

# Transpiration



**Transpiration ?**

**Guttation ?**

**Evaporation ?**

# Guttation



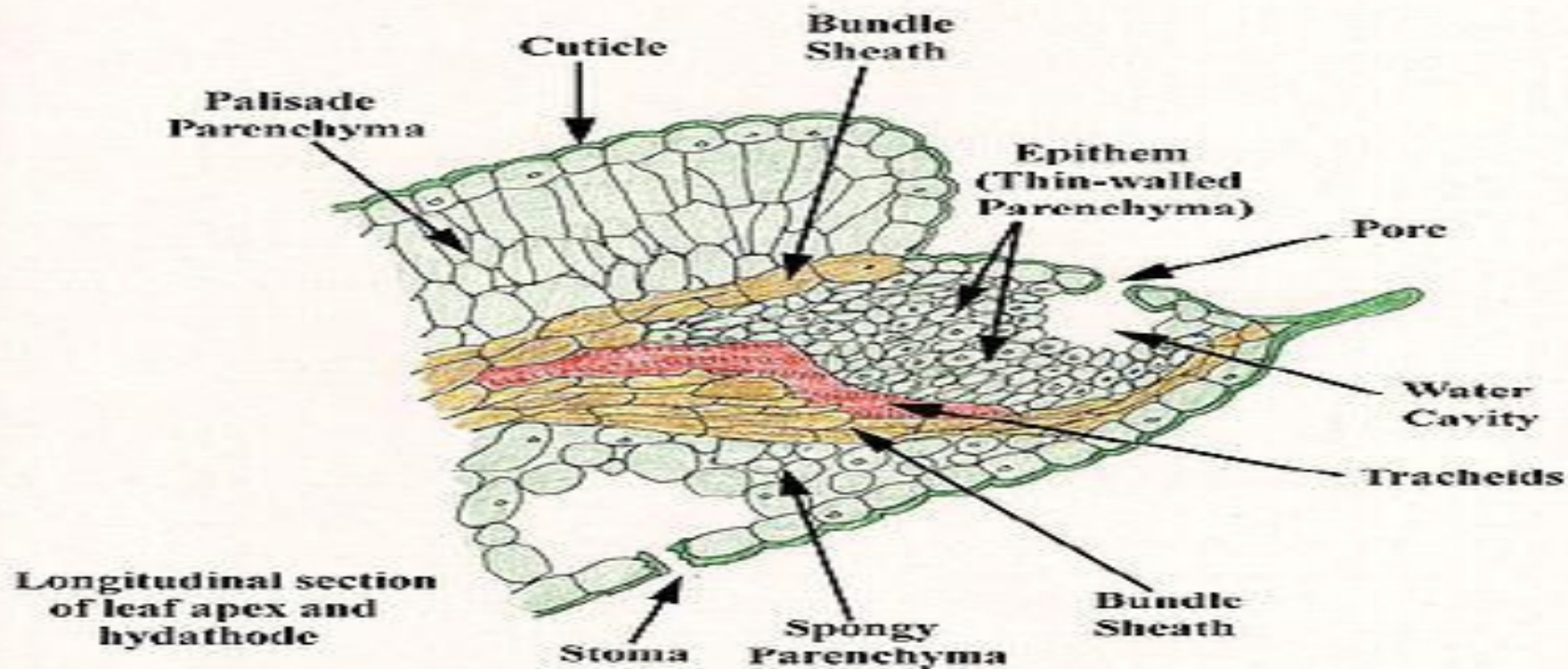


# Hydathode

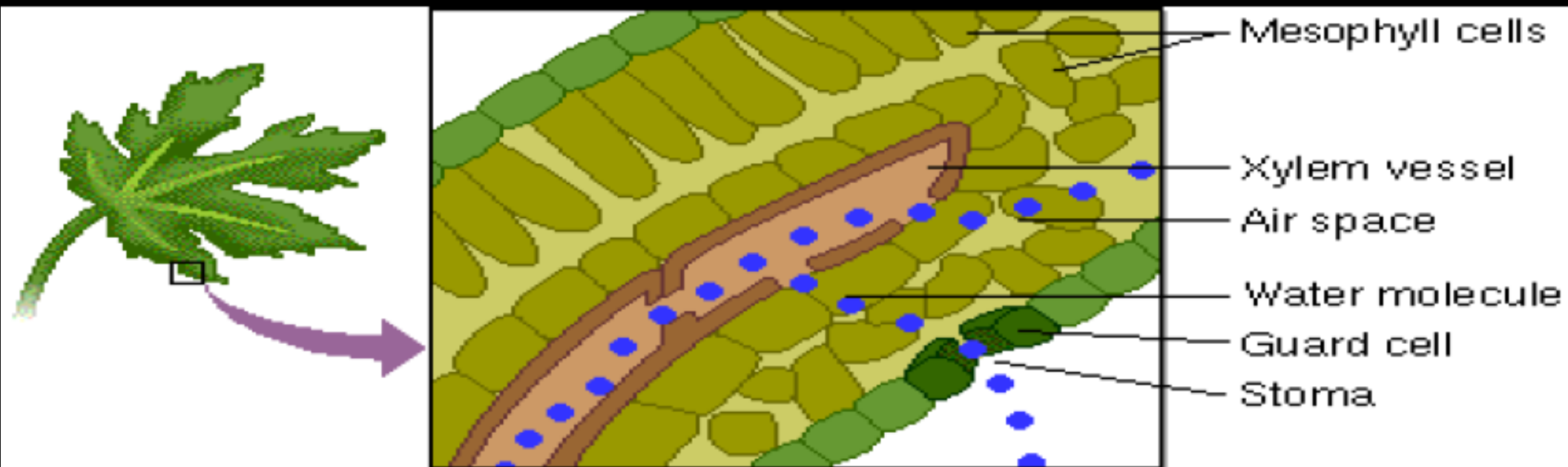


Guttation-exudation of water from hydathodes of leaf margins is caused by root