

Plant biochemistry

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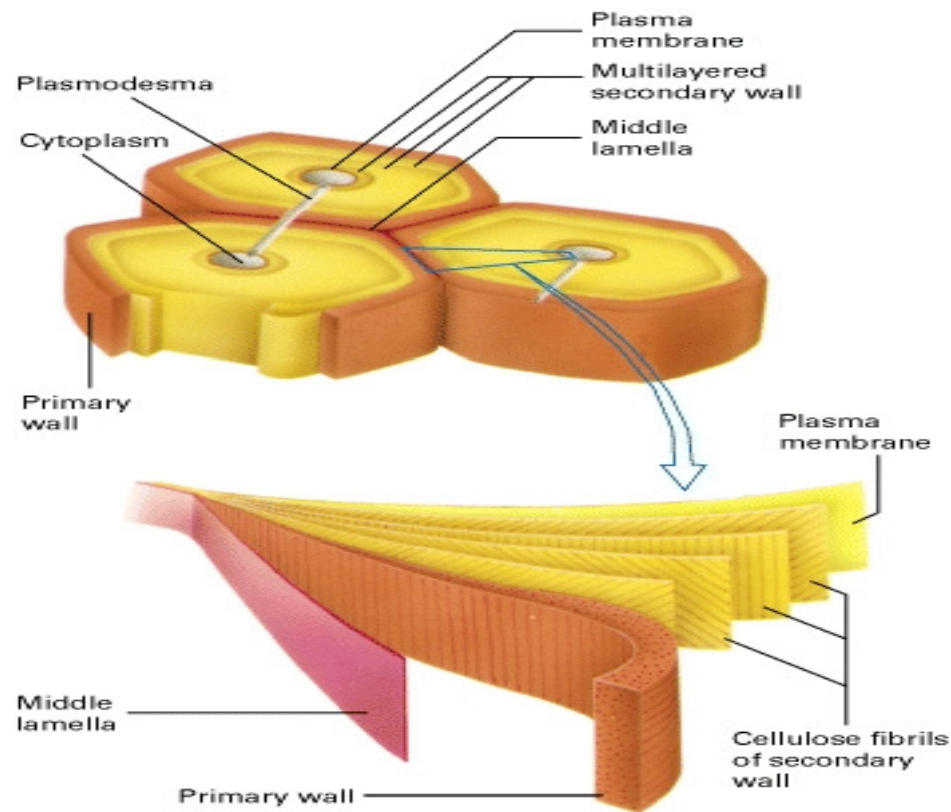
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Department of Biochemistry

Formation and growth of the cell wall

- It happens immediately after nuclear division .
- Granules arising from the Golgi complex arrange themselves on the equator of the cell, they fuse to form the cell plate .
- The cell plate grows in thickness by addition of new material From Golgi complex .

- Narrow openings " the plasmodesmata " between cells are retained through them .



- During the development of the cell wall, the middle lamella is formed first .
- The primary cell wall is secreted against the middle lamella.
- After the period of growth is over a secondary cell wall may be laid down between the primary cell wall and the cytoplasm of the cell.

Biosynthesis of cell wall components (location)

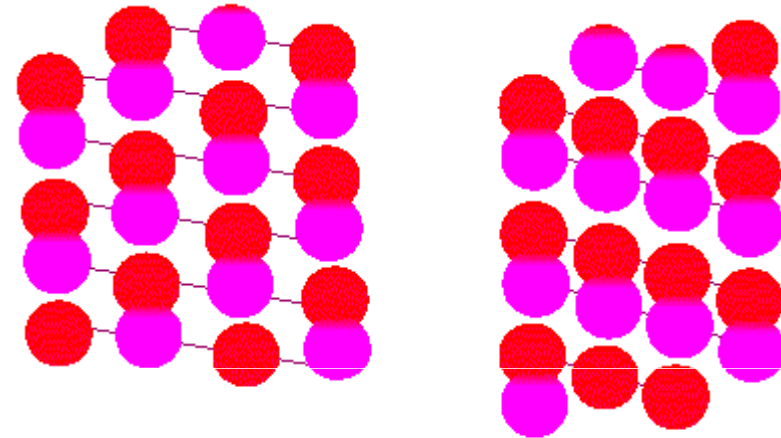
1. Polysaccharides:

