بِسْمِ اللّٰهِ الرَّحْمٰنِ الرَّحِيْمِ

বিস্‌মিল্লাহির রাহ্‌মানির রাহীম

# উদ্ভাস

একাডেমিক এন্ড এডমিশন কেয়ার

# Class XII: Biology (Chapter-9)

## Plant Physiology (Mineral absorption, Transpiration)

Lecture B-15

# PLANT PHYSIOLOGY

❖Plant Physiology word came from two Greek words, one is **physis (nature)** and another one is **logos (discourse)**.

❑ Here in this chapter we will briefly discuss about four types of mechanism of the plants.

a. Absorption of Mineral salts
b. Transpiration
c. Photosynthesis
d. Respiration

# ABSORPTION OF MINERAL SALT:

❖ By the process a plant intake Mineral salt from the outside (specially soil) to the inside of the cell is called absorption of the salt.

- Do you want to know what kind of mineral salts are present ?
- There are Two types of mineral salt one is called **macronutrients or macro elements** and another one is **micronutrients or microelements**.

➢ **8 Types** of Microelements are present**:**

Chlorine, Boron, Copper, Manganese, Molybdenum, Nickel, Zinc and Iron

➢ **9 Types** of Macroelements are present**:**

Magnesium,Potassium,Calcium,Nitrogen,Carbon,Hydrogen,Oxygen,Phosphorus and Sulfur.

*** Total **17 Elements are** present**.**

- **The nutrient components plants direct get from air and water is called non mineral nutrients like Oxygen, Carbon, Hydrogen.**
- **The nutrient components plants get from soil is called mineral nutrients like Calcium, Magnesium ions.**

# Poll Question 01

Which one is microelements?

(a) Magnesium

(b) Carbon

(c) Phosphorus

(d) Manganese

# STRUCTURES INVOLVED IN ABSORPTION

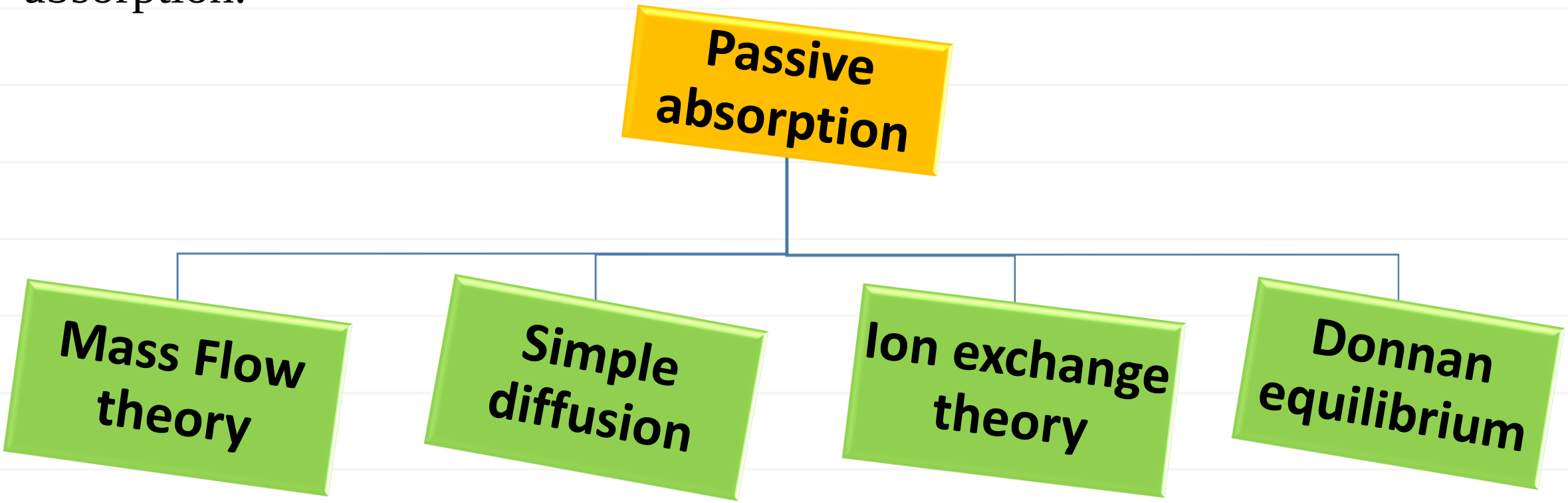
* The Meristematic region of the root
* Root hair

