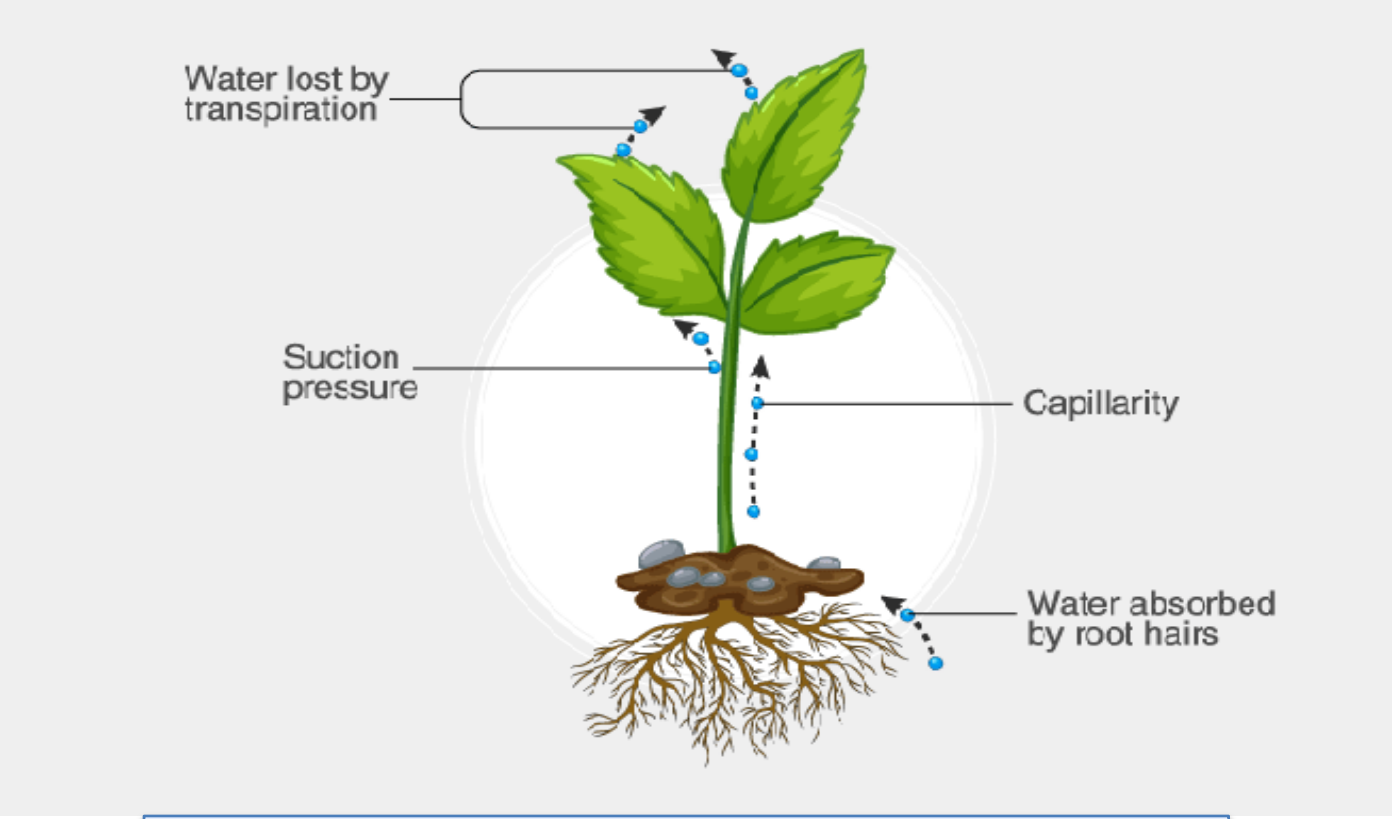
Bhagalpur National College, Bhagalpur

(A Constituent unit of Tilka Manjhi Bhagalpur University, Bhagalpur)