I. Microfibrillar polysaccharides

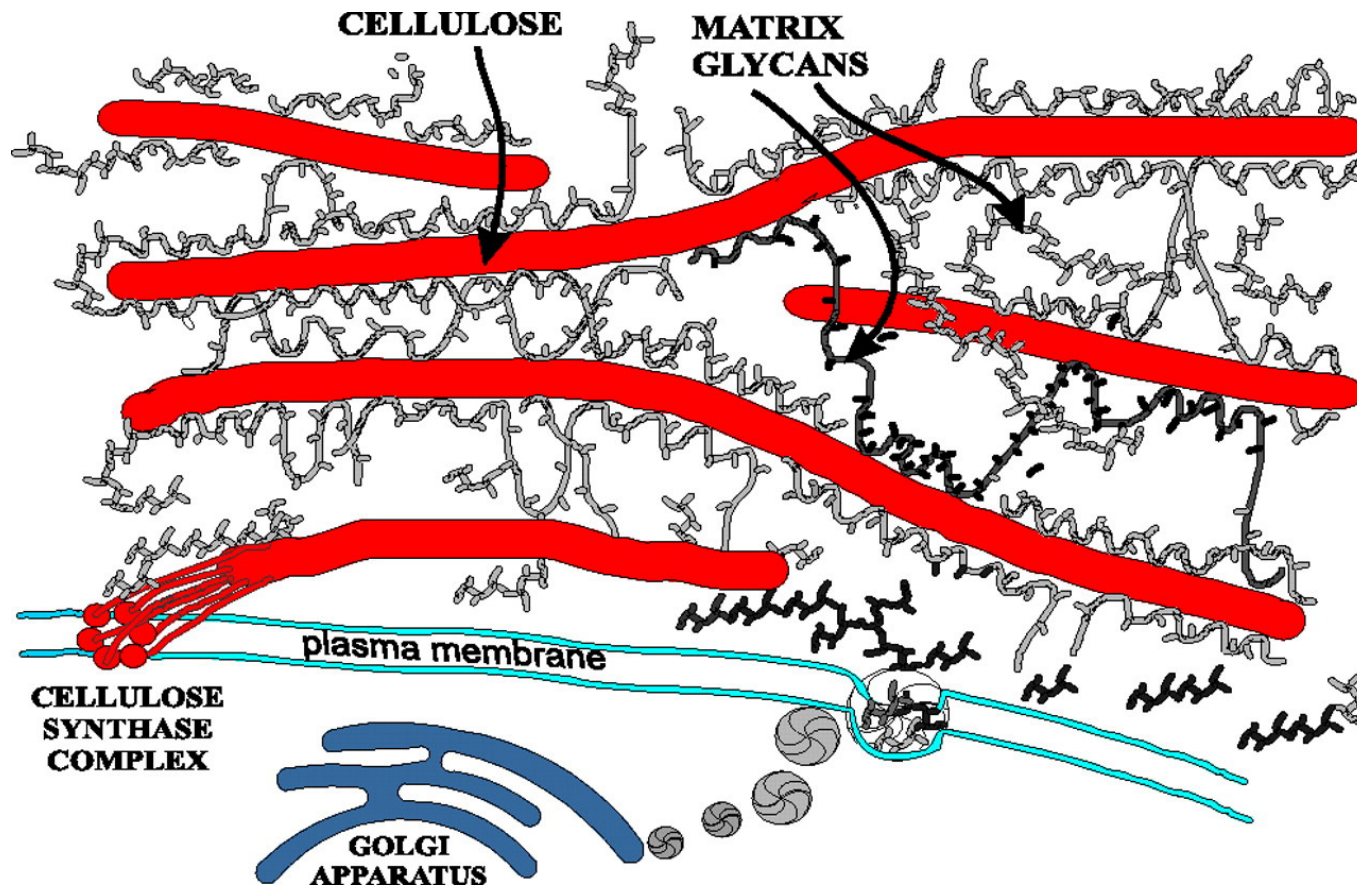
- Cellulose micro fibrils are almost certainly formed at the outer surface of the plasma membrane .

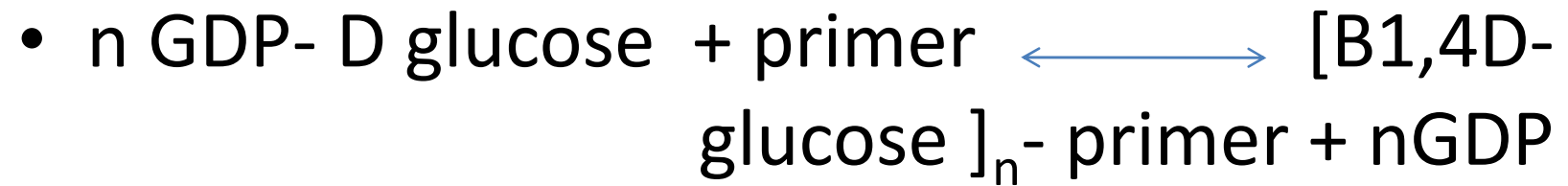
.

- Plasma membrane is covered with partly embedded, square packed, spherical granules



- It is generally thought that these granules are aggregates of the enzyme cellulose synthetase which catalyze elongation of cellulose microfibrils .
- (catalyze the transfer of glucose residue from GDP-D glucose to the outer end of cellulose primer).





ii Matrix polysaccharide  **pectin**
hemicellulose

- in the cisternae of the Golgi bodies which contain synthetase enzymes that catalyze the characteristic reactions of pectin and hemicellulose formation , then transported in vesicles nipped off the golgi cisternae to the plasma membrane.
- vesicles fuse with the plasma membrane & empty their contents into the cell wall by exocytosis.

