell is Fully turgid.
DPD = 0. It means that movement ability of water inside cell is equal to pure water when DPD is zero.

Therefore,
∴ No net entry of water into cell.

3#⇒ When TP = −ve, Plasmolysed cell.
↳ DPD = OP − (−TP) = OP + TP.
∴ DPD > OP.

→ water moves from Low DPD → High DPD.
(High movement ability ⇄ Low movement ability.
(High DP.) (low DP.)

(*) DPD is also regarded as water demand of plant cells. As higher is the DPD more is the entry of the water into such cells. Therefore DPD is also called Suction pressure.

Q:→

A	B.
OP = 6 pascal	OP = 18 pascal
TP = 2 pascal	TP = 17 pascal

DPD = 4 ← 1.

Water potential :→ (ψ_w) It is the total available free energy of water molecules which can be used for their movement.

* Under normal conditions it is the chemical potential of water molecules.

→ ψ_w is maxm for pure water and it's numerical value is zero.

$$\psi_w = \psi_s + \psi_p + \psi_g + \psi_m.$$

ψ_s → Solute potential pot.
ψ_p → pressure pot.
ψ_g → gravitational pot.
ψ_m → matric pot.

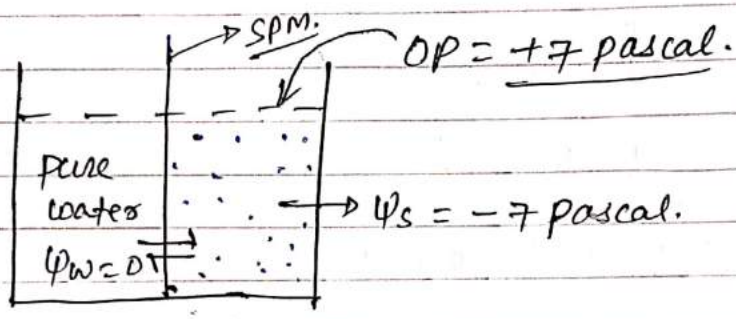
* Solute potential or osmotic potential :→ (ψ_s) (JAN 21)
↳ This factor is due to the presence of solute

For pure water,

$\psi_s = 0$

* For any cell or solution it's value is always -ve, b/z addition of solute always decreases the potential.

** $\psi_s = -OP$ → osmotic pressure



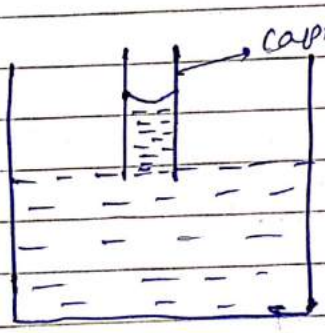
** More is the amount of solute lower or more negative is the value of ψ_s.

pressure potential. (ψ_p)

- For any cell $\psi_p = TP$
- For solution · ψ_p = artificially applied pressure.
- Atmospheric pressure neglected.

* Gravitational potential (ψ_g)
  - This factor is due to difference of height.
  - It is neglected for water movement b/w plant cells.
  - It can be considered when height diff. is large like water store in a dam.
  - ψ_g has the ability to make water potential +ve, but it is physical potential.

* Matric potential (ψ_M):-
  - It is due to Adherence or Attraction of water molecules over a surface.
  - It helps in rise of water in a narrow capillary.



It is also neglected b/z it is soon Balanced by gravitational pool.

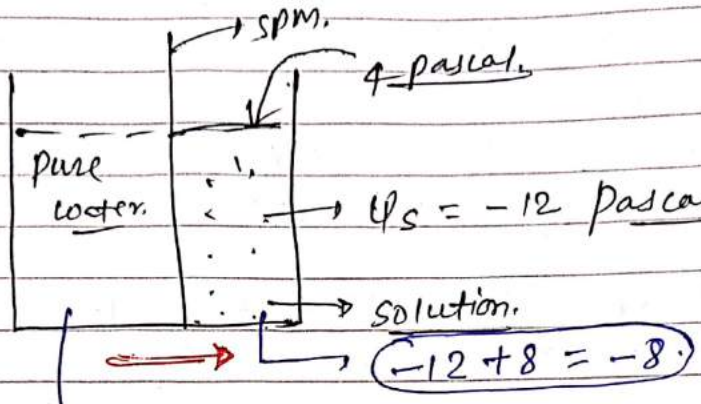
$$\psi_w = \psi_s + \psi_p.$$

→ Water moves from heigh ψ_w ⟶ low ψ_w.

→ High ψ_w ⟶ Low ψ_w.