PPT Presentation for B.Sc. II-Transpiration



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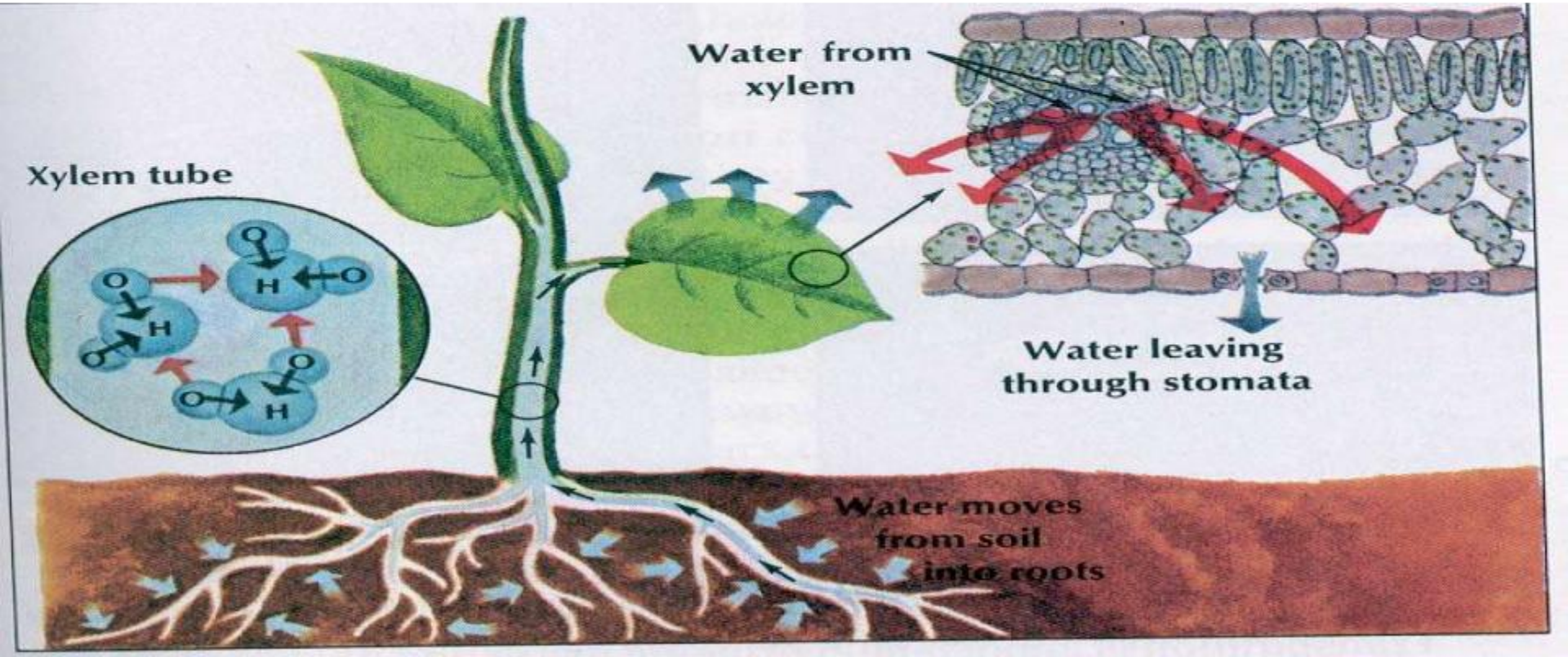
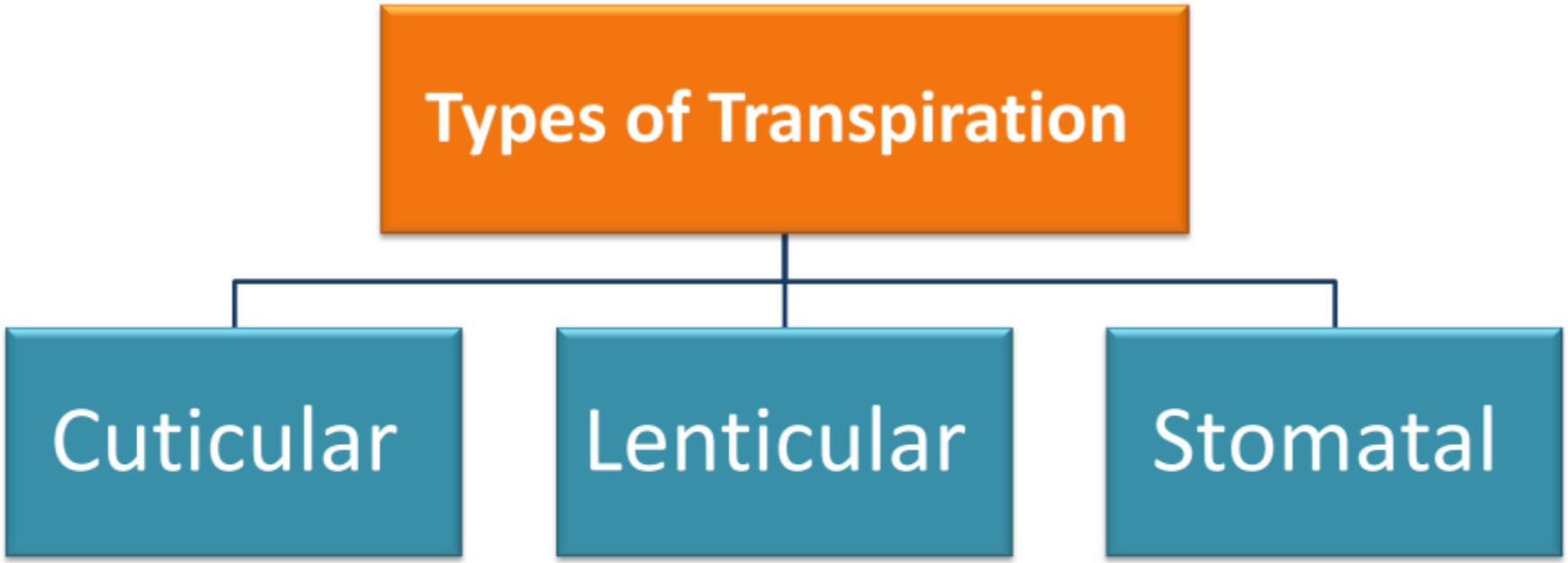
Definition of Transpiration