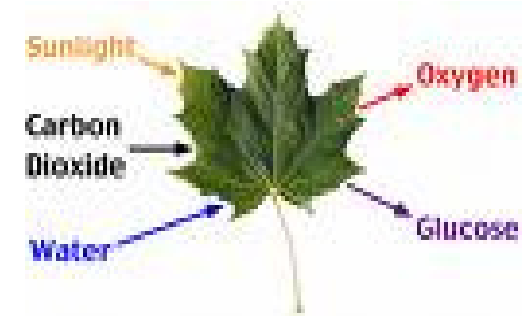
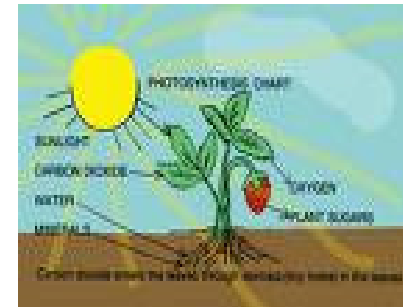
2- Proteins :

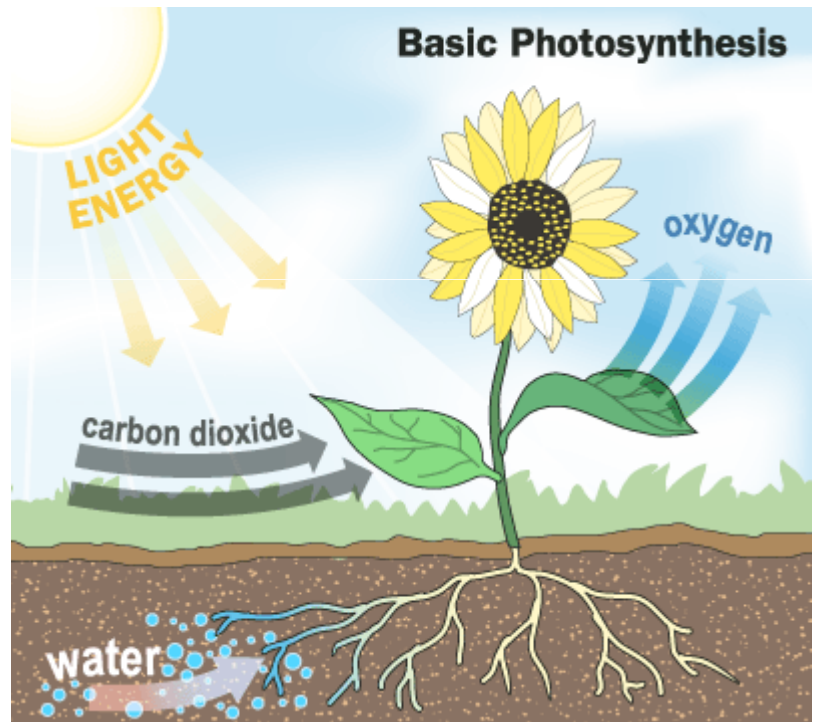
- little is known of the biosynthesis of the specific proteins , structural proteins of the cell wall .
- In an animal cells proteins which are destined for secretion are synthesized on the RER.
- Golgi bodies are concerned with the glycosylation of hydroxyproline -rich glycoprotein & its transport to the wall (through Golgi vesicles in the some manner previously described) .

Photosynthesis

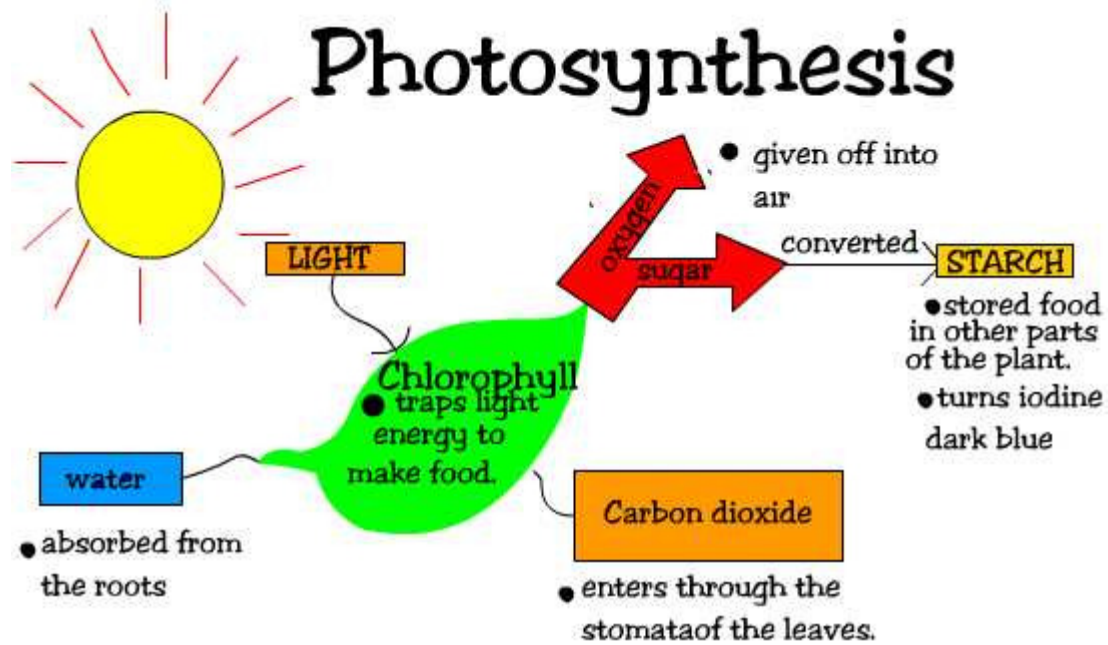
- **Photosynthesis**
- **Definition :**

☐ Utilization of solar (sun) energy by photosynthetic (e.g plant) cells for the biosynthesis of cell components in carbohydrates





