PHOTOSYNTHESIS: UNIT-I

Study Material for

B.Sc. Part III

Botany Hons.

Paper VI

and

B.Sc Part II (subsi)

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PHOTOSYNTHESIS:UNIT-I

- PHOTOSYNTHESIS
- PHOTOSYNTHETIC APPARATUS
- PHOTOSYNTHETIC PIGMENTS

PHOTOSYNTHESIS

- **PHOTOSYNTHESIS** is an anabolic process in which green parts of the plant synthesize complex carbonaceous organic food substances (Carbohydrates) with carbon-di-oxide and water in the presence of sunlight, releasing oxygen as a bi-product.

- In this process **Radiant energy** is converted into **Chemical energy.**
- The summary equation of Photosynthesis:

$$6CO_2 + 6H_2O \xrightarrow[\text{chlorophyll}]{\text{Radiant Energy}} C_6H_{12}O_6 + 6O_2$$

PHOTOSYNTHESIS

- Photosynthesis is a complex biochemical process involving **series of enzymatic activities;** taking place in light phase and dark phase
- Those enzymatic activities which take place during presence of light is known as **Light Reaction of Photosynthesis** and those which take place in absence or very low intensity of light is known as **Dark Reaction of Photosynthesis**
- During Photosynthesis, **carbon dioxide is chemically reduced to carbohydrate**
- **Photolysis of water** takes place in presence of light
- **Oxygen released** during Photosynthesis **comes from water**
- **Assimilatory power (ATP+$NADPH_2$)** synthesized during light reaction is channelized to convert 3-carbon compound into 6-carbon compound i.e., **carbohydrate** during dark reaction
- The complete process of photosynthesis takes place inside the **Chloroplast**