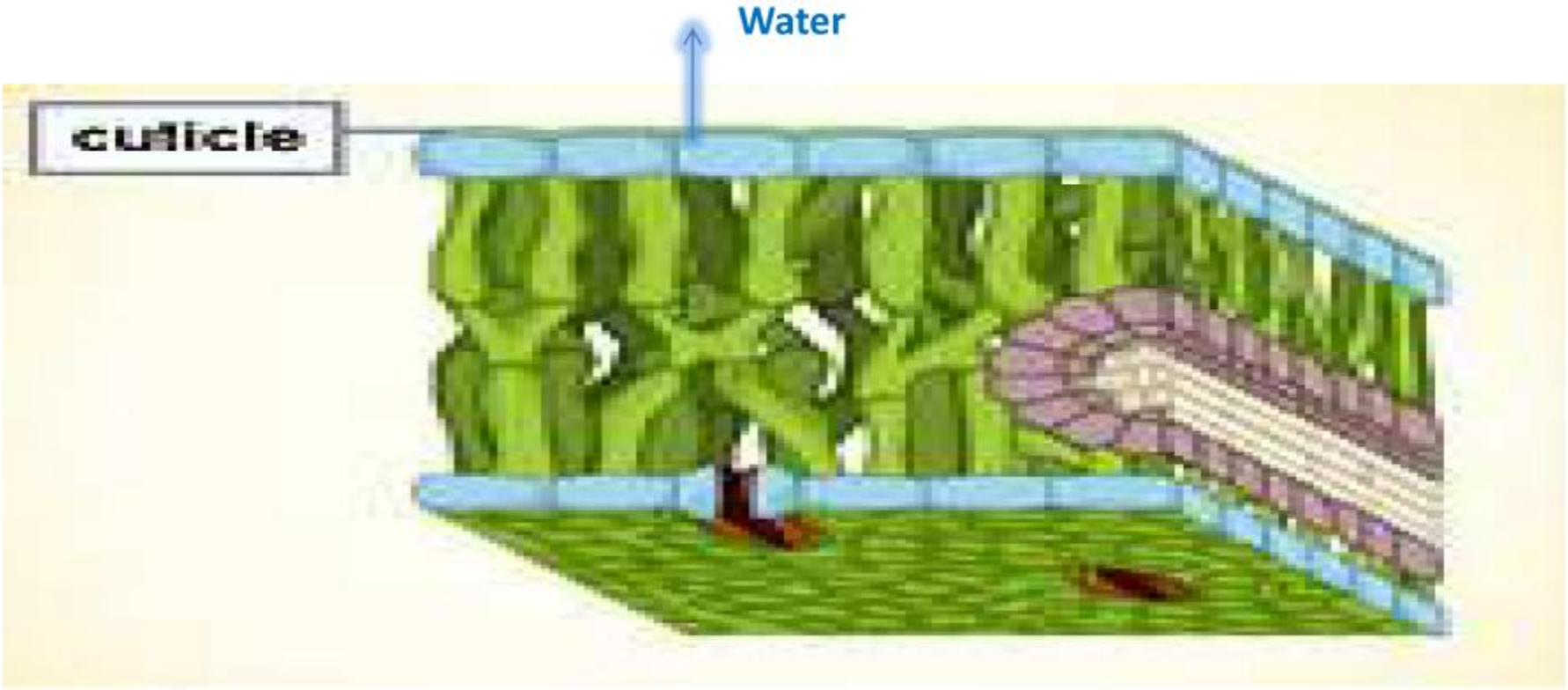
Transpiration: is the process of water movement through a plant and its evaporation from aerial parts especially from leaves.




Types of Transpiration
Cuticular
Lenticular
Stomatal

Types of Transpiration

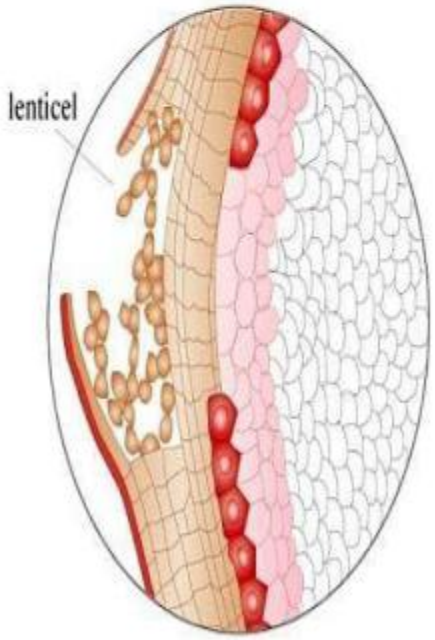
1. Cuticular Transpiration: the loss of water through the cuticle is known as Cuticular transpiration.