Photosynthesis



Photosynthetic organisms :

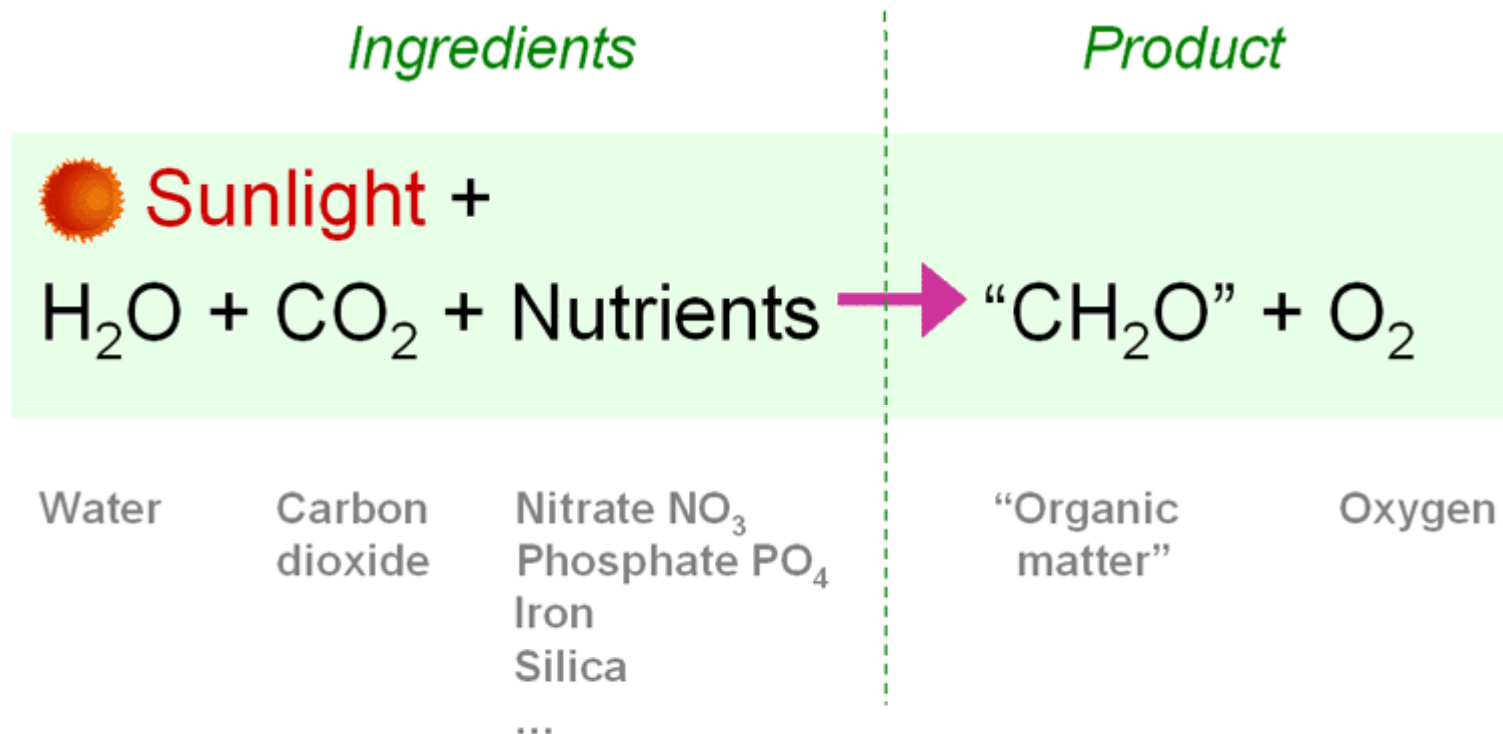
* The capacity to carry out photosynthesis is found in a wide range of organisms in both the prokaryotic (**PK**) and eukaryotic (**EK**) domains.

- **EK** : higher green plants, multicellular green , brown and red algae (chlorophyll is masked by other pigments)
- **PK** : blue green algae, sulfur bacteria , purple bacteria .

Photosynthesis :

- The overall process of photosynthesis involve the absorption and retention of light energy , it's conversion into chemical energy and the storage of this chemical energy in the final products of photosynthesis .
- Organisms capable of photosynthesis produce carbohydrate , molecular oxygen from CO_2 , H_2O , ATP and NADPH .

Photosynthesis



Same rule applies to marine life that applies to terrestrial life.

