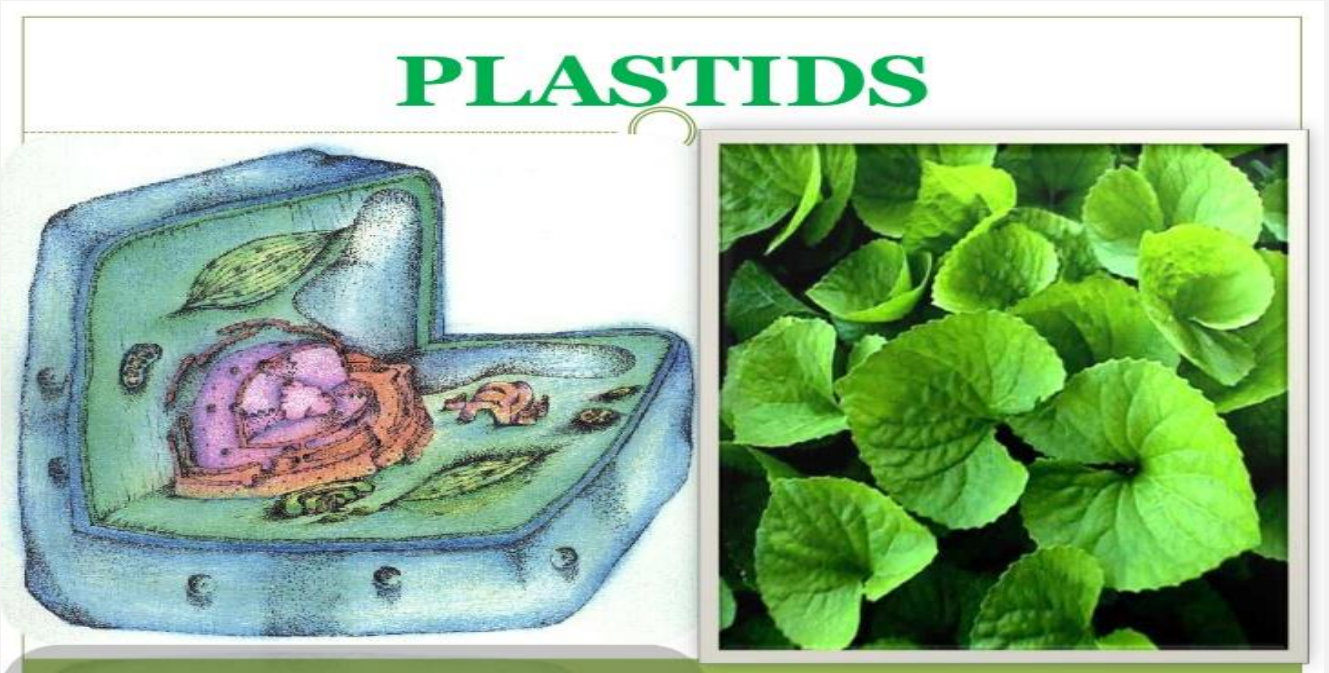
Plastids

Plastids are double membrane bound organelles found inside plants and algae, which are primarily responsible for activities related to **manufacture and storage of important chemical compounds** used by the cells . the types of pigments present can determine the cell's color.

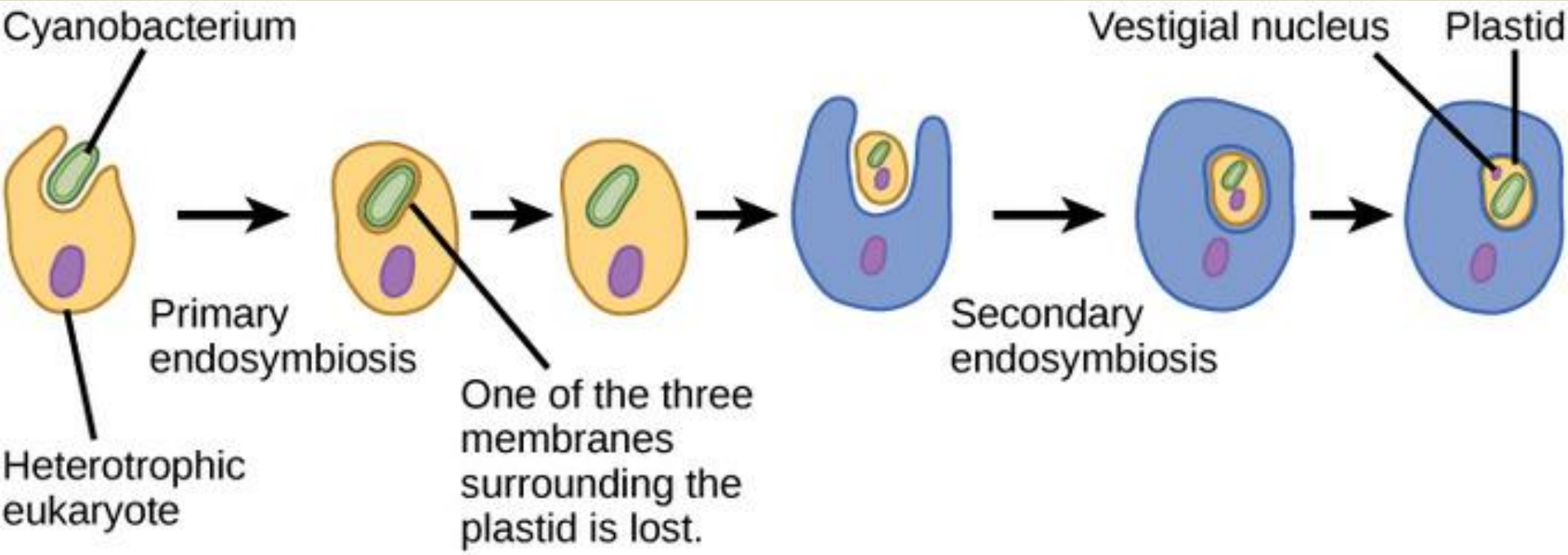
In plants, plastids may differentiate into several forms, depending upon which function they play in the cell. Undifferentiated plastids (***proplastids***) may develop into of the following:

- **Chloroplasts**
- **Chromoplasts**
- **Leucoplasts**

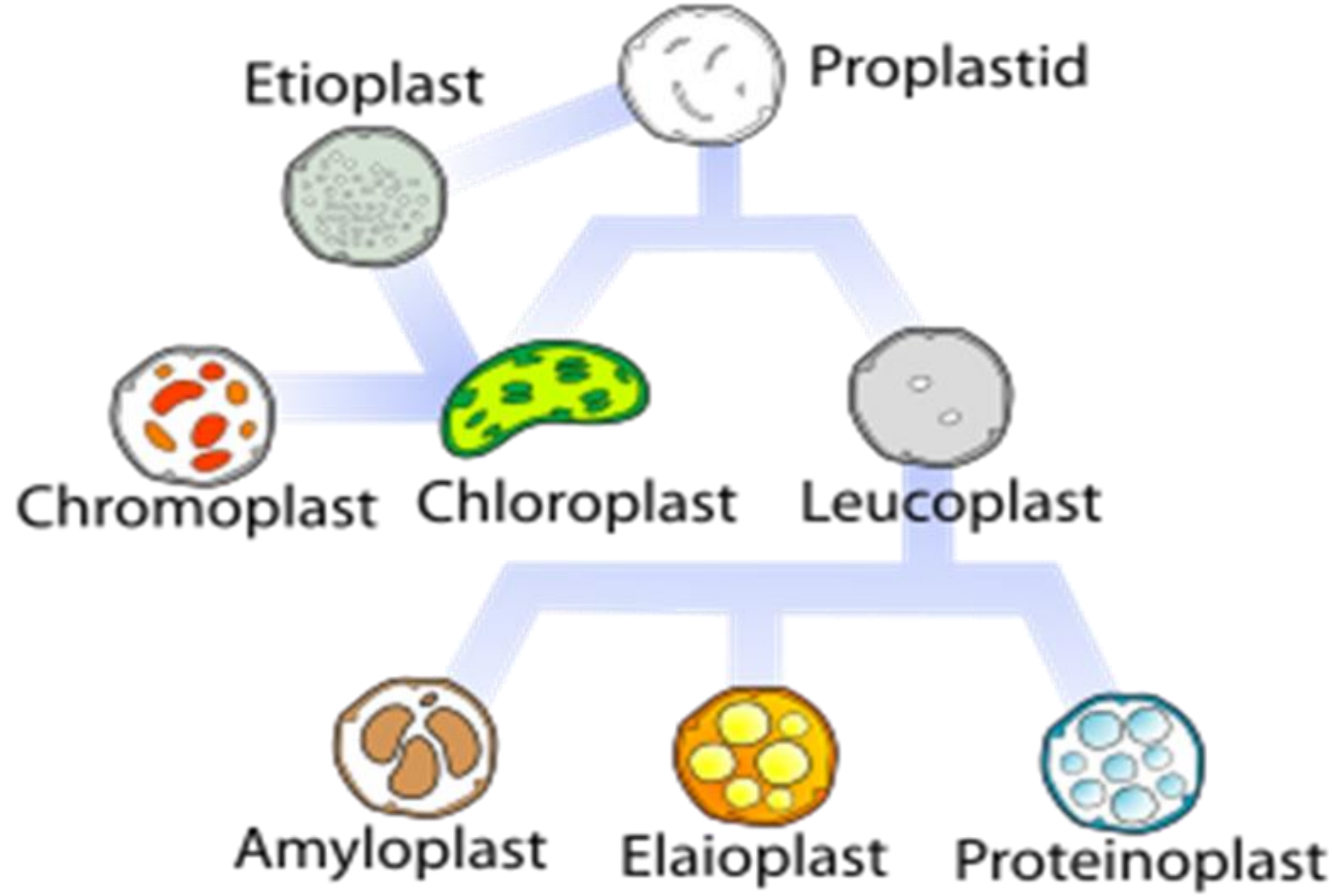


Origin of plastids

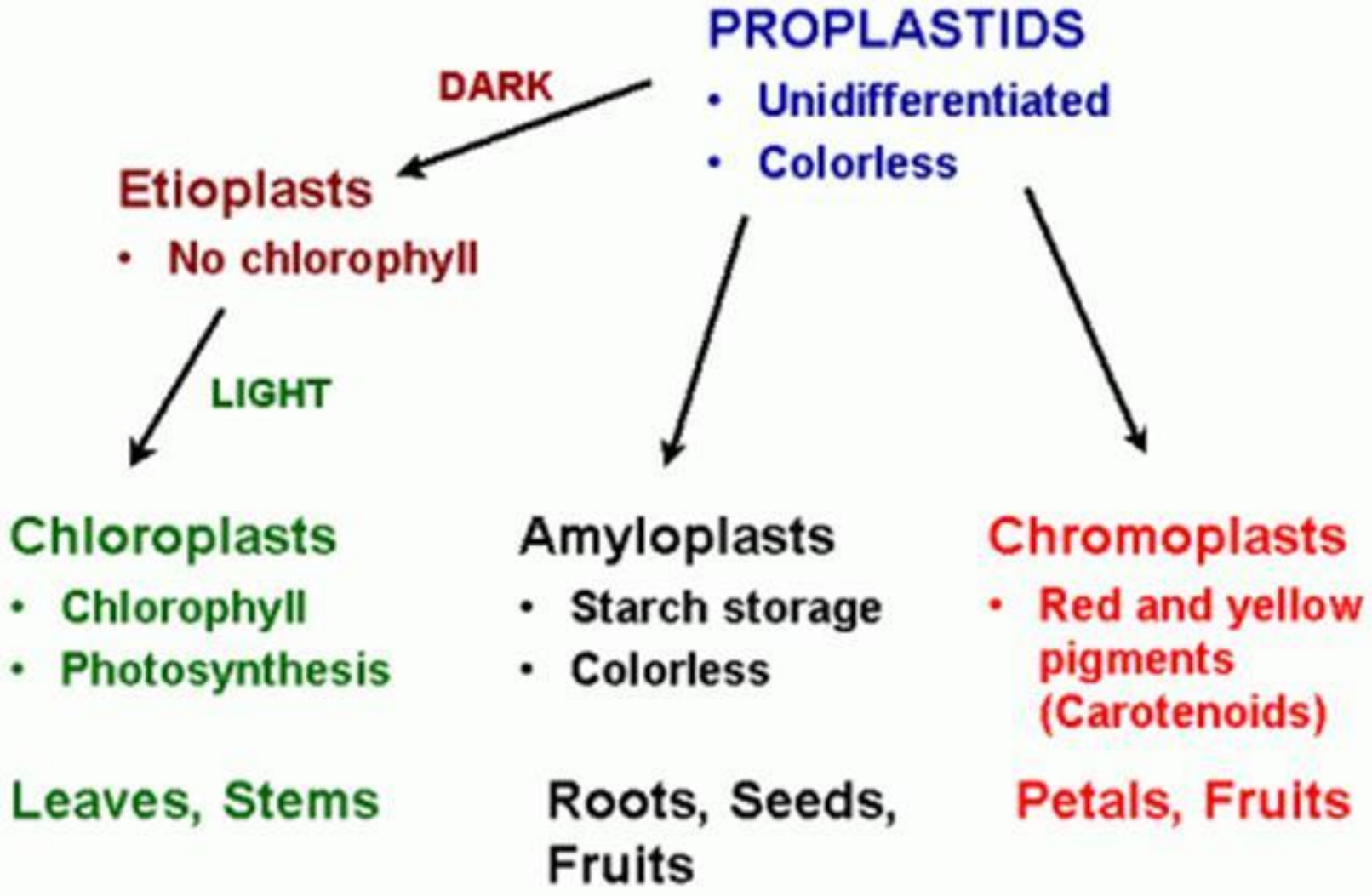
symbiosis may explain the origin of chloroplasts. Chloroplasts have many similarities with Photosynthetic bacteria ,including a circular DNA , prokaryotic-type ribosomes , and similar proteins in the photosynthetic reaction center. The endosymbiosis theory suggests that photosynthetic bacteria were engulfed by early eukaryotic cells to form the firs plant cells. Therefore, chloroplasts may be photosynthetic bacteria that adapted to life inside plant cells.



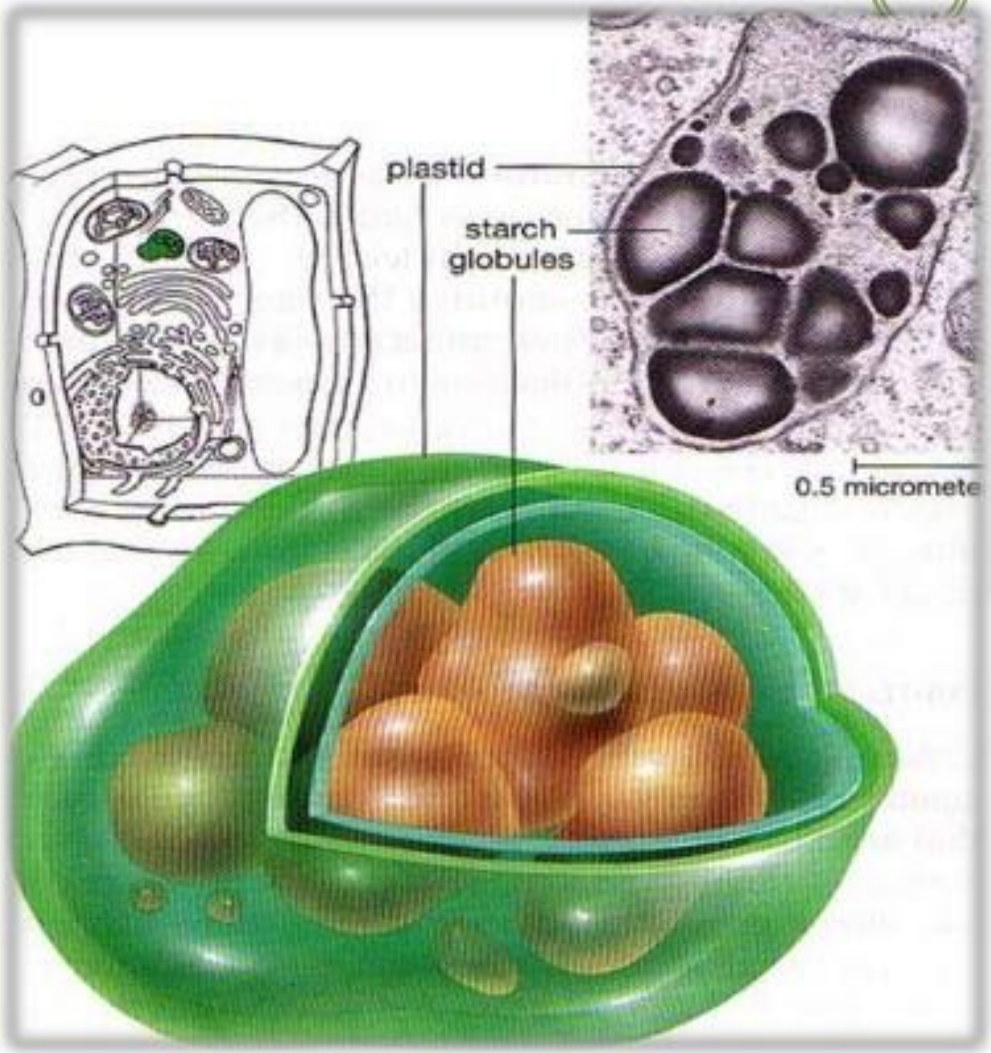
Plastids

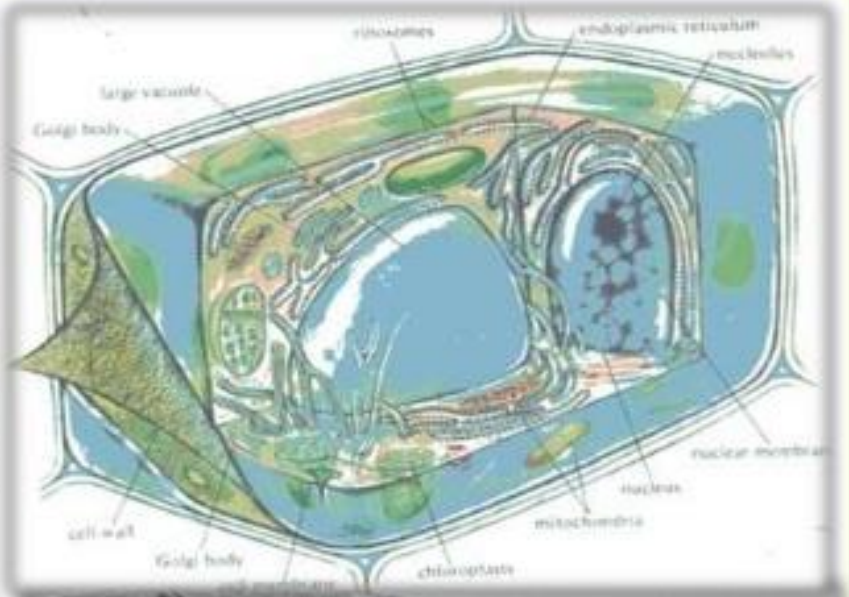

Proplastid
Etioplast
Chromoplast
Chloroplast
Leucoplast
Amyloplast
Elaioplast
Proteinoplast

