

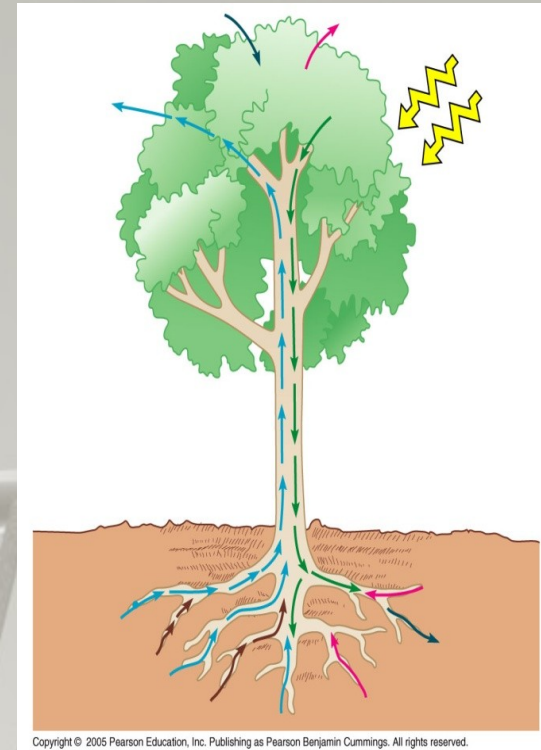
# PLANT WATER RELATIONS



**SJ**

# PLANT WATER RELATIONS

- **Fundamental concepts**
- **Absorption of water**
- **Ascent of sap**
- **Transpiration**
- **Guttation**
- **Translocation of organic solutes**



# FUNDAMENTAL CONCEPTS

- **Passive transport:**

- **IMBIBITION**

- **DIFFUSION**

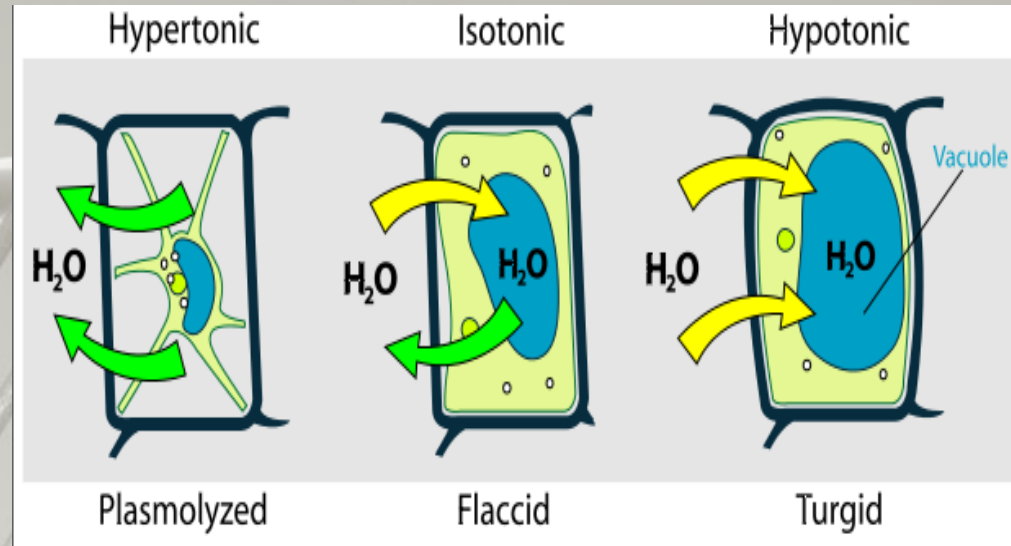
- **OSMOSIS:**

- **Endosmosis, Exosmosis, Turgidity, Plasmolysis**

- **Hypotonic, Hypertonic and Isotonic solutions**

- **Water potential & its components**

- **Active transport:**



# Water absorption

- **Structure of root hair**
- **Sources of water for absorption**
- **Regions of root**
- **Radial transport:-**
  - Symplast & Apoplast**
- **Mechanism:-**
  - 1. Active osmotic and non-osmotic absorption**
  - 2. Passive absorption**



# Ascent of sap

- Path of ascent of sap:- **Xylem**

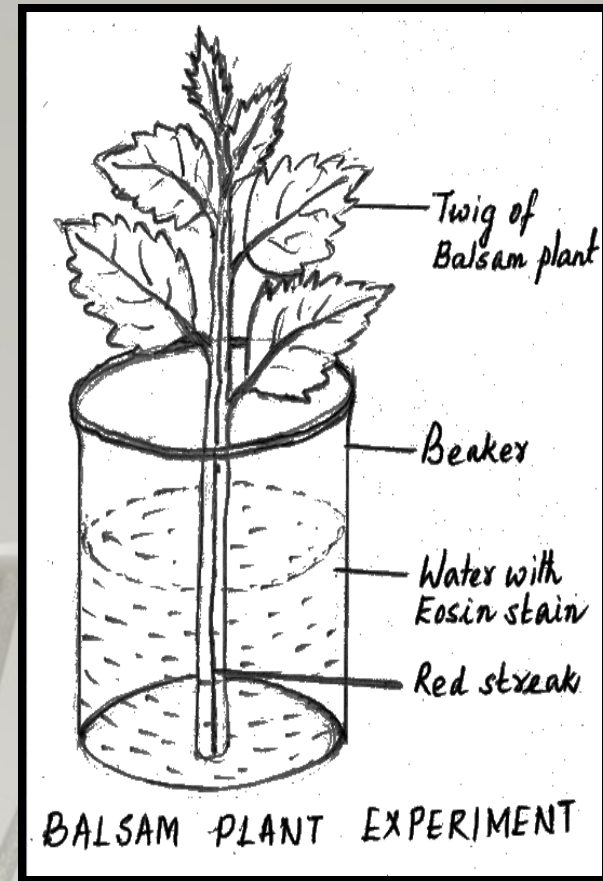
## -Balsam plant experiment

- Components of xylem sap
- Transpiration pull theory:

**Cohesion**

**Adhesion**

**Transpiration pull**



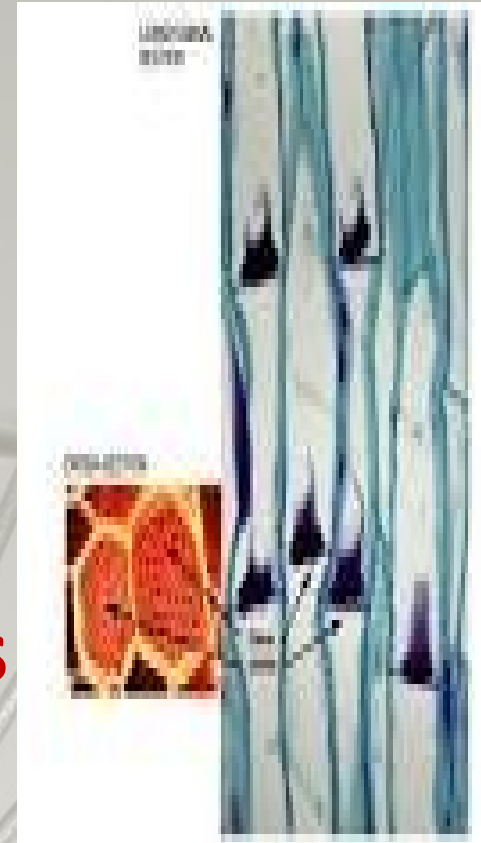
# Transpiration

- **Types:-**
- Stomatal, lenticular & cuticular
- Structure of stomata
- **Mechanism:-**
- Starch hydrolysis theory
- Proton transport theory
- **External factors , Significance, Antitranspirants, Guttation.**



# Translocation of organic solutes

- **Path of translocation:**
  - Girdling experiment**
  - Tracer method**
- **Composition of phloem sap**
- **Munch's mass flow hypothesis**
- **vein loading**