PHOTOSYNTHESIS

CO_2 →

Dark Reactions

ATP

NADPH

H_2O
+
CO_2 →

Light Reactions

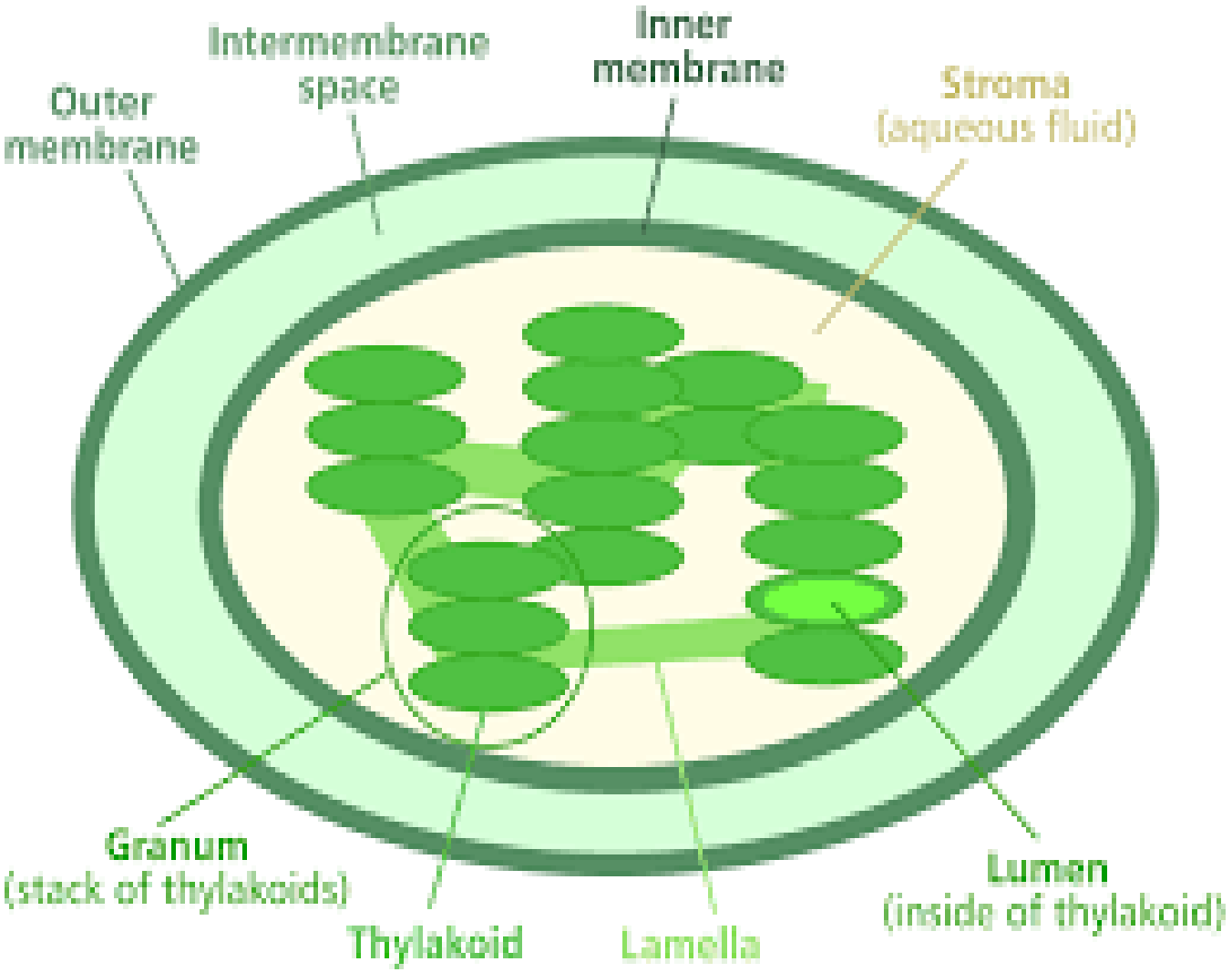
Sugars

O_2

Over view of Photosynthesis

PHOTOSYNTHETIC APPARATUS

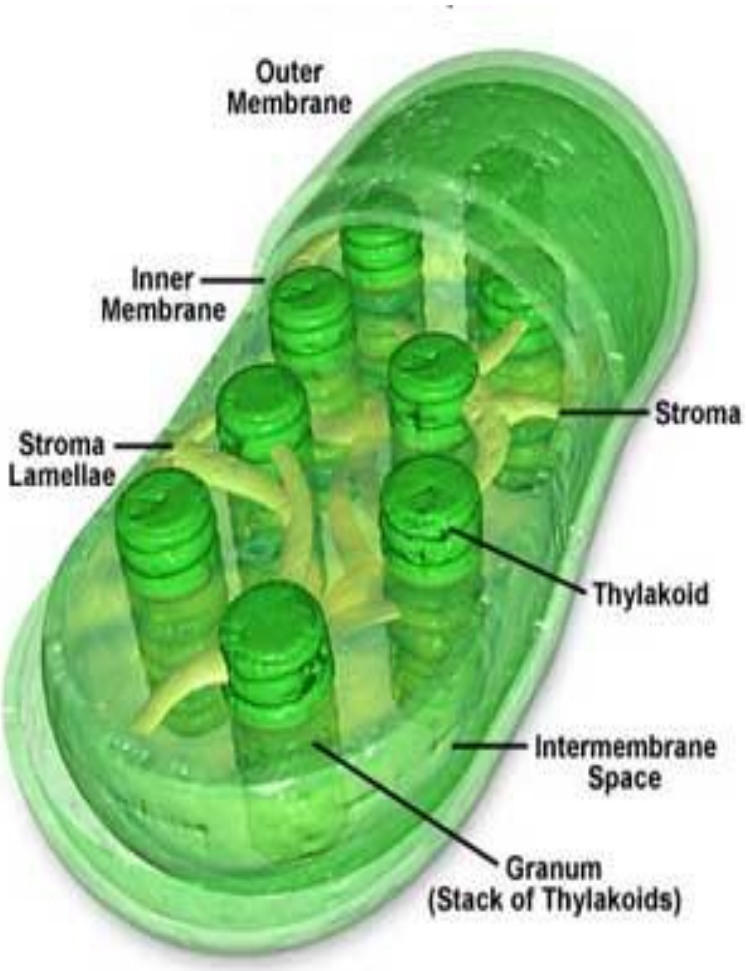
Photosynthesis takes place in chloroplast



PHOTOSYNTHETIC APPARATUS

STRUCTUREOF CHLOROPLAST:

- Membrane bound **plant cell organelle**
- Double membranous structure
- Each membrane is 40-60 Angstrom thick and the space between them vary from 25 to 75 Angstrom
- Proteinaceous matrix called **stroma** contains starch grains, pyrenoids and osmophillic droplets remain present inside the chloroplast. Several membranous disc like structures **(Thylakoids)** remain stacked upon each other which are known as **Grana**
- Each granum remain connected with several intergranal stacks through **Lamellae (Stroma lamellae/ Fret Channels)**
- These Stroma lamellae serve as the site of photochemical reaction/ Light reaction of photosynthesis
- The **chlorophyll pigments** and other pigments are found adhered on the surface of the lamellae and **capture the solar energy**