## ❑ Mechanism of mineral absorption:

1. Non-mediated or **passive absorption**
2. Mediated or **active absorption**

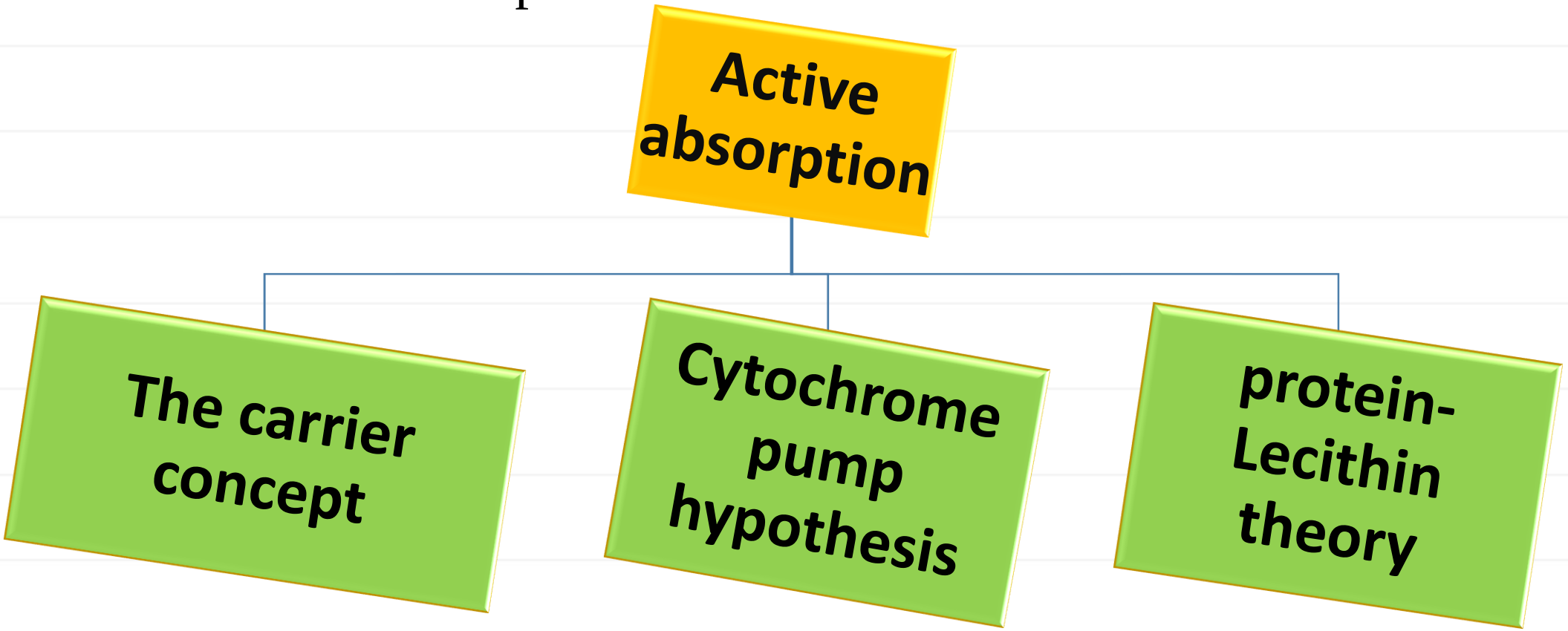
# NON MEDIATED OR PASSIVE ABSORPTION

**1.Non Mediated or passive absorption:** If ion transport of cells occurs spontaneously down a gradient of electrochemical potential energy, it is called passive Absorption. **Metabolic energy** is not necessary in passive absorption.



# MEDIATED OR ACTIVE ABSORPTION

**2.Mediated or Active absorption**: If mineral ions moves against the concentration gradient with the **expenditure of energy** in the form of ATP released as a result of respiration.