# The process of imbibition involves

**A. Semi permeable membrane**

**B. Adsorption**

**C. Hydrophilic substances**

**D. Swelling of imbibiant**

**1. Only A**

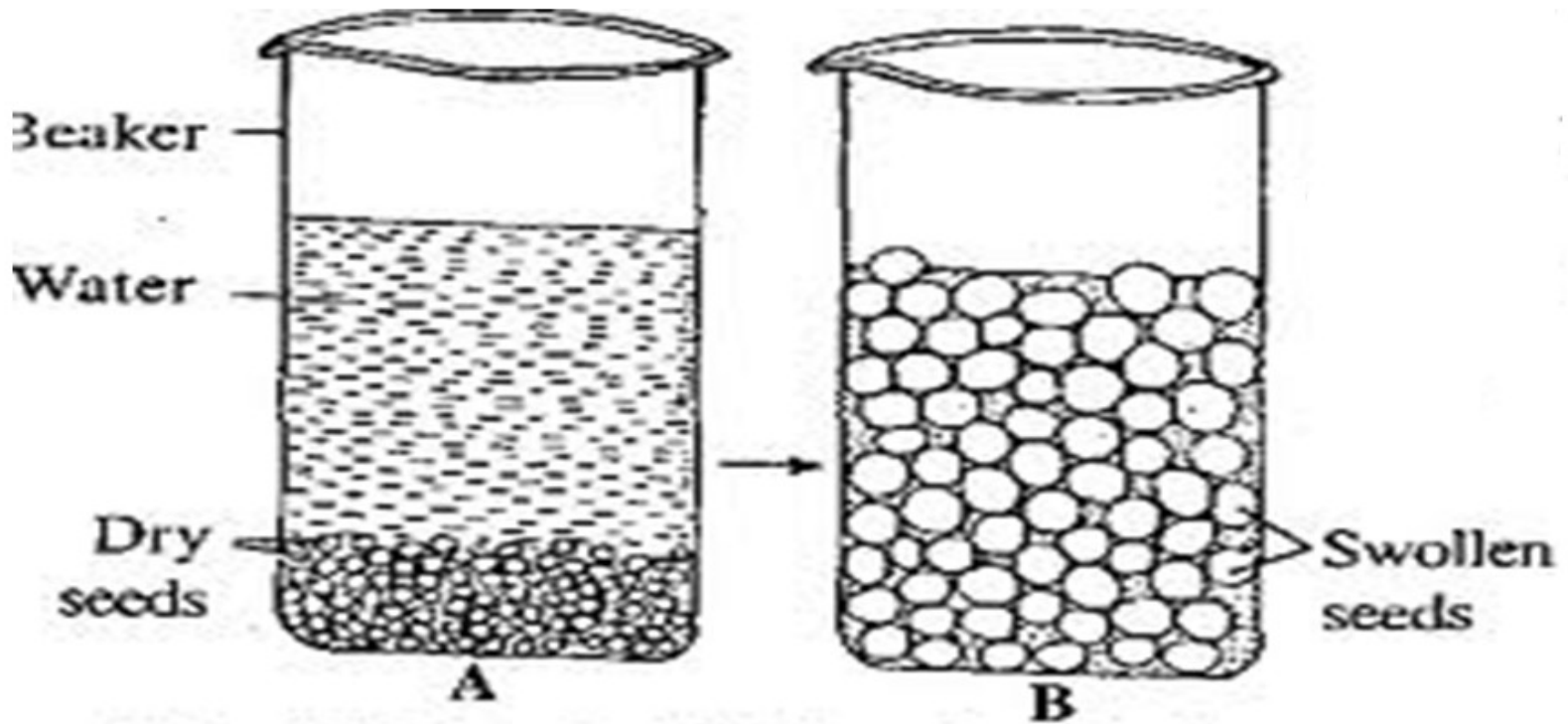
**2. Only B & C**

**3. Only B, C & D**

**4. Only A & C**

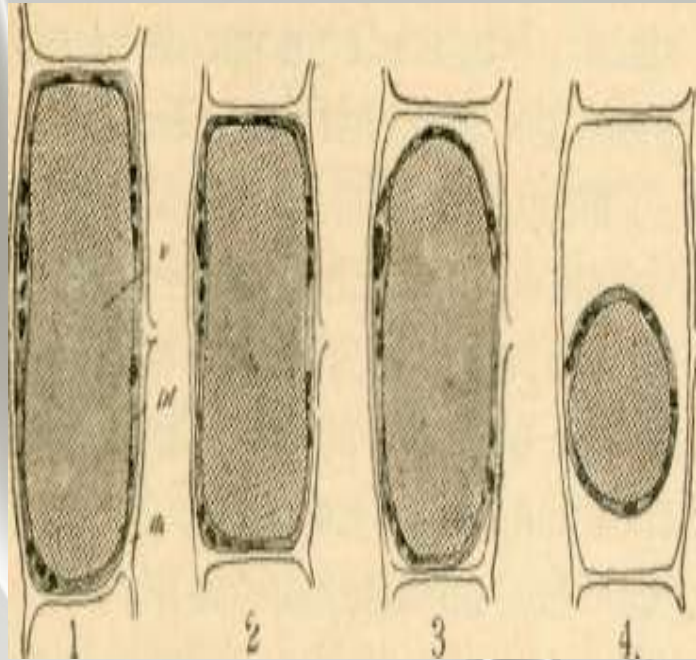


# IMBIBITION

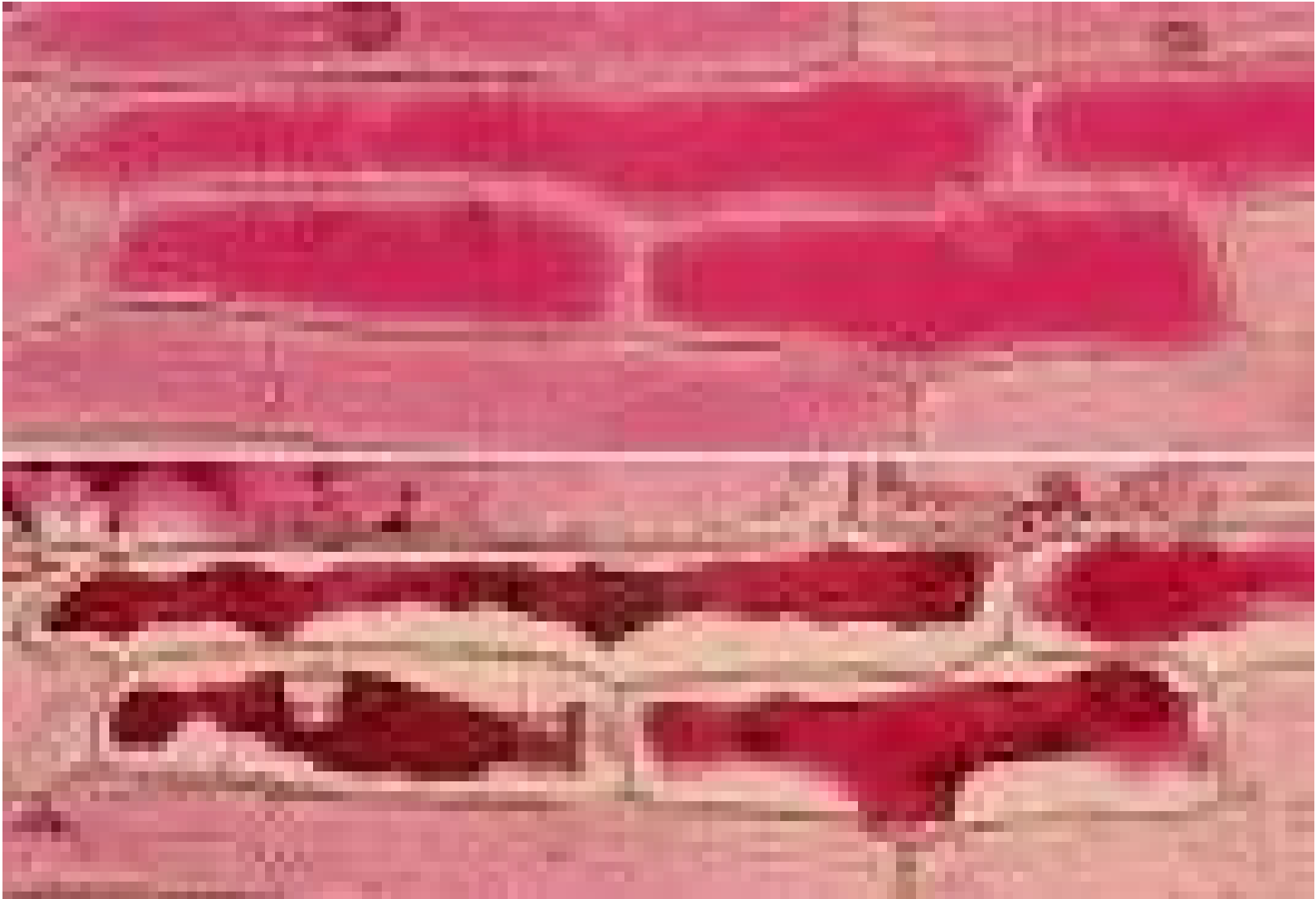


**When protoplasm just begins retreating from the cell wall it is called**

- 1. Plasmolysis**
- 2. Deplasmolysis**
- 3. Incipient plasmolysis**
- 4. Replasmolysis**



# Incipient Plasmolysis



# **Turgidity of cell is necessary for**

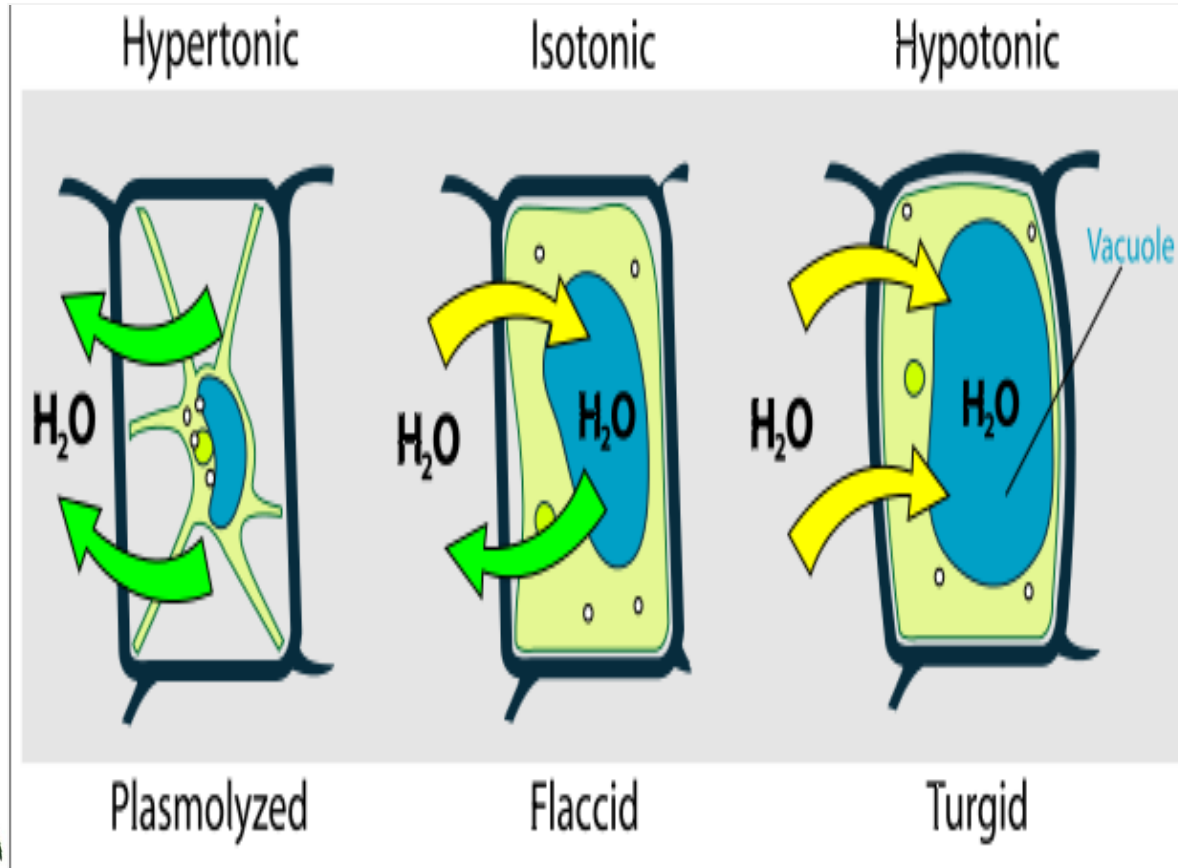
- A. Cell elongation**
- B. Opening of stomata**
- C. Mechanical strength of soft parts**
- D. Wilting**

**ANS:**

- |                          |                            |
|--------------------------|----------------------------|
| <b>1. All these</b>      | <b>2. only A,B &amp; C</b> |
| <b>3. Only A &amp; B</b> | <b>4. Only D</b>           |



# Turgidity & Plasmolysis



**Given below are the  $\Psi_s$  and  $\Psi_p$  of few cells, identify the turgid cell**

**1.  $\Psi_s = -10$  bars &  $\Psi_p = 10$  bars**

**2.  $\Psi_s = 10$  bars &  $\Psi_p = -10$  bars**

**3.  $\Psi_s = -8$  bars &  $\Psi_p = 4$  bars**

**4.  $\Psi_s = -3$  bars &  $\Psi_p = 0$  bars**

# Components of water potential

- $\Psi_w = \Psi_s + \Psi_p + \Psi_m$
- $\Psi_w = \Psi_s + \Psi_p$
- In a turgid cell  $\Psi_w = -\Psi_s + \Psi_p$   
 $\Psi_w = 0$
- In a Plasmolysed cell  
 $\Psi_w = -\Psi_s$

**Lignin & Cellulose present in the xylem vessels show affinity to water due to**

- 1. Cohesive force**
- 2. Water potential**
- 3. Wall pressure**
- 4. Adhesive force**



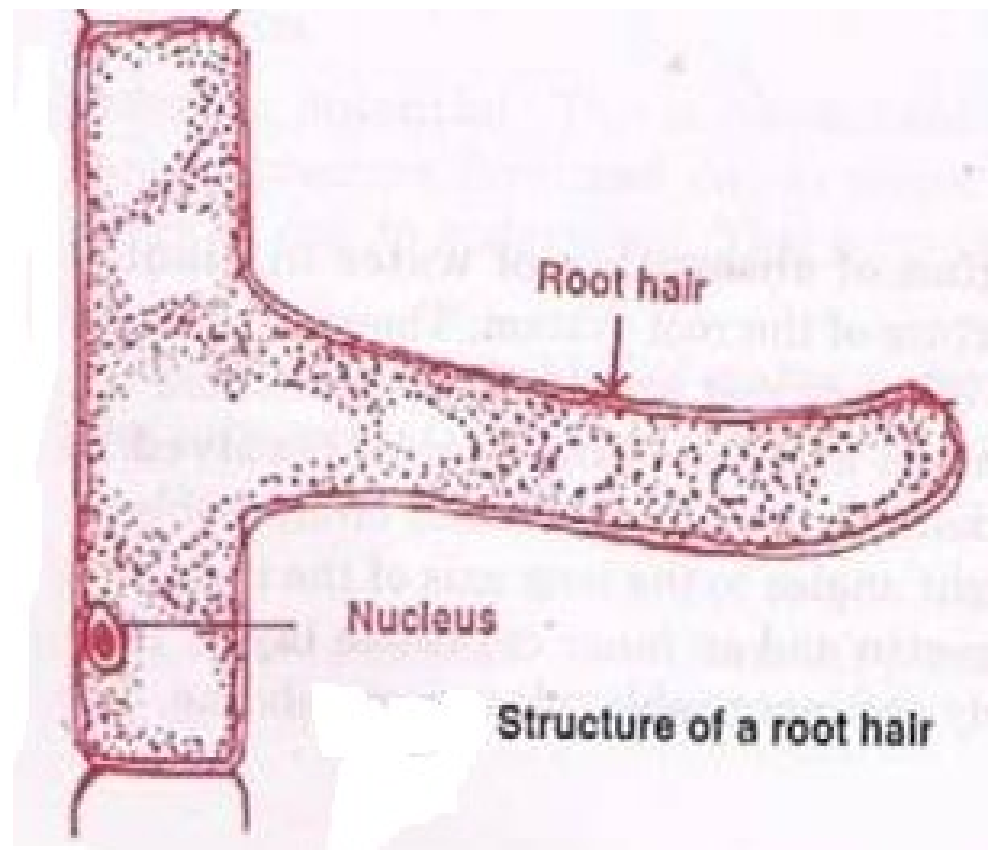


# Transplanted plant some time fails to survive because of

- 1. Damaged leaves**
- 2. Loss of root hair**
- 3. Fail to adapt to new environment**
- 4. Absence of minerals**