The Plastid Family of Organelles



PLASTIDS


plastid
starch globules
0.5 micrometer


ribosomes
endoplasmic reticulum
nucleolus
large vacuole
Golgi body
nucleus
mitochondria
cell wall
chloroplasts

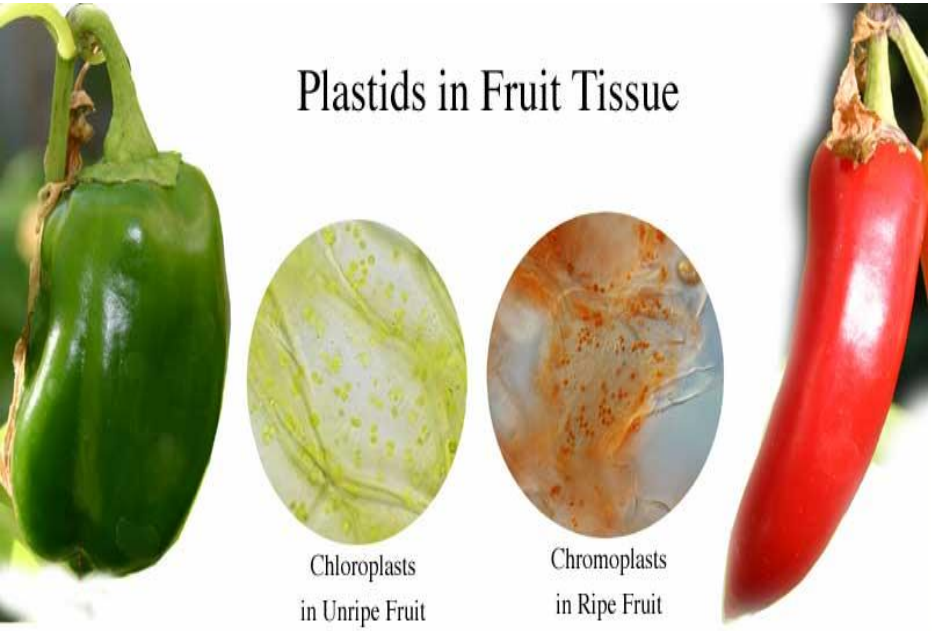
- **Chromoplasts**
- **Leucoplasts**

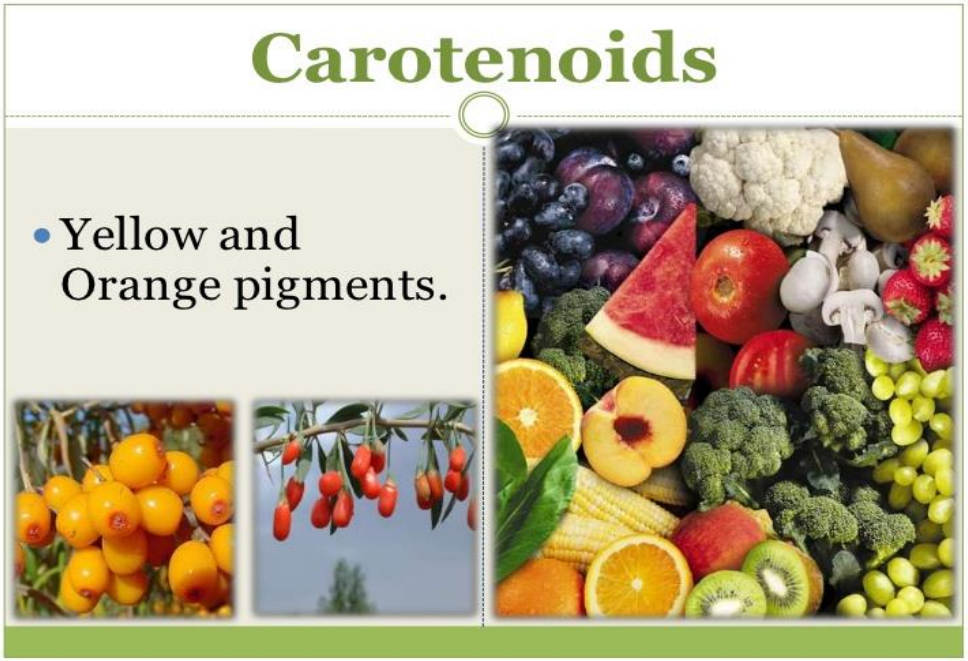
Chromoplasts

Chromoplasts are red , yellow or orange in color and are found in petals of flowers and in fruit. Their color is due to two pigments, **Carotene and Xanthophyll**.

Functions of chromoplast

- Flowers is to *attract agents of pollination*.
- Fruit to *attract agents of dispersal*.





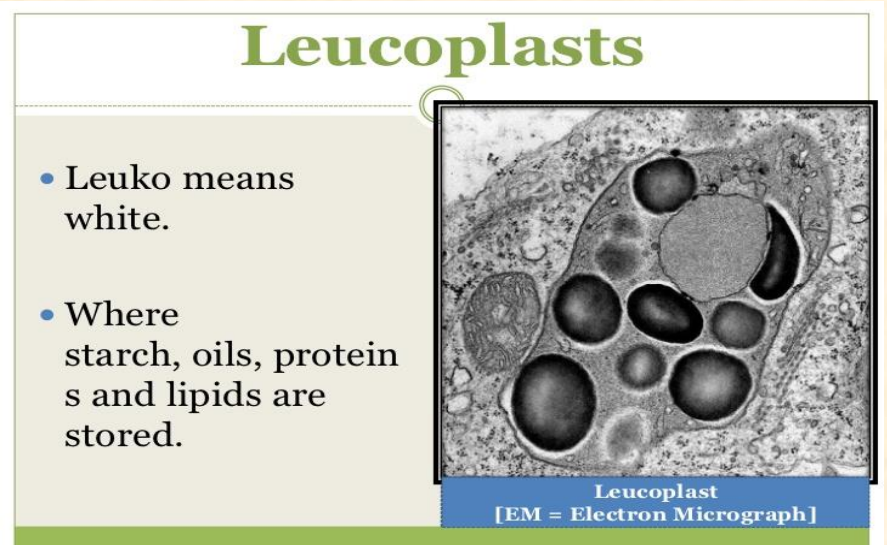
Leucoplasts

Leucoplasts are colorless plastids and occur in plant cells not exposed to light, such as roots and seeds. They are colorless due the absent of pigments. leucoplasts sometimes differentiate into more specialized plastids

- ✓ **Amyloplasts** :for starch storage and detecting gravity
- ✓ **Elaioplasts** :for lipids storage
- ✓ **Proteinoplasts** :for storing and modifying protein
- ✓ **Tannosomes** :for synthesizing and producing tannins and polyphenols

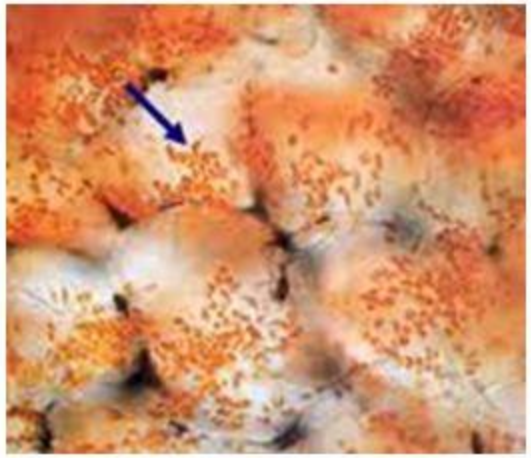
Functions of leucoplasts

- starch grain , oils ,proteins and lipids are stored .
- the synthesis of fatty acids, amino acids.