(less -ve) (more -ve)

Q:→



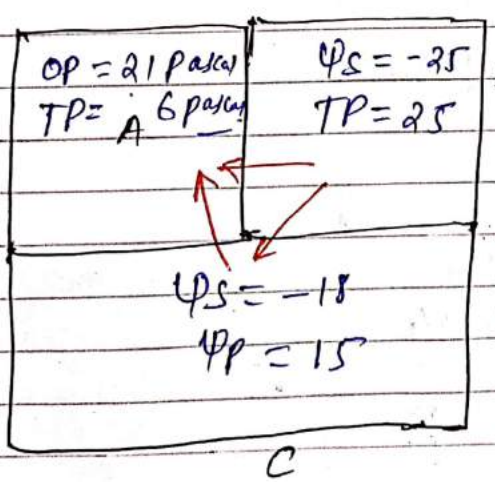
ψ_w : ~~-12 + 4 = -8~~ $\psi_s + \psi_p$

$= 0 + 0$

$= 0$.

NOTE:→ under atmospheric pressure $\psi_w = \psi_s$.
(HINTA - जिस external pressure नहीं लगाया है)

Q:→



DPD

A = 21 − 6 = 15

B = 0

C = $\psi_s + \psi_p$ = ~~-18 + 15~~

= 3

ψ_w
-15
0

$\psi_w = -DPD$

07/10/2019.

Imbibition :→

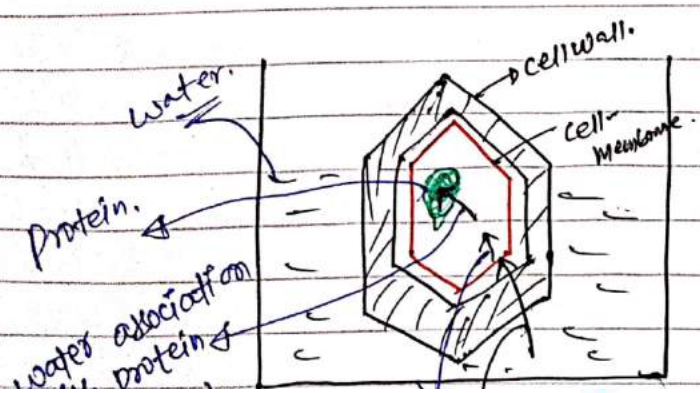
- Adsorption of water molecules.
  - at a suitable surface.
    - imbibant.
- eg:→ Entry of moisture into wooden doors in rainy season.
  - Conch difference or gradient
  - & imbibent must have affinity for water.

→ Special case of diffusion.

matric potential helps in this process.

Imbibition involves.

- volume ↑.
  - eg:→ swelling of dry seeds in water.
- imbibition pressure..
  - pushes seedlings out of soil.
  - rupturing of seed coat.



Imbibition :→ adsorpti

↓
water

→ Imbibition also involves release of heat, which is called heat of wetting. K.E of water molecules is converted into heat energy.

Imbibition capacity:

Agar-Agar > pectin > proteins > starch > cellulose.

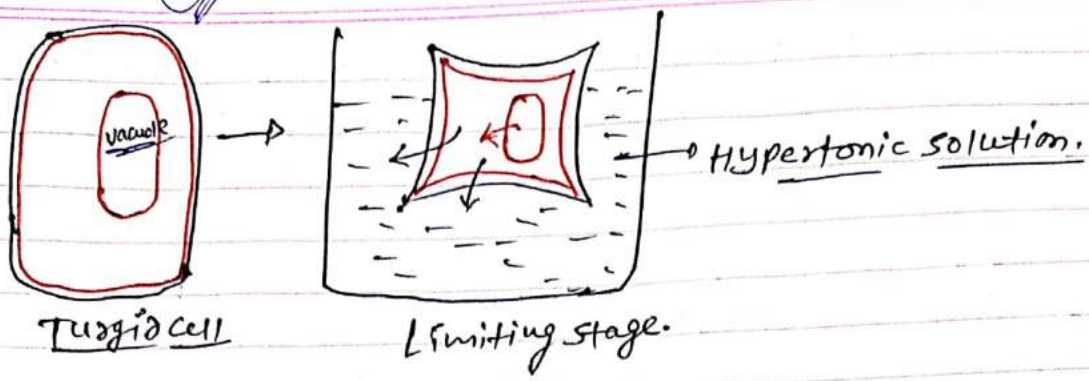
* Dry gram seeds soaked.	* Dry wheat grains soaked.
* Swelling.	* Swelling.
* Seed coat ruptured.	* No seed coat rupturing.
→ More IP. → protein rich.	* Less IP → starch rich.

Plasmolysis:→ It is the phenomenon of loss of water from plant cells or other cells having cell wall, through exosmosis, when they are placed in hypertonic solution. Cell membrane is slowly separated from cell-wall.

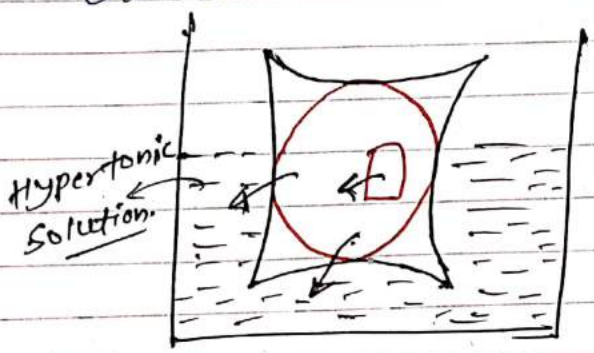
Stages:→

i) Limiting plasmolysis:→ due to loss of water some shrinking occurs in C.W but cell-membrane is completely attached with C.W.