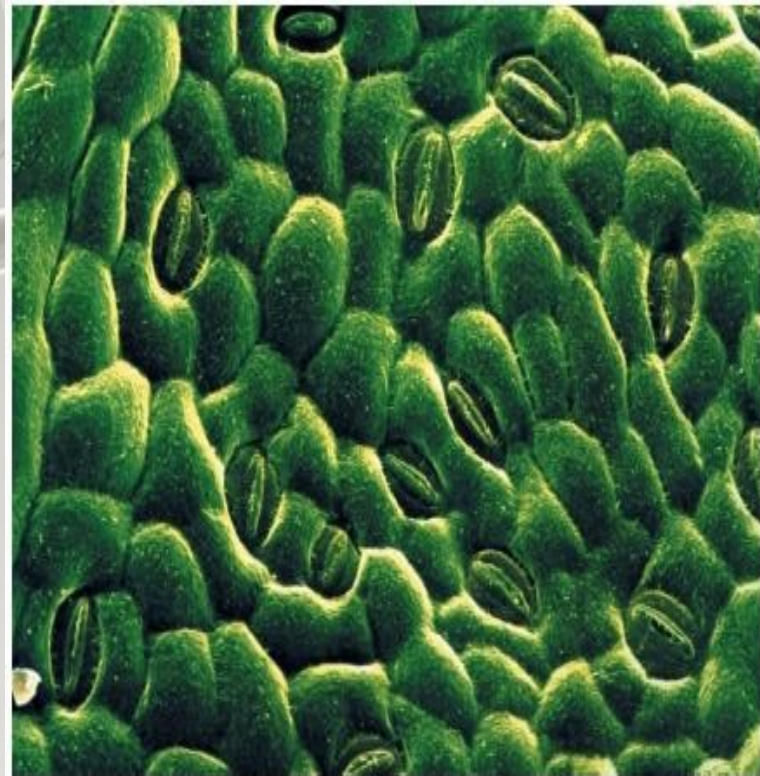


# Root hair



**“Transpiration is a necessary evil”. This statement was given by**

- 1. Steward**
- 2. Abbe Nollet**
- 3. Slayter & Taylor**
- 4. Curtis**



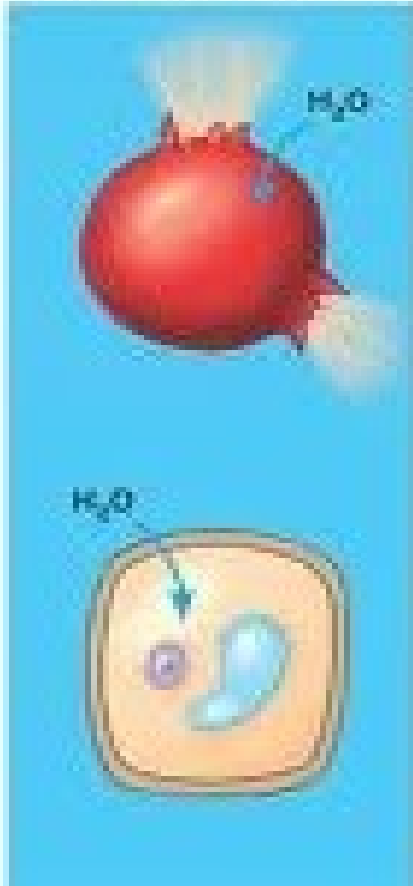
**When a red blood cell and a Parenchyma cell are placed in pure water**

- 1. Both become turgid**
- 2. Both become plasmolyzed**
- 3. Blood cell bursts open & parenchyma cell becomes turgid**
- 4. Blood cell becomes turgid & parenchyma cell bursts open**

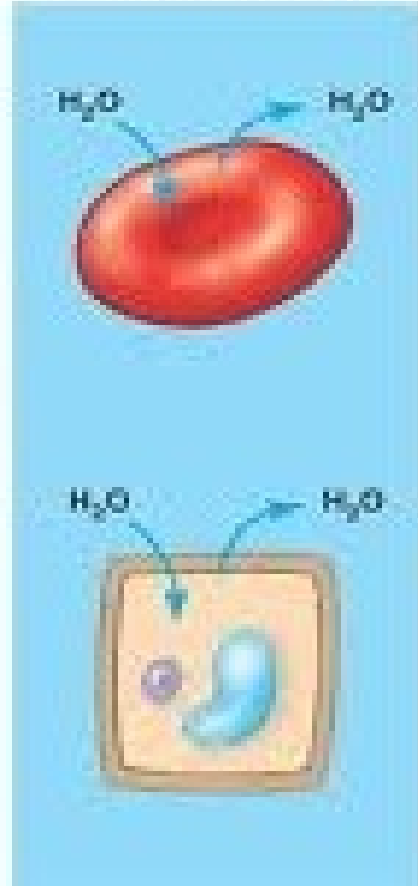
# Types of osmosis

1)

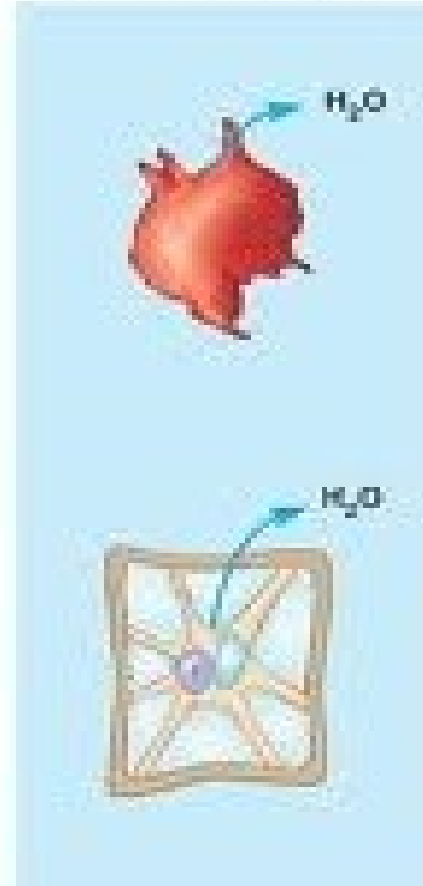
Hypotonic solution



Isotonic solution

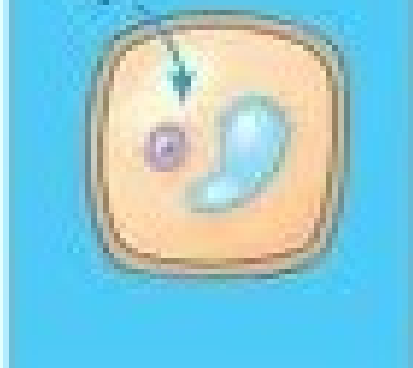


Hypertonic solution



2)

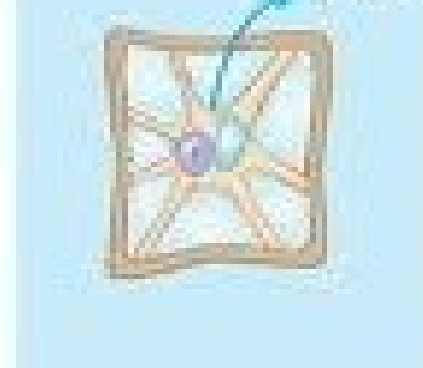
Hypotonic solution



Isotonic solution



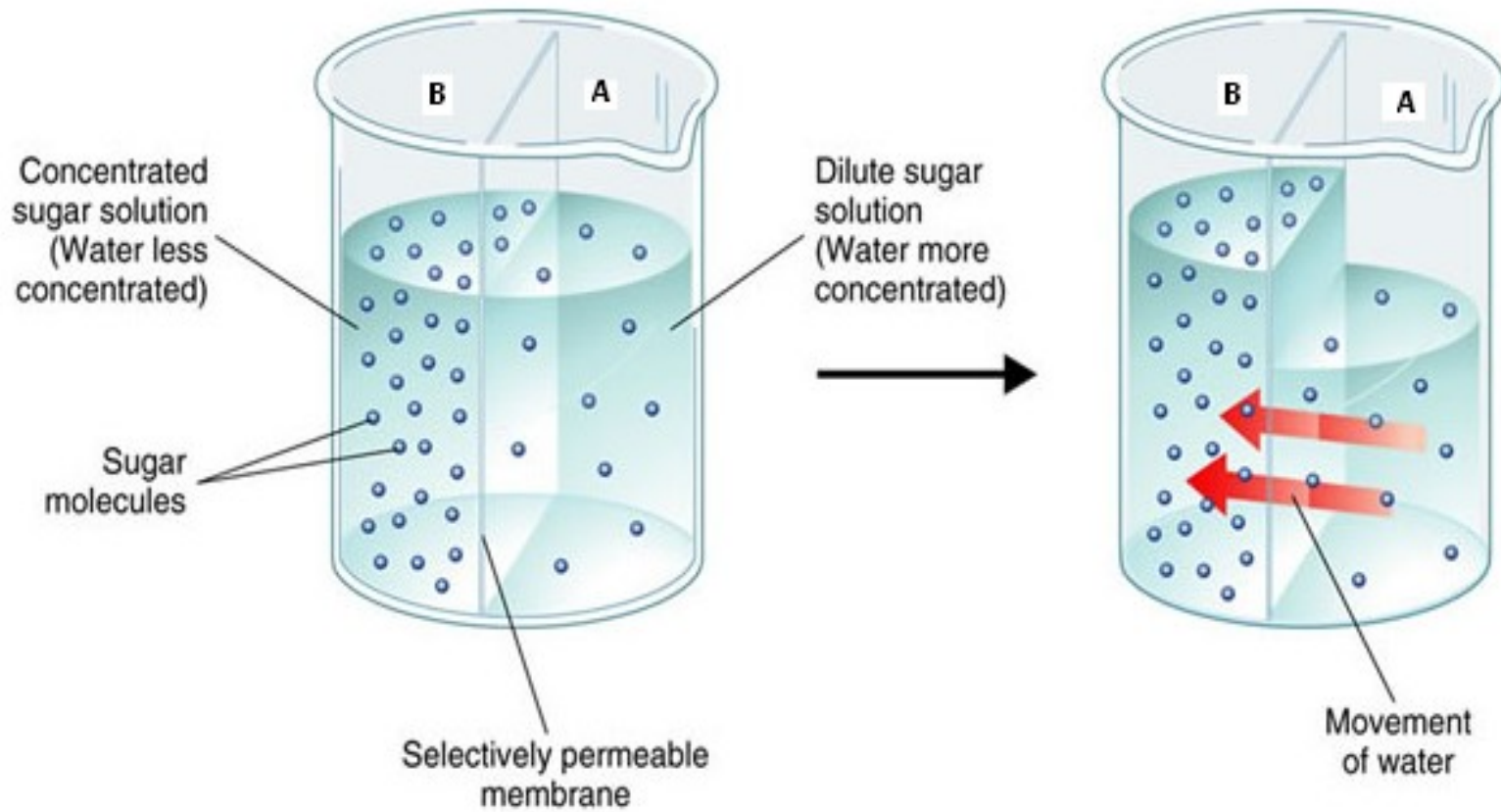
Hypertonic solution



When 30% sugar solution 'A' is separated by 60% sugar solution 'B' by a semi permeable membrane, then water moves from

- 1. Solution 'B' to solution 'A'**
- 2. Solution 'A' to solution 'B'**
- 3. Both from solution 'A' to solution 'B' and solution 'B' to solution 'A'**
- 4. Neither solution 'A' to solution 'B' nor solution 'B' to solution 'A'**

# OSMOSIS



**Rate of transpiration depends on**

- A. Stomatal frequency**
- B. Distribution of stomata**
- C. Temperature**
- D. CO<sub>2</sub> concentration**

**ANS:- 1. Only A**

**2. Only C & D**

**3. Only A & B**

**4. A, B, C & D**



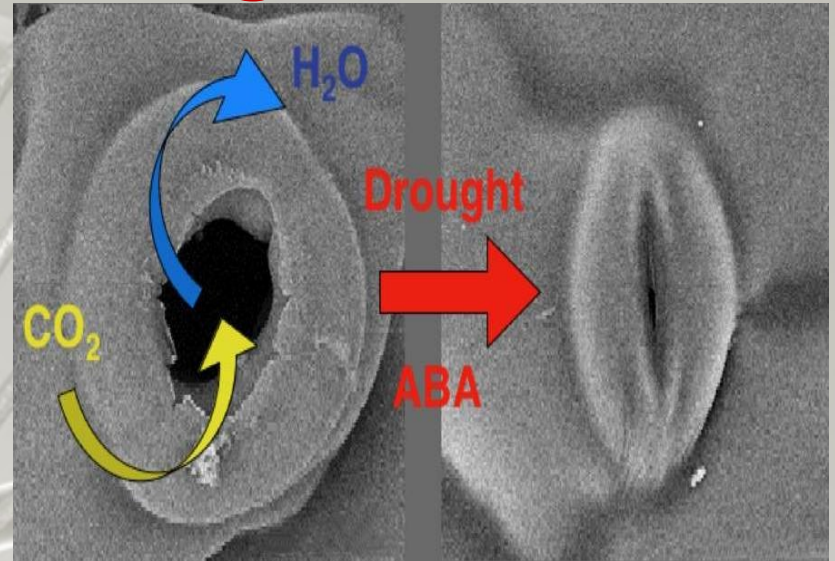
# Root hair absorb water from the soil, when