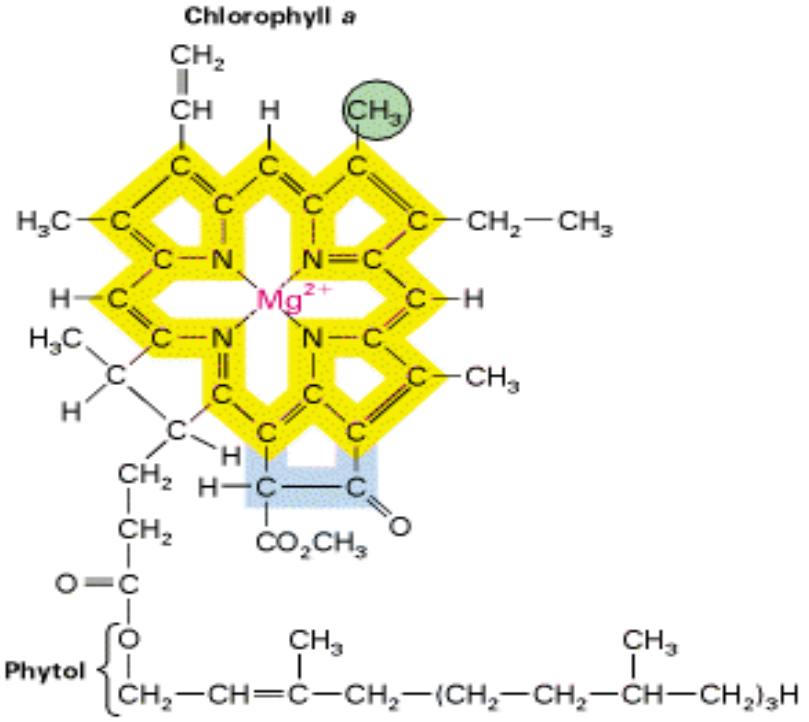
PHOTOSYNTHETIC PIGMENTS

- **CHLOROPHYLLS** are the most important green pigments of plants which are active in photosynthesis
- **Chlorophyll a and b** are most important chlorophylls which are active in photosynthesis
- Both are **insoluble in water**
- **Chlorophyll a** molecule consist of a cyclic structure composed of four pyrronuclei containing **Mg** atom at its center. From one end of pyrronuclei ring extends a long chain of alcohol (Phytol part of chlorophyll)
- The molecular formulae for Chlorophyll a and b are;

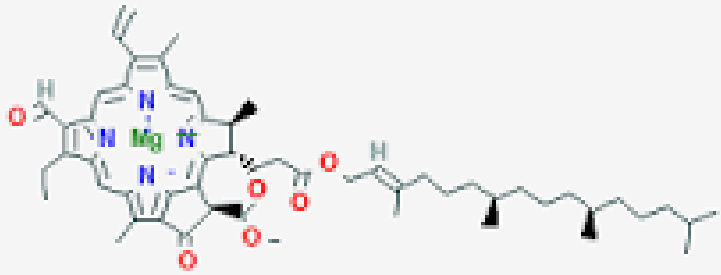
  $C_{55}H_{72}O_5N_4Mg$ and **$C_{55}H_{70}O_5N_4Mg$**
- **Chlorophyll b** constitutes about one fourth of total constituent of chlorophyll content and absorbs light of different wavelength than the **chlorophyll a**
- On absorbing lights the **chlorophyll b** gets excited and transfers its energy to **chlorophyll a** molecule
- **Caretenoids** and **Phycobillins** are accessory pigments which actively participates in transfer of energy during photosynthesis