(*) इसी fig में vacuole का size बढ़ा हुआ है।

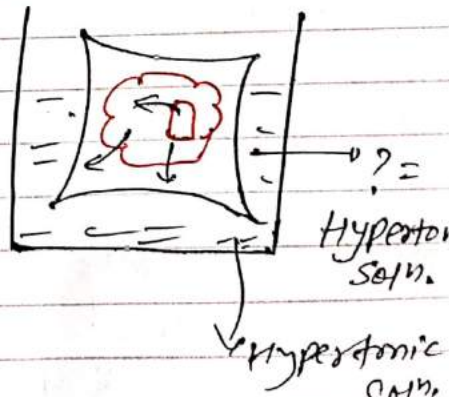


ii.) Incipient plasmolysis:→ due to further Loss of water cell-membrane starts separating from cell-wall particularly at the corners of cell.



(iii.) Evident plasmolysis:→

In evident stage cell-membrane is fully seperated from cell-wall. but cell is still alive.



सूजन के बाद imbibition होगा But Deplasmolysis नहीं होता है।

iv) Complete plasmolysis:→ Due to excessive Loss of water protoplasm and cell-membrane properties are Lost i.e cell is now dead.

* High salt conc^n and sugar conc^n are used as preservatives as they control bacterial (आचार को) and fungal infection by complete plasmolysis.

* High conc^n of salt or chemical fertilizer around the roots of the plant may cause plant death due to plasmolysis.

Deplasmolysis:→ If a living plasmolysed cell is placed in hypotonic solution or pure water than it regains turgidity, and this process is called deplasmolysis. (विलयन)

* Transpiration:→

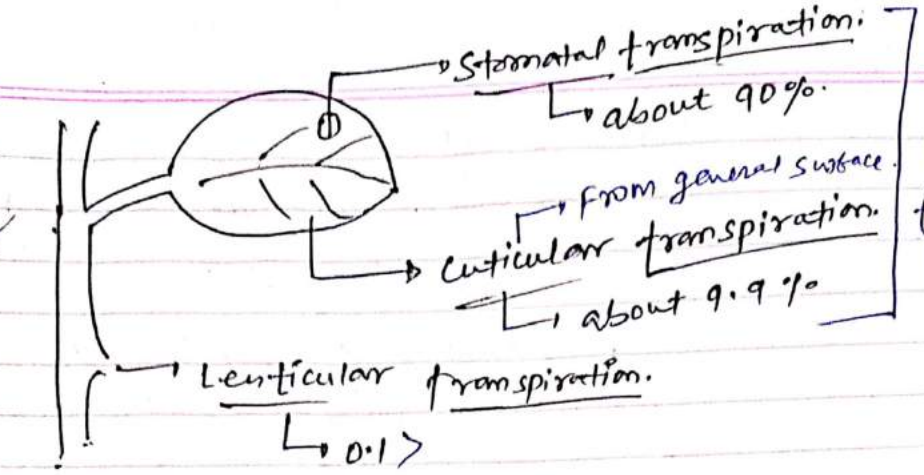
Transpiration is the loss of water from plants in the form of *water vapours.*
gas के Form में।

A/c to curtis transpiration is "necessary evil" (आवश्यक बुराई)

Benefits.

* Cooling effect.
* Transpiration pull for rise of water.
* It helps in re-entry of water into plant cell and thus helps to regain turgidity.

Date 9/oct/2019

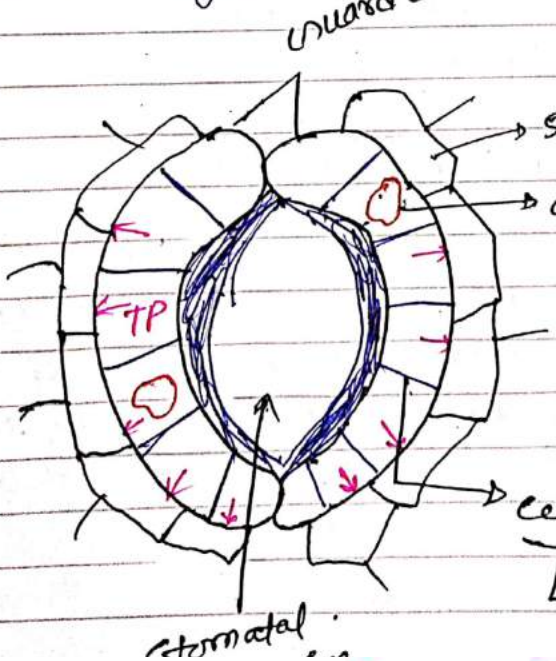


* Submerged Hydrophytes do not shows transpiration.

* Maxm transpiration is observed in mesophytes.

