

TRANSPORT IN PLANTS

In a flowering plant water, mineral nutrients, organic nutrients and hormones are transported. In a small distance they are moved by diffusion and cytoplasmic streaming.

Transport of substances over long distance is through xylem and phloem. it is called *translocation*. transport of substances in xylem is unidirectional that means from root to stem.

Means of transport

diffusion:- diffusion is a passive process, i.e here no energy is used. Diffusion is the movement of substances from region of higher concentration to the region of lower concentration.

A pressure formed in the substances due to the diffusion is called diffusion pressure. (D.P)

Eg. spreading of a drop of ink in water

diffusion rates are affected by

- the gradient of concentration
- the permeability of the membrane.
- temperature
- pressure

facilitated diffusion

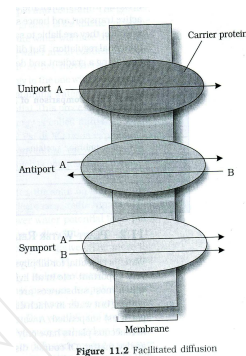
The diffusion rate depends on the size of substances . The smaller substances move faster. The diffusion of substance across the membrane also depend on solubility of it in lipids. Lipid soluble substances move faster. Substances with hydrophilic moiety, find difficult to pass through the membrane. Their movement has to be facilitated. That means such substances are moved by the help of proteins present in the membrane. Such diffusions take place with the help of proteins is called facilitated diffusion.

In facilitated diffusion there is no expenditure of energy. Facilitated diffusion is very specific. That means selective.

Porins:- they are the proteins that form huge pores in the outer membranes of the plastids, mitochondria and some bacteria. *Aquaporins* are the water channels made up of eight different types of aquaporins.

Passive symport and antiports

Some proteins allow diffusion only if two types of molecules move together. In a *symport*, both molecules cross the membrane in same direction. In an *antiport* they move in opposite direction. If only one molecule is transported through membrane is called *uniport*.



Active transport

This type of transport uses energy. It is carried out by membrane proteins. It takes place against the concentration gradient.

Comparison of different transport

property	Simple diffusion	Facilitated diffusion	Active transport
Requires special membrane proteins	No	Yes	Yes
Highly selective	No	Yes	Yes
Transport saturates	No	Yes	Yes
Uphill transport	No	No	Yes
Require ATP	No	No	Yes

Water potential

It is the chemical potential of water. It is denoted by the symbol ψ_w .

The water potential of pure water is the maximum, it is 0. If solute is added it is decreased to negative value.

Solute potential (ψ_s) and pressure potential (ψ_p) are the two components of ψ_w .

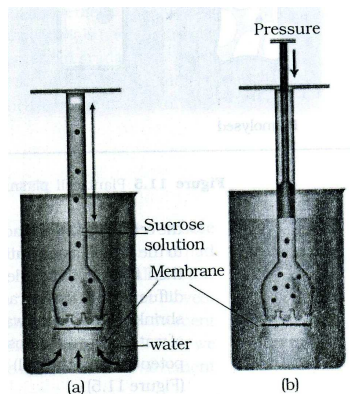
So
$$\psi_w = \psi_s + \psi_p$$

ψ_s will be negative

OSMOSIS

Osmosis is the simple diffusion across a semi permeable membrane. Here water move from a region of high water potential to a region of lower water potential. As a result of osmosis a pressure is exerted, is called osmotic pressure. If we give a pressure against the osmotic pressure the process of osmosis will stop. If we increase such pressure again; the osmosis take place in reverse direction. This is called reverse osmosis.

The reverse osmosis is used for the purification of water.



Osmosis are of two type.; endosmosis and exosmosis.

Endosmosis: if a cell is placed in the hypotonic solution the water will move in to the cell. It is called endosmosis. Due to the endosmosis the cell become turgid

Exosmosis: if a cell is placed in the hypertonic solution the water will move out of the cell. It is called exosmosis. Due to exosmosis the cell become flaccid.

Hypotonic solution means the solution with comparatively less concentration

Hypertonic solution means the solution with comparatively high concentration

Plasmolysis

When water move out of the cell the cell (by exosmosis) membrane shrinks and detaches from the cell wall. This process is called plasmolysis.