– The net reaction of photosynthesis :



– Photosynthesis occurs in 2 phases

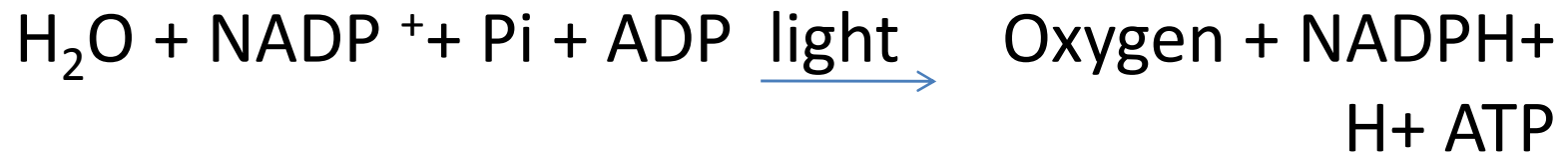
i. Light phase

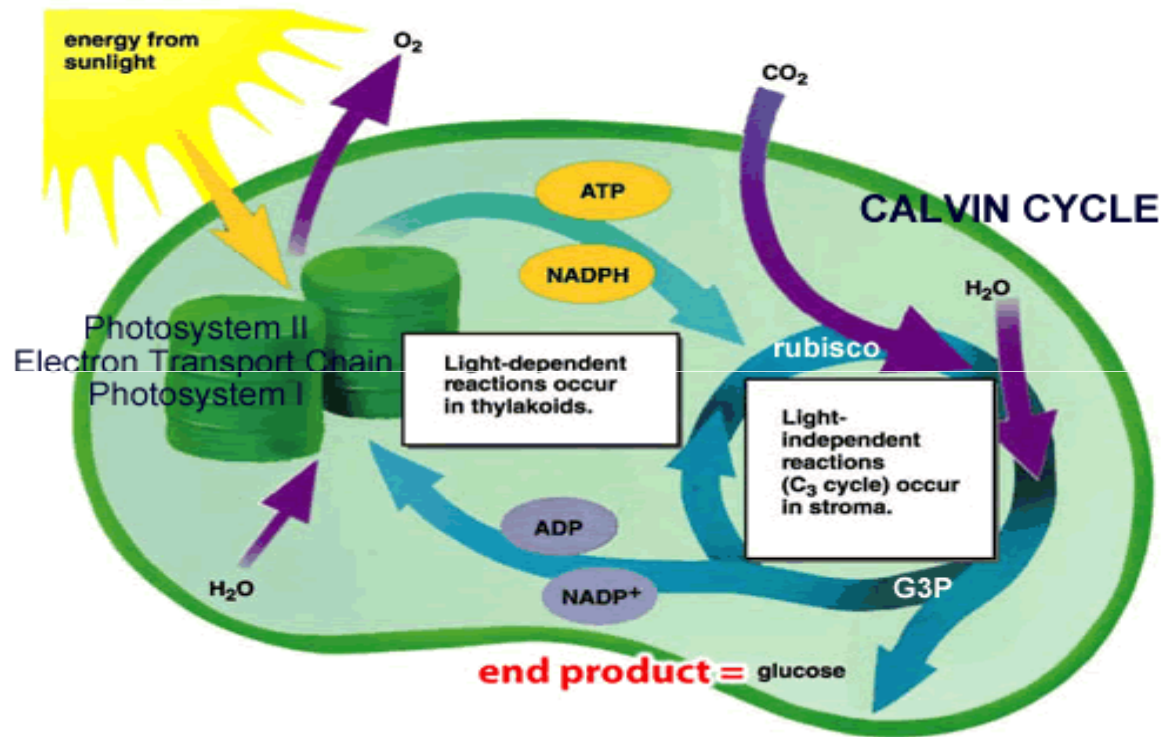
ii . Dark phase .

- The **light phase** (or light reaction) which are directly dependent on light energy , and the **dark reactions** (phase) which occur in the absence of light.
- However, the **term dark reaction** should not be taken to mean that it takes place only in the dark or at night, in living plants they takes place together with the light reactions, in the day time.

I) Light phase :

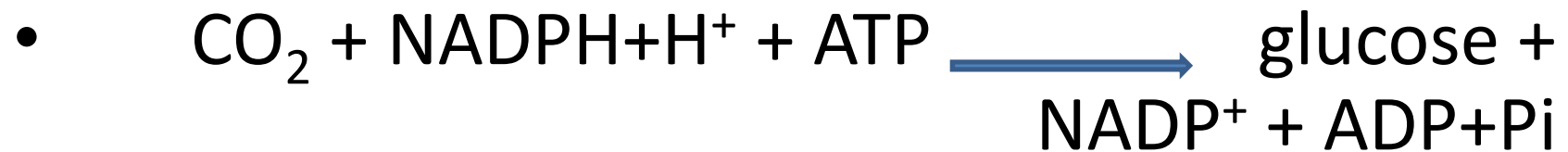
- This is the first phase and involves the capture of light energy by light absorbing pigments and its conversion in to chemical energy of ATP and certain reducing agents particularly NADPH as shown below .