pressure. It is often mistaken for dew in the morning because it occurs at night when water is not processed as quickly within the plant.

**Leaf with guttation droplet from hydathode**



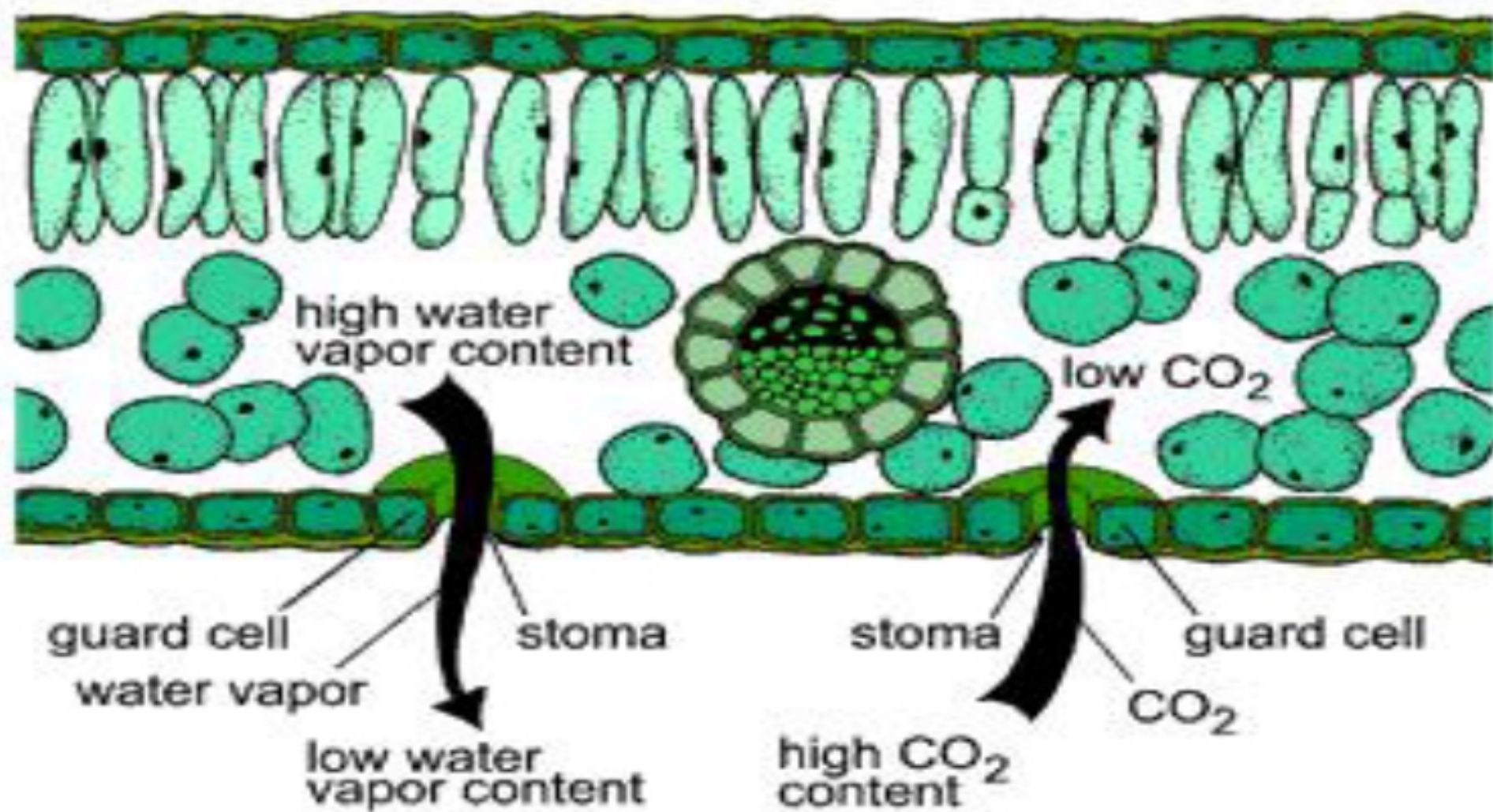
# Transpiration is necessary evil !!!!!!!!!!!!!!!