# NON MEDIATED OR PASSIVE ABSORPTION

**1.Non mediated or passive absorption:**

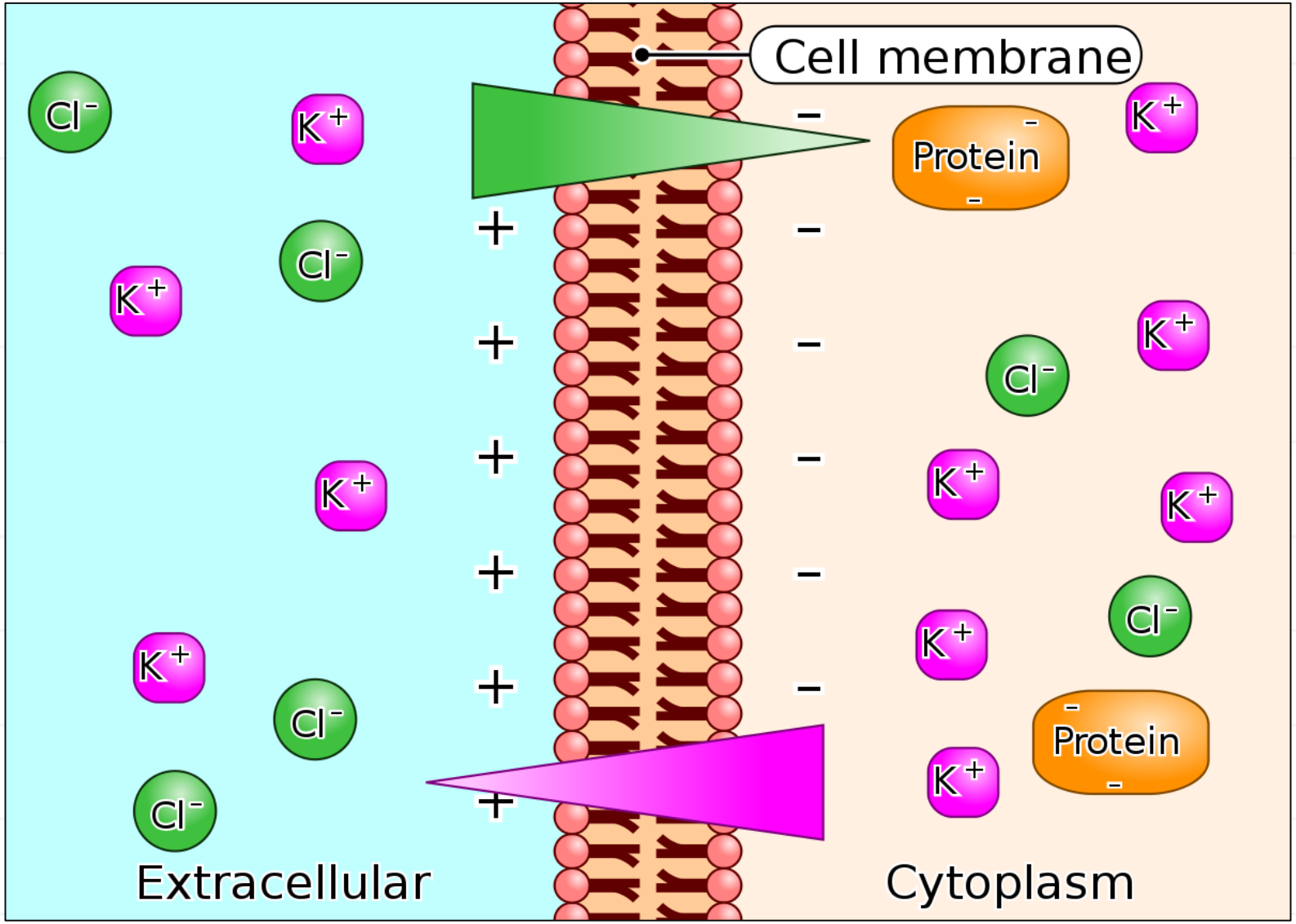
**a.Mass flow theory**: According to this theory ions are absorbed by the root hair with mass flow of water under the influence of the Transpiration. This theory failed to explore the salt accumulation against osmotic gradient.

**b.Theory of simple diffusion:** according to this Theory, solute move from soil water into the cell sap along concentration gradient by the process of simple diffusion.

**c.ion exchange theory:** Both cations and anions have a tendency to get adsorbed on the surface of the cell walls, and exchange with ions present in the soil solution. This process of exchange between the absorbed ions and ions in solution is known as ion exchange. Minerals elements can be absorbed in the form of molecules or as ions.

**d.Donnan equilibrium:** British Chemist Frederick George Donnan stated that, the ionic equilibrium reached in a solution of an electrolyte whose ions are diffusible through a semi permeable membrane but are distributed unequally on the two sides of the membrane because of the presence of a non diffusible colloidal ion(as a protein ion) on one side of the membrane.