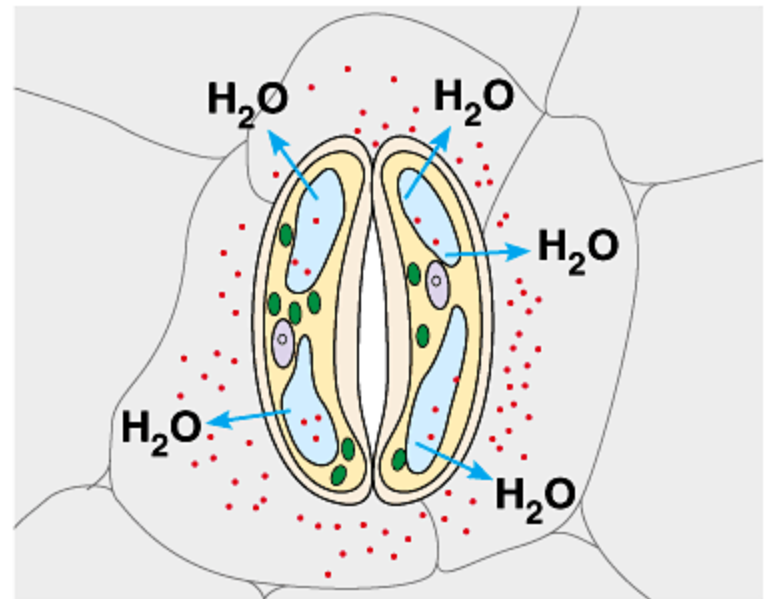
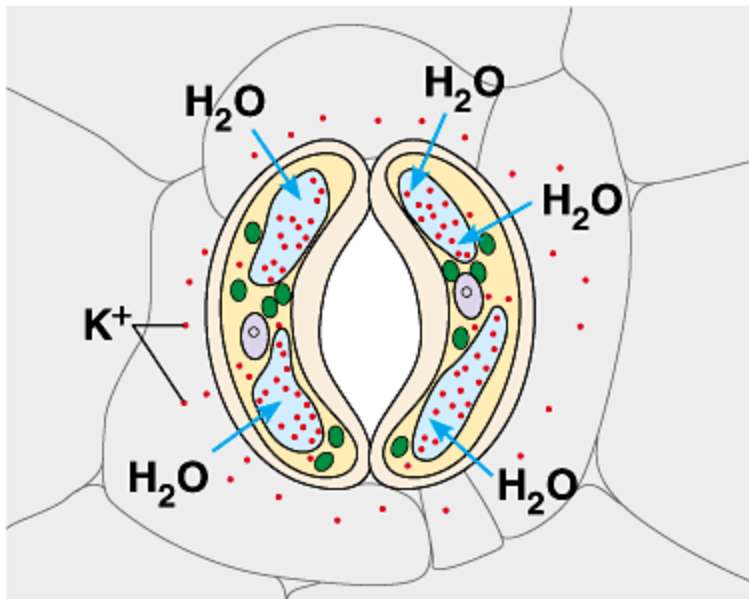
- 1. Osmotic concentration is same in soil and cell**
- 2. Solute concentration is low in root cells**
- 3. Solute concentration is high in root hairs**
- 4. Solute concentration is high in soil solution**

# Stomata open when the guard cell posses

1. Less  $K^+$
2. More  $K^+$
3. More ABA
4. High  $CO_2$  concentration



# Proton transport theory

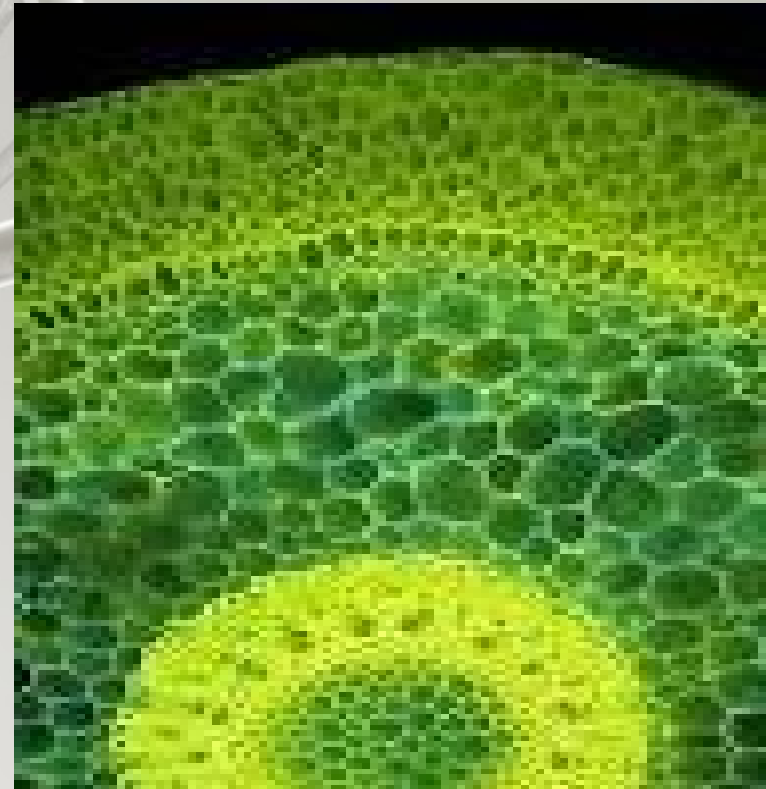


**(b) Role of potassium in stomatal opening and closing**

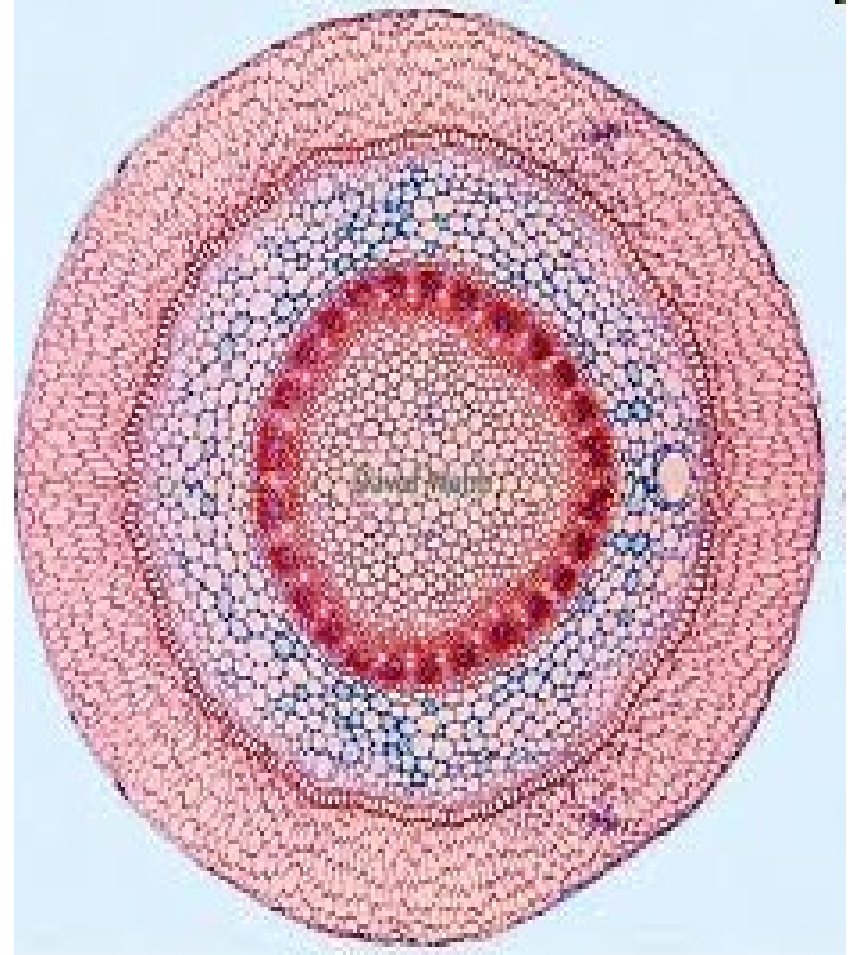
Copyright © Pearson Education, Inc., publishing as Benjamin Cummings.

# Moisture absorbing velamen tissue is present in

- 1. Epiphytic leaves**
- 2. Hydrophytes**
- 3. Epiphytic roots**
- 4. Aerial root tissue**



# Epiphytic root



# **Guttation occurs during**

- A. High root pressure**
- B. More transpiration**
- C. Less transpiration**
- D. Low root pressure**



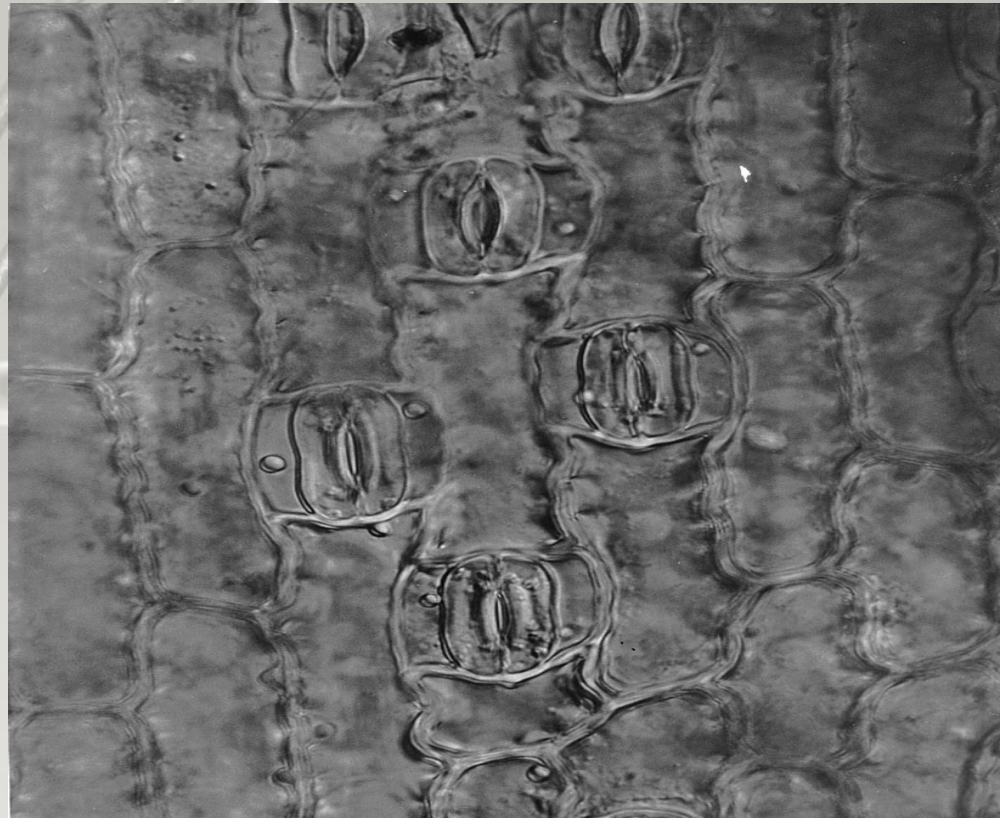
- ANS:-**
- 1. Both A & B**
  - 2. Both C & D**
  - 3. Both A & C**
  - 4. All these**