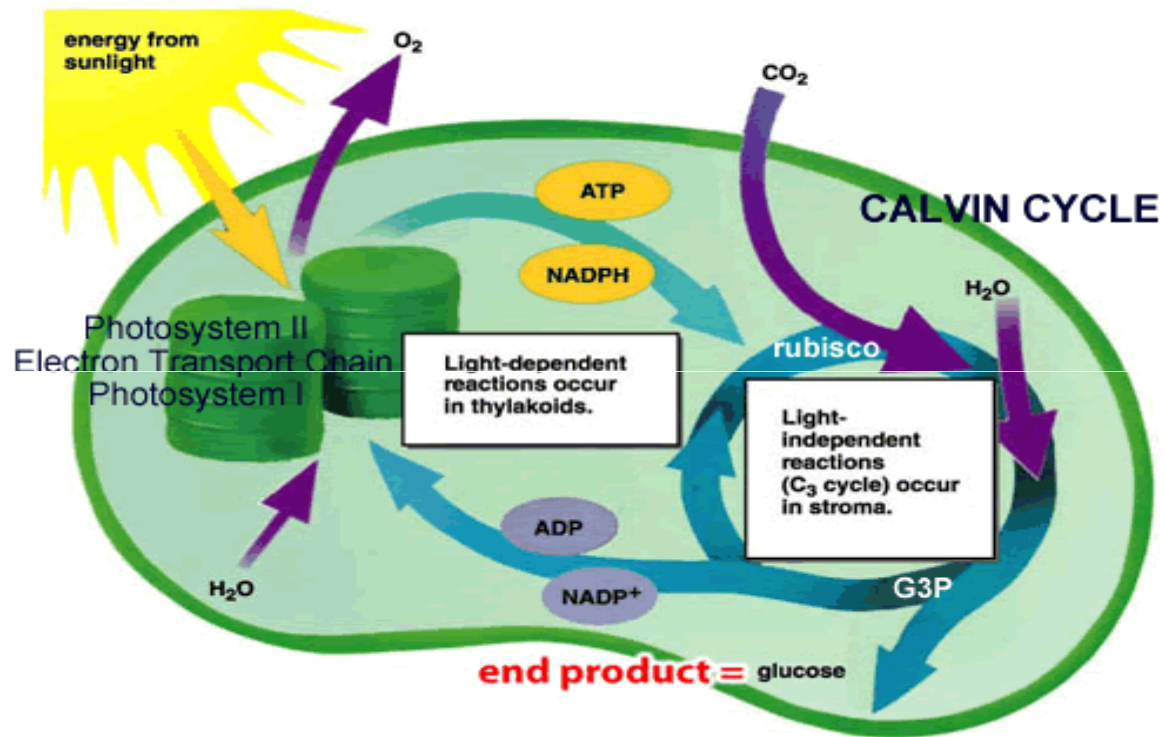


ii) Dark phase :

➤ In the second phase of photosynthesis the energy rich products of the first phase NADPH , ATP are used as sources of energy to bring about the reduction of CO_2 to yield glucose as shown below .



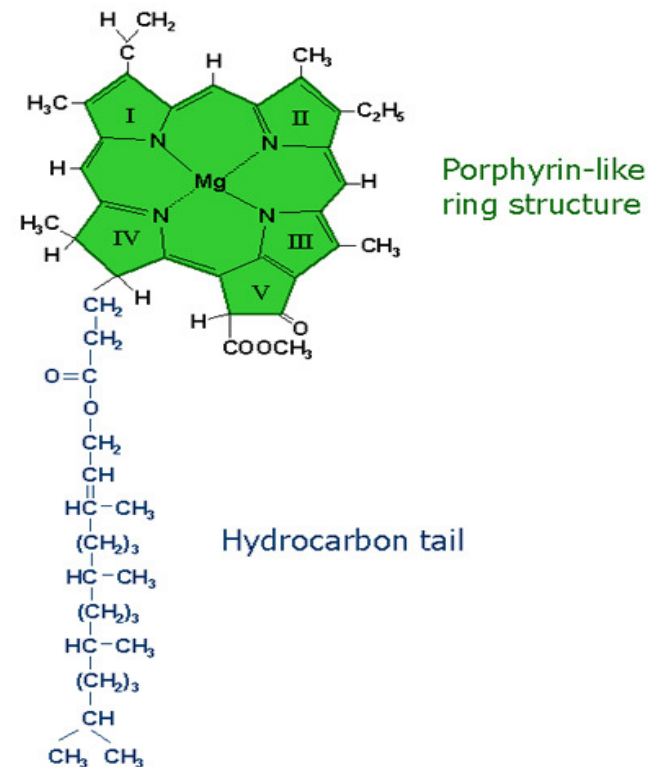
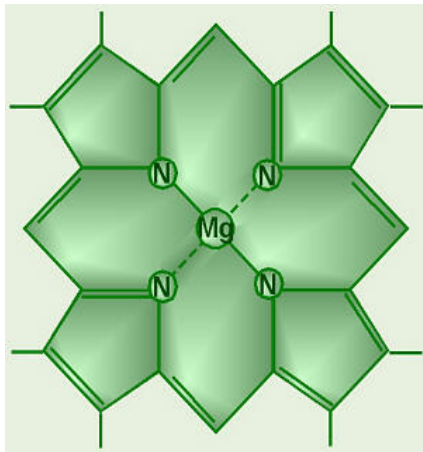
➤ Photosynthesis requires the interaction of two light reactions, both of them can be driven by light of wave length less than 680 nm but only one of them requires light of longer wave length .