Stomata :- Stomata are small-pore over leaves and herbaceous stem, for the purpose of gaseous exchange.
- water vapour, CO_2, O_2.

* Stomata are found only in sporophytic (2n) plant body.



Monocot

1 cotyledon, vein usually parallel, fibrous root System, Floral part usually in multiples of three.

Guard cells.

- epidermal cells.
- have chloroplast.
- outer wall is thin & elastic.
- inner wall is thick & elastic.
- Bean / kidney / crescent shaped in dicots.

Dumbell shaped in monocots.

NEET → 2018. (In grass. Stomata shape is → Dumbell shape)

When guard cells are turgid.

- TP high
- outer wall is pushed out.
- inner wall is pulled out with the help of cellulose microfibrils.
- Stomata open.

When guard cells are flaccid.

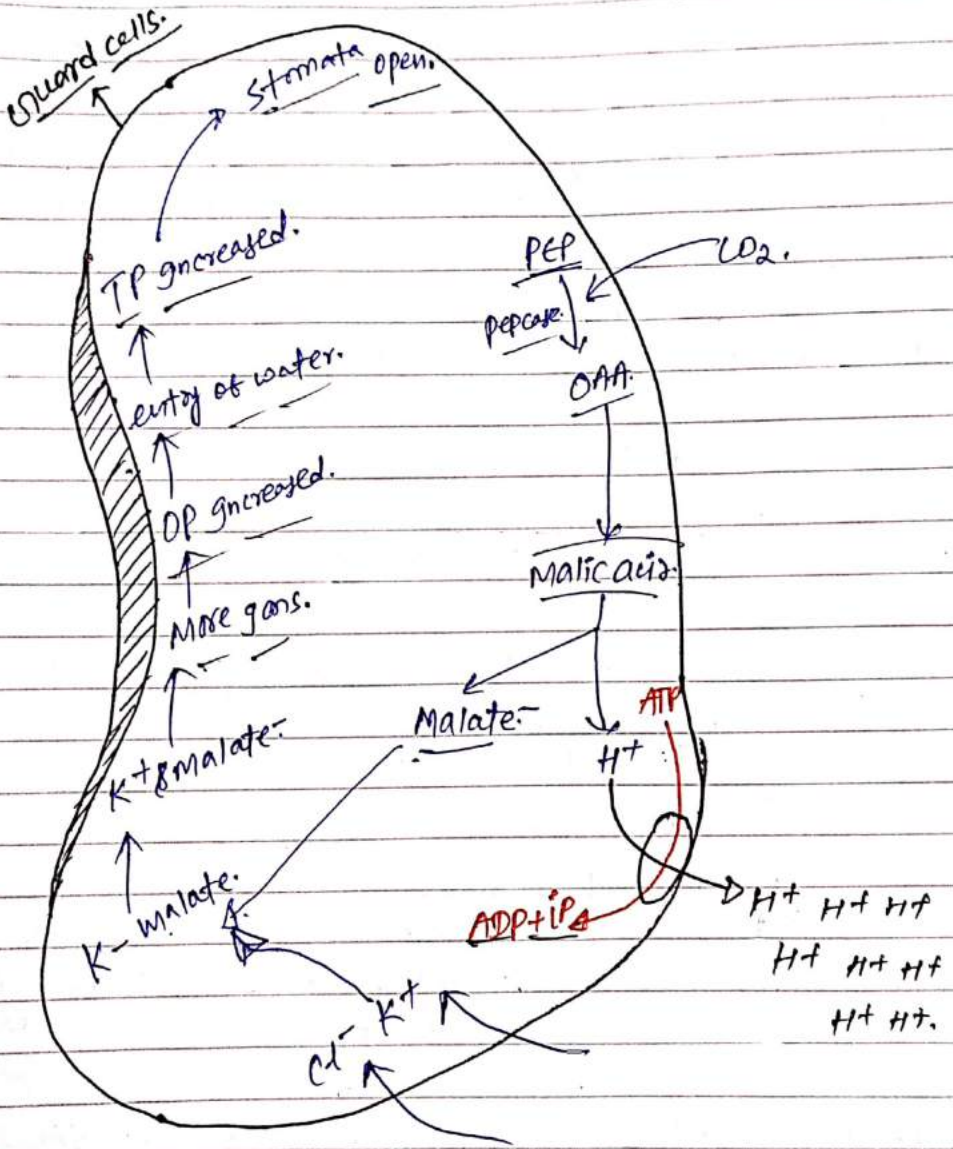
- TP = 0
- outer wall is not pushed out, its move towards inner side and thus pulling pressure on inner wall is relaxed due to which inner wall also moves towards inner side.
- Stomata closed.

Dicot

Two cotyledons, veins usually net like, Taproot usually present, Floral parts usually in multiples of 4 or 5.

* $K^+ \rightleftharpoons H^+$ theory by Levitt.

↳ explains opening & closing of stomata.



(*) Malic acid.
↳ weak electrolyte की
तरह ions कम देगा so, H+ remove किया
जाएगा।

* Opening.
  - Malic acid = weak electrolyte.
    - Less ions.
    - H+ pumping out ↑ ionisation.
  - K-Malate → strong electrolyte.
    - more ions.