## **Importance of Transpiration**

- 1. Cooling effect**
- 2. Suction force**
- 3. Absorption of water and mineral salts**
- 4. Removal of excess water**
- 5. Gaseous exchange**



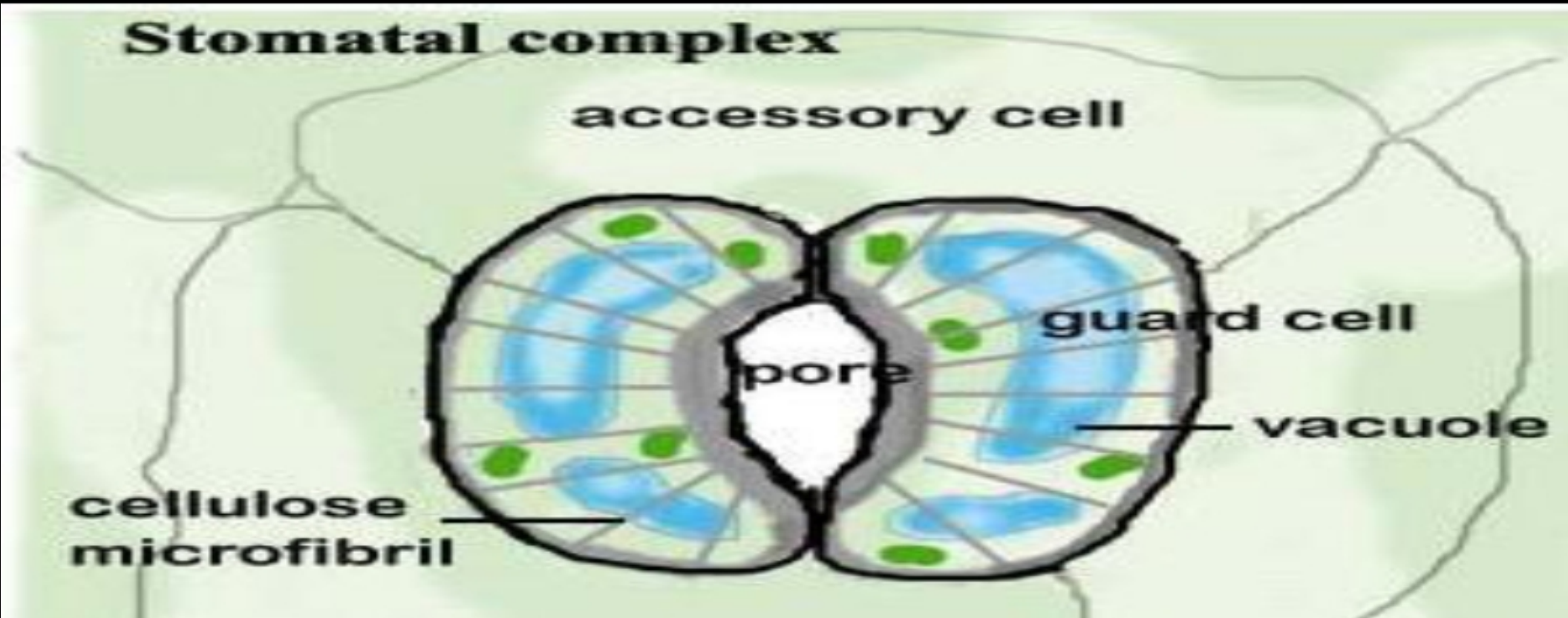


## **Kinds of Transpiration:**

- 1. Cuticular transpiration (up to 20%)**
- 2. Lenticular transpiration ( 0.1%)**
- 3. Stomatal transpiration (80-90%)**