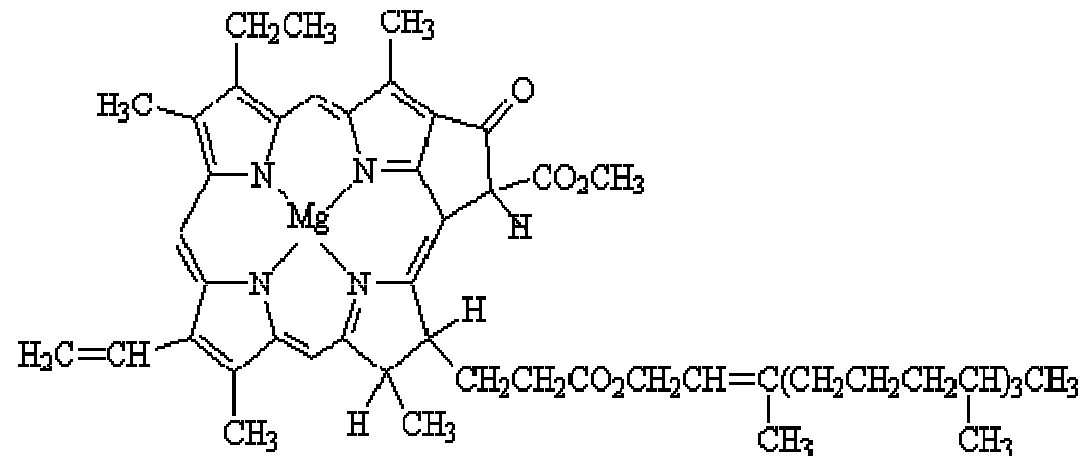


Chlorophyll :

- (The pigments necessary for photosynthesis)
 - chlorophylls are the pigments absolutely necessary for photosynthesis to occur .
 - Higher plants contain two types of chlorophyll:
- Chlorophyll a and chlorophyll b .

- **Chlorophyll a** : a substituted tetrapyrrole , the four nitrogen atoms of the pyrroles are coordinated to a Mg atom to form an extremely stable essentially planar complex
- thus chlorophyll is a magnesium porphyrin .
- whereas heme is an iron porphyrin.

