

Chloroplast

By:

Dr Arun kumar singh
Associate professor in Botany
JLN College Dehri –on sone
Gmail:-arunsinghbot85@gmail.com

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Chloroplast is an organelle that contains the photosynthetic pigment chlorophyll that captures sunlight and convert it into useful energy,thereby, releasing oxygen from water.

1. **Shape**:-Spherical, ovoid or disc-shaped.
2. **Size**:- It's size varies from 2 to 3 μ in thickness and 5 to 10 μ long .
 - Shaded plants have larger chloroplast than unshaded plants and polyploids have larger chloroplast than diploids.
3. **Number**:-Higher plants there are usually 20 to 40 chloroplast per cell.
4. **Chemical composition**:

Proteins - 35 – 55%,lipids -20 -30%,chlorophyll -9%,4 -5% carotenoids,DNA and RNA.

Ultrastructure of Chloroplasts:

Structurally each Chloroplast consists of two parts:

- (1) outer limiting membrane, and
- (2) inner matrix or stroma.

Limiting Membrane:-

- This is a double membrane and each membrane is trilaminar and lipoproteinous and lacks chlorophyll and cytochromes.

- All molecular interchanges occur between the cytoplasm and chloroplast through this limiting membrane.
- The outer membrane is smooth and freely permeable to small molecule
- Inner membrane is Impermeable to small molecules,even to H⁺ Hwever permeable to dicarboxylic acids,ATP and other organic phosphate.
- The inner membrane is highly selectively permeable to molecules. Each membrane is of about 40-60 A in thickness.
- Intervening space between the two membranes is called the periplastidial space and is 25-75 A.
- Inner membrane encloses a homogenous matrix which is called stroma.

2. Stroma (matrix):

- Stroma are filled with a watery, proteinaceous substance . It contains about 50% of the chloroplast proteins and most of these are of the soluble type.
- Stroma contain following substances:-
 1. **Enzymes:**The stroma of the chloroplast contains enzymes required for synthesis of carbohydrate(i.e. enzymes of calvin cycle or dark reaction)and protein synthesis.The most important enzyme of calvin cycle is Rubisco.
 2. **DNA :**Stroma contain small double-stranded circular DNA molecules.
 3. **Ribosomes:**The stroma of chloroplast contain 70s Ribosome.
 - **Special points :**Chloplasts have their own genetic system and complete protein synthesis machinery.Thus chloroplasts are also called as **semi autonomous organelle** of the cell.

Thylakoid :-

- In the stroma are embedded disc-like flattened structures made of double membranes. These discs are called lamellae (**thylakoids**).
- The outer surface of the thylakoid is in contact with the stroma and its inner surface encloses an intrathylakoid space.
- Thylakoids may be stacked like a pile of coins, forming the grana or they may be unstacked called **stroma thylakoids**.
- Thylakoids provide a large membrane area to hold the photosynthetic pigments and enzymes.
- Thylakoids containing chlorophyll (photic apparatus) for photosynthesis, permit separation of the light reactions that occur there from the dark

reactions in the chloroplast stroma that fix CO₂ to synthesize sugars, starch, fatty acids and some proteins.

- ATP and reduced coenzymes diffuse from thylakoids where they are formed into the stroma, where they are used as energy source and reductant respectively, for the fixation of carbon dioxide.