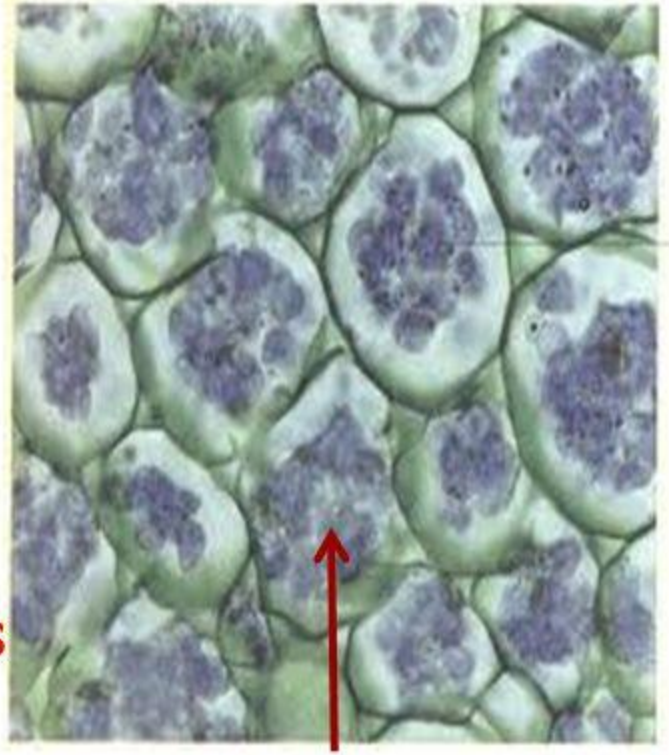


There are three types of plastids found in plant cells: Plastids

← Chloroplasts



← Chromoplasts



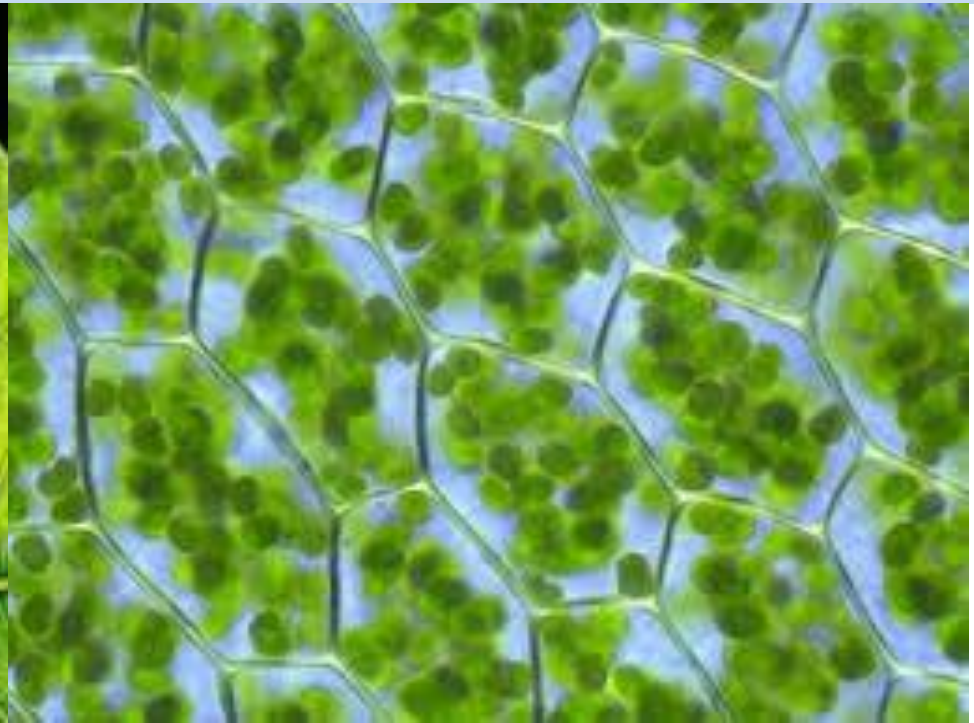
Leukoplasts

Chloroplasts

A **chloroplast** is an organelle unique to plant cells that contains chlorophyll are responsible for photosynthesis process so that plants can convert sunlight into chemical energy.

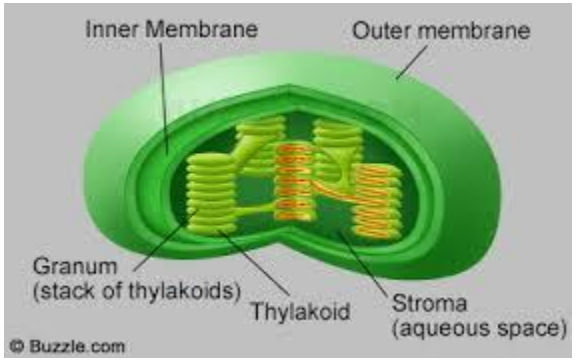
Functions of chloroplasts

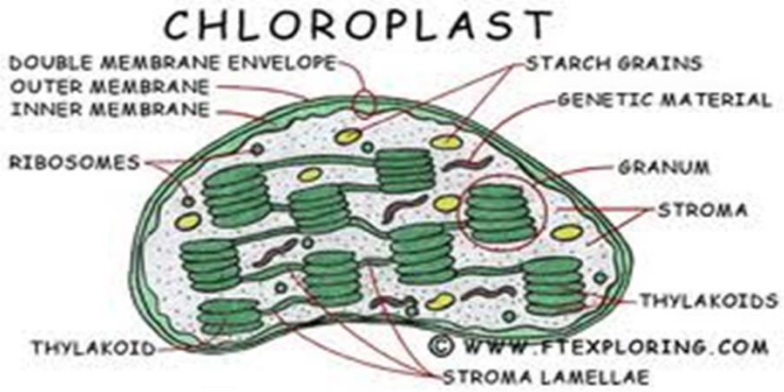
•chloroplasts are the sites for photosynthesis and glucose production



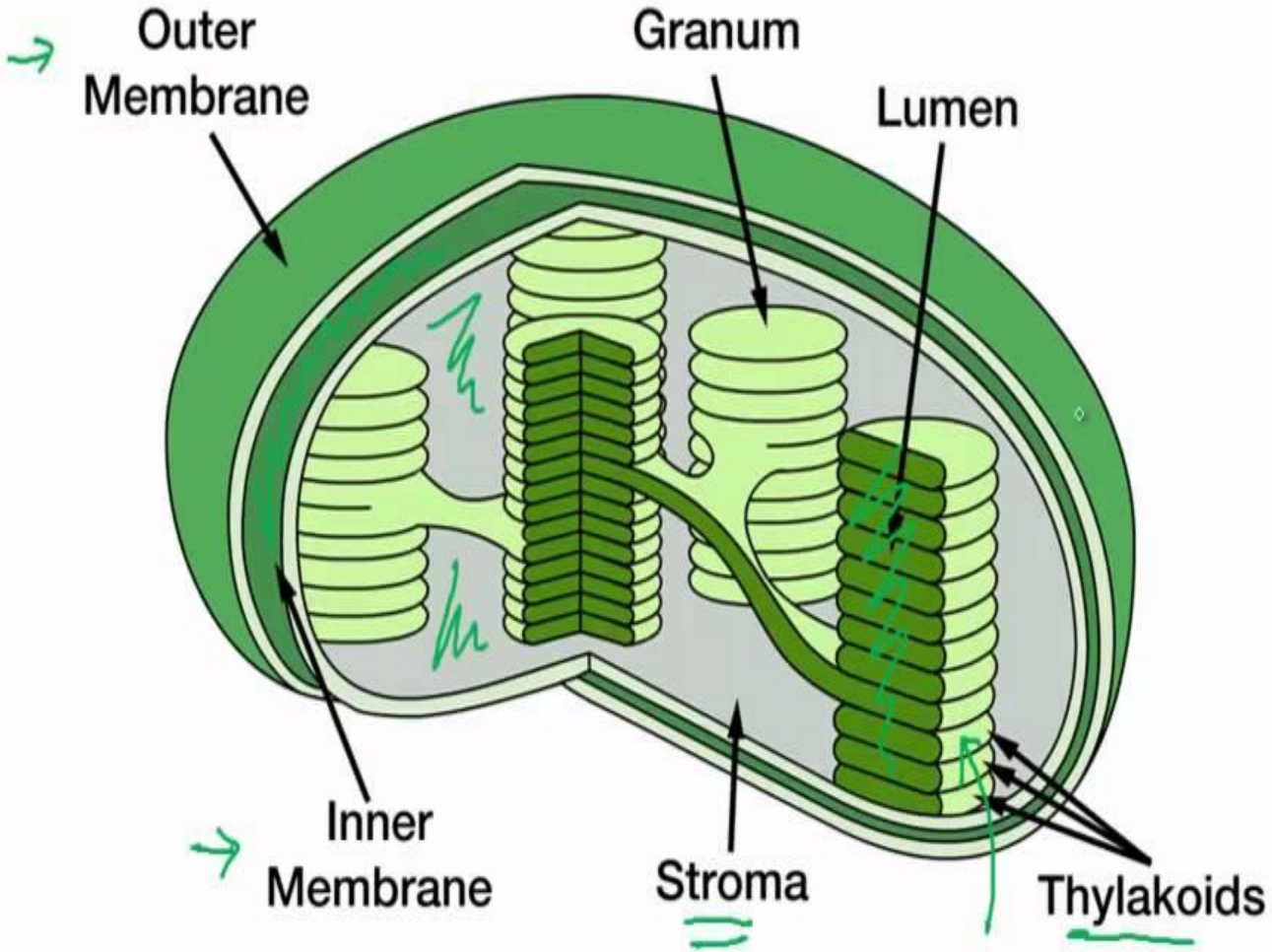
Chloroplast structures include:

- **Outer membrane** - It is a semi-porous membrane and is permeable to small molecules and ions and not permeable to larger proteins.
- **Intermembrane Space** - It is usually a thin intermembrane space about 10-20 nanometers and it is present between the outer and the inner membrane of the chloroplast.
- **Inner membrane** - The inner membrane of the chloroplast forms a border to the stroma. It regulates passage of materials in and out of the chloroplast. In addition the fatty acids, lipids and carotenoids are synthesized in the inner chloroplast membrane.





What is the structure of a chloroplast?