# Guttation



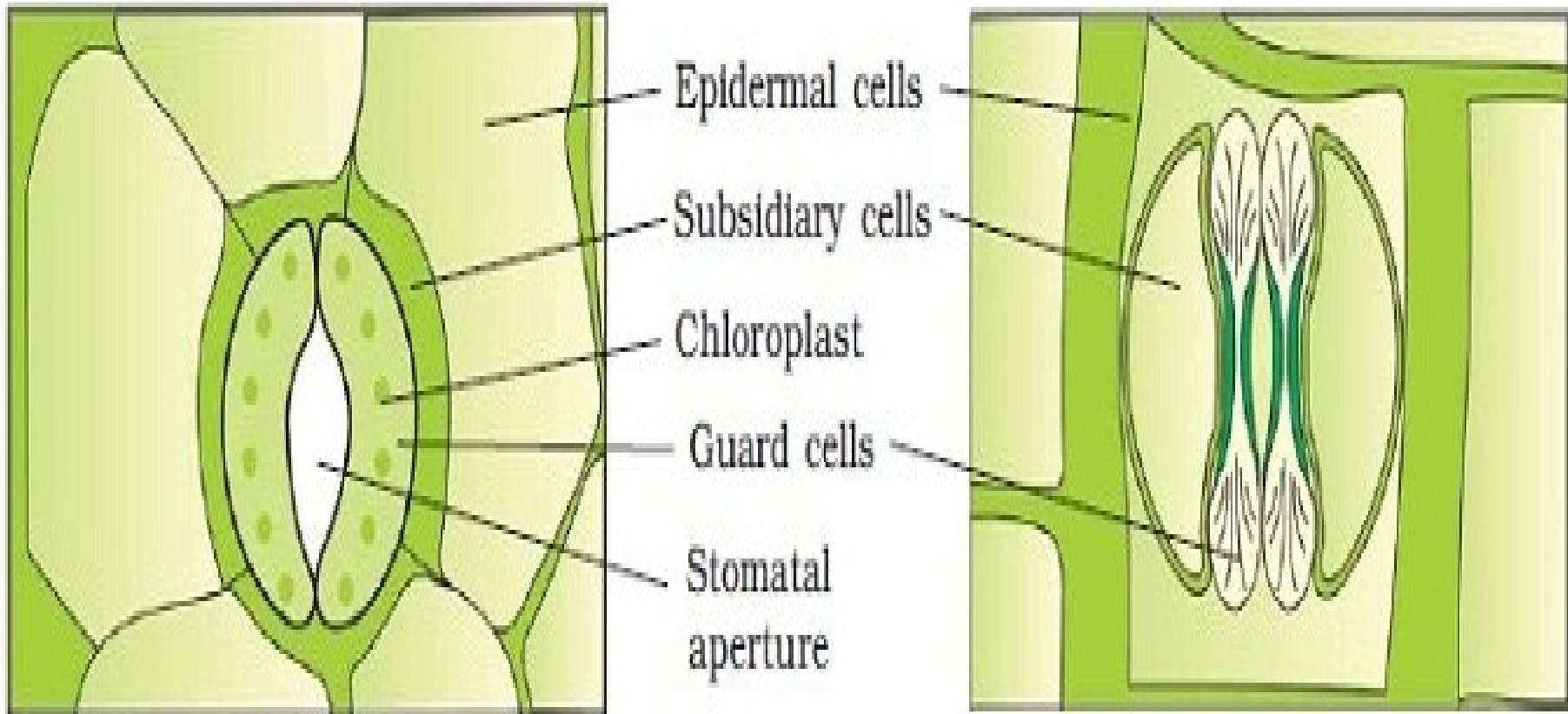
**Dumbbell shaped guard cell are generally found in which of these plant species?**

- 1. Wheat**
- 2. Ground nut**
- 3. Gram**
- 4. Sun flower**





# Guard cells of stomata



**Following are the adaptations to check transpiration in plants**

**A. Thick cuticle**

**B. Multilayered epidermis**

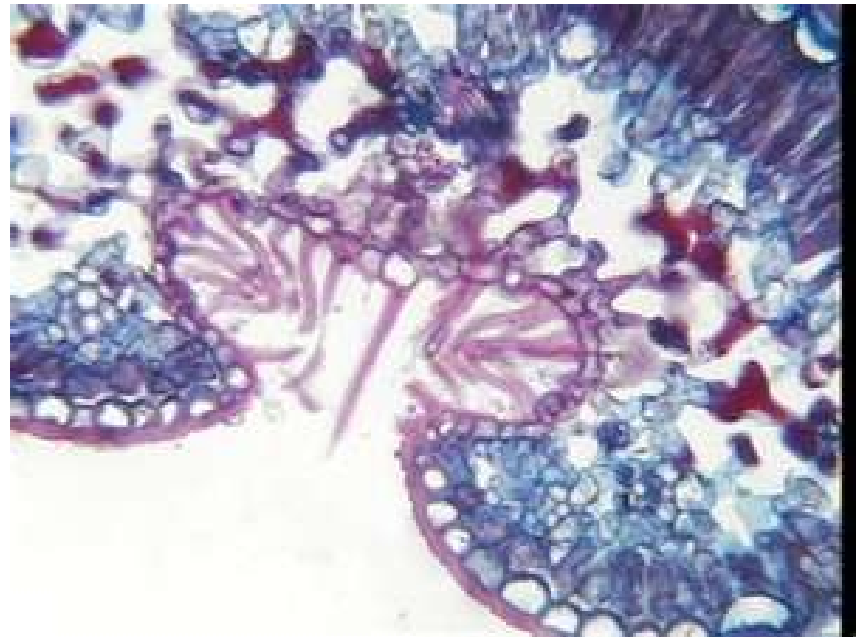
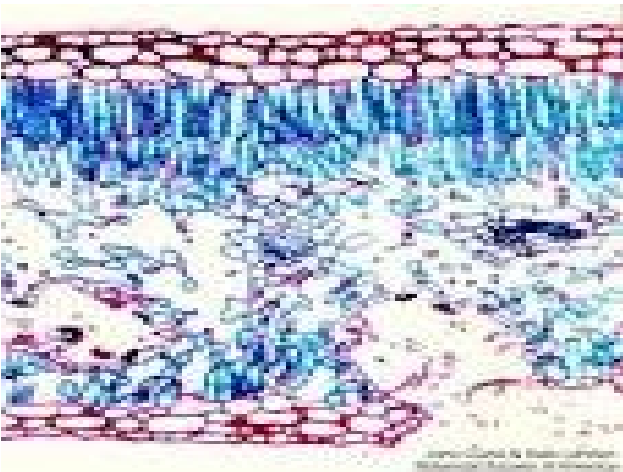
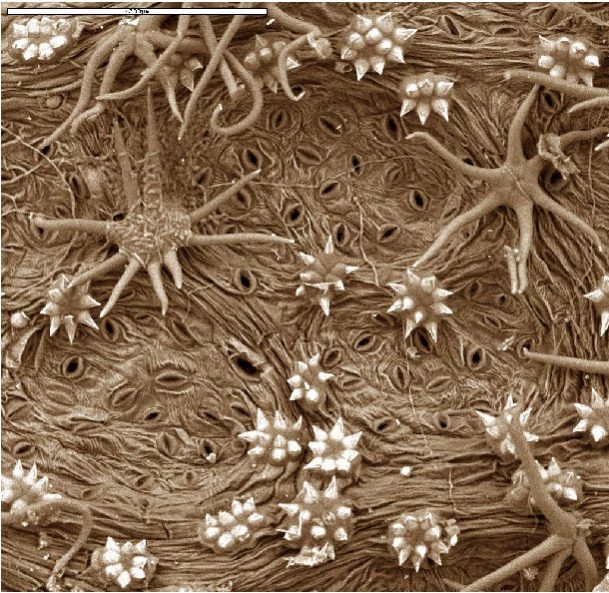
**C. Sunken stomata**

**D. Many hydathodes**

**ANS:- 1. A,B,C & D      2. only A, B & C**

**3. Only A & B      4. Only C & D**

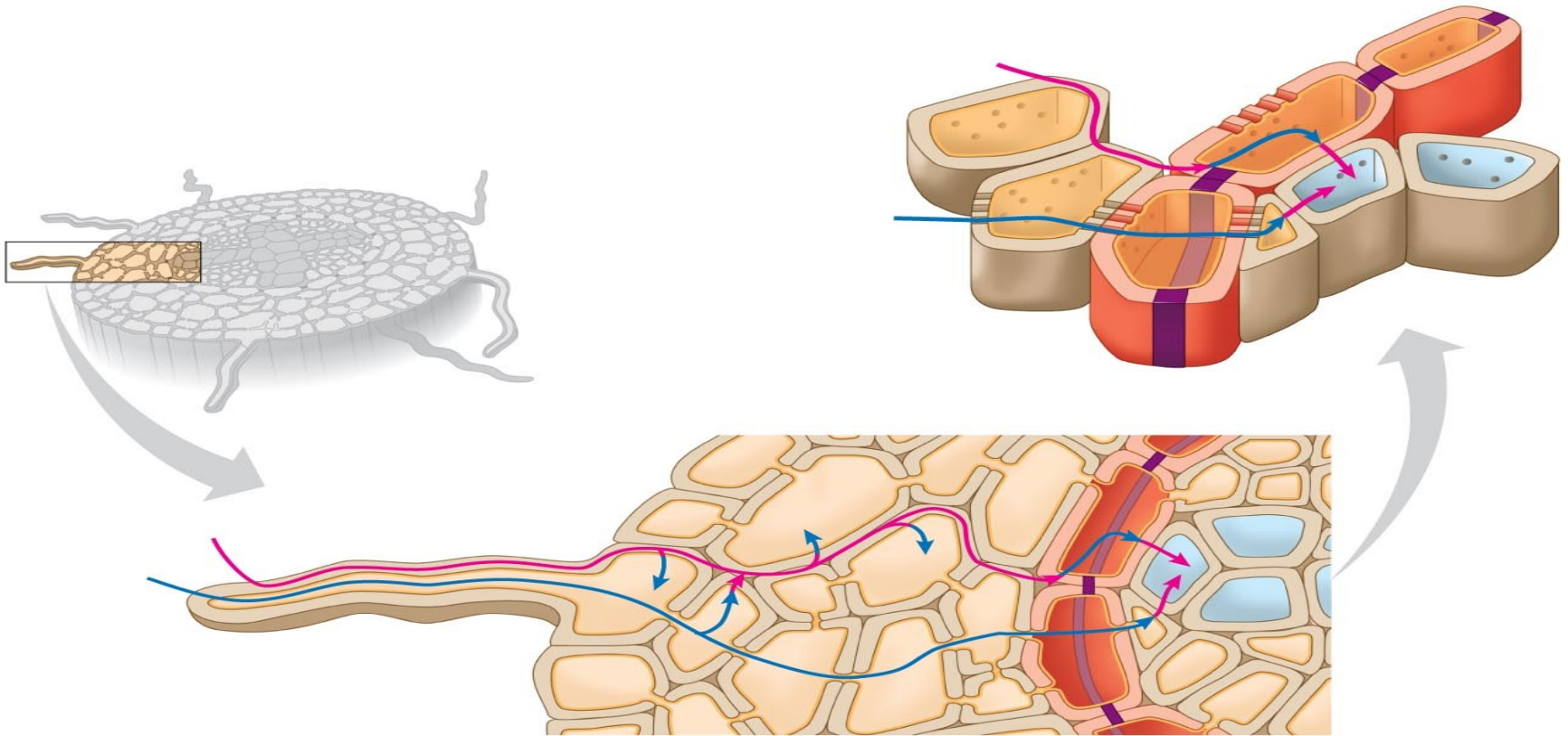
# Adaptation to check transpiration



**The movement of water through cell wall and intercellular spaces during radial transport in roots constitutes**

- 1. Apoplast pathway**
- 2. Symplast pathway**
- 3. Vacuolar pathway**
- 4. Both apoplast & symplast pathway**

# Radial transport of water



# **Drip irrigation is better than flooding for plant growth, because**

- 1. It maintains hygroscopic water**
- 2. It helps to maintain capillary water**
- 3. It maintains gravitational water**
- 4. It decreases transpiration**