# Stomata

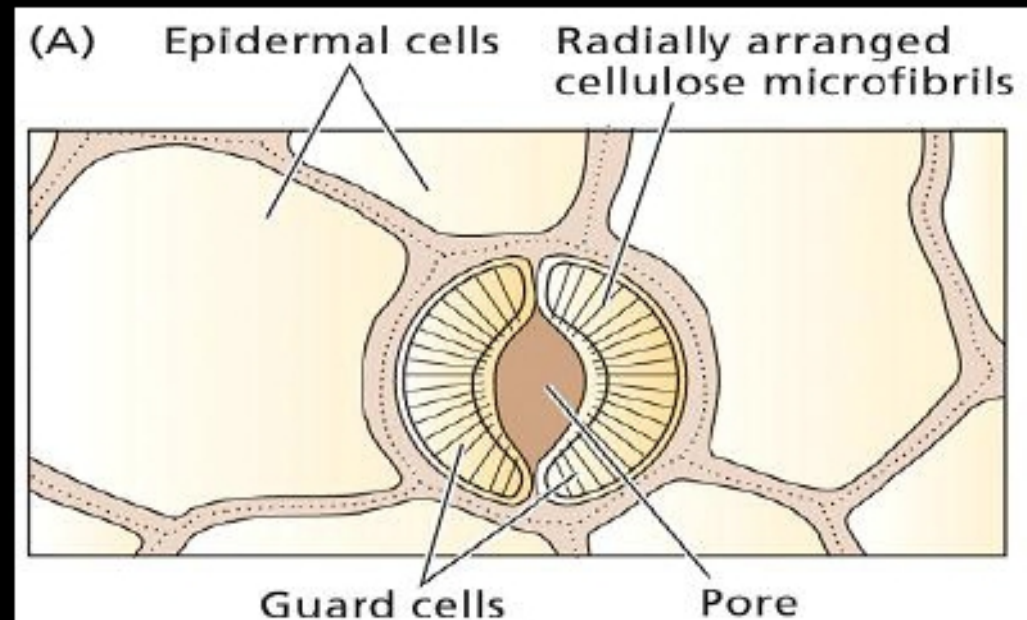
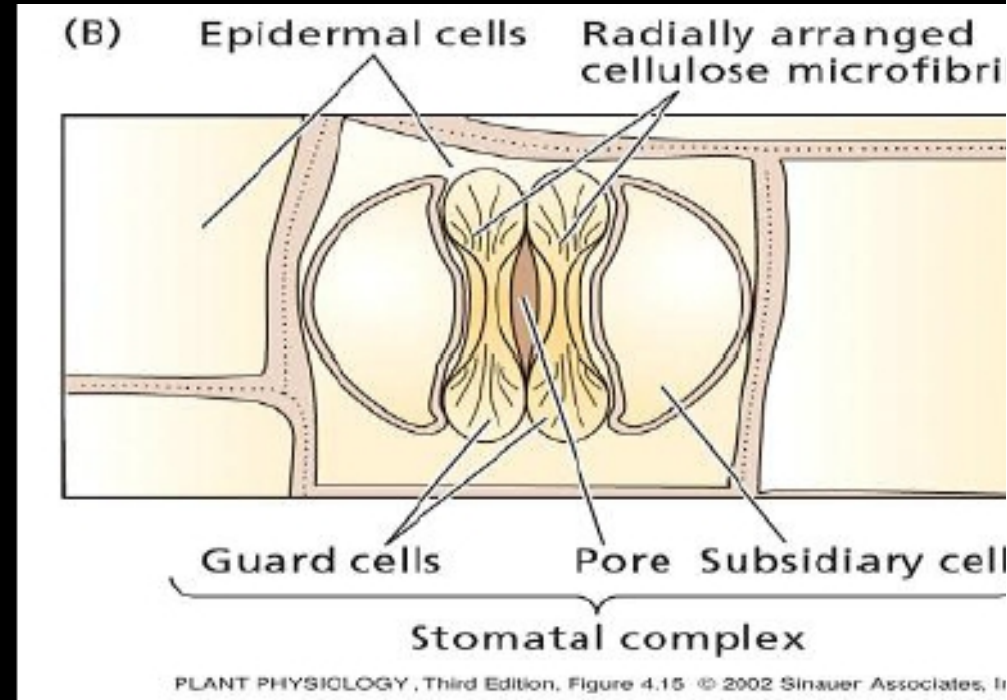


## **Stomata distribution:**

- 1. Apple or mulberry type: Hypostomatic**
- 2. Potato type : Amphistomatic and anisostomatic**
- 3. Oat type: Amphistomatic and isostomatic**
- 4. Wild lily type: Epistomatic**
- 5. Potomageton**