* Closing.
  - K+ efflux.
  - H+ influx.
    - associate with malate → to form malic acid
      - ions decreased.
        - OP ↓
        - water moves out of guard cells = TP ↓

factors affecting rate of transpiration.
↳ also used module theory.

(i.) Humidity:→ It is most important factor affecting transpiration when stomata are open.

- High transpn = atm. dry + plant moisture ↑
- When relative humidity of atmosphere is 100% then transpiration does not occur.

(ii.) Temperature:→

- Transpiration ↑ with temp. ↑ upto 50°C thereafter stomata closed.
- Increase in temp also increases vapour holding capacity of atm.

(iii.) Wind velocity :→

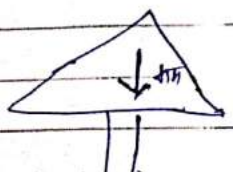
- Slow and moderate wind.
  - Transpn ↑
- High wind velocity.
  - Stomata closed.
  - transpiration ↓.

(iv.) Atmospheric pressure :→

- Decrease = Transpiration ↑.

(v.) Tree-canopy.

due to difference in surface area.



vi) Light
- Blue > Red.

viii) Anti-transpirants.
- PMA (phenyl mercuric Acetate)
- ABA, CO_2] → induce closing of stomata.
- Silicon oil, Low viscosity wax.

Absorption of water.

Passive.

* Osmotic entry of water into roots is supported by transpiration pull.
* Passive water absorption is the main method of water uptake.

Active.

* Osmotic entry of water is supported by active mineral absorption.
* This absorption of water is indirectly active.

Forms of water in soil

i) Capillary water: in small pores of soil.
ii) Hygroscopic water: thin layer of water over soil particles.

} Available for xerophytic plants

(iii) Chemically combined water:-
↳ chemically bond with other compounds.

(iv) Gravitational water :-
excess water.

Not available for plants. = Echard Holard

* Roots of only some plants are able to rich upto ground water. Eg:- Acacia, Eucalyptus, Calotropis.

Apoplastic & Symplastic movement of water

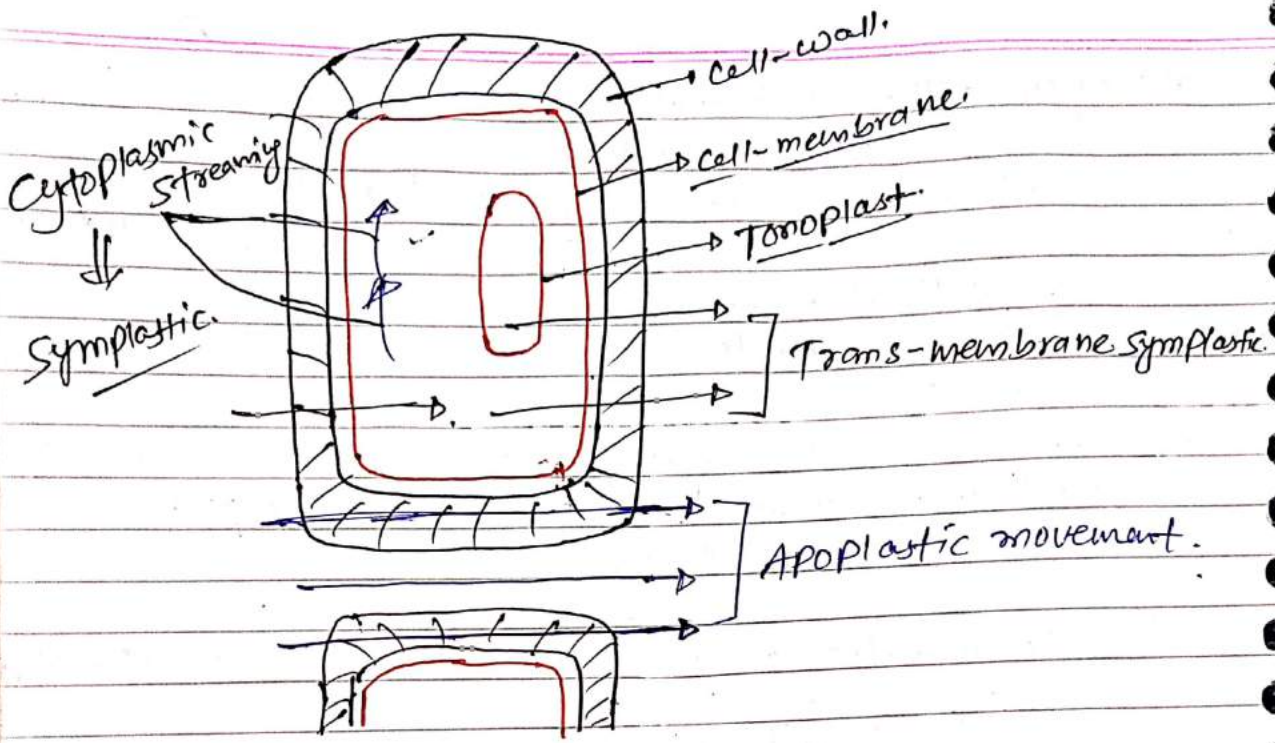
↳ Concept by Munch.