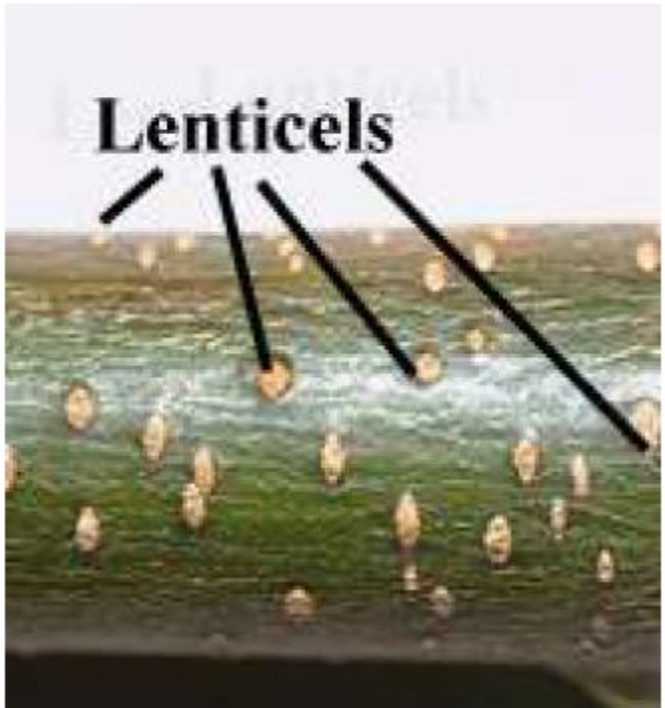


Cross section of leaf

Types of Transpiration

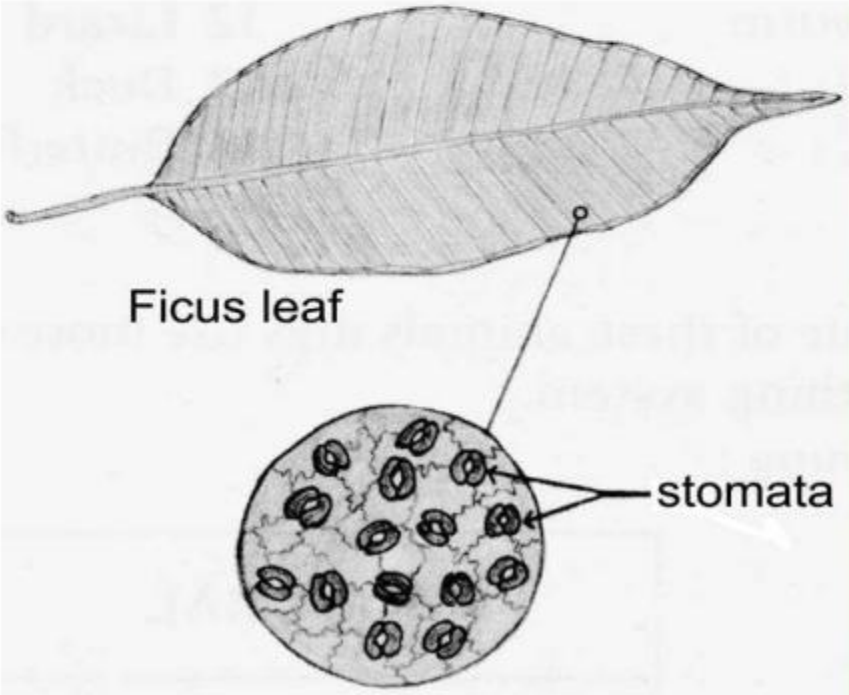
2. Lenticular Transpiration: Loss of water in the form of water vapour taking place through the lenticels present in woody stem and fruits.

