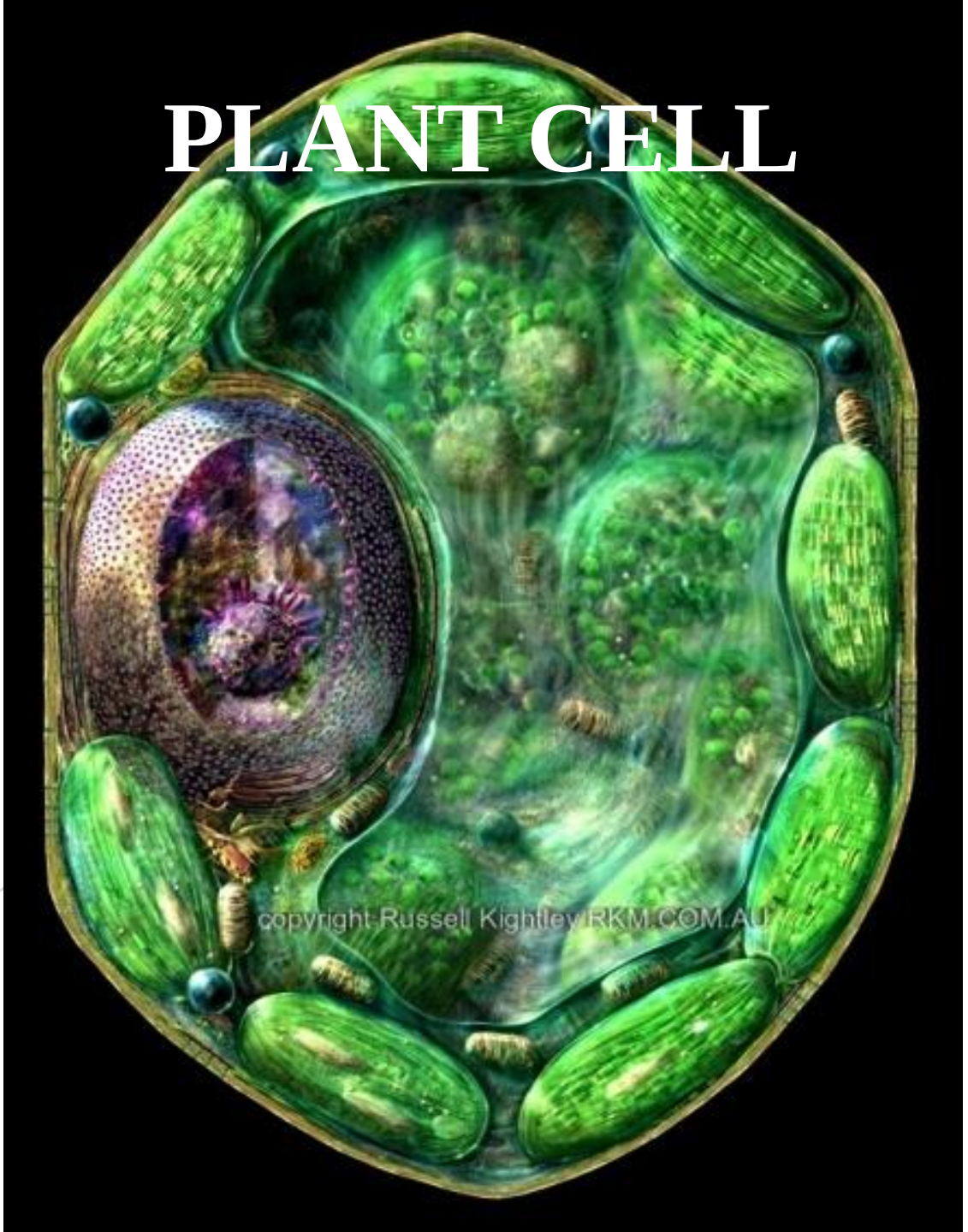
PLANT CELL

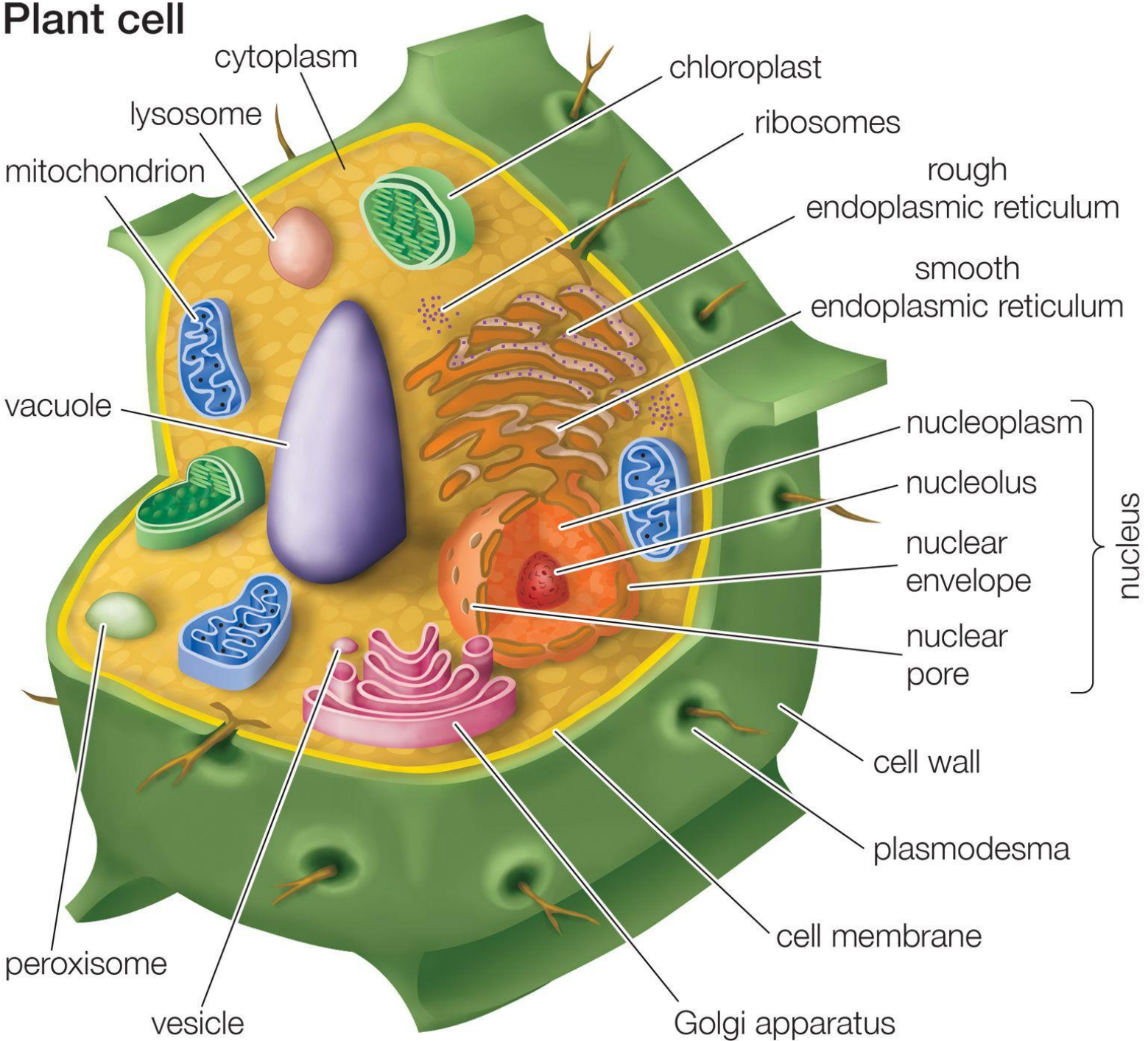


Structure of Plant Cell

- The plant cell is formed of three components- plasma membrane, cytoplasm, nucleus.
- The cell is surrounded by a plasma membrane. It is filled with colloidal substances called cytoplasm. The cytoplasm contains a spherical body, the nucleus and cell organelles like endoplasmic reticulum, lysosome, plastids, ribosomes, Golgi complex, mitochondria, peroxisome and non-living inclusions.