Apoplast is the dead content of plant body. including intercellular spaces and cell wall. and water movement through these regions is called apoplastic.

→ Apoplastic movement of water is faster than Symplastic.

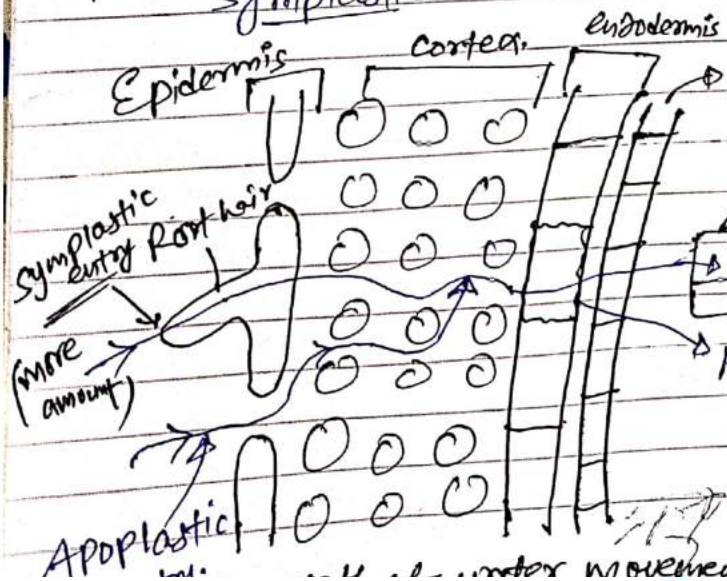
⇒ Symplast is the living content including protoplast, cell membrane and tonoplast. (vacuole membrane)

Water movement through these regions is called symplastic.



⇒ Cytoplasmic Streaming is active process as it occurs with the help of microfilament which utilises ATP. It is movement of cytoplasm within the cell.

⇒ movement through plasmodesmata is also symplastic.



test 13

Root hair → cortex → Endodermis → pericycle → proto & Meta-xylem.

Sym. (APO) mainly → (Passage cell) Sym. → Sym.

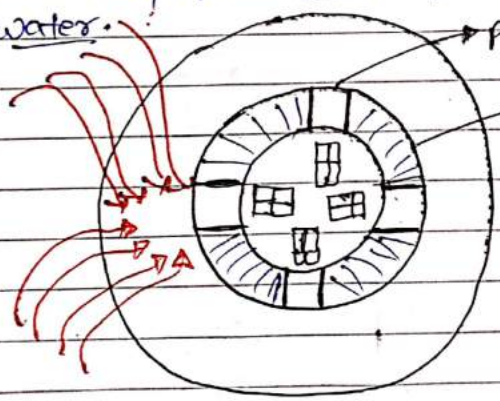
Apo.

* Endodermis cells have casparian strip formed of suberin lipid, on their transverse and radial walls, and thus apoplastic passage is not allowed.

Transverse

* passage cells do not have casparian strip. and they allow symplastic passage of water.

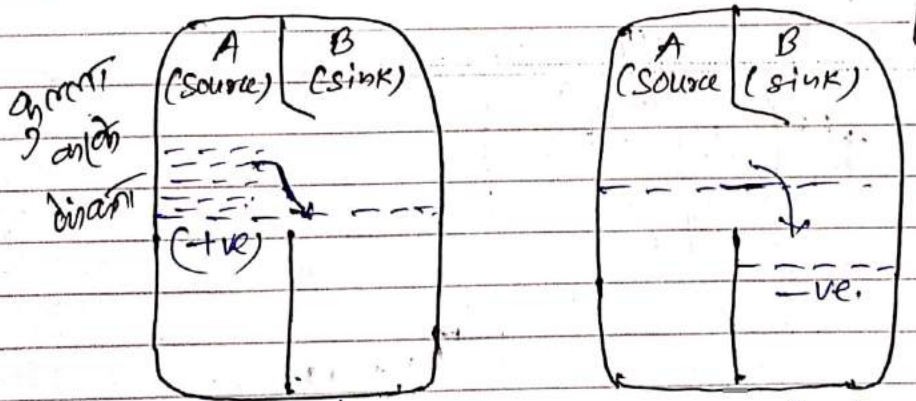
* Casparian strips helps to prevent backflow of water.



Long distance transport

- occurs by mass flow. (en masse)
  - bulk transport.
- In mass flow material dissolved or suspended in water is transported with the flow of water. and this transport is not dependent upon the concn. of such material.

⇒ Movement of water for supporting long distance transport occurs due to difference of pressure, b/w two positions.



Pepsi को या पानी को pipe से खींचना।

Positive pressure or pushing pressure.

eg:- Root pressure.