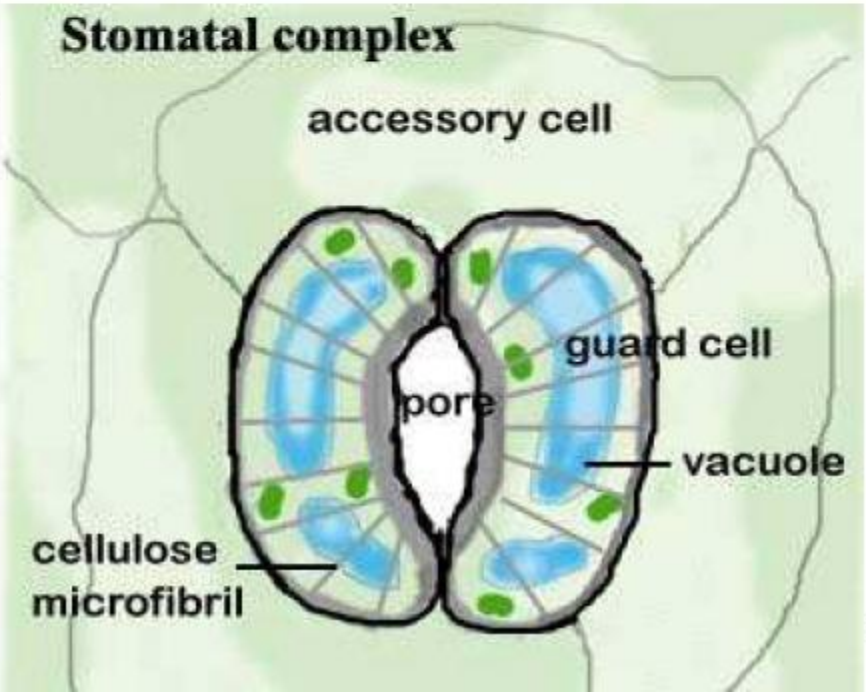




Types of Transpiration

3. Stomatal Transpiration: Stomata are minute pores confined to epidermis of green shoot and leaves.





Importance of transpiration to plant

- Transpiration allow the diffusion of carbon dioxide gas from the air for photosynthesis.

- Transpiration cools plant.

- Absorption of mineral nutrients and water from roots to shoots.

