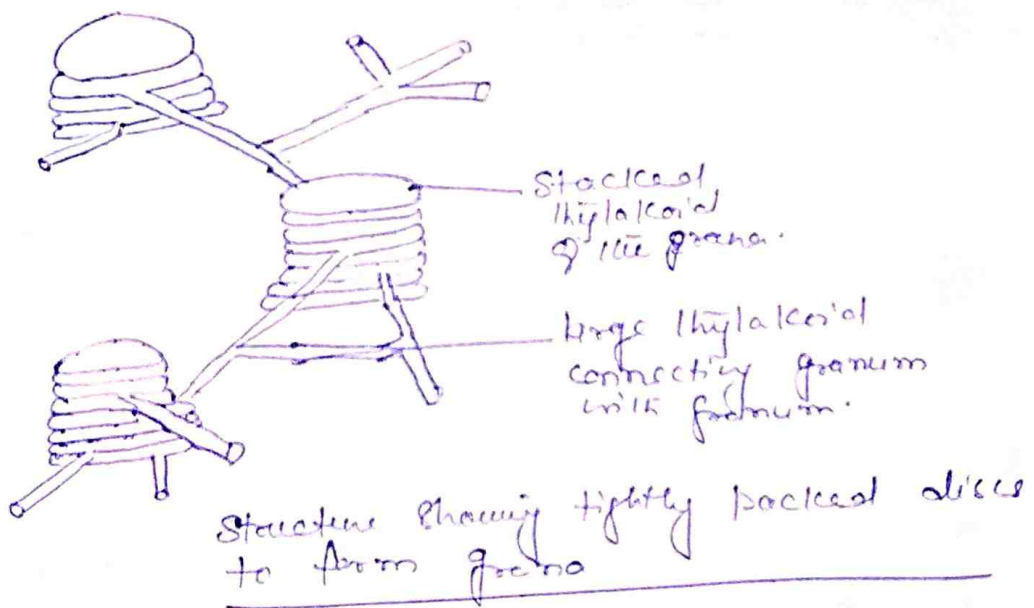
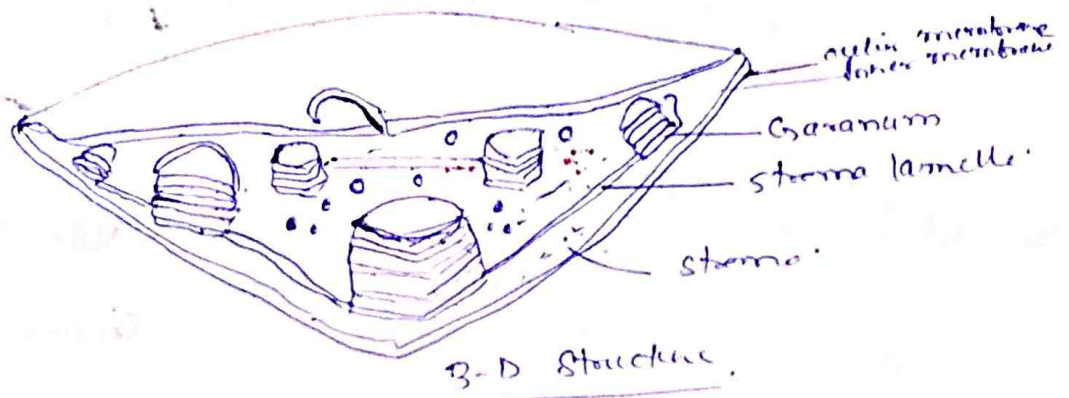
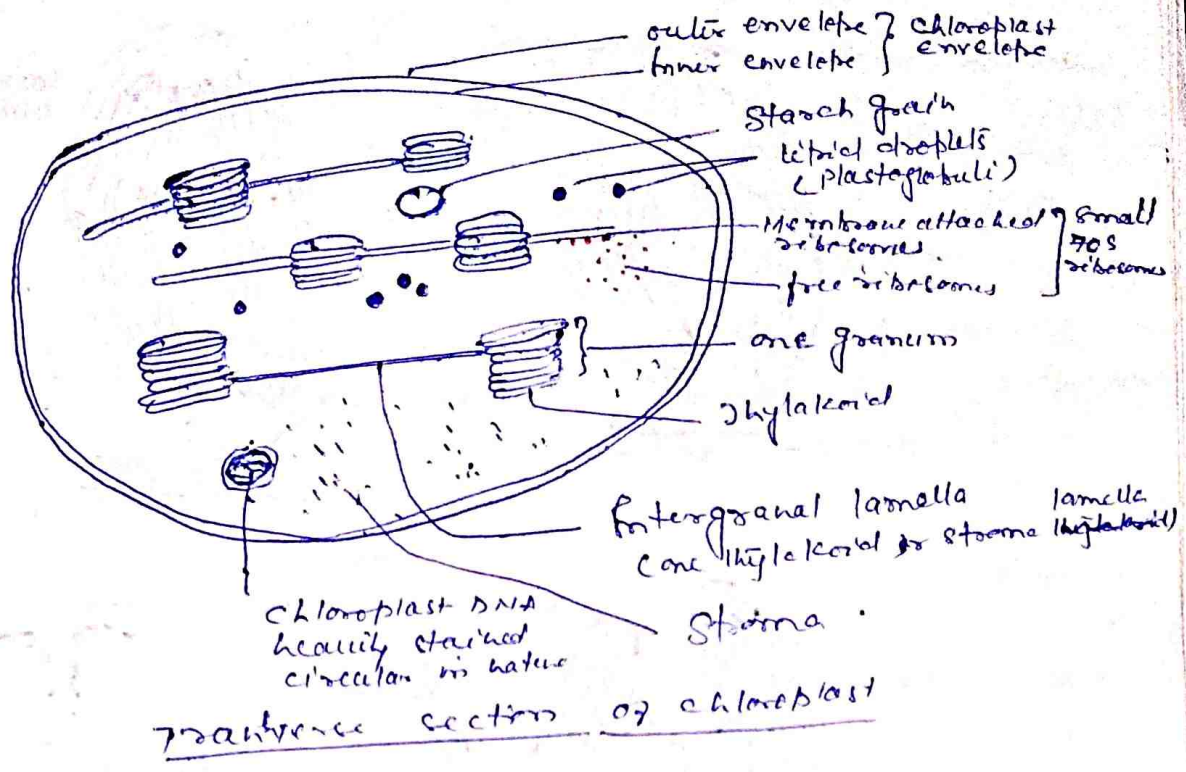