Negative pressure (or) pulling pressure.

eg:- Transpiration pull

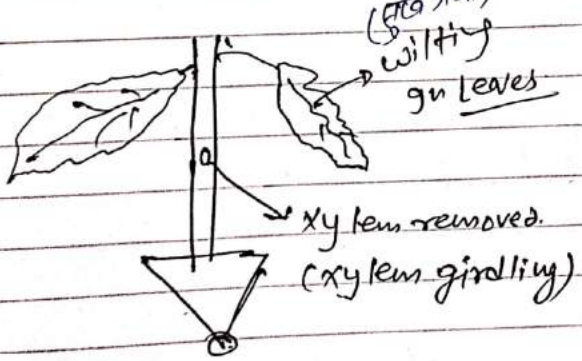
Increase in pressure in source generates pushing pressure.

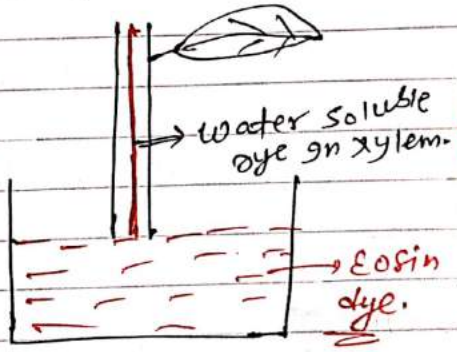
decrease in pressure at sink or destination generates pulling pressure.

(A) Ascent of sap. (rise.)

- water + minerals + organic amides + plant hormones
- rise of water and it's dissolved content occurs through xylem, and it can be proved by using xylem girdling experiment and Balsam twig (dent) experiment.

NEET → 2019.



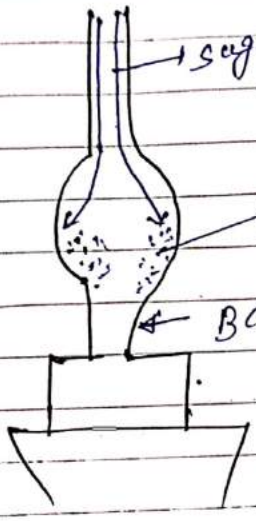


i) Cohesion - tension transpiration pull theory:→
by Dixon & Jolly

→ Transpiratory loss of water from leaves highly decreases water potential or highly increases DPD in leaves.

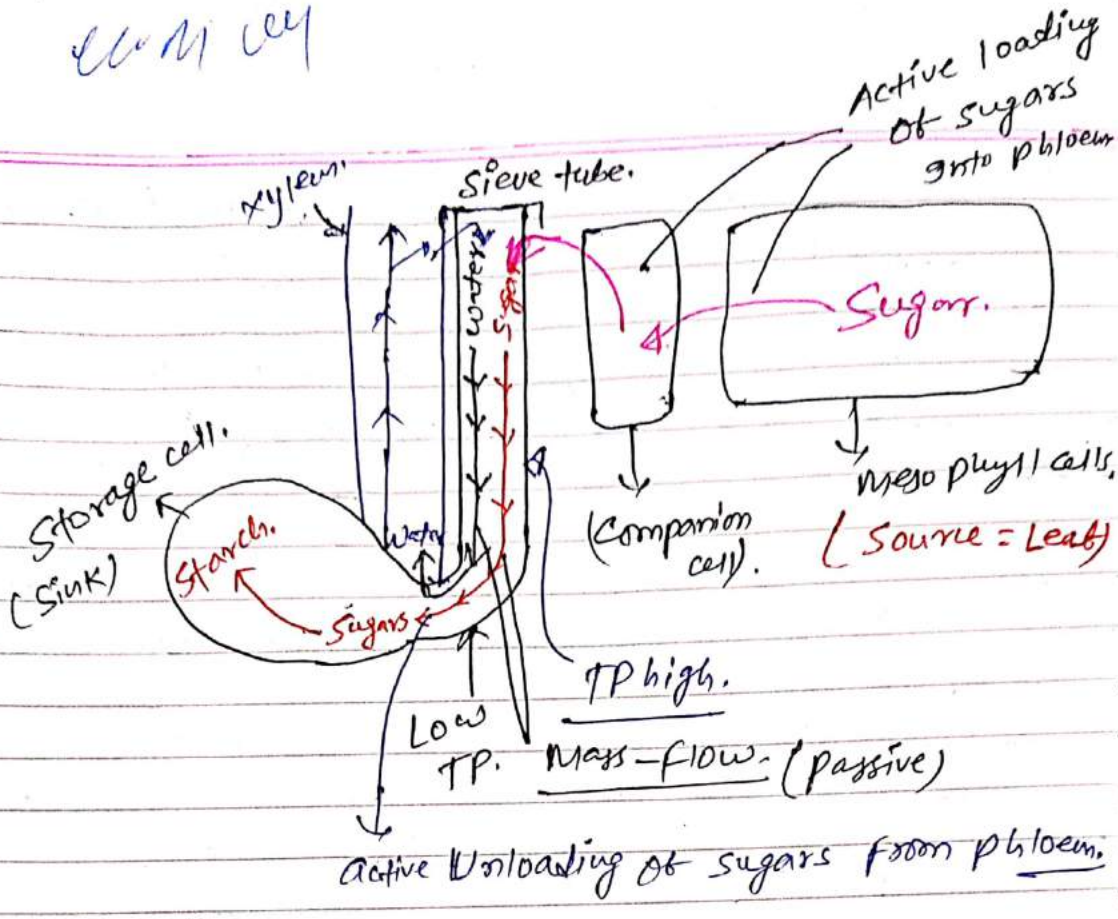
(B.) Translocation of sugars through phloem :-

Girdling or ringing experiment can be used to prove that sugar transport occurs through phloem.



