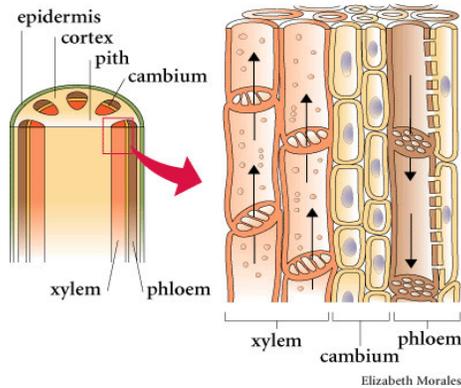


1. Vascular Tissues- Xylem and Phloem

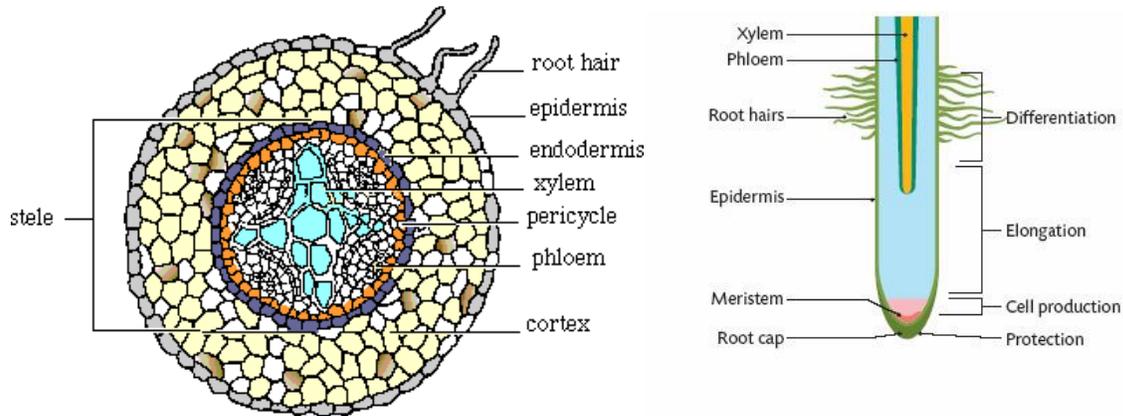


| XYLEM  | PHLOEM   |
|--|--|
| It carries water and minerals from roots to the remaining parts of plant body. | It translocates food from leaves to the remaining parts of plant body. |
| Functional xylem cells are nonliving.  | Functional phloem cells are alive (living).                            |
| The movement in xylem is only in upward direction.                             | The movement in phloem is in upward as well as downward direction.     |

- **Phloem:**
  - Mainly Consist of sieve tubes and companion cells to transport manufactured food (sucrose and amino acids) from green part of plant to other parts.
  - Each **Sieve tube** consists of a column of elongated living cells separated by sieve plates with holes. These cells had lost most of its organelles and central vacuole.
  - **Companion cells** have many mitochondria which provide the energy needed for the sieve tube cells to carry out active transport.
- **Xylem:**
  - Mainly consists of xylem vessels made up of dead cells.
  - **2 main functions:** (a) Conducts water and dissolve minerals from the root to other parts (b) Mechanical support to the plant.
  - Xylem tubes are **hollows without cross walls** to enable water to flow through.
  - The tubes' wall are **thicken with lignin** (in ring, spiral or tube with pits) to prevent collapse of the hollow tube
- **Vascular bundle (Phloem, Xylem and Cambium) in stems**
  - **Cambium:** divide and differentiate to form xylem and phloem tissue during plant growth.
  - **Cortex and Pitch:** store food substances such as starch.
  - **Epidermis:** covered with a waxy cuticle that minimizes water lost from the stem.

2. **Structure of Roots** : the xylem and phloem are not bundle together

- **Piliferous layer:** the outer most layer which bear the root hair cells with elongated shape to increase surface area to volume ratio for absorption of water and dissolved minerals.
- **Root apex & cap:** to protect the growing parts of the root from friction with the soil.
- Traverse section (LS) versus longitudinal section (LS) diagram.



### 3. Entry of water into a plant

- Root hair cells grown in between the soil particle come in contact with the water with dissolved minerals
- The sap in the root hair cells are more concentrated than the water in the soil thus water enter the root hair cells by **Osmosis** through the cells surface membrane.
- The entry of water make the root hair cells having higher water potential than the inner cells thus water will pass through progressively to the xylem vessels.
  - Mineral in the soil water can enter the root hair cells by **diffusion** (when concentration is higher) or by **active transport** (when concentration is lower).

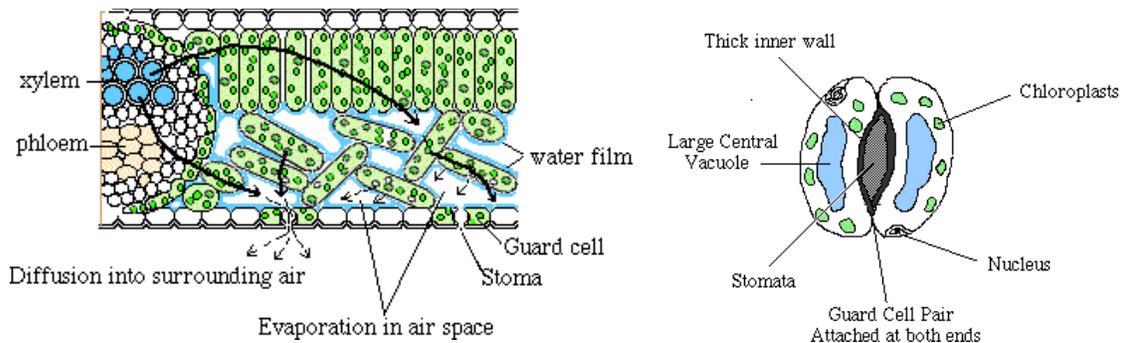
### 4. Moving of water upwards against gravity

- **1. Root pressure:**
  - The living cells around the root xylem vessels use **active transport to pump mineral ions into the vessels** lowering the water potential of the vessel. Water therefore passes from the living cells into the xylem vessels by Osmosis and flow upwards. This effect is called root pressure.
- **2. Capillary action:**
  - The water molecules interact with the wall of the narrow and hollow xylem vessels. This effect which, tend to move the water up the vessel is called capillary action.
- **3. Transpiration**
  - The loss of water by evaporation from the aerial parts of the plants, especially through the stomata of the leaves is called **transpiration**.
  - **Transpiration pull** is the suction force caused by transpiration to pull the water up the xylem vessels against gravity.
  - **Factors affecting rate of transpiration** are: (a) Temperature of the air High causes High (b) Humidity of the air High causes Low (c) Wind or Movement of the air High causes High (d) Light High cause High due to stomata guard cells photosynthesis.

## 5. Loss of water by evaporation of water from the leaves

### ○ Stomata:

- A **stoma** is a physical gap between two special epidermal cells called guard cells. When the pair of guard cells is turgid, they bow in such a way as to increase the gap -- stoma -- between them.
- The **two guard cells** are fused at their ends. The inner cell walls which form the stoma are thicker than the outer walls. The structure of guard cells explains why they bow apart when turgid.



## 6. Important of Transpiration

- Transpiration **draws the water and minerals** from the roots to the stem and leaves.
- The evaporation of water in the leaf **cool the leaf** prevent it from being scorched by the hot sun.
- Water transported to the leaf can be used for photosynthesis, to keep the cells turgid so as to reach out to the sun light.
- Wilting** occurs when the rate of water lost is more than the rate of absorption. The cells in the leaf and stem become flaccid and the stomata close to minimize water lost.