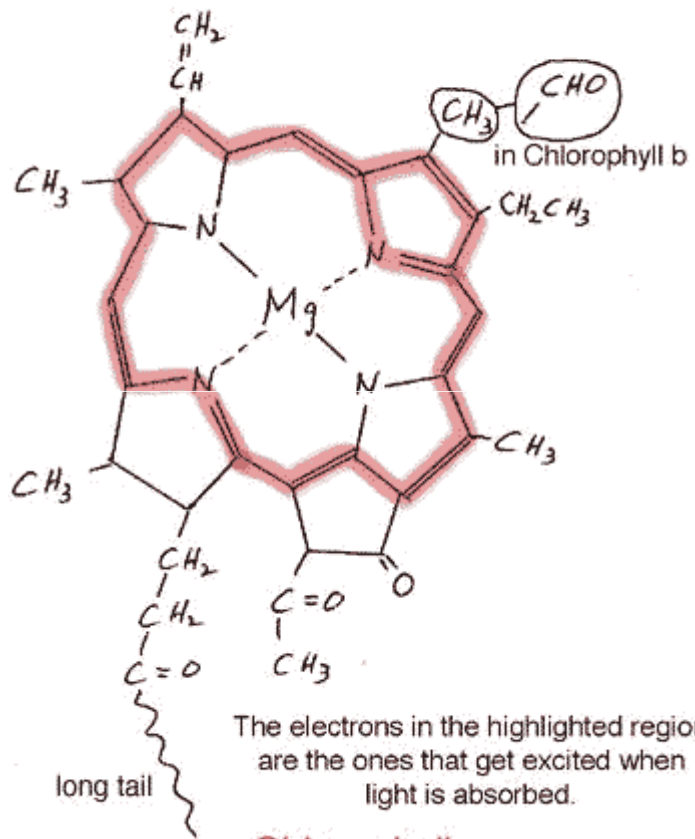




Chlorophyll a

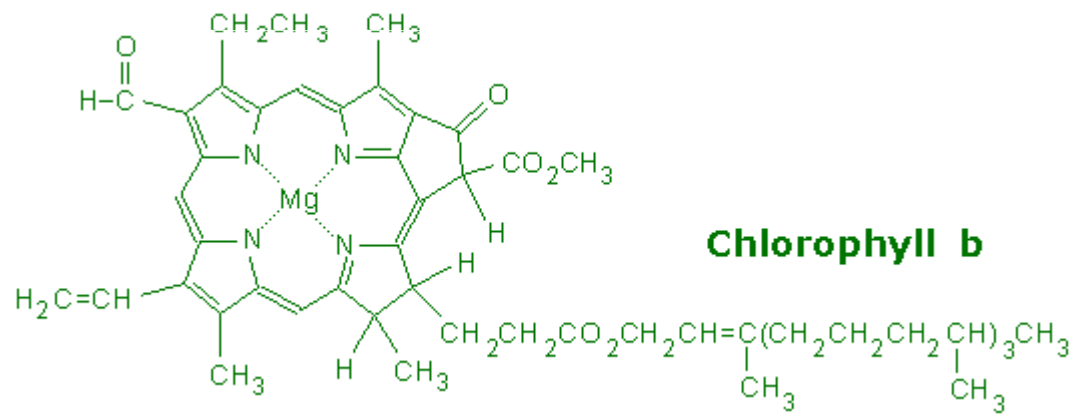
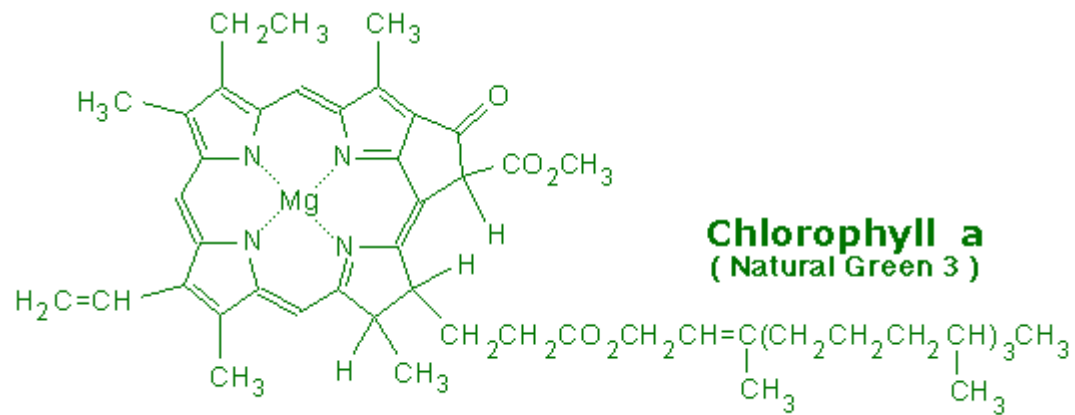
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- **Chlorophyll b** : differs from chlorophyll a in having a formyl (CHO) group in a place of methyl (CH₃) group on one of its pyrroles .



The electrons in the highlighted region are the ones that get excited when light is absorbed.

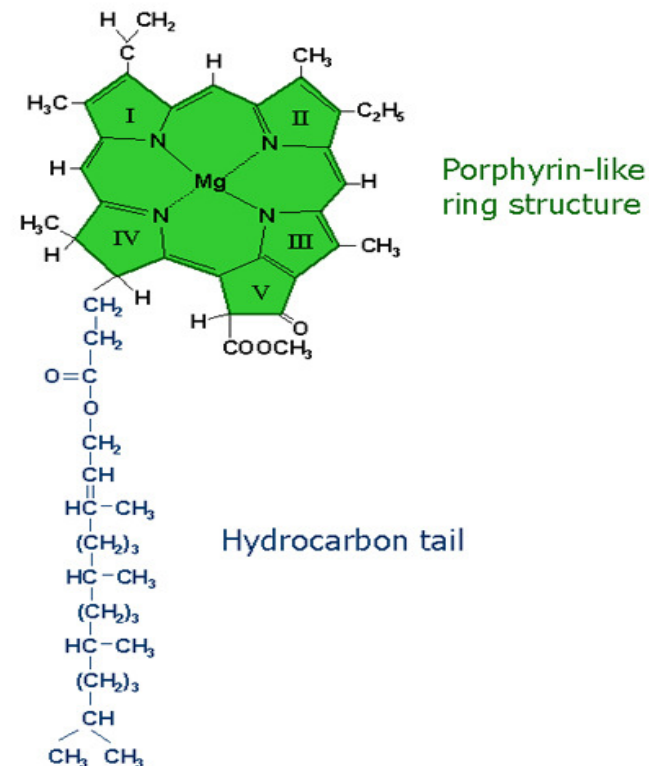
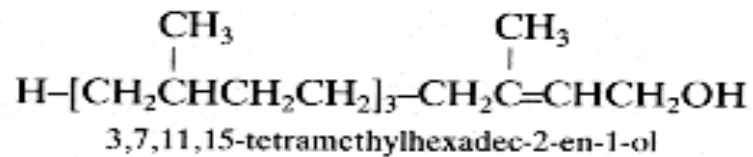
Chlorophyll a



- Another distinctive feature of chlorophyll is the presence of phytol, a highly hydrophobic 20-carbon alcohol, esterified to an acid side chain .

The alcohol phytol .

phytol (C₂₀H₄₀O),



- The chlorophyll are very effective photoreceptors because they contain networks of alternating single and double bonds. Such compounds are called polyenes.

Accessory pigments also absorb light :

- In addition to chlorophylls, the thylakoid membranes contain secondary light – absorbing pigments, called the accessory pigments, the **carotenoids and phycobilins** .
- The most important are **β -Carotene**
 - a red – orange isoprenoid compound (precursor of vit A in animals).
 - a Yellow corotenoid xanthophyll.

- The carotenoid pigments absorb light at wave length after than those absorbed by the chlorophylls . (supplementary light receptors)
- Phycobilins are linear tetrapyrroles (not have cyclic structure or Mg^{2+} as chlorophyll)
 - ex. phycoerythrin
 - phycocyanin .