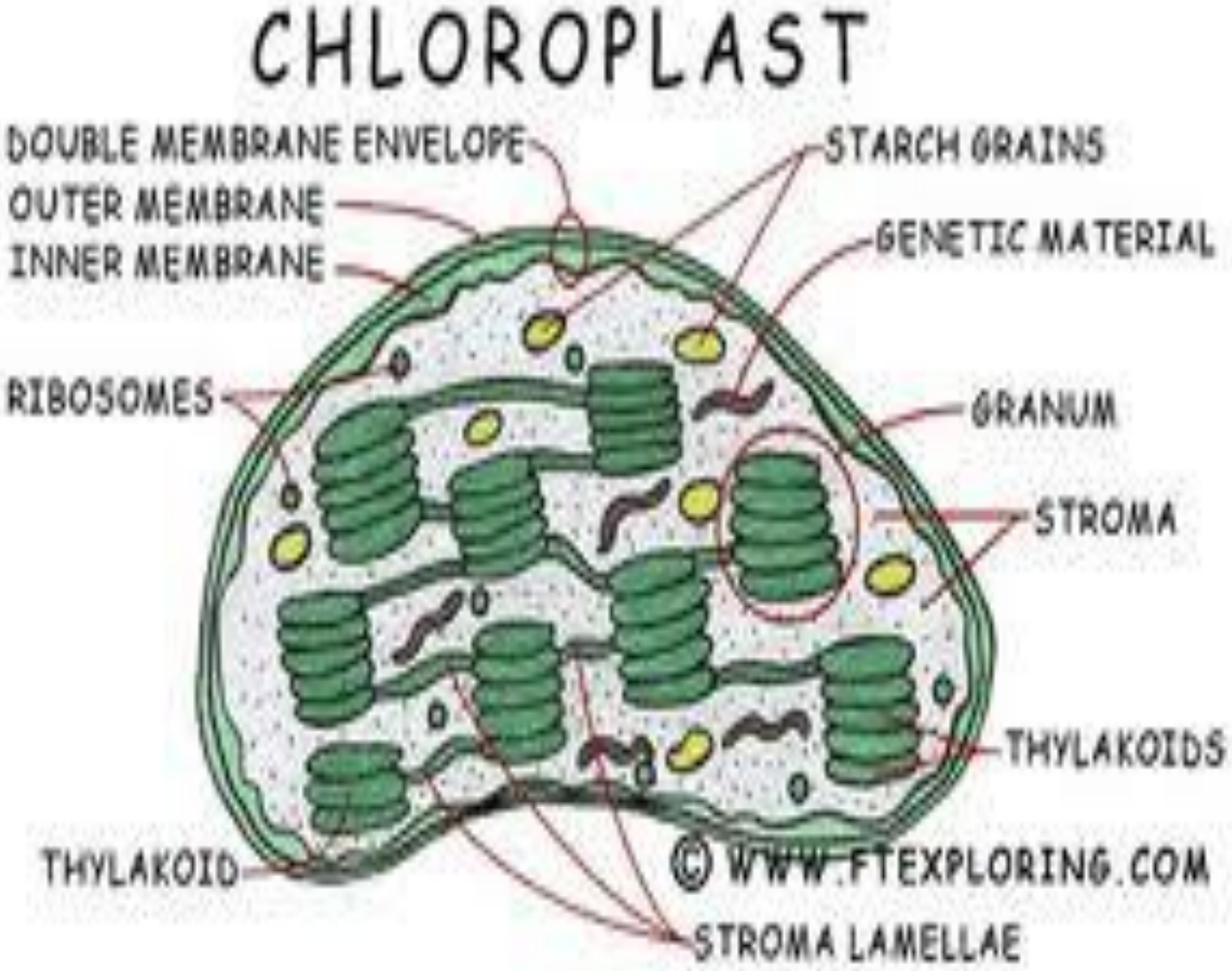


•**Grana (singular granum)** - dense layered stacks of thylakoid sacs that serve as the **sites of conversion of light energy to chemical energy.**

•**Thylakoid Membrane** - internal membrane system consisting of *flattened sac-like* membrane structures called **thylakoids**

Chlorophyll-a green photosynthetic pigment and ethers pigment within the chloroplast grana that absorbs light energy .

•**Stroma** - dense fluid within the chloroplast that lies inside the envelope but outside the thylakoid membrane. **This is the site of conversion of carbon dioxide to carbohydrates (sugar).**
DNA of chloroplast, ribosomes ,thylakoid system, starch granules and many enzymes are found floating around the stroma.


CHLOROPLAST
DOUBLE MEMBRANE ENVELOPE
OUTER MEMBRANE
INNER MEMBRANE
RIBOSOMES
THYLAKOID
STARCH GRAINS
GENETIC MATERIAL
GRANUM
STROMA
THYLAKOIDS
© WWW.FTEXPLORING.COM
STROMA LAMELLAE

Functions

Envelope

① Trapping of sunlight and ATP formation ✓

2 membranes

Stroma

- Co_2 fixation to form food
- Protein synthesis

Thylakoid

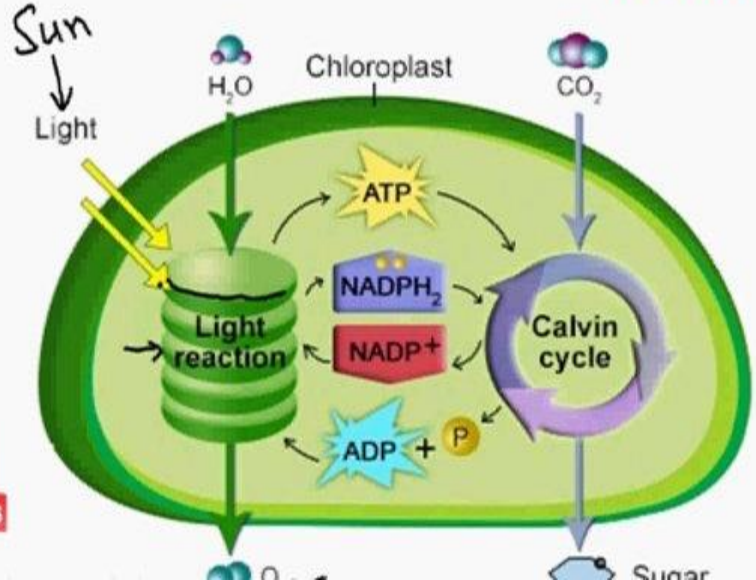
Green Chlorophyll

↓

Capture light

↓

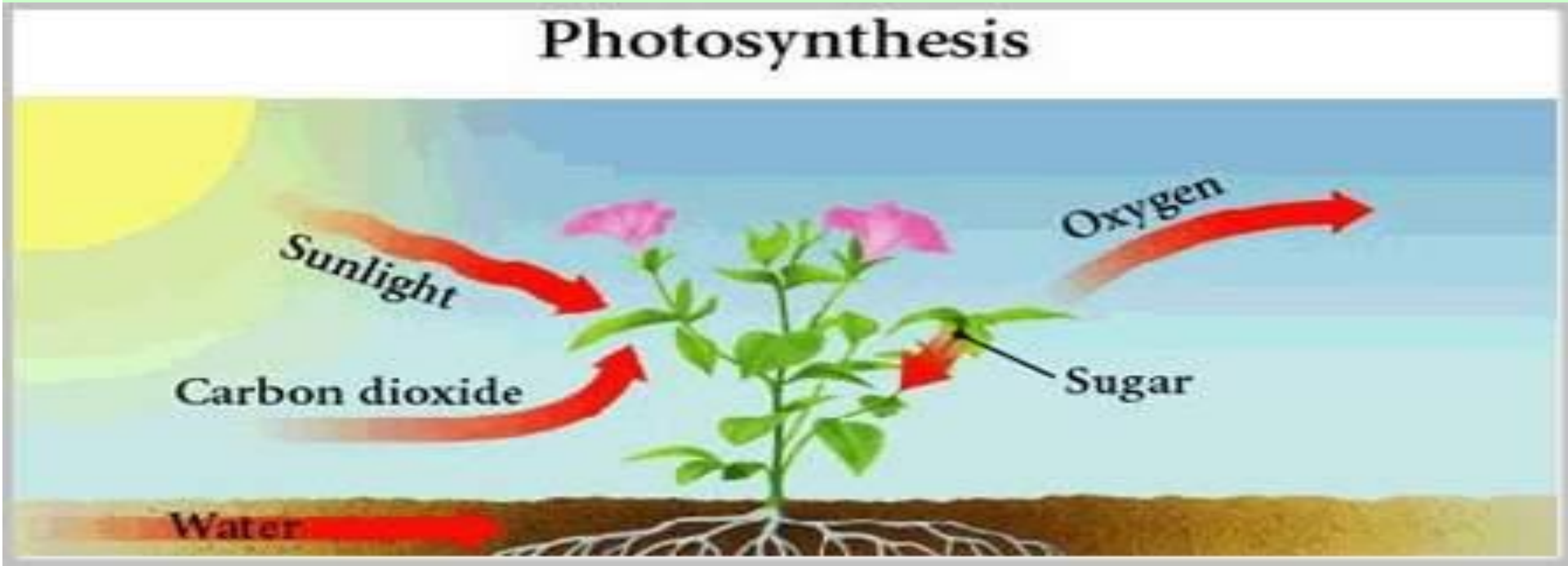
Light reaction



Photosynthesis

Photosynthesis is the process of converting light energy to chemical energy and storing it in the bonds of sugar. This process occurs in plants and algae. Plants need only light energy, CO_2, H_2O and light are converted to sugar and oxygen . The process of photosynthesis takes place in the chloroplasts , in chloroplast are pigment that absorb wavelength of light .