Water lost from cytoplasm first and then from vacuole during plasmolysis.

By endosmosis the cytoplasm exerts a pressure against the cell wall , is called *turgor pressure*.

Imbibition

Here water is absorbed by the solids colloids and result in the increase in volume.

Eg. Absorb water by dry seeds, dry wood.

The prerequisite for the imbibition are:

1. water potential gradient between the absorbent and the liquid imbibed
2. affinity between the adsorbent and liquid

water absorption

water from soil is absorbed by the root hair. Then from there it is moved deeper through two pathway.

- a) apoplast pathway
- b) symplast pathway

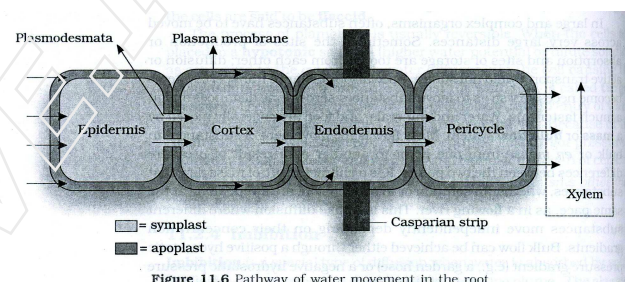
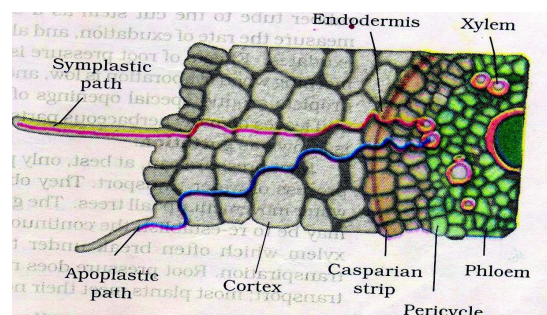


Figure 11.6 Pathway of water movement in the root

apoplast: here water moves through inter cellular spaces and cell wall.

Symplast: here water move by crossing the cell membrane, and through the plasmodesmata.



Water movement up a plant

Can be explained by various theories.

1. Root pressure theory

Root pressure is the pressure developed inside the root due to the accumulation of water. This pressure helps for the upward movement.

Guttation is the process take place by the phenomenon of root pressure.

Guttation is the water loss from plants in the form of liquid. It take place at the openings of veins of leaf blade and leaf tip.

It occurs in herbs . and take place in night.

2. Transpiration pull theory

Transpiration is a water loss process in plants. Transpiration takes place through stomata and cuticle. Transpired water is in the form of vapour.

When transpiration take place in leaves a pull is occurred . that pull affects at the root xylem. So that pull result in the absorption of water and upward movement of water.

It is because of the presence of continuous column of water in the xylem from leaf to root.

The continuous column of water is maintained by the two special properties of water; cohesion and adhesion

1. **cohesion:** is the affinity between the similar molecules. Here water molecules show affinity.
2. **adhesion:** is the affinity between the dissimilar molecules. Here the affinity between the water molecule and inner wall of xylem.

Transpiration – merits

1. creates transpiration pull
2. helps in the absorption and upward movement of water
3. helps in the absorption and upward movement of minerals
4. cools leaf surfaces
5. maintains the structure and shape of plants by keeping cells turgid.

Transpiration – demerits

1. leads to wilting and death of plant

uptake of mineral ions

Minerals are absorbed and transported by both active and passive mode.

Phloem transport

The prepared food from leaves are transported to different regions of the plant through the phloem. Sometimes it is stored at some parts. That part is called sink.

Form sink the food again move to different parts when it is needed. So here we can see a source to sink transport and sink to source transport. So the phloem transport is a bidirectional one.

But the xylem transport is unidirectional.

Pressure flow hypothesis is used to explain the phloem transport from source to sink.

The glucose formed in the leaves then converted into sucrose and reach at companion cell, and then into sieve tubes by active transport. This produce a hypertonic condition inside the phloem. So water in the adjacent xylem move into the phloem by osmosis. Then the phloem sap will move to lower pressure area.