# DONNAN EQUILIBRIUM:

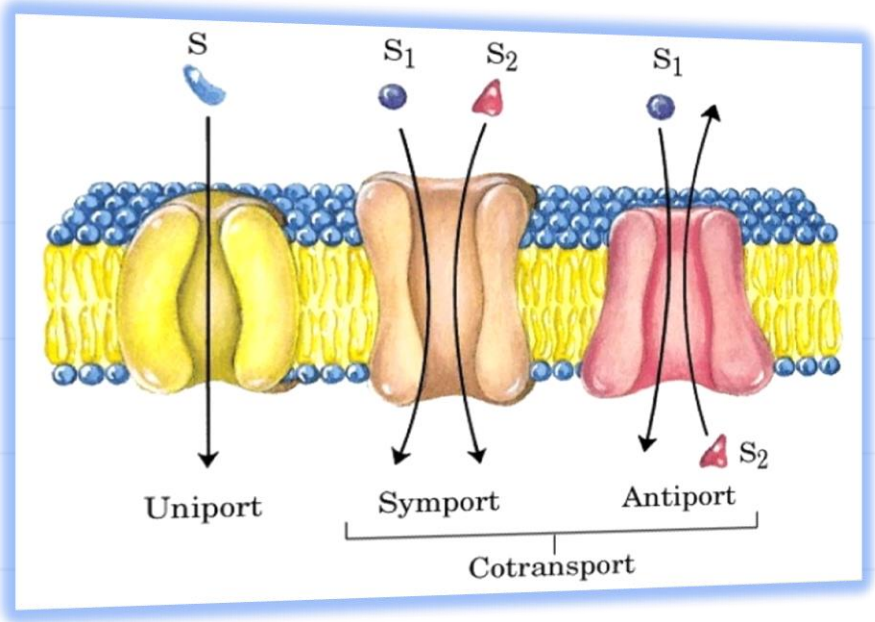


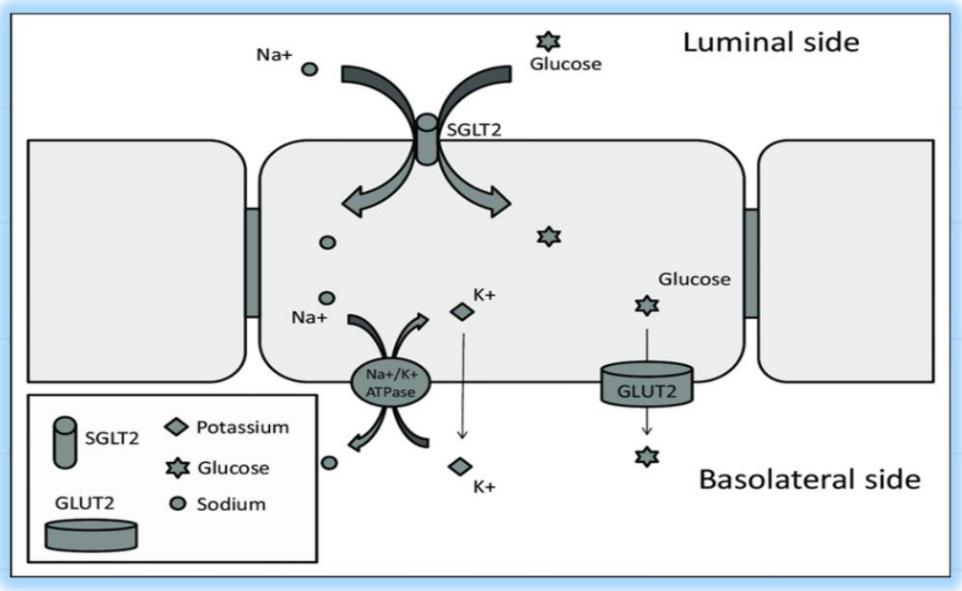
# MEDIATED OR ACTIVE ABSORPTION

**2.Mediated or Active absorption:**

**a.The carrier concept:** The theory was proposed by the **vanden Honert in 1937.**According to this theory there are certain organic molecules which act as carriers or transporters. These carrier molecules are highly specific for each ions, it carries ions from outer space to inner space by forming the ion carrier complexes.

**b.Protein-lecithin theory: Bennet Clark 1956 proposed** the theory in which the carrier is a **phosphatide protein**. The lecithin carriers both the anions ad cations by forming the lecithin-ion complex. This is mediated by the enzyme **lecithinase**.