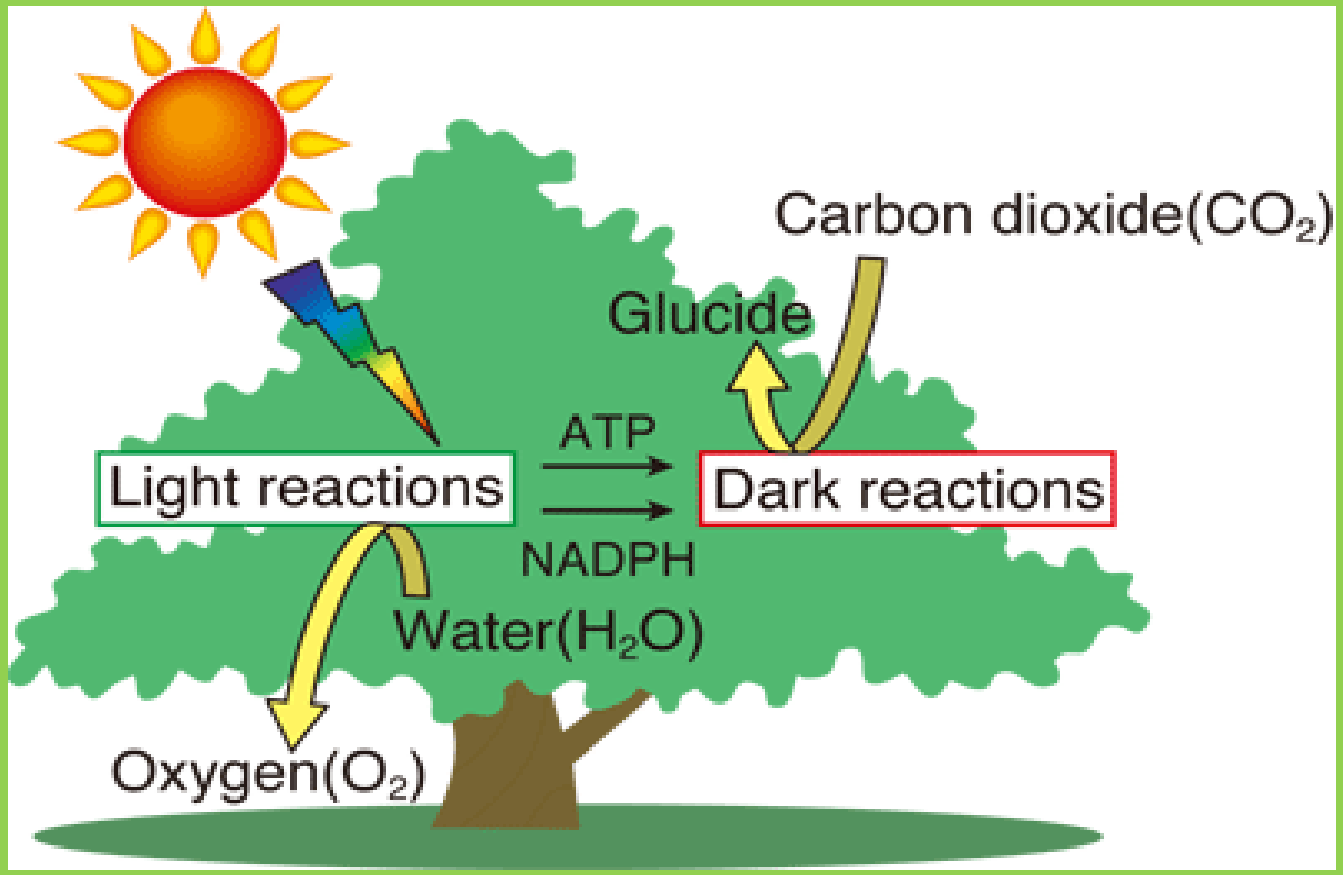
The overall chemical reaction involved in photosynthesis is:



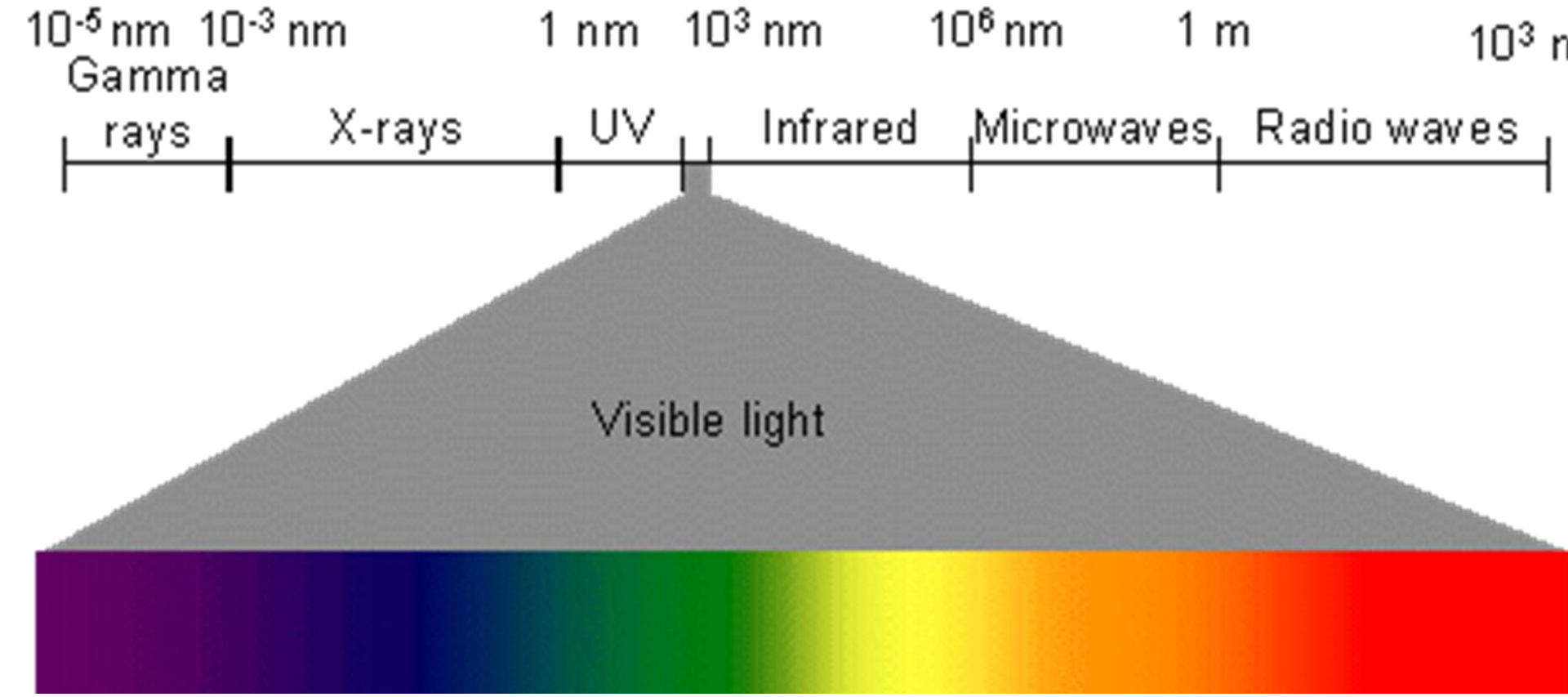
PHOTOSYNTHESIS

- Absorbing Light Energy to make chemical energy: glucose!
  - Pigments: Absorb different colors of white light (ROY G BIV)
    - Main pigment: Chlorophyll a
    - Accessory pigments: Chlorophyll b and Carotenoids
    - These pigments absorb all wavelengths (light) BUT green!