**There are two main types**

- **One is typical of *monocots and grasses***
  - **Dumbbell shape with bulbous ends**
  - **Pore is a long slit**
- **The other is typical of *dicots***
  - **Kidney shaped - have an elliptical contour with pore in the center**





(A)

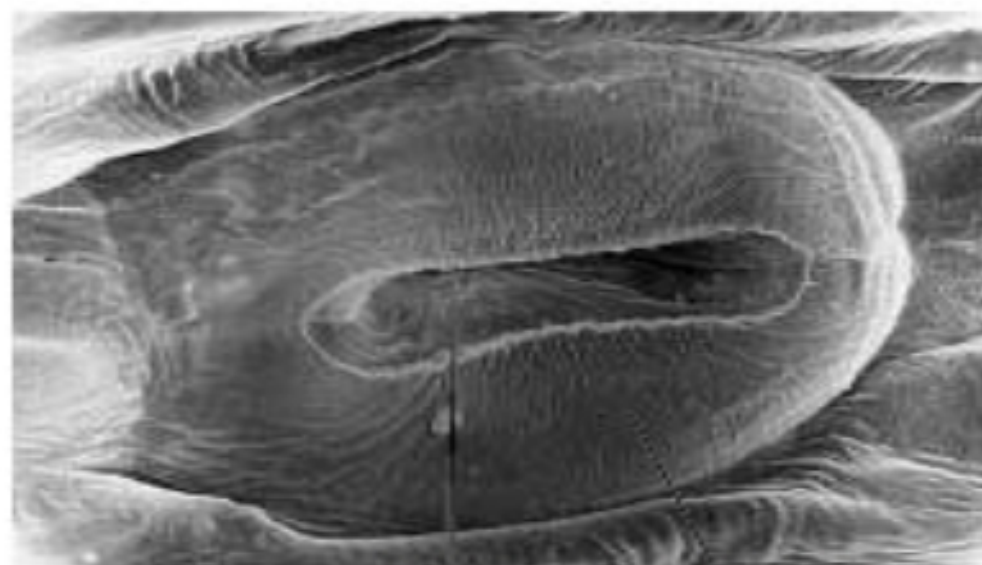
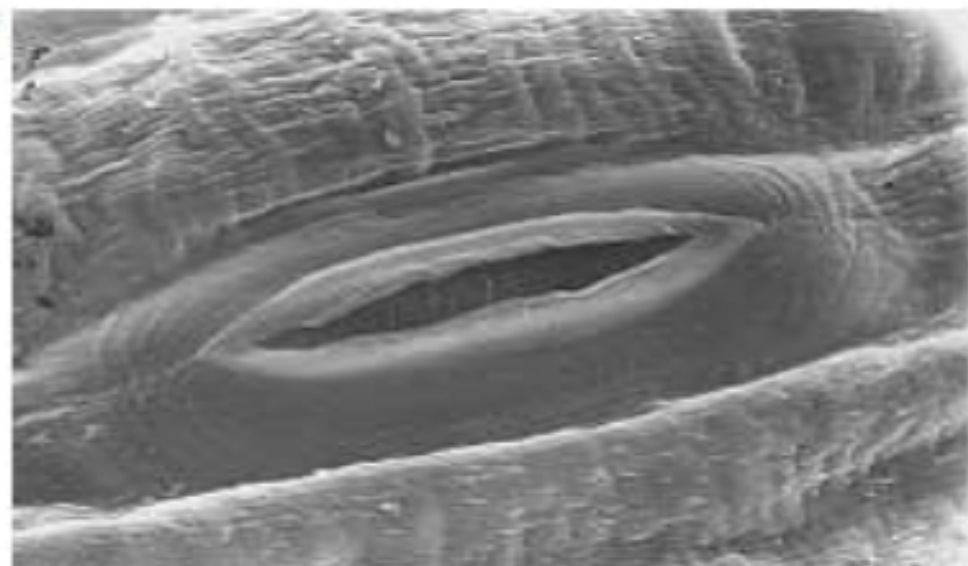
Cytosol and vacuole

Pore

Heavily thickened  
guard cell wall



(C)



Stomatal pore

Guard cell

## **Stomatal guard cells**

- Thickened inner wall**
- Radial micellation**
- Choloroplast**
- Connected end-end**



## **Mechanism of stomatal opening and closing**

**Stomata closed (GC flaccid) > water uptake (osmosis) >  
Increase pressure > stomata open (GC turgid)**



## **Theory of photosynthesis in guard cells:**

**Von Mohl (1956)**

**Light > Photosynthesis > sugar formation > decrease osmotic potential > endosmosis > Turgidity increase > stomata open**