Removal of phloem inhibits sugar transport towards root and it proves that phloem is responsible for sugar transport.

Plant on which such experiment is conducted ultimately dies and roots die early than sugar.



* Sugars are actively remove from mesophyll cells b/z increase in sugar concn in these cells inhibits the photosynthesis.

* Transport from companion cells to sieve tube is also active.

* High Sugar concn. inside phloem promotes entry of water from xylem due to which TP or Hydrostatic pressure in phloem closed to shoots become high.

* Sugars are actively removed from the phloem and transported into sink, where sugars are converted in starch which is insoluble in water and does not behave

* Active removal of sugars from phloem is necessary so that low solute conch in phloem is maintend and it helps in removing water throughout the phloem and the T.P in phloem closed to sink remains flow.

* Sucrose is the most common transport sugar, it is unknown reducing sugar.

* Stachyose, verbescose & Raffinose are the minor transports sugars in plant.

* phloem pH is alkaline. (about 8)

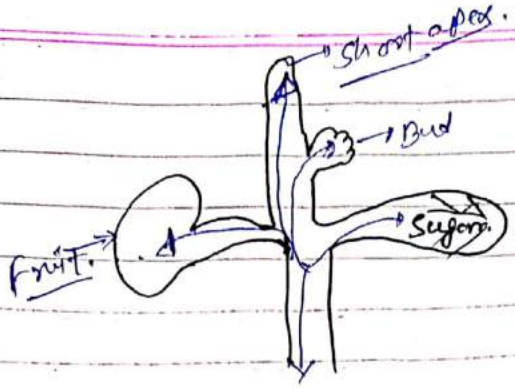
* In sugarcane sucrose is the storage sugar which is water soluble and its reserves in water accumulation.

NEET-2019.
NCERT

* Sugar transport in phloem is bidirectional.

* Sugar transport is mostly from leaves to roots. But if required then stores sugars can be hydrolysed into simple sugars and transported upwards, with the help of upthrust in the phloem.

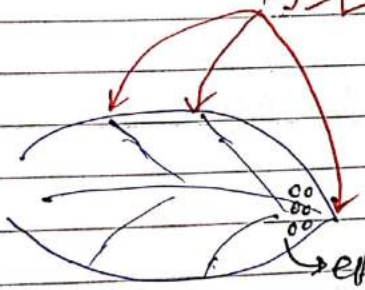
* Sugar transport in complete plant is multi-directional.



Guttation :→ ↑ Liquid.

↳ Loss of water & dissolved content = (Sap) from the opening called hydathodes.

Hydathodes.
↳ small pores.



- present at leaf margin.
- No guard cell.
- always open.

→ Guttation occurs due to root pressure.

→ Guttation is observe in night time and morning and only in small plants.

→ During guttation water potential of leaves almost zero.

** Bleeding / Exudation :→ Release of liquid content from any cut or injury in plant.

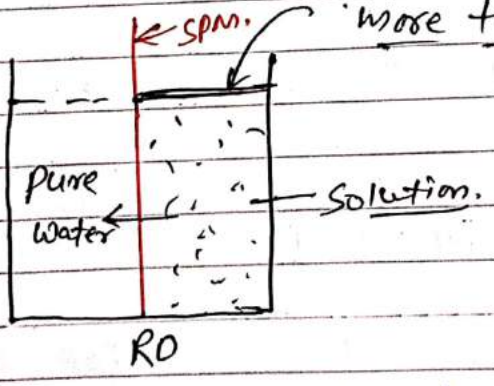
→ It has Commercial importance.
Ex:→ Release of gums
" " Latex from Rubber plant.
" " " " Opium plant.

→ Sugar syrup from toddy palm (Cryota ureans).
↳ Fermentation → Toddy.

Note:→ Potometer:→ Measurement of rate of Transpiration.
Manometer:→ Measurement of root pressure.

Cobalt chloride paper test :→ Comparision of rate of transpiration from 2 surface of leaves.

Reverse osmosis :→ (RO)



It is the movement of water from soln to pure water through SPM when pressure more than OP is artificially applied over soln site.

NCERT Correct: Plasma membrane (X) ↓ Cell wall (✓)
Jia :-)

During RO water potential of soln is +ve. This process is used for obtaining fresh-water from slime water. and also used for water purification.