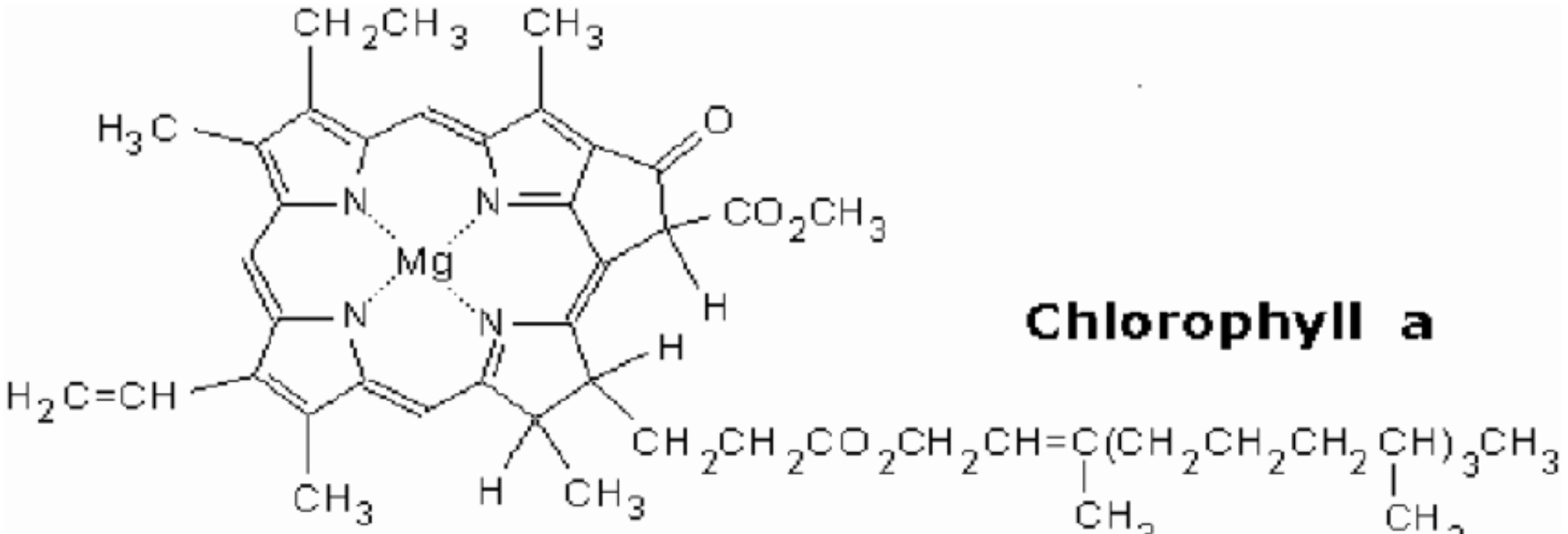
PHOTOSYNTHETIC PIGMENTS

- Finally the **chlorophyll a** molecule converts the **light energy into electrical energy** by bringing about charge separation
- The **chlorophyll a** molecule act as reaction centres

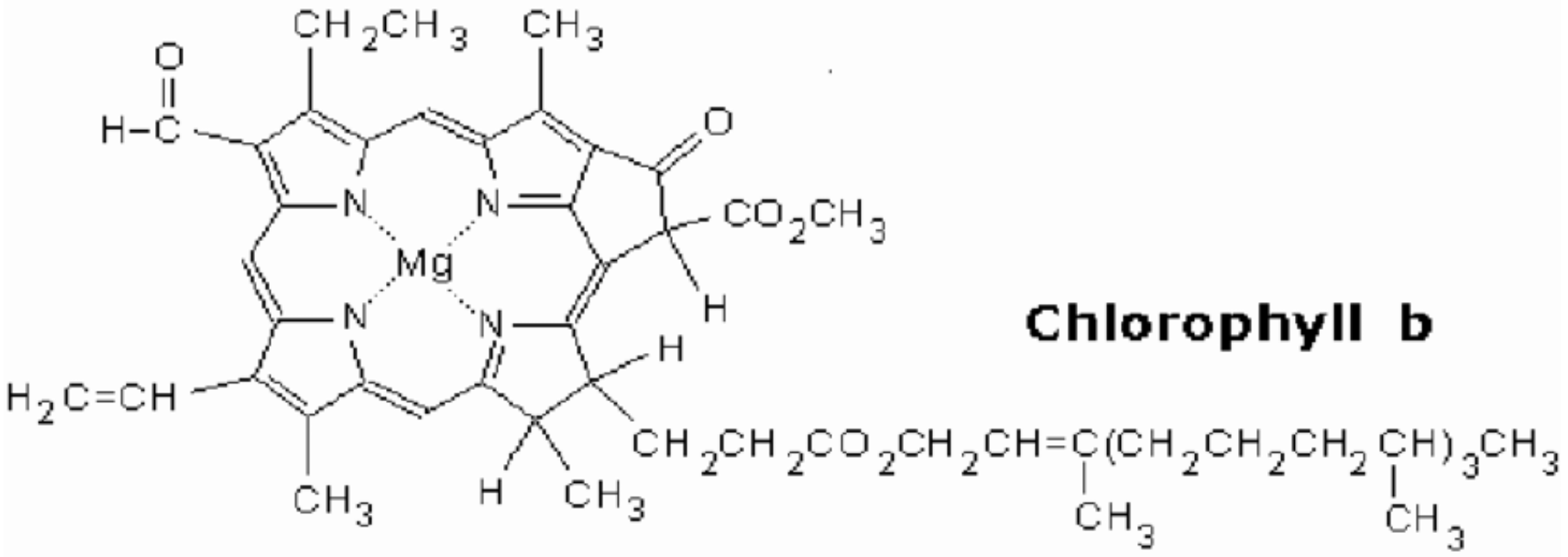


Chlorophyll b





Chlorophyll a



Chlorophyll b

TO BE CONTINUED IN UNIT - II