**?**

**Photosynthesis by guard cell is too slow.**

**Sugar accumulation is not sufficient.**

## **Theory of starch – sugar interconversion:**

**Stomata open – neutral or alkaline pH ( even in dark)**

**Scarth (1932)**

**CO<sub>2</sub> consumed > pH rise > hydrolysis of starch into sugar  
> decrease OP > water uptake > stomata open**

**?**

**Insufficient decrease in OP**

## **Theory of starch – glucose interconversion:**

**After discovery of phosphorylase in guard cells**

**Steward (1964):**

**Light > Photosynthesis in mesophyll cells > CO<sub>2</sub> removed from intercellular space > increase in pH in guard cells > starch converted into glucose > decrease OP > endosmosis > guard cell turgid > stomata open**



?

**-Effect of light**

**-Some guard cells lack starch**

# **Theory of proton transport and Hormonal regulation:**

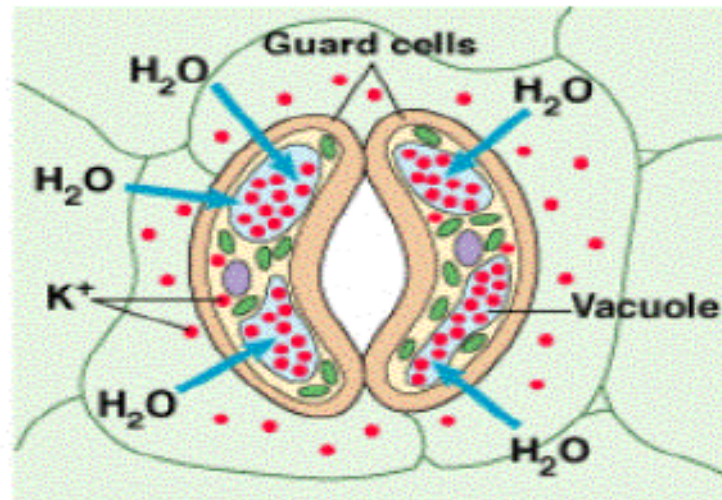
**(Active  $K^+$  transport mechanism)**

**Levitt (1974)**

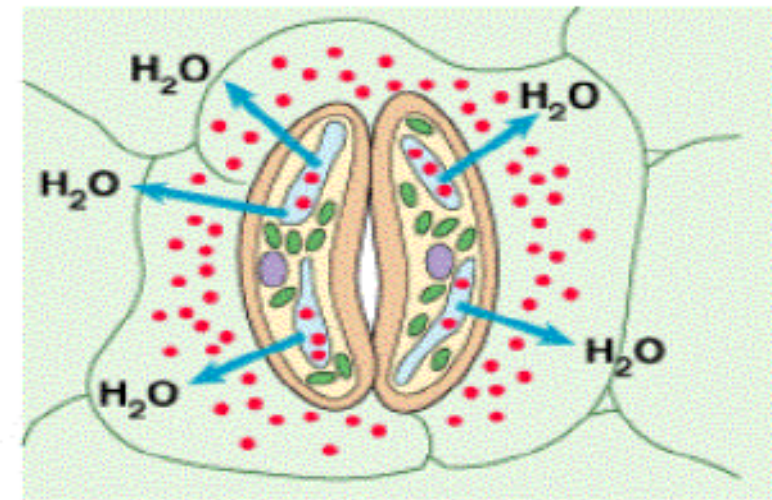
**GC flaccid  $>$   $K^+$  and Cl uptake, Malate synthesis  $>$   
lower solute potential  $>$  water uptake  $>$  stomata open**

# Control of Stomatal Opening and Closing

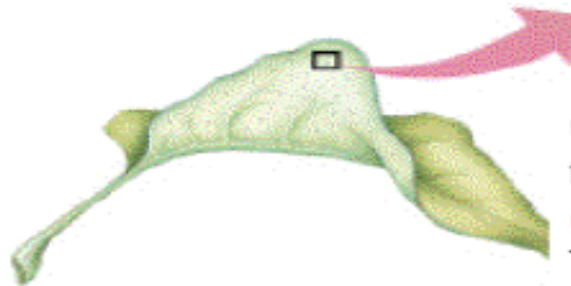
Guard cells take up potassium ions ( $K^+$ ) by **active transport** (which requires ATP). This causes water to enter the cell by **osmosis**.