Types of transpiration

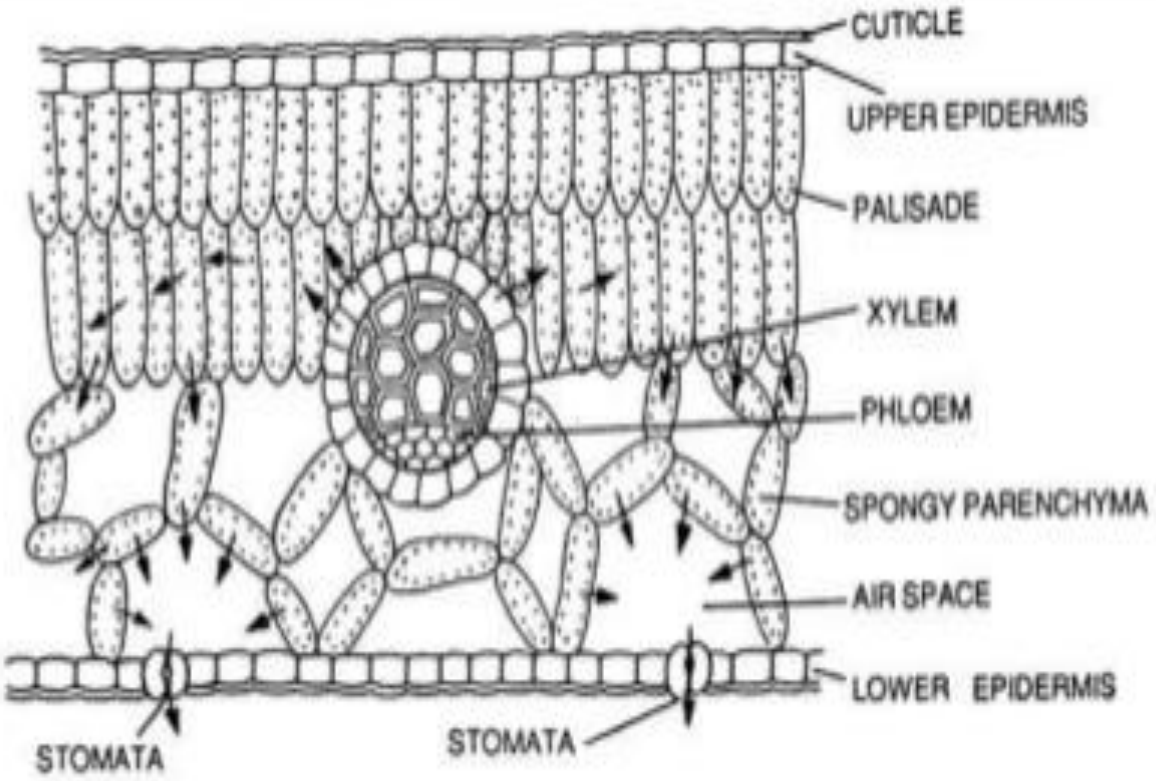
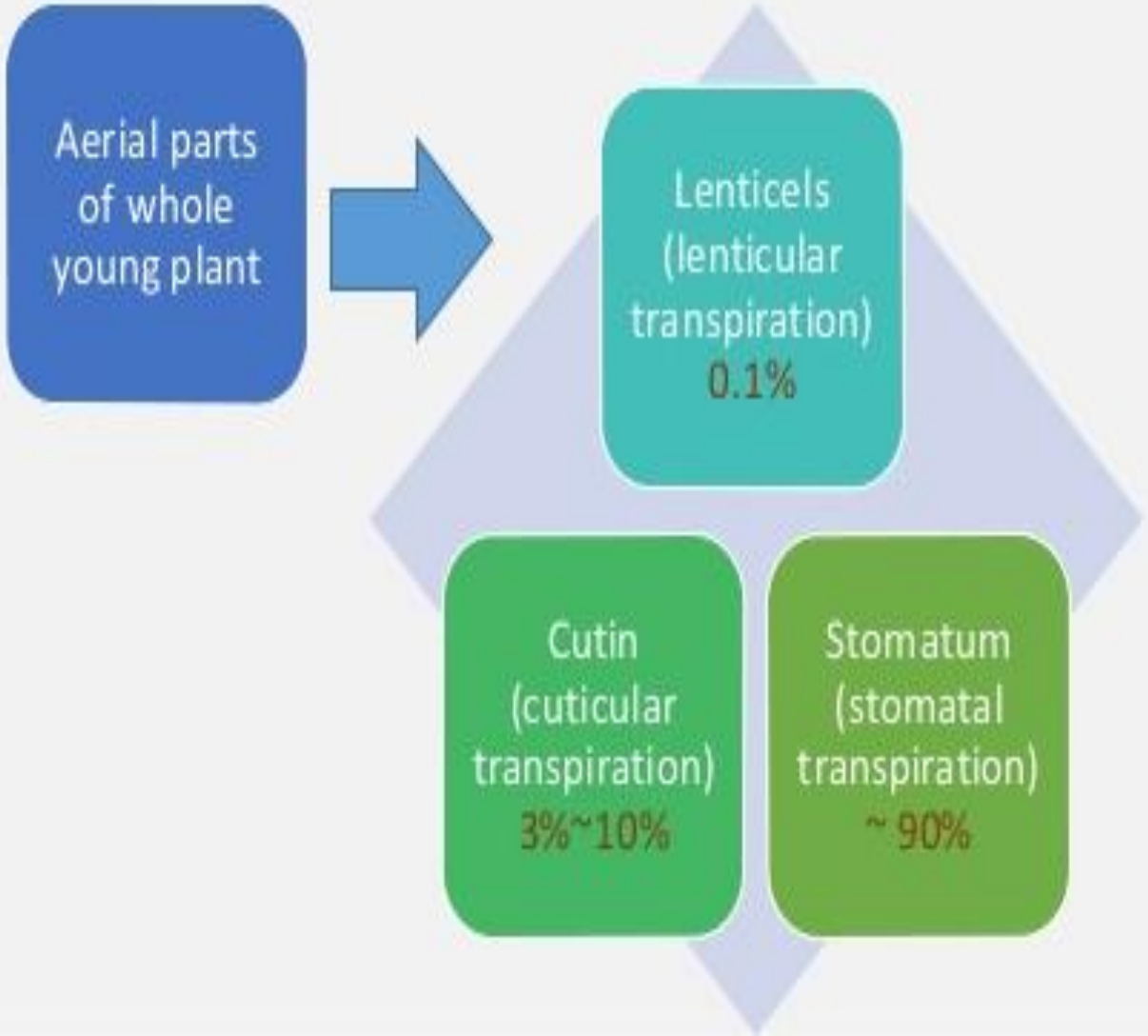
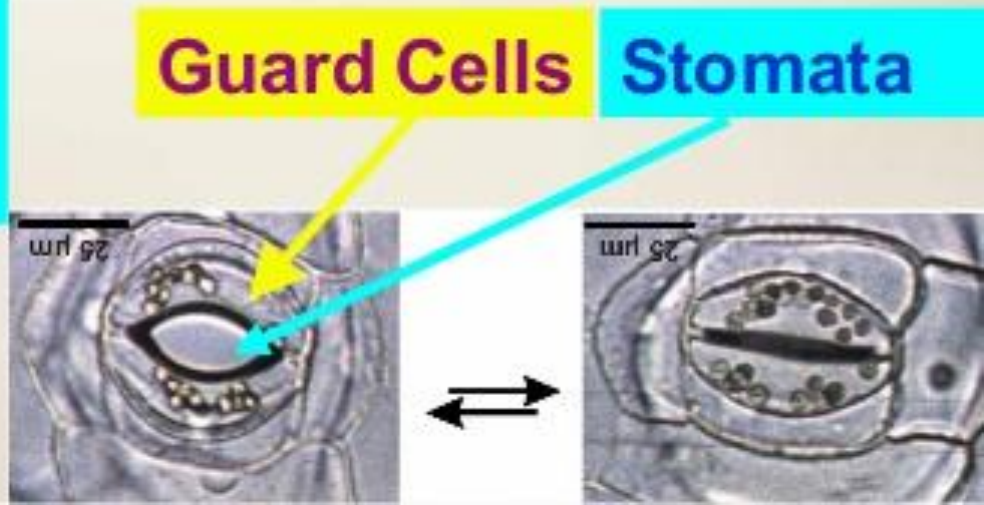


Fig. 2.11. Mechanism of stomatal transpiration. V.T.S. of a typical dicot leaf. The arrows show the movement of air.