# Drip irrigation

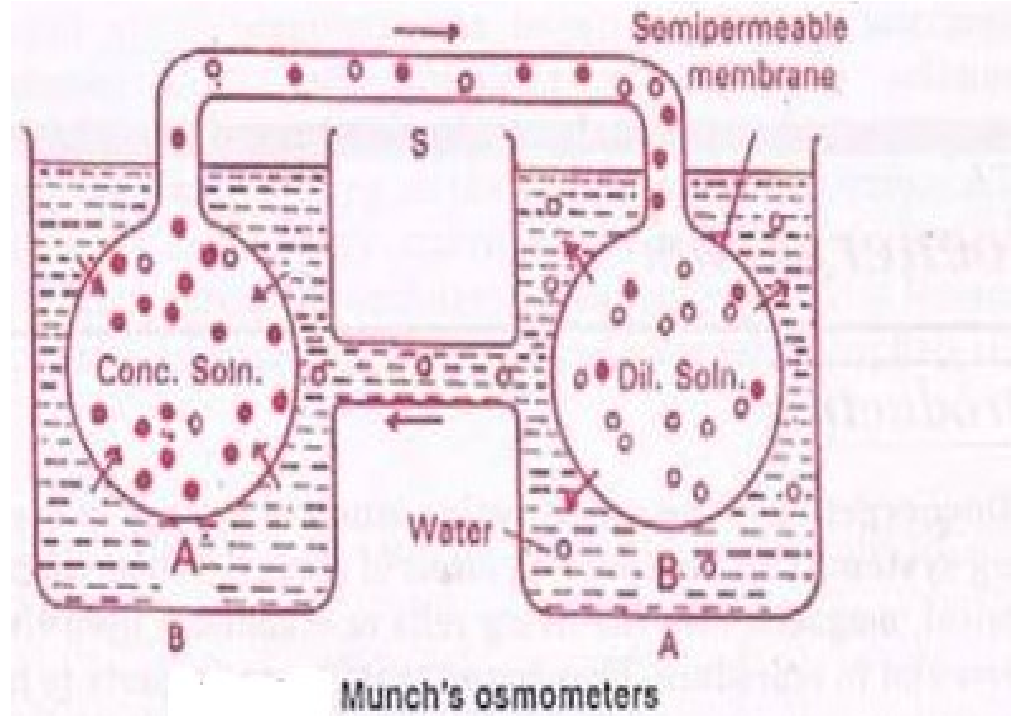
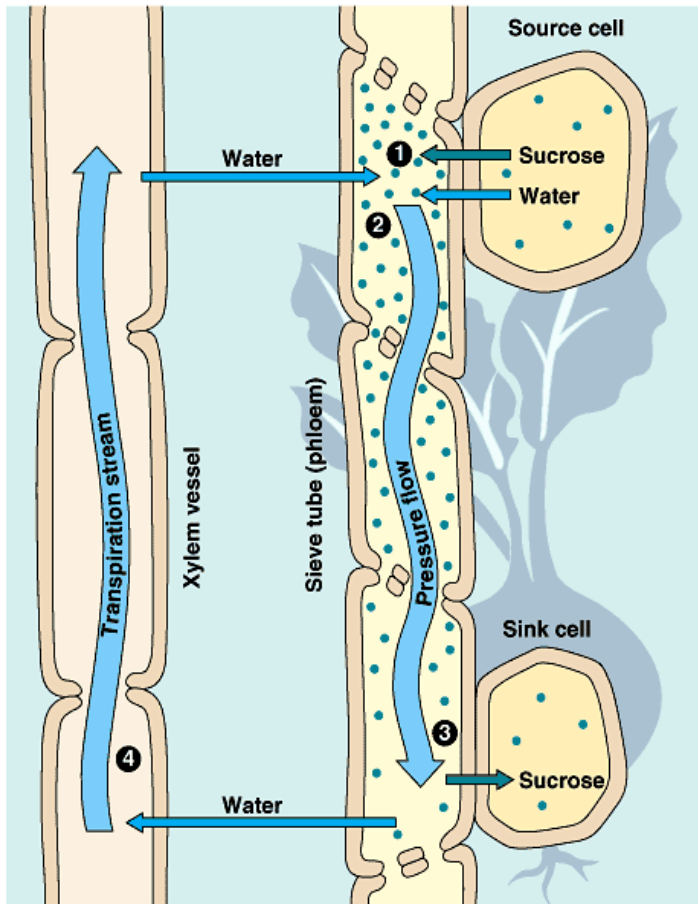


**The following is not true with respect to Mass flow hypothesis**

- 1. High turgor pressure at the sink**
- 2. It explains only unidirectional flow of solutes**
- 3. The source & sink are connected by sieve tubes of phloem**
- 4. The flow of organic solutes en masse due to difference in turgor pressure**



# Mass flow hypothesis

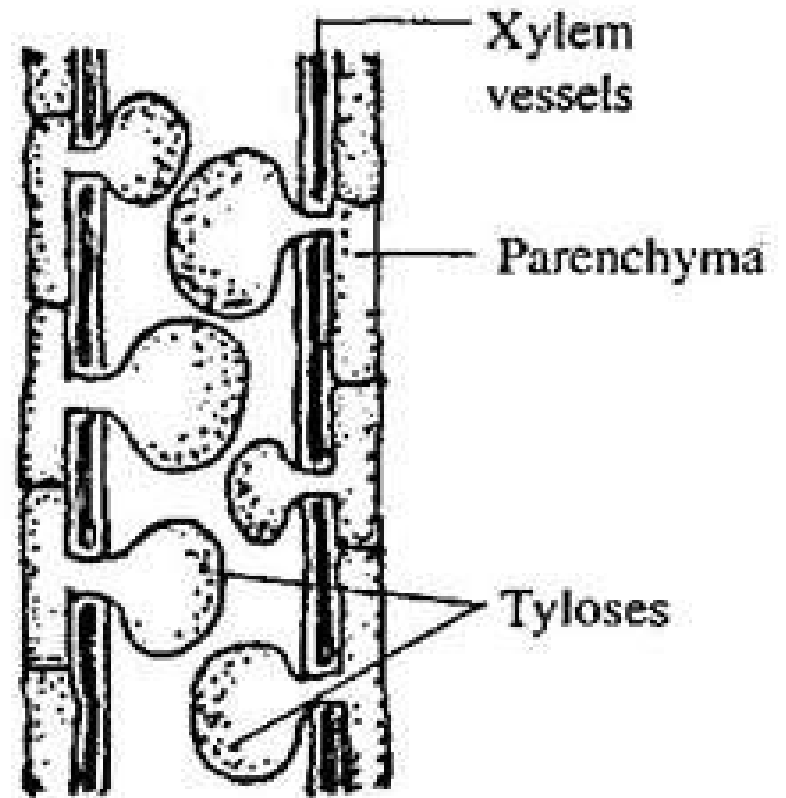


# Passage or lumen of xylem vessels are blocked by

- 1. Callus pad of Duramen**
- 2. Callus pad of Alburnum**
- 3. Tyloses of Duramen**
- 4. Tyloses of Alburnum**



# Tyloses



• Fig. 3.3.2.5 : Tyloses in xylem vessel

**Phenyl mercuric acetate is a**

- A. Antitranspirant**
- B. Herbicide**
- C. Fungicide**
- D. Plant Nutrient**

**ANS:-**

- 1. Only A & B**
- 3. Only A, B & C**

- 2. Only A & C**
- 4. All these**





**Match the following experiments with the respective physiological process and pick the correct answer**

**1. Potato osmoscope**

**2. Simple potometer**

**3. Cobalt chloride paper expt.**

**4. Arc auxanometer**

**A. Unequal rate of transpiration**

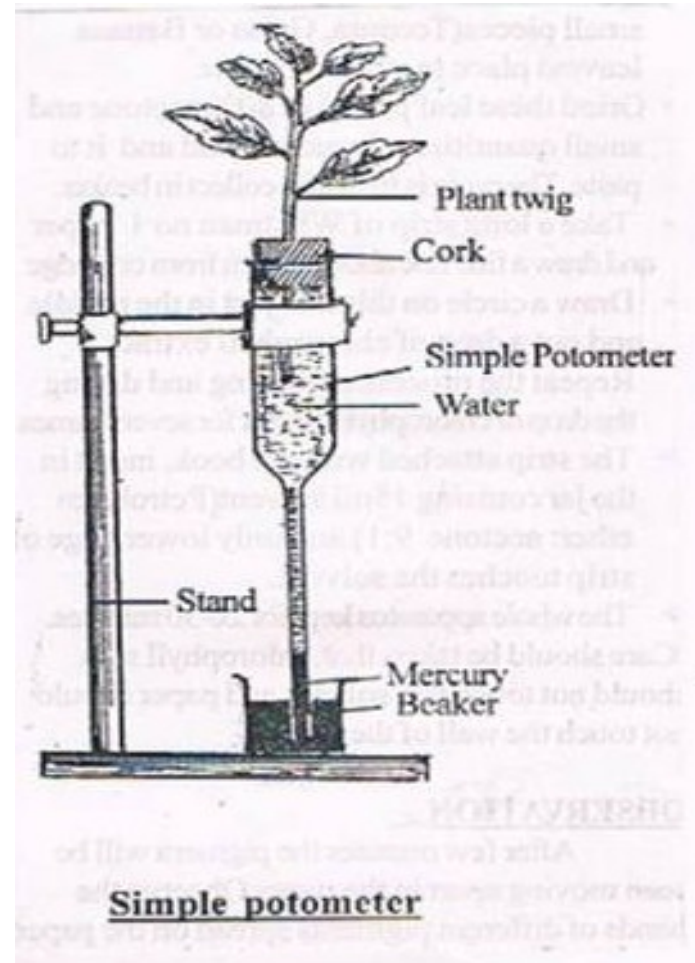
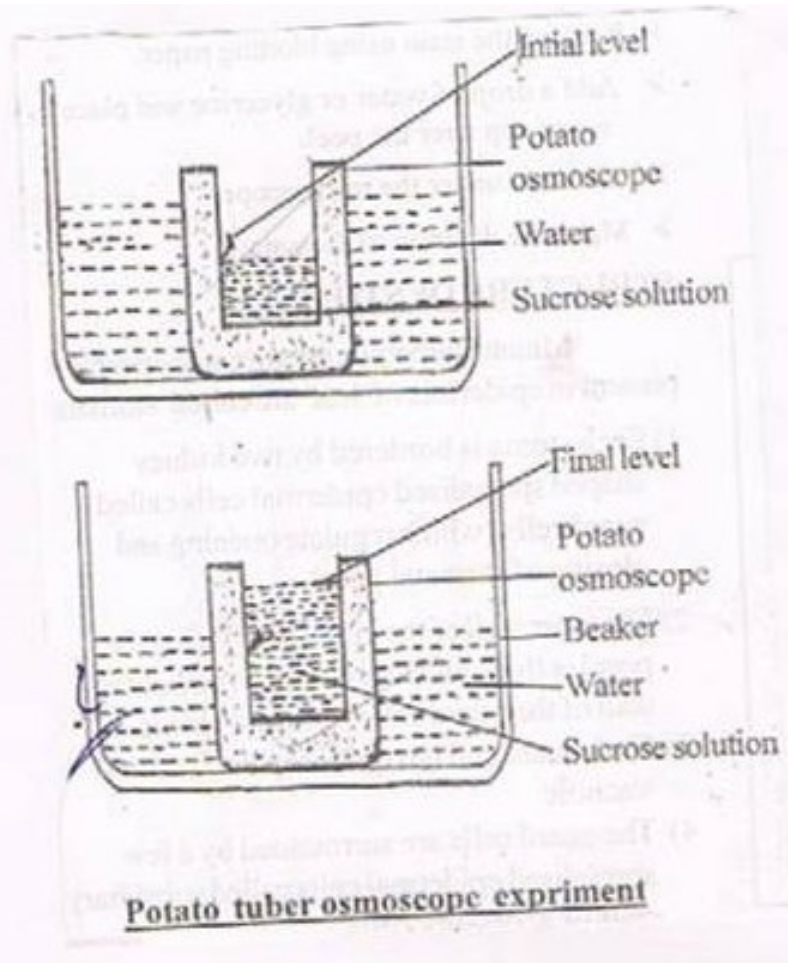
**B. Plasmolysis**