# CYTOCHROME PUMP HYPOTHESIS

**c.Cytochrome pump hypothesis:** Cytochrome pump theory was proposed by **H.Lundegardh** in 1954. This theory supports that there is a direct co relation between the anion absorption and respiration. The transport of anions takes place through **cytochrome system**, so the cytochrome acts as carrier. Anions are actively absorbed via a cytochrome pump and cations are passively absorbed.

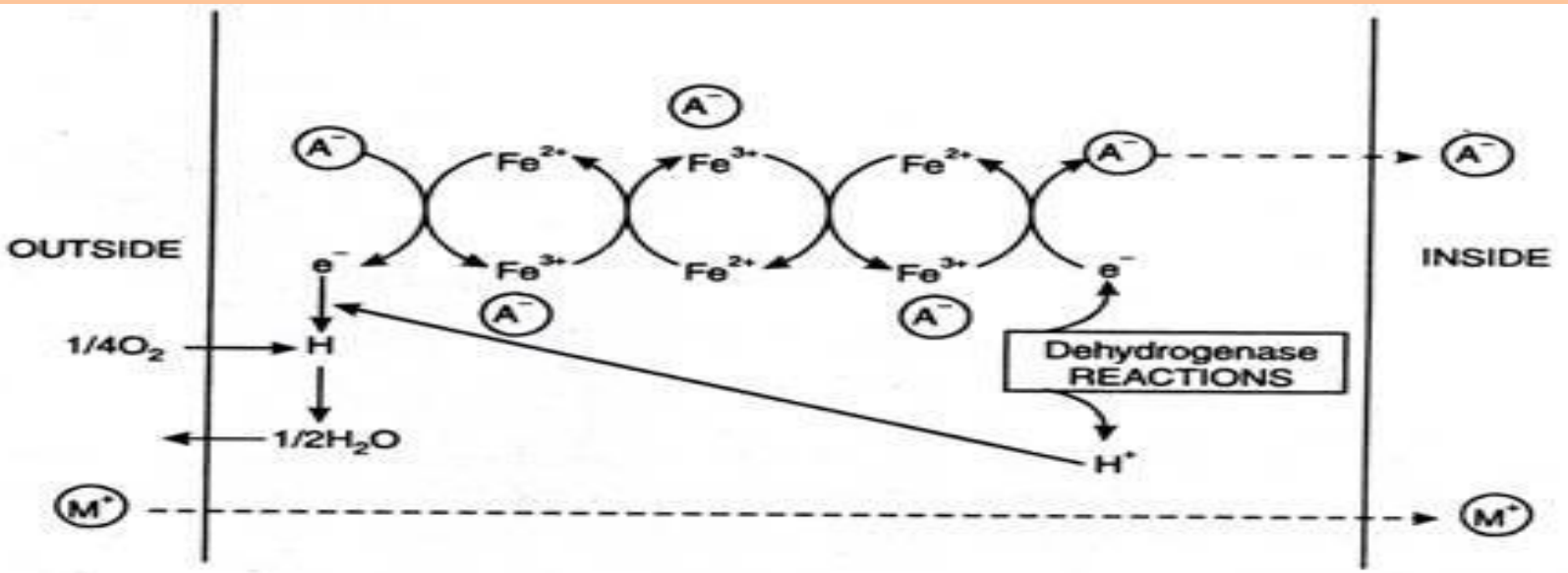



Fig. 7.3 Diagrammatic representation of the Lundegardh's cytochrome pump theory.

# Poll Question 02

Which one is not Active absorption?

(a) The Carrier Concept.

(b) Cytochrome Pump hypothesis.

(c) Donnan equilibrium.

(d) Protein-Lecithin Theory.

# FACTORS AFFECTING ABSORPTION OF MINERAL SALT:

- Temperature
- Oxygen
- Light
- pH
- Presence of other ions
- Growth

# TRANSPIRATION

- ✓ **Transpiration** is the process by which water is carried through plants from roots to small pores on the underside of leaves, where it changes to **vapour** and is released to the atmosphere.