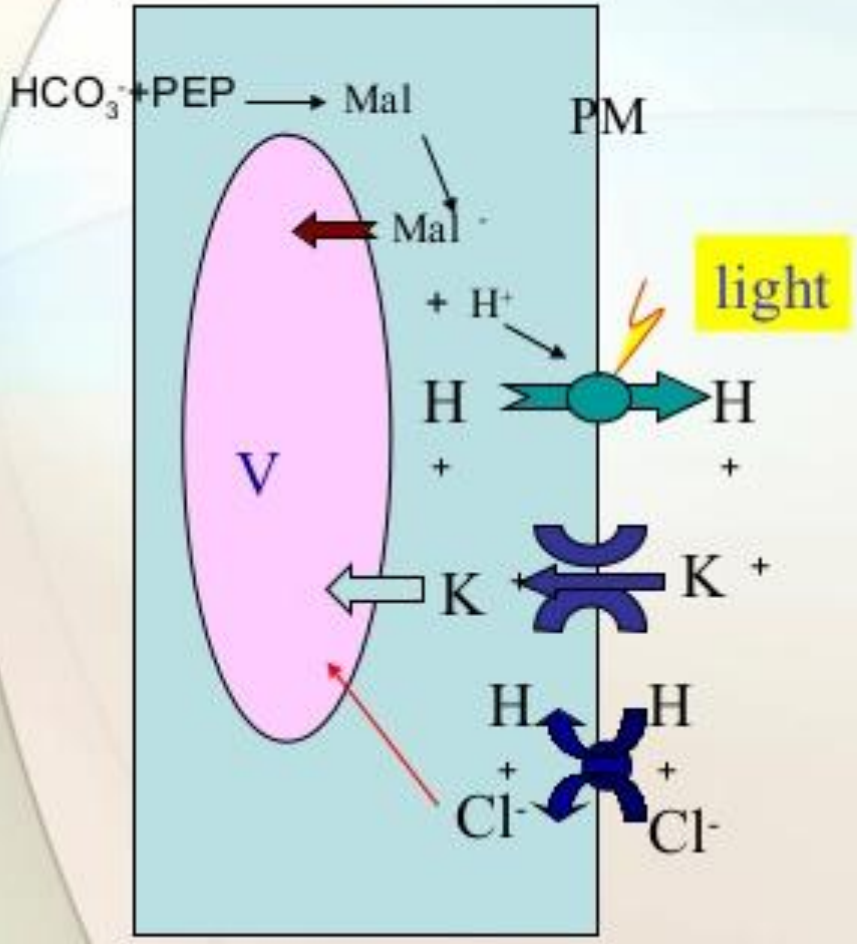
Types of transpiration



4. **Guard cells**:
   - cells that open and close the stoma
4. **Stomata**: openings in leaf's surface; when open:
   - **GAS EXCHANGE**: Allows CO_2 in & O_2 out of leaf
   - **TRANSPIRATION**:



Mechanism of stomata opening
K^+ absorption theory



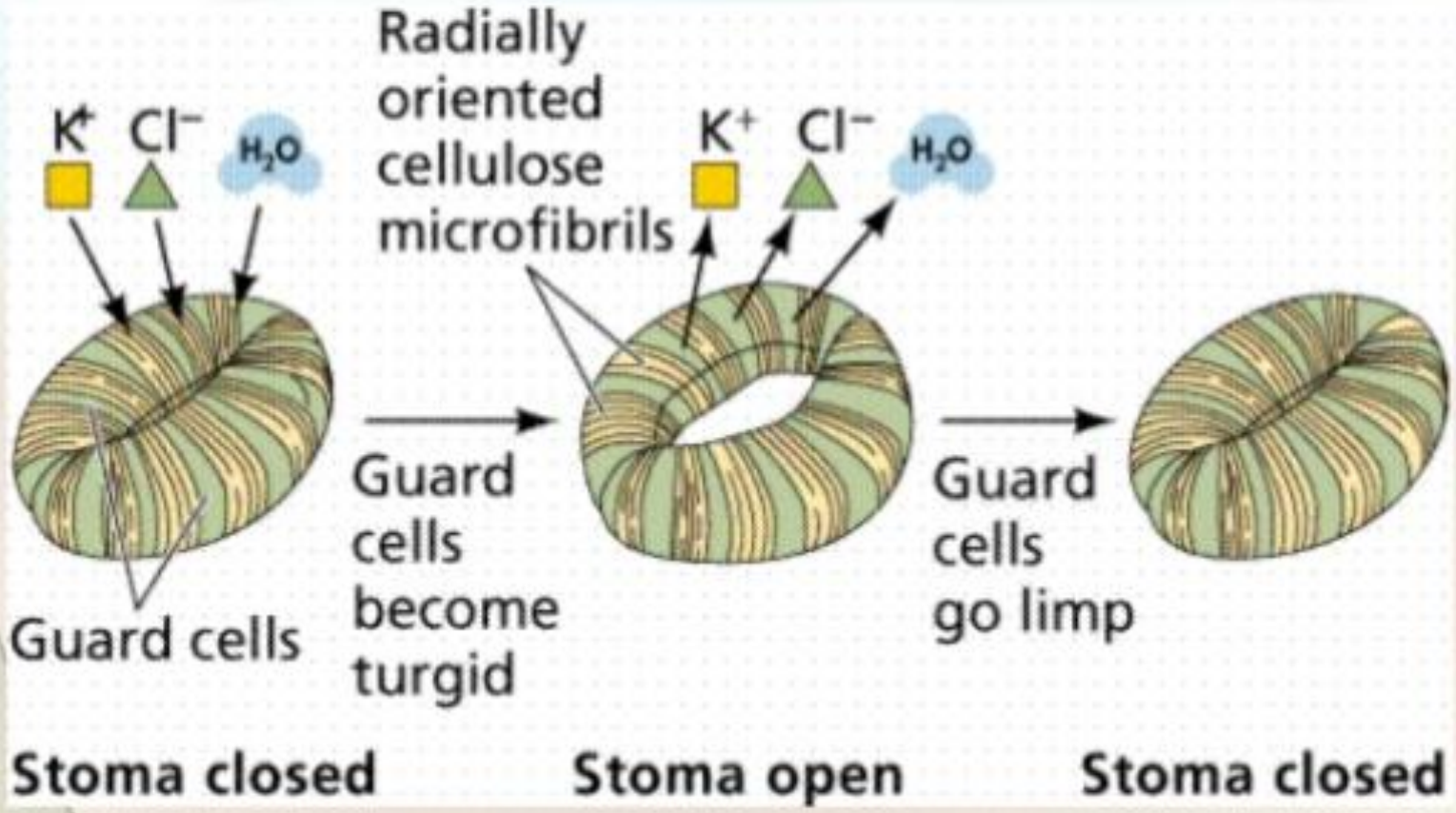
H^+-ATPase in PM is light activated

Its function is out-pumping H^+

Inward rectifier K^+ channel is voltage dependent, PM hyperpolarization activates the channel and carry K+ inward

Cl- is transported through Cl^- /H^+ symport or Cl^-/OH^- antiport

When the stomatum is opening, the [K^+] rises to 0.5M, anions rise to 0.2-0.5M, the osmotic potential drops 2MPa, thus bring water in.



Mechanism for stomatal close

- Uptake of Ca^{+2} into the cytosol
- Depolarize the membranes
- Anion channel opened and Cl^- and malate released from the vacuole.
- K^+ channel opened and K^+ released from vacuole and subsequently into subsidiary cells.

- Osmotic potential increase
- Water potential increase

- Water comes out from vacuole

- decrease turgor

- Stomata close

Factors influencing stomata aperture

- Light
- Temp
- CO_2
- Water content

(1). Light

- Stomata of most plant open in the day and close at night, while CAM plants are just the opposite.
- Stomata opening are sensitive to red light and blue light, and blue light is more effective, it stimulates opening by a blue-light receptor: zeaxanthin.

- Blue light has direct effect on stomatal opening.
- At low fluence rate, blue light causes stomatal opening, but not red light.
- At high fluence rate, stomatal opening under blue light is consistently higher than under red light.
- Blue light -> blue/UV-A cytochrome -> proton extrusion -> photosynthesis -> ATP production -> stomatal opening.

(2) Temperature

- Stomatal aperture increase with Temp, within 20-30℃ (the optimal).
- **Temp increase -> stimulate respiration and impair photosynthesis -> CO_2 conc. increase -> stomata close**
- **Midday closure**
- **temp increase -> photosynthesis reduced**
- **water deficit occur -> photosynthesis reduced**

(3). CO_2

- Low CO_2 conc. promotes stomatal opening, while high CO_2 conc. inhibits stomatal opening through its acidification of the guard cell thus inhibits PM hyperpolarization.

Effect of CO_2 on stomatal movement

- **CO_2 conc. decrease => stomata open => to uptake more CO_2**
- **CO_2 conc. increase => stomata close**
- The response of the stomata is to the intracellular conc. of CO_2 in the guard cells.
- When CO_2 level decrease or photosynthesis is needed, guard cells will take up water and swell to open the pores, in order to take more CO_2.
- When CO_2 level increase or the water stress override the photosynthesis, the guard cells will close.

(4) Water content

- Stomata open when the leaf contain enough water. When there is a water shortage, they close.
- At night, no photosynthesis

  Stomata close, preventing unnecessary loss of water.

  - Sunny morning, photosynthesis is demanding, supply of water is abundant.

References

- F.B Salisbury:ross "Plant Physiology" 3rd Edition.
- Taiz & Zeiger "plant Physiology" 5th Edition.
- Cowan, I. R. and Farquhar, G. D. (1977). Stomatal function in relation to leaf metabolism and environment:471-505.
- http://www.wikipedia.stoamatal regulation.

Any Question?