**Stoma opening**

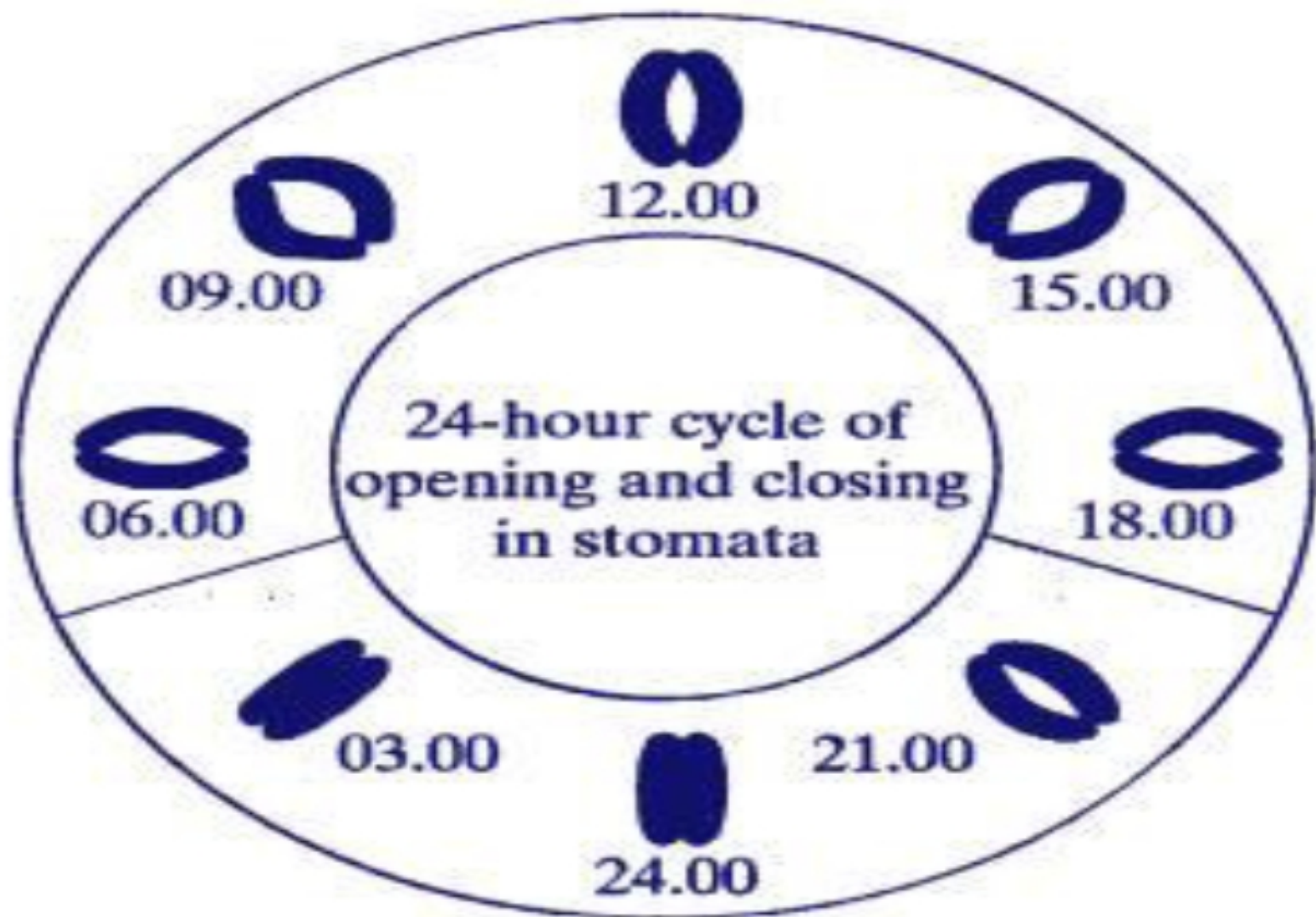


**Stoma closing**



Guard cell walls are unevenly thickened and have **radially oriented cellulose microfibrils**. This causes the cells to bow as they become turgid. The stoma opens.