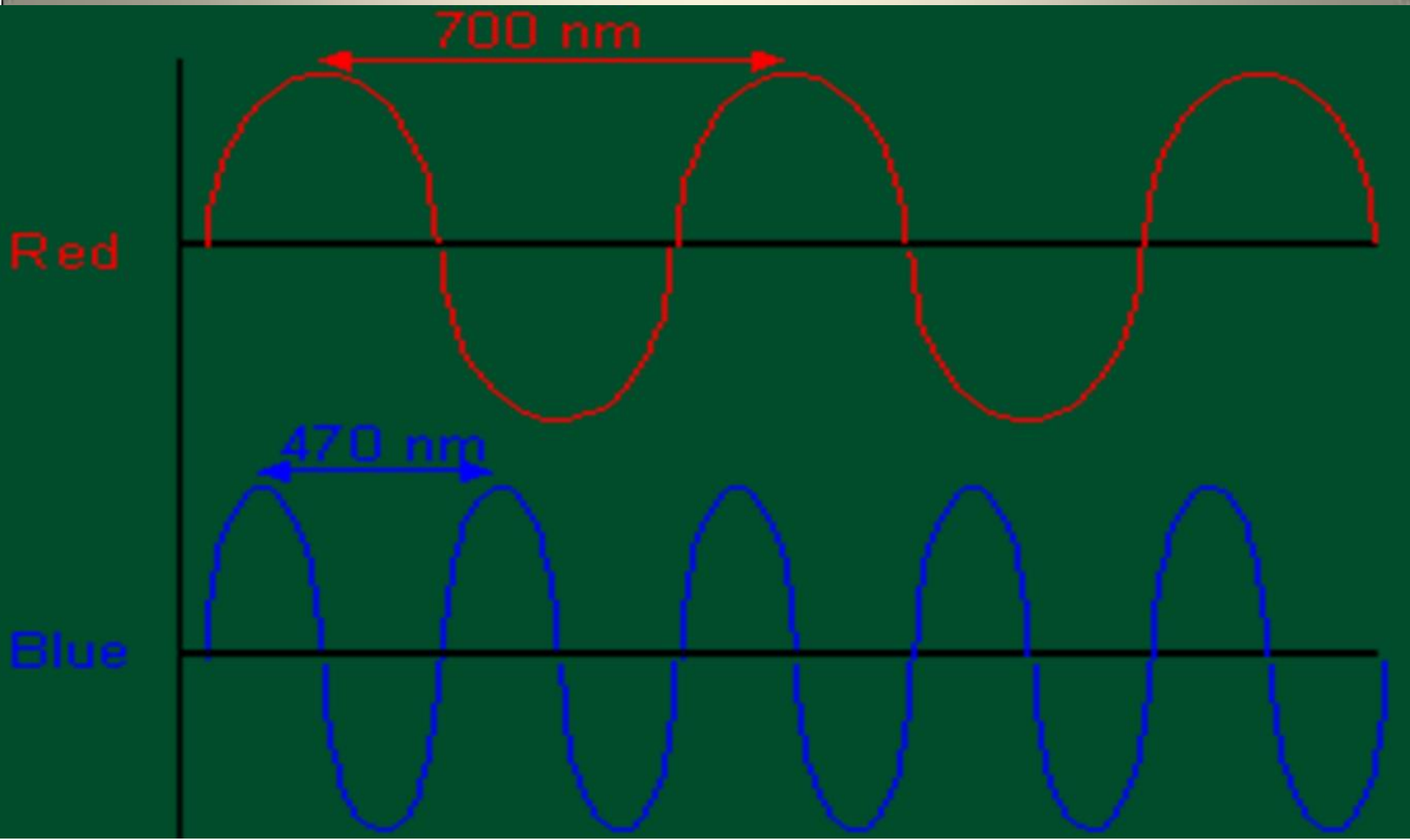
Green plants are green because they contain a pigment called chlorophyll. Chlorophyll absorbs certain wavelengths of light within the visible light spectrum. As shown in detail in the absorption spectra, chlorophyll absorbs light in the red (long wavelength) and the blue (short wavelength) regions of the visible light spectrum. Green light is not absorbed but reflected, making the plant appear green.

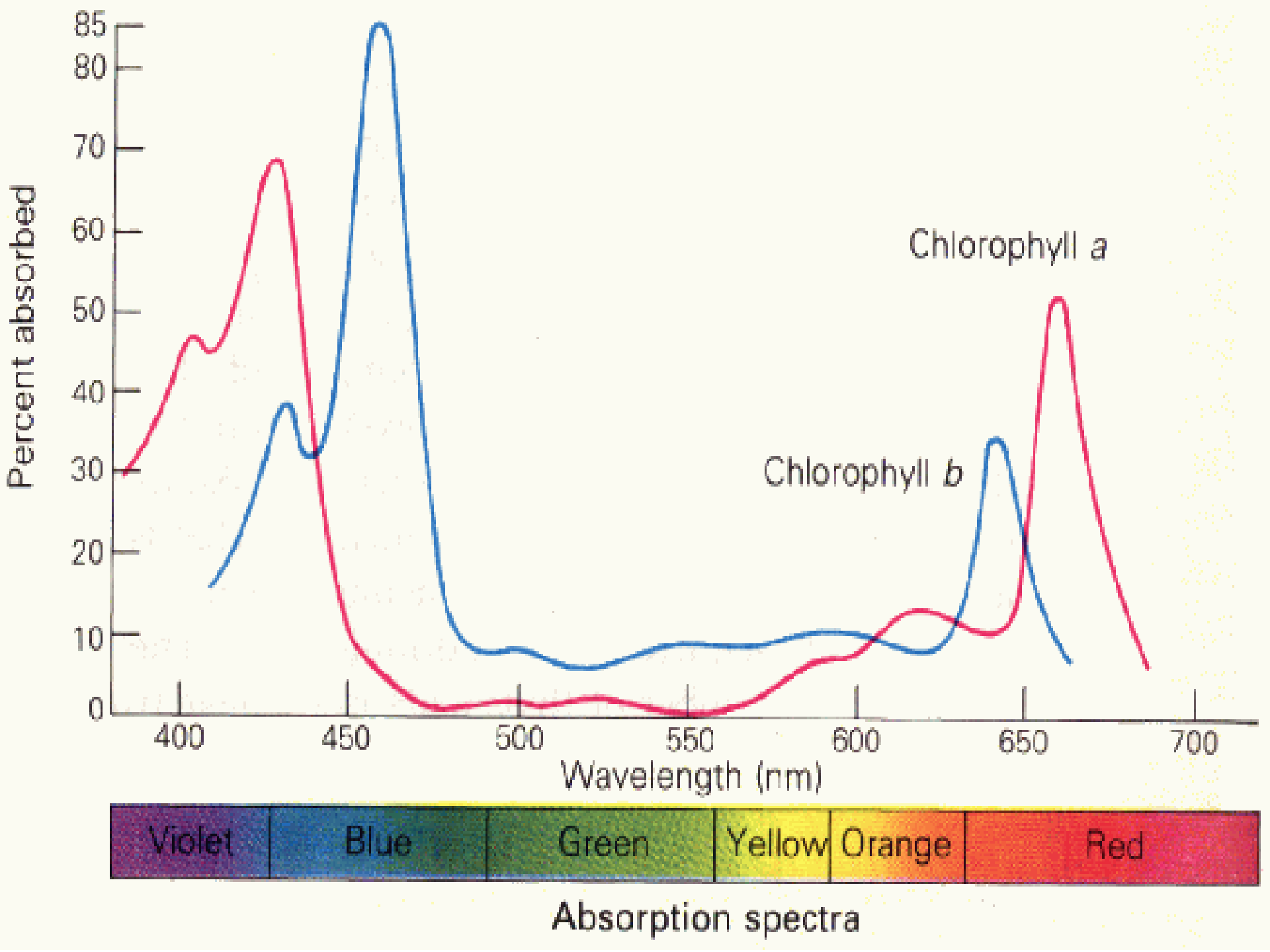


Visible light is only a small part of the electromagnetic spectrum (all forms of light).



LIGHT behaves as if it were composed of "units" or "packets" of energy that travel in waves. These packets are **photons** .
The wavelength of light determines its color.