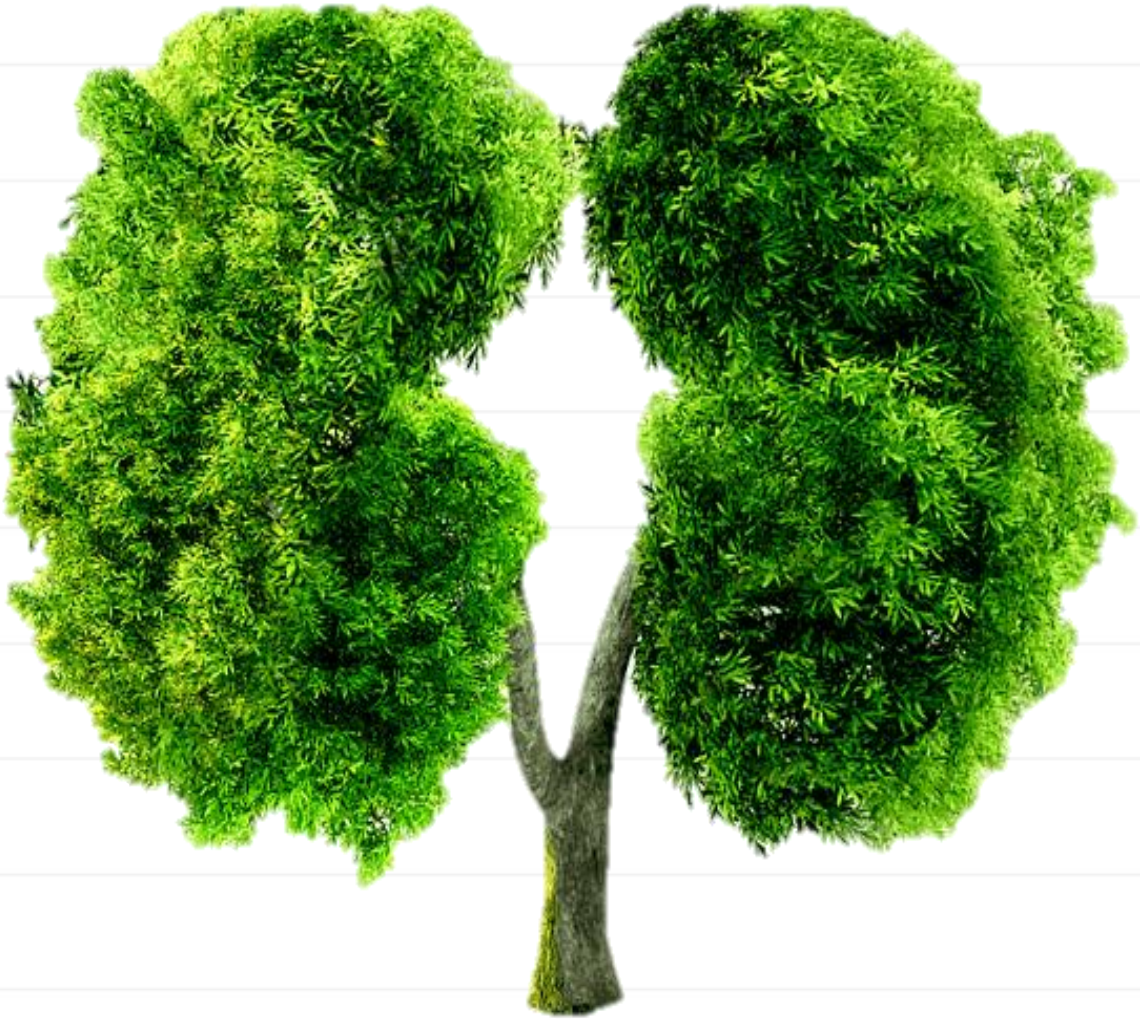
*** There is a another process named **gattation**, which is the loss of water in **liquid** form the uninjured leaf or stem of the plant, mainly through water stomata or **hydathode.**

**Types of Transpiration:** The transpiration is **three** types -

**a.Cuticular transpiration:** The loss of water in the form of water vapour through the **cuticle** is known as cuticular transpiration. Cuticular transpiration accounts nearly **20%** of the total water loss by a plant.

**b.Lenticular transpiration:** Loss of water in the form of water Vapour taking place through the **lenticels** presents in the woody stem and fruits is called as lenticular transpiration. It amounts **1-5 percent** of the total water loss by the plant.

**c.Stomatal transpiration:** Maximum loss **(80-90 percent** of the total water loss) of water from the plant tissues takes place through the **stomatal openings.**



# Poll Question 03

Who give the modern law?