**C. Transpiration pull**

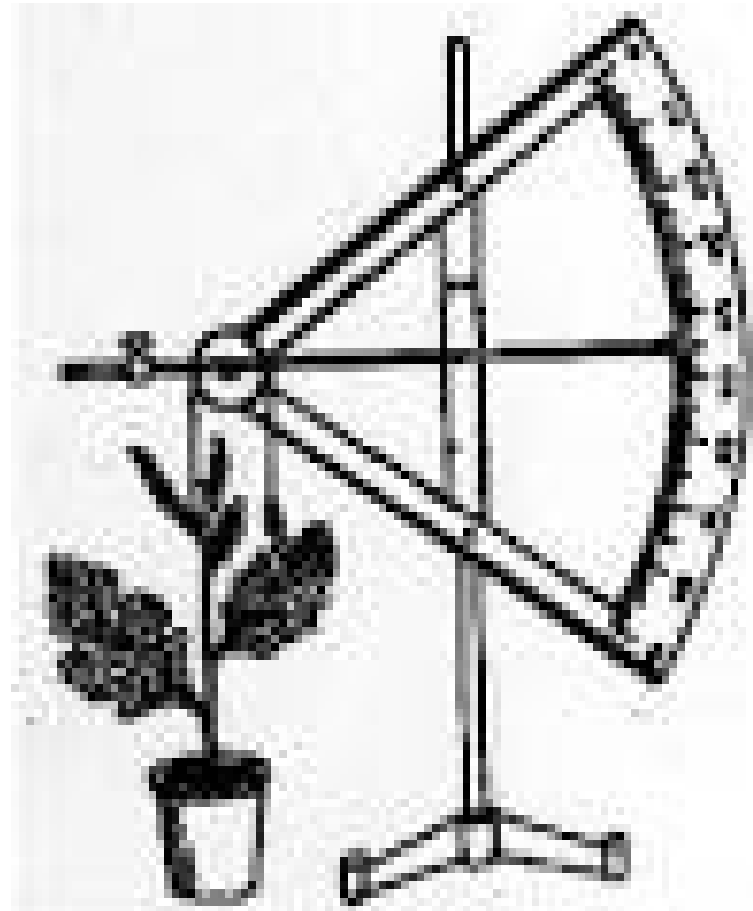
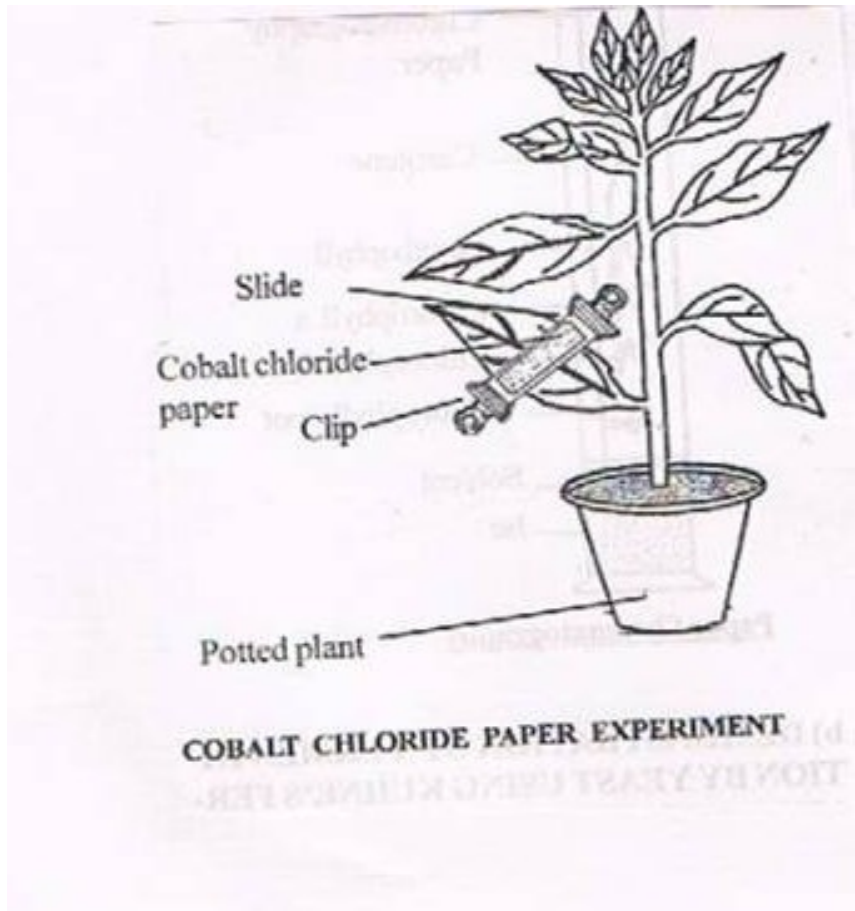
**D. Rate of plant growth**

**E. Osmosis**

# POTATO OSMOSCOPE & SIMPLE POTOMETER



# COBALT CHLORIDE PAPER EXPERIMENT. ARC AUXANOMETER



# Pick the correct answer

- 1. 1-B, 2-D, 3-A and 4-E**
- 2. 1-E, 2-C, 3-A and 4-D**
- 3. 1-E, 2-C, 3-A and 4-E**
- 4. 1-E, 2-D, 3-B and 4-C**



**The following condition is true in stomata during day as per starch hydrolysis theory**

- 1. High pH with low  $\text{CO}_2$  concentration**
- 2. Low pH with high  $\text{CO}_2$  concentration**
- 3. High pH & high  $\text{CO}_2$  concentration**
- 4. Low pH & low  $\text{CO}_2$  concentration**

# Starch hydrolysis theory fails explain stomatal mechanism in CAM plants because

- 1. Stomata opens only during the day in CAM plants**
- 2. Stomata opens only during the night in CAM plants**
- 3. Starch is not produced in CAM plants**
- 4. Stomata are absent in CAM plants**

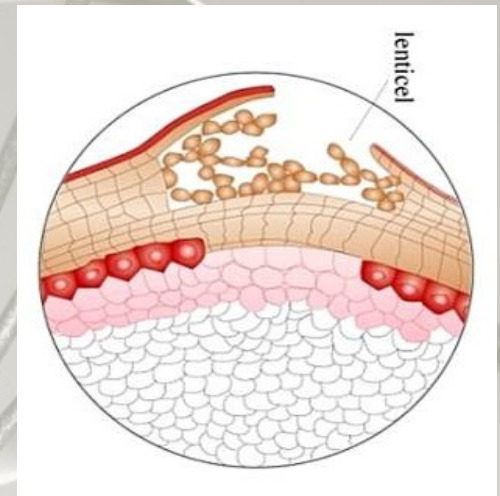
**Blowing wind increases the ascent of sap because**

- 1. It decreases transpiration**
- 2. It decreases temperature**
- 3. It increases transpiration**
- 4. It reduces root pressure**



**Pick the odd pair from the following**

- 1. Lenticels – complementary cell**
- 2. Tracheae – Phloem**
- 3. Sieve tube – companion cell**
- 4. Hydathode - Guttation**



**Sugar transfer from mesophyll cell to sieve tube is called**

- 1. Translocation**
- 2. Translation**
- 3. Vein loading**
- 4. Vein unloading**

A large, semi-transparent, light gray DNA double helix is shown in the background, winding across the slide from the top left towards the bottom right.

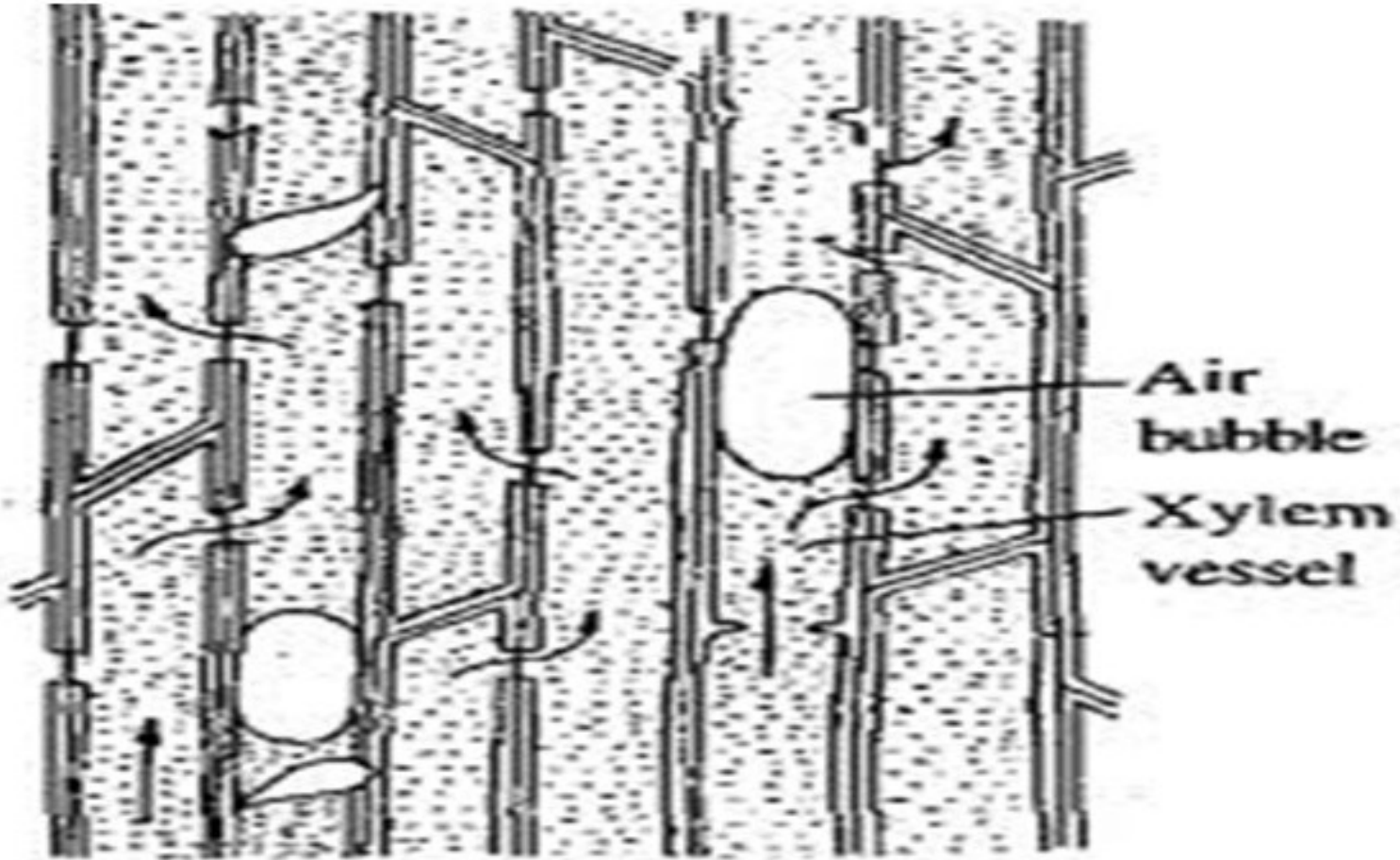
**Pick the differentially permeable membrane from the following**

- 1. Copper ferrocyanide membrane**
- 2. Parchment membrane**
- 3. Tonoplast**
- 4. Cell wall**

**The presence of air bubbles in xylem vessels breaks the continuity of water column. This was shown by**

- 1. Renner**
- 2. Scholander**
- 3. Bode**
- 4. Copemann**

# Xylem vessels with air bubbles



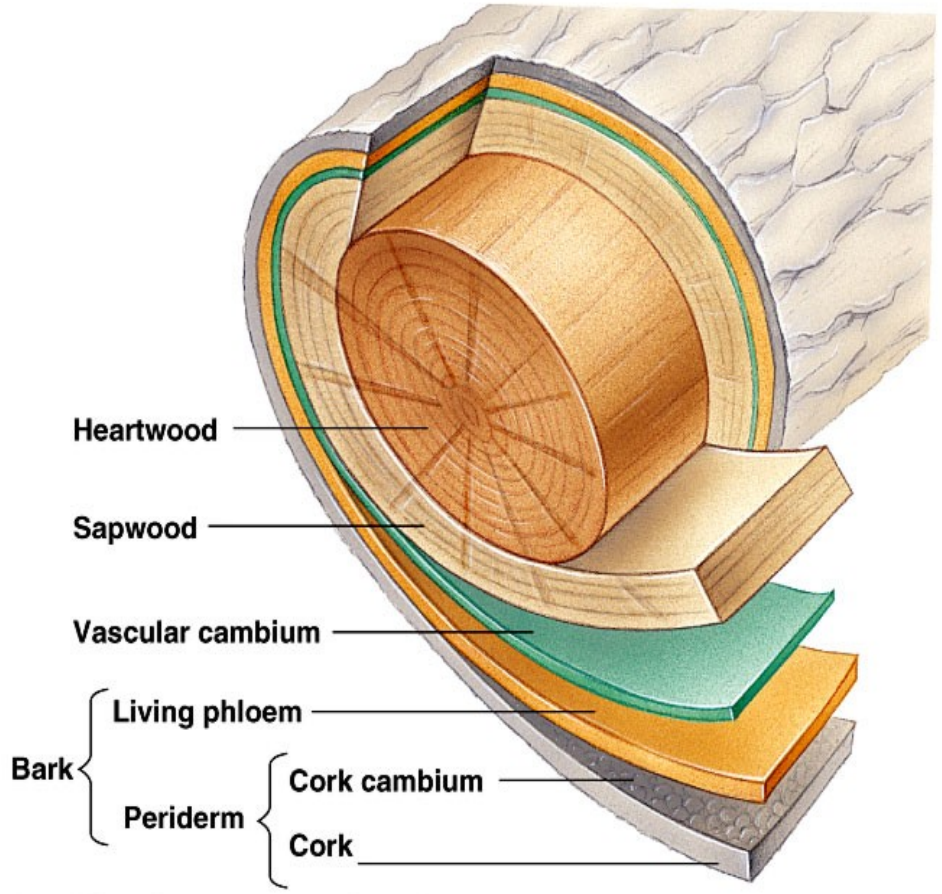
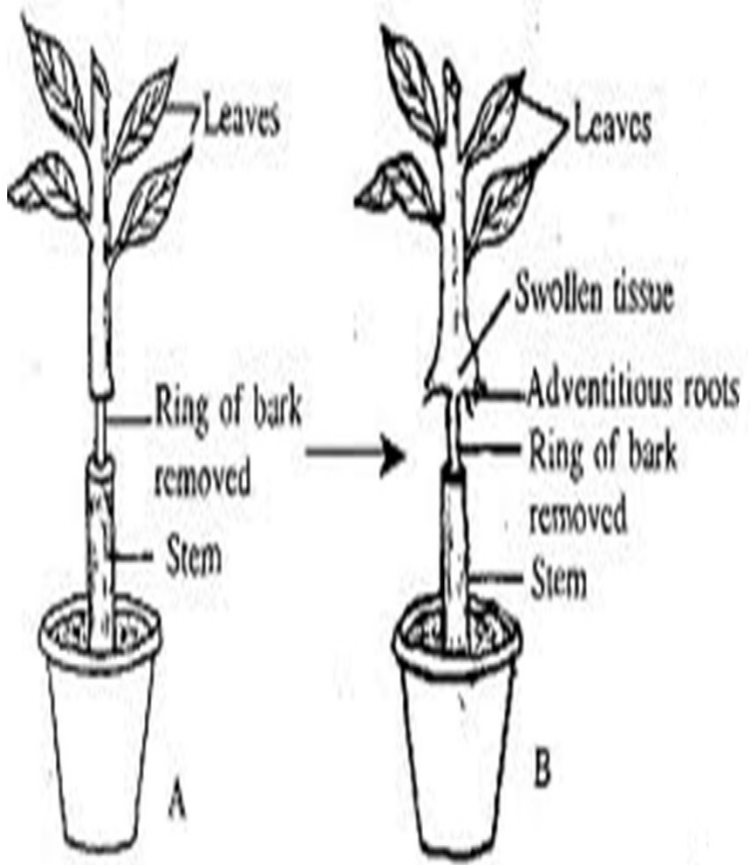