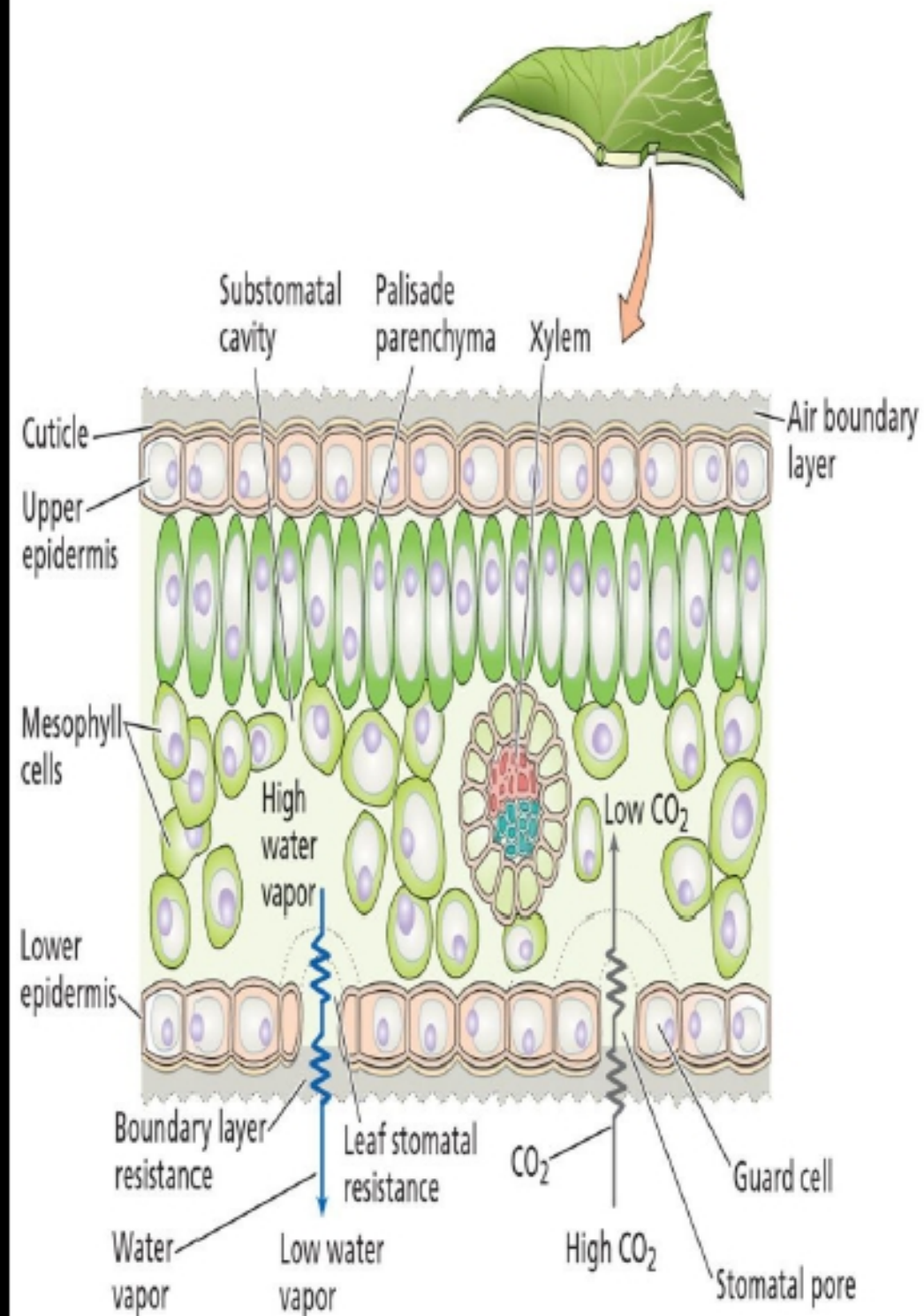
When  $K^+$  ions are pumped out of the cell, water follows by osmosis and the stoma closes.





# Transpiration:

1. Evaporation from cell wall
2. Diffusion of these water vapours into atmosphere



# **Factor affecting transpiration:**

## **External factors:**

**Air humidity**

**Temperature**

**Wind Velocity**

**Light, Water supply**

[Watch animation of factor affecting transpiration](#)

## **Internal factors:**

**Stomatal frequency**

**Leaf structure**

## **Transpiration from the leaf regulates by**

- 1. difference in water vapor concentration between the leaf air spaces and the external air**
- 2. diffusional resistance of this pathway**
- 3. leaf stomatal resistance**
- 4. leaf boundary layer resistance**
- 5. control of stomatal apertures by the guard cells**

## **Transpiration**

- 1. Water is lost from aerial parts of plants in the form of invisible water vapours**
- 2. Transpiration occurs mostly through stomata. It may also takes place through cuticle and lenticels**
- 3. It takes place throughout the day, its rate being maximum at noon.**

## **Guttation**

- Watery solution oozes out from uninjured margins of aerial leaves only**
- It occurs only through hydathodes (water stomata)**
- It takes place only early in the morning when root pressure and the rate of water absorption are higher**



# Antitranspirants

**Thank You**