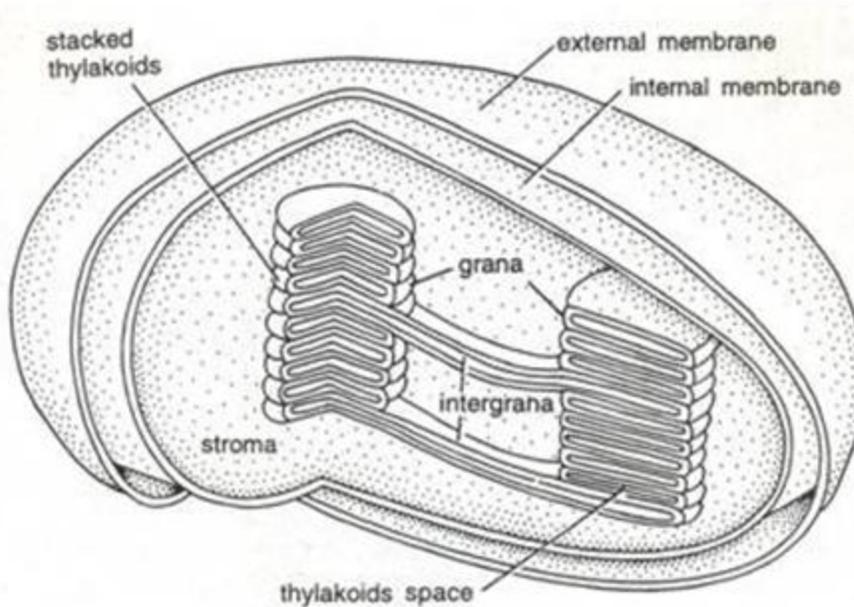


Fig.I. Sectional view of chloroplast

Granum:-

- **It** consists of a series of membrane discs packed back to back, like a stack of coins.
- However, each disc is interconnected at an angle to all other discs in a granum by tubules called frets.
- By branching, a fret connects a disc to each of the other discs in turn.
- It vary in size from 0.3 to 1.7 μm in various species.
- Membrane lamellae of the grana contain protein, and lipid layers, and in between these two is present the chlorophyll layer .
- The chloroplasts may contain 40-60 grana in their stroma.
- Each granum of the chloroplasts of higher plant cells contains 10 to 100 disc-like, superimposed membranous compartments called the thylakoids

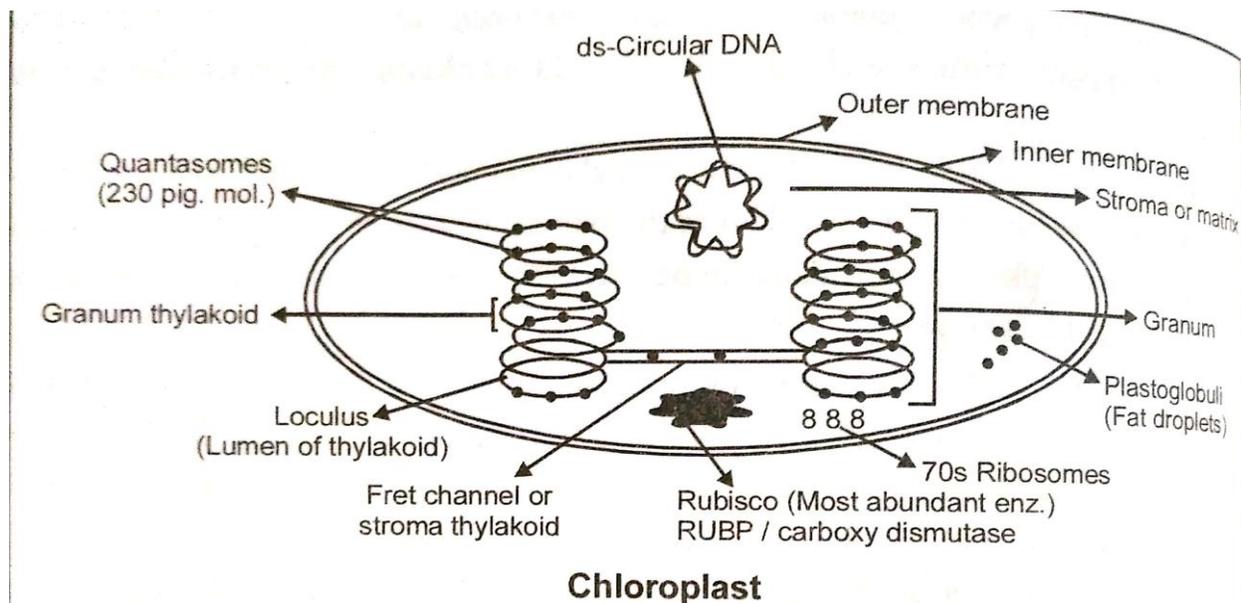


Fig.II. Chloroplast: Internal structure

Quantasome:

- Some smaller paracrystalline spheroid bodies inside the membranes of thylakoids of the grana are found, called quantasomes.
- These are roughly rectangular (18.0 nm × 15.5 nm × 10.0 nm).
- Each quantasome is composed of four subunits .
- The quantasomes are composed of about equal amounts of lipid and protein, and contain chlorophyll, carotenoids and other components of the photosynthetic apparatus.
- Quantasomes are plates or ellipsoids measuring about 200 Å in diameter and 100 Å thick, arranged in a regular, lateral array.
- These quantasomes are believed to be the units of photosynthesis
- Each quantasome comprises about 300 molecules of chlorophyll, necessary amount for photosynthesis.

Origin:

- Chloroplast originate from proplastids. These are small spheres with double membranes.
- From binary fission of pre –existing plastids

FUNCTION:

- Photosynthesis: The chloroplast trap the light energy of sun and transform it into the chemical energy in the form of food.
- Balancing of O₂ AND CO₂ in nature.
- Light reactions take place on the membranes of thylakoids.
- Dark reation,also known as Calvin cycle,takes place in the stroma of Chloroplast.
- Production of NADPH₂ and evaluation oxygn through the process of photolysis of water