**In girdling experiment, the following tissue layers are removed**

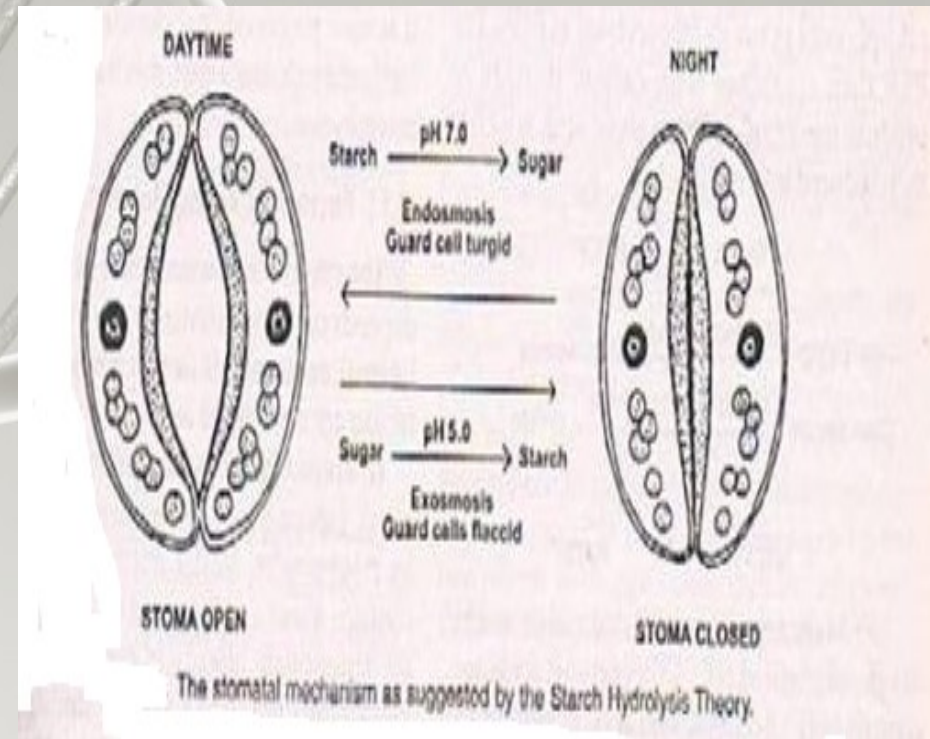
- 1. Epidermis, cortex and endodermis**
- 2. Epidermis, cortex, endodermis & pericycle**
- 3. Epidermis, cortex, endodermis, pericycle & Phloem.**
- 4. Epidermis, cortex, endodermis, pericycle & Xylem.**

# Girdling experiment



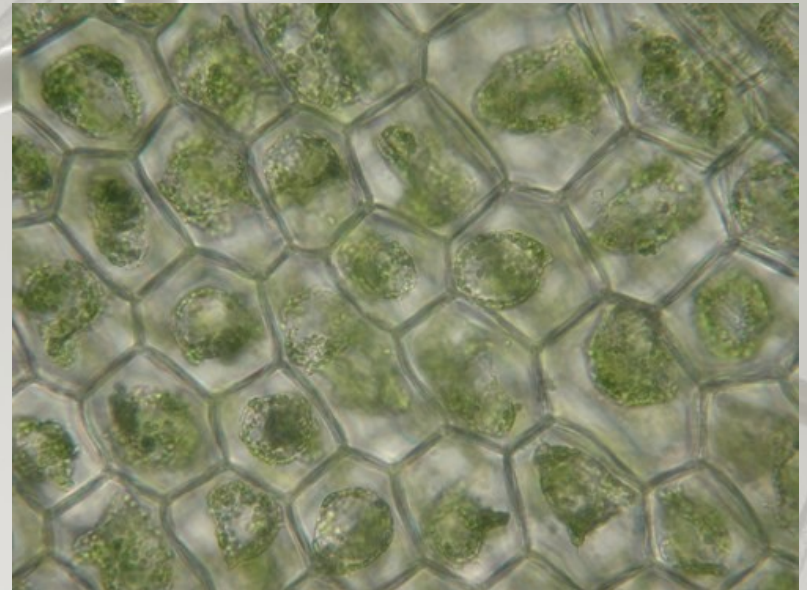
# The starch phosphorylase enzyme in the guard cell is secreted by

1. Nucleus
2. Chloroplast
3. Ribosome
4. Mitochondria



The space between the plasma membrane & cell wall of plasmolysed cell is occupied by

- 1. Hypotonic solution**
- 2. Hypertonic solution**
- 3. Isotonic solution**
- 4. Water**



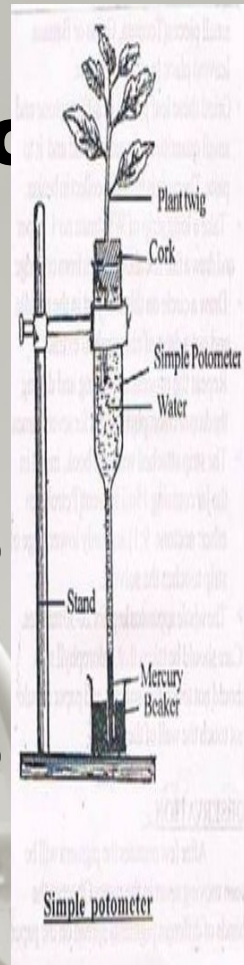
**Following statement is not true with respect to guttation**

- 1. It occurs in all woody plants**
- 2. It releases impure water**
- 3. Loss of water in the form of droplets**
- 4. It occurs through hydathodes**



**During simple potometer experiment the plant twig is cut under water, because**

- 1. To prevent entry of solutes into trachea**
- 2. To prevent entry of water into tracheids**
- 3. To prevent the entry of air into trachea**
- 4. To prevent the entry of air into sieve tube**



**Most abundant sugar constituent of phloem sap is**

- 1. Raffinose**
- 2. Stachyose**
- 3. Mannitol**
- 4. Sucrose**

## **Cobalt chloride paper experiment is performed to demonstrate**

- 1. Rate of transpiration**
- 2. Rate of ascent of sap**
- 3. Unequal rate of transpiration in dorsiventral leaf**
- 4. Unequal rate of transpiration in isobilateral leaf**



**A wooden peg inserted in to a rock causes its breaking after wetting, is due to**

- 1. Turgor pressure**
- 2. Osmotic pressure**
- 3. Imbibition pressure**
- 4. Plasmolysis**



**In which of following plant, there will be no transpiration.**

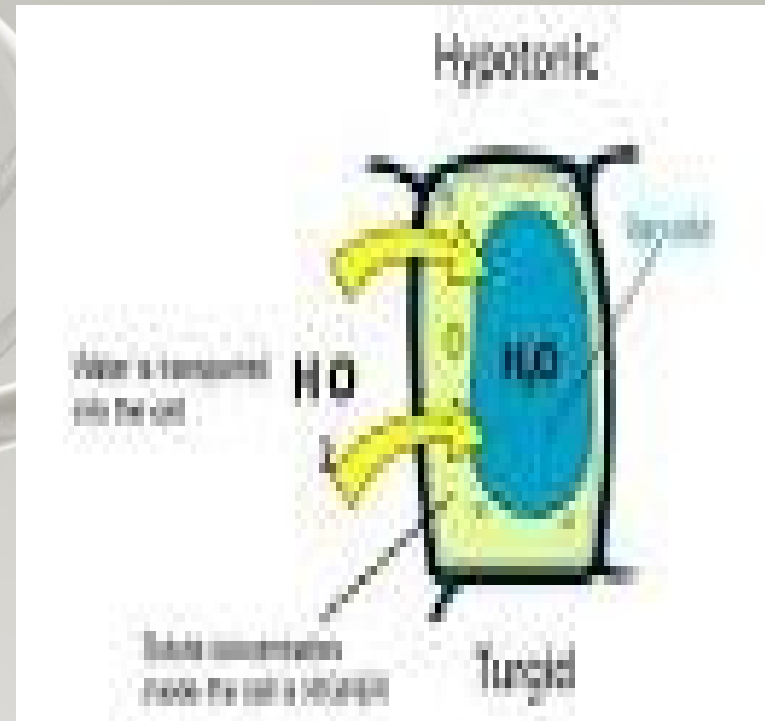
- 1. Plants living in deserts**
- 2. Plants growing at hilly regions**
- 3. Aquatic plants with floating leaves**
- 4. Aquatic submerged plants**

# Hydrophytes



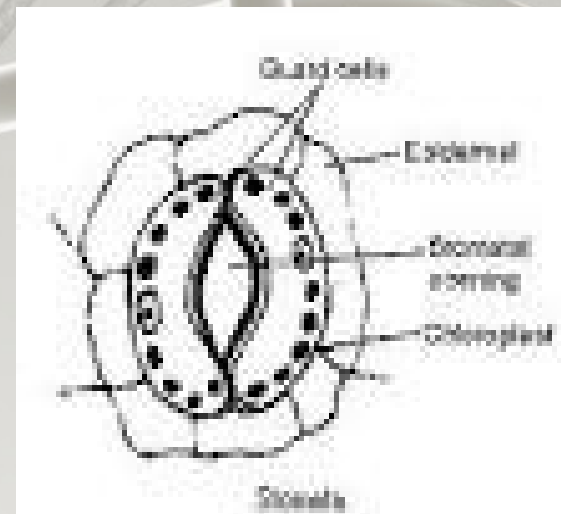
**With the rise in turgidity, wall pressure of cell will**

- 1. Increases**
- 2. Decreases**
- 3. Remain constant**
- 4. Fluctuating**



# Which wall of the guard cell is thick and non elastic

1. Outer wall
2. Inner wall
3. Middle wall
4. Lateral wall

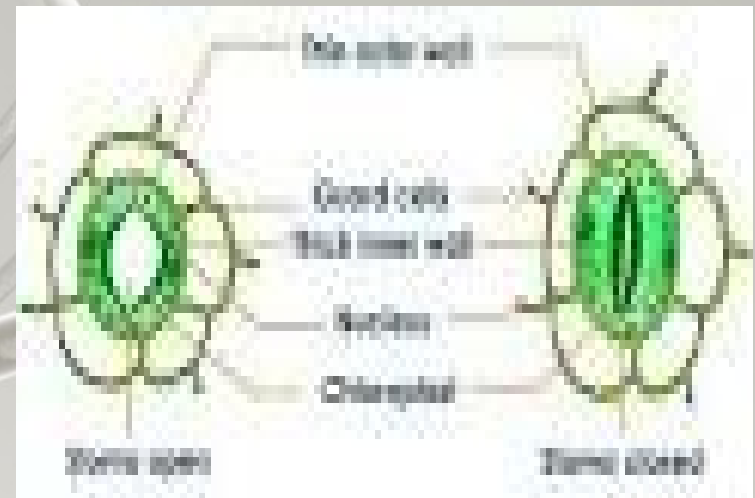


# Transpiration is not helpful for

- 1. Cooling**
- 2. Ascent of sap**
- 3. Water absorption**
- 4. Loss of nutrients**

# Chlorophyllous cells of the leaf epidermis are

- 1. Motar cells**
- 2. Guard cells**
- 3. Subsidiary cells**
- 4. Epiblema cells**





THANK YOU