(a) Sayeri

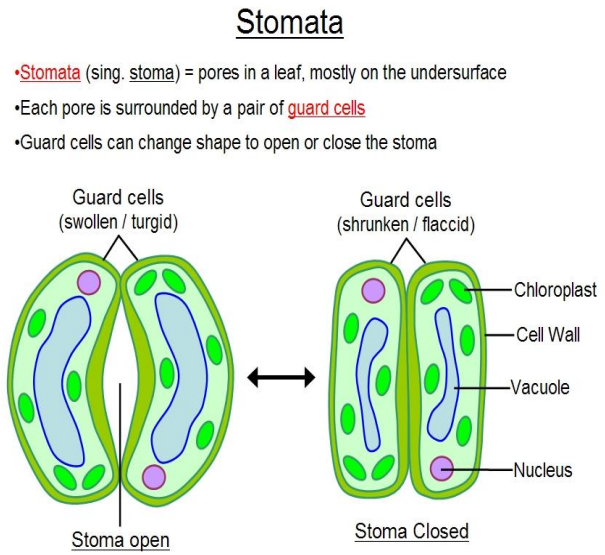
(b) Steward

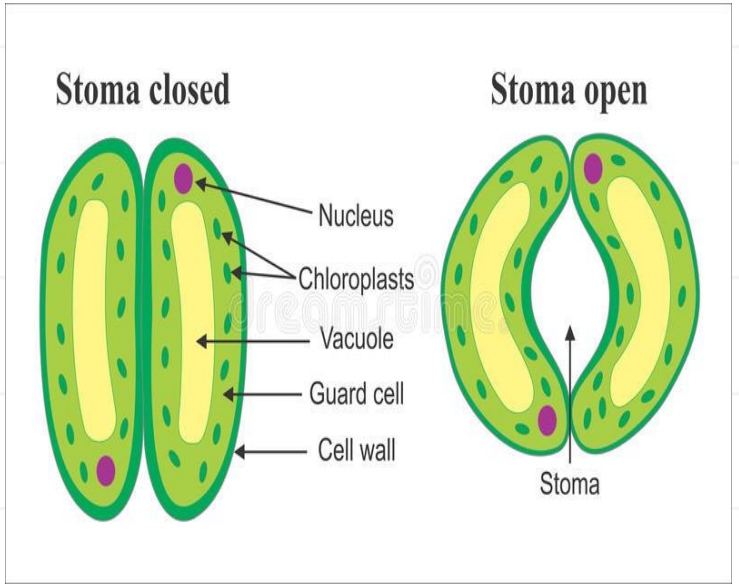
(c) Lloyd

(d) Lexitt

# STRUCTURE OF STOMATA:

- The exchange of atmospheric gases is essential to the process of photosynthesis. A stoma is a pore, found in the epidermal layer of the leaves, stems, and other organs that is used to control gas exchange. Each stoma is formed by two kidney shaped or bean shaped cells called **guard cell**. Each cells contains a large nucleus, dense cytoplasm and numerous chlorophyll and there is also some specialized **subsidiary cells.**
- There is a cavity named **substomatal cavity** its acts as a diffusion chamber connected with the intercellular air spaces and allowed rapid diffusion of carbon dioxide and other gases

# THE MECHANISM OF OPENING AND CLOSING STOMATA:

- Scientist **H.Von Mohl** gave a statement in 1856 that is, **dilatation of guard** cell can occur opening or closing of the stomata.
- Scientist **F.E Lloyd** gave a statement in 1908 that is, opening and closing of the stomata is totally depends on **osmotic pressure** difference.
- Scientist **Sayeri** gave a statement in 1926 that is totally depends on **pH** which is created just because of the intermediary changes of glucose and sugar.
- Scientist **Steward** gave a theory of **starch-glucose** interconversion .
- scientist **Lexitt** 1974 gave a hypothesis named **K+ ion pump** hypothesis.This is called modern theory.

$$R COOH_2 \longleftrightarrow R(COO-)_2 + 2H+$$

malic acid — malate — proton

# FACTORS INFLUENCING TRANSPIRATION:

- Internal or plant factors :
  1. Root-shoot ratio
  2. stomata
  3. leaf area
  4. structure of leaf
- External or environmental factors:
  1. Temperature
  2. Light
  3. Wind
  4. Hydration
  5. Atmospheric pressure

লেগে থাকো সৎভাবে,
স্বপ্ন জয় তোমারই হবে

উদ্ভাস-উন্মেষ শিক্ষা পরিবার

# Thank You