Chloroplast - the photosynthetic apparatus

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Gr. A.

- ① Chloroplasts are discrete membrane bound structure found in algae and higher plants for carrying out photosynthesis. They are predominantly located in the mesophyll cells of leaves.
- ② Chloroplasts of higher organisms/plants are lens-shaped, approximately 2 to 4 μm wide and 5 to 10 μm long and typically numbering 20 to 40 per cell.
- ③ In algae, the chloroplasts are of different shapes -
Ribbon/Spiral like - in Spirogyra
Reticulate - Oedogonium, Hydrodictyon
Cup-like - Chlamydomonas
Stellate - Zygnema
Grindle shaped - Ullothrix etc.
- ④ Structure - The ultrastructure of chloroplast shows an outer envelope enclosing stroma, grana and other structures like ribosomes as well as lipid and starch granules.
(a) The outer envelope - It is composed of a system of double membrane, each of which is 40-60 \AA thick, and has a unit membrane structure. The outer membrane is separated from the inner membrane by an intermembrane space of about 100 \AA .
The outer membrane is permeable to a wide variety of compounds of low mol. wt., which keep on entering the intermembrane space from the cytoplasm. The inner membrane of the envelope is highly impermeable, substances moving through this layer do so only with the aid of a variety of transporters. Some, like CO_2 and monocarboxylic acids such as acetic acid, glyceric acid, glycolic acid etc., however, can pass through the inner membrane. In this respect, the chloroplast resembles the inner membrane of mitochondria.



(b) Stroma: It is a heterogeneous matrix enclosed by the inner membrane of the chloroplast envelope. It contains starch grains, lipid droplets, small double-stranded circular DNA and ribosomes of 70S type [Some evidences suggest that the cpDNA more commonly takes a linear shape]. The matrix also contains the enzymes necessary to carry out metabolic activities of CO_2 fixation, as the dark reaction of photosynthesis takes place here.

(c) Grana: Grana are densely packed stacks of membrane layers called thylakoids. Large number of grana are formed at frequent intervals by packed stacks of thylakoids. This is the place where light reaction of photosynthesis takes place. Two adjacent grana are joined with one another by lamellae called intergranal lamellae or stroma lamellae. The number of discs in a granum ranges from 10 to 100. Each chloroplast contains 40-60 grana (singular - granum). The space inside a thylakoid sac is the lumen.

The thylakoid membranes have a high protein content and are unusual in having relatively little phospholipids. Instead, these membranes have a high percentage of galactose-containing glycolipids. Chlorophyll molecules are embedded in the thylakoid membrane. These molecules are so arranged in this layer that their hydrophilic porphyrin head is close to the outer layer of proteins and absorb light energy. The hydrophobic tail embeds the chlorophyll molecules into the thylakoid membrane.

(d) Plastoglobuli: They are the round particles freely lying in the stroma. They are lipid-rich granules that can be traced in all stages of growth and differentiation of plastids. They vary in size from 30-300 nm in diameter.