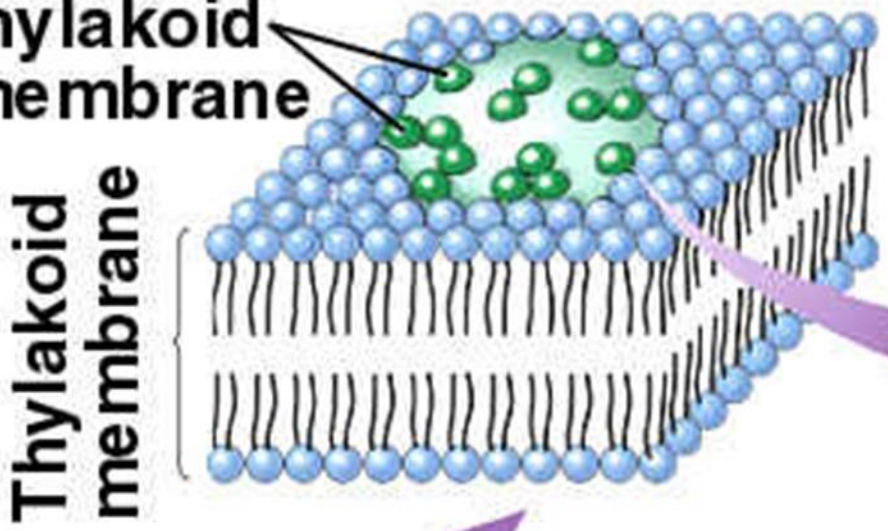




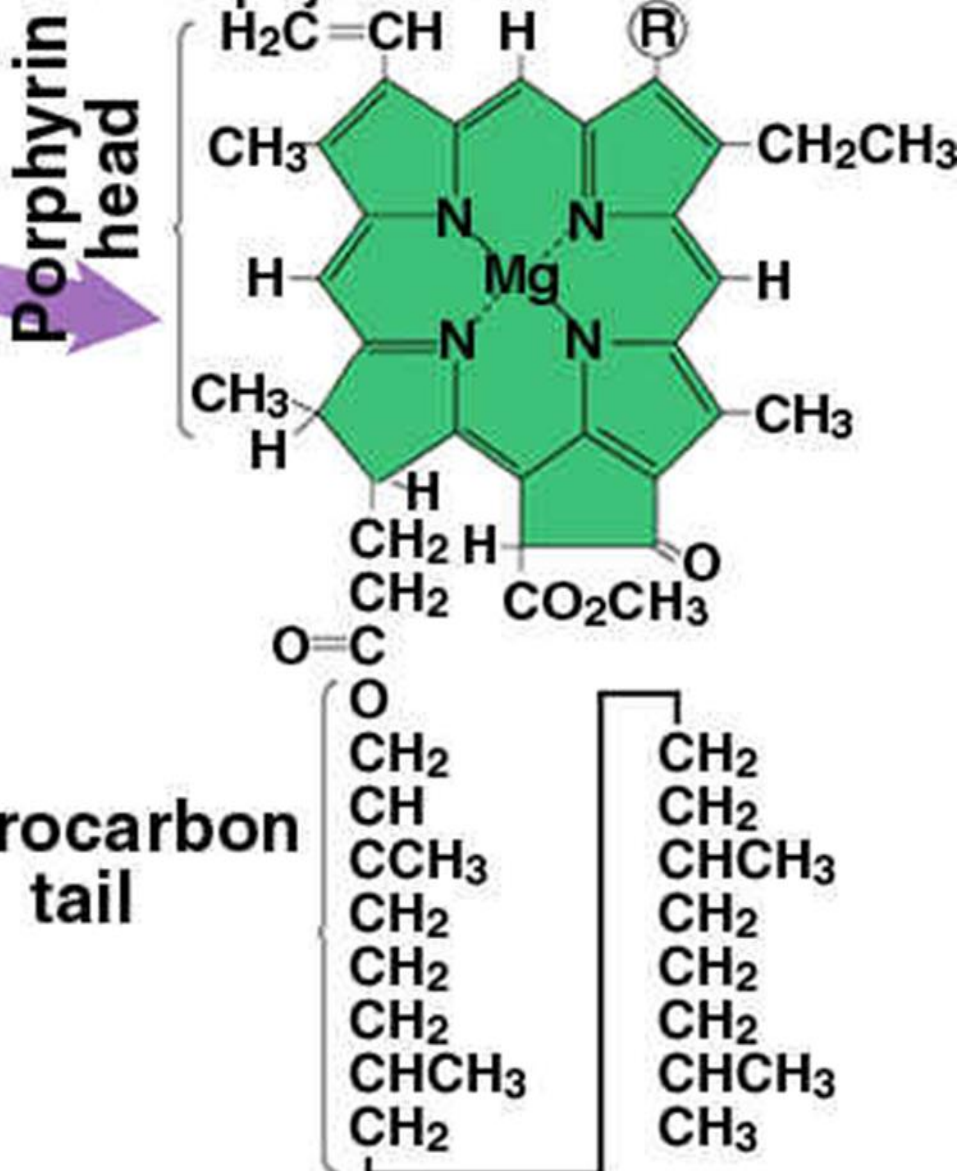
Absorption spectra

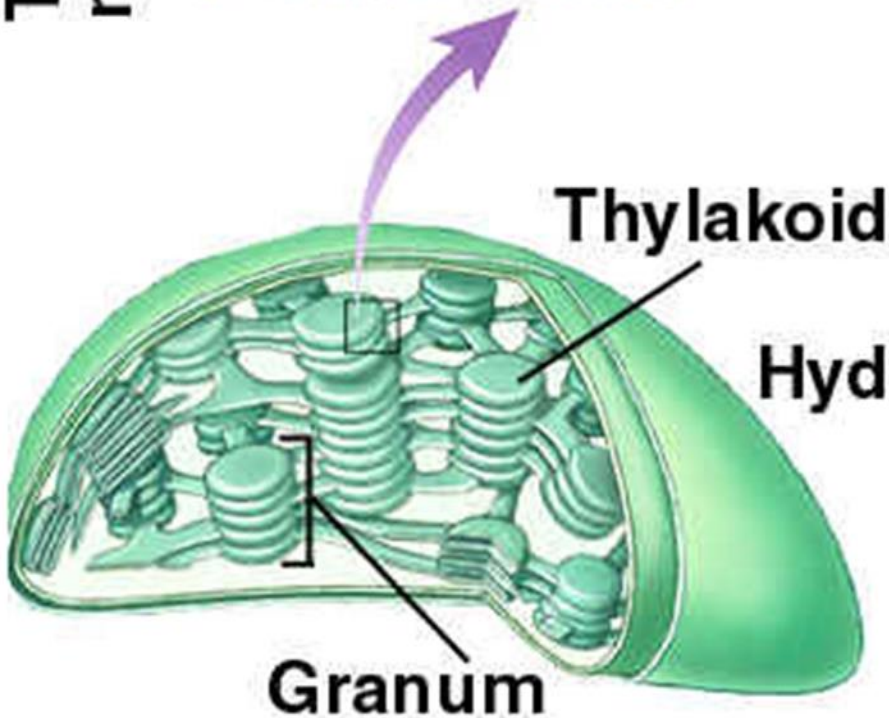
Chlorophyll

Chlorophyll molecules embedded in a protein complex in the thylakoid membrane



Chlorophyll *a*: R = –CH_3
Chlorophyll *b*: R = –CHO





photosynthesis occurs in two stages:

- **light reaction stage** (light-dependent reactions) or Hill reaction takes place in the presence of light and occurs within the **chloroplast grana**. The primary pigment used to convert light energy into chemical energy is **chlorophyll a** and other pigments involved in light absorption include chlorophyll b, xanthophyll and carotene. In the light reaction stage, sunlight is converted to chemical energy in the form of ATP and NADPH .

Both ATP and NADPH are used in the dark reaction stage to produce sugar.

- **Dark reaction stage** (light-independent reactions). is also known the Calvin cycle. Dark reactions occur in the **stroma**. The stroma contains enzymes which facilitate a series of reactions that use ATP, NADPH, and carbon dioxide to produce sugar.

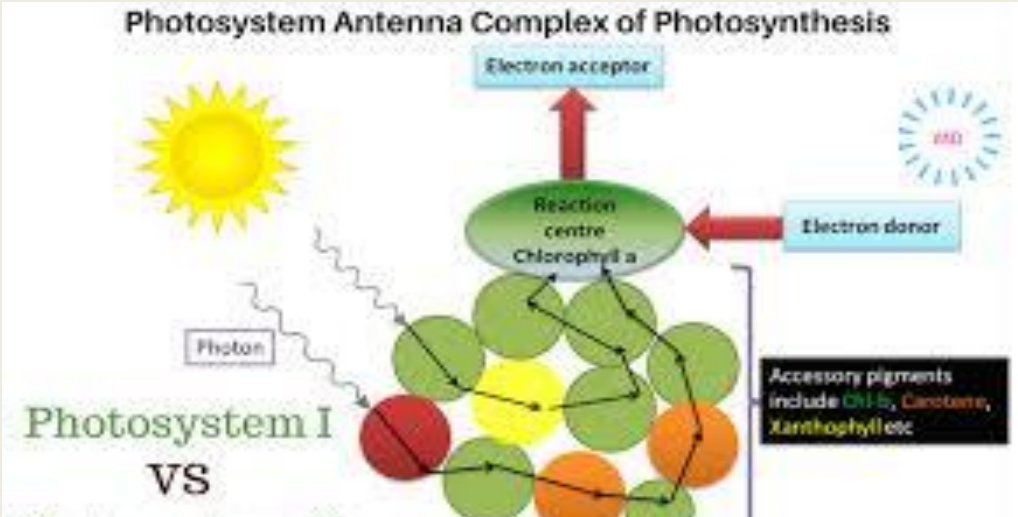
Photosystem

They are Tow types of photosystems in thylakoid membrane:

I. **Photosystems I (PSI):** is defined as containing reaction center chlorophyll with maximal light absorption at 700nm and are called P700 molecules

II. **Photosystems II (PSII):** The chlorophyll molecules of PSII absorb light with a peak wavelength of 680 nm and are called P680 molecules.

The tow photosystems work to gather to used light energy to generate ATP and NADPH



Factors affecting Photosynthesis

- The rate of photosynthesis is defined in terms of the rate of oxygen production per unit mass of green plant tissues or per unit weight of total chlorophyll.

- The main factors are:
  1. Light intensity
  2. Wavelength
  3. Carbon dioxide concentration
  4. Temperature
  5. Water supply
  6. Chlorophyll Concentration
  7. Pollution

Difference between light and dark reaction in photosynthesis

Light Reaction	Dark Reaction
Occurs : Grana of the chloroplasts.	Occurs: Stroma of the chloroplast
It is a light dependent process Involves two photosystems: PS I and PS II	This process does not require light. No photosystem is required.
Photolysis of water takes place and oxygen is liberated.	Photolysis of water does not take place. Carbon dioxide is absorbed.
ATP and NADPH is produced and they are used to drive the dark reaction.	Glucose is produced. Reduced NADP is oxidised.

Compare between photosynthesis and Respiration

	Photosynthesis		Respiration
1.	It is constructive or anabolic process.	1.	It is destructive or catabolic process.
2.	It is energy trapping process.	2.	It is energy releasing process.
3.	It is completed in chloroplast.	3.	It is completed in cytoplasm and mitochondria.
4.	Synthesis of glucose from CO_2 and H_2O occurs.	4.	Break down of glucose into CO_2 and H_2O occurs.
5.	CO_2 and H_2O are raw materials.	5.	Glucose is the raw material.
6.	It is light dependent process.	6.	It is light independent process.
7.	Photosynthetic pigments are involved.	7.	Phosynthetic pigments are not involed.
8.	O_2 is liberated.	8.	O_2 is absorbed.
9.	CO_2 is absorbed to form the glucose as end product.	9.	CO_2 is evolved along with water as end product.
10.	ATP are synthesized using light energy i.e. photophosphorylation.	10.	ATP are synthesized using oxidative i.e. oxidative phosphorylation.
11.	The process occurs during day time only.	11.	The process occurs day and night.
12.	It is present only in autotrophs (green plants).	12.	It is present in all living organisms.


THANK YOU