Structure Of Plant Cell

- Cytoplasm + Nucleus = Protoplasm.
- Cytoplasm excluding cell organelles is called cytosol. (Cytoplasm – Cell Organelles= Cytosol)
- Cytosol is again differentiated into peripheral-non-granular, clear ectoplasm and inner granular, less viscous endoplasm.


Plant cell
cytoplasm
lysosome
mitochondrion
vacuole
peroxisome
vesicle
chloroplast
ribosomes
rough endoplasmic reticulum
smooth endoplasmic reticulum
nucleoplasm
nucleolus
nuclear envelope
nuclear pore
nucleus
cell wall
plasmodesma
cell membrane
Golgi apparatus

Cell Wall

- *"A non-living rigid structure called the cell wall forms an outer covering for the plasma membrane of fungi and plants".*
- "The cell wall is a non-living structure which is formed by the living protoplast".
- Plant and animal cells are different as the former possess cell wall, plastids and a large central vacuole which are absent in animal cells.
- A plant cell without its cell wall is called a protoplast.
- Protoplasm+ Plasma membrane= Protoplast

Composition of Cell Wall

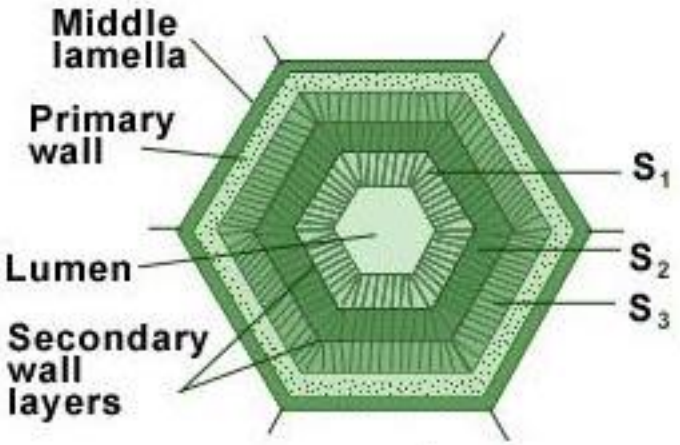
- Plant cells- Cellulose, Hemicellulose, Pectin & Protein.
- Fungi- Chitin (Fungal Cellulose)
- Bacteria: Protein-lipid-polysaccharide complexes.
- Algae : Cellulose, Galactans, Mannans and Minerals (Calcium Carbonate).

Structure of Cell Wall

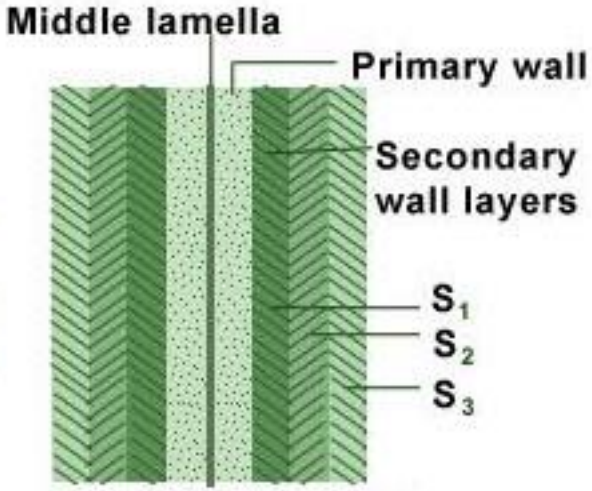
- Cell wall of young plant cell is called the primary wall. It is capable of growth.
- As the cell matures the growth diminishes due to the deposition of secondary wall material (lignin, suberin etc.).
- Middle lamella – a cementing material (glue) - calcium pectate – holds different neighbouring cells together.
- The cell wall and middle lamellae is traversed by fine cytoplasmic channels called plasmodesmata. It connects the cytoplasm of neighbouring cells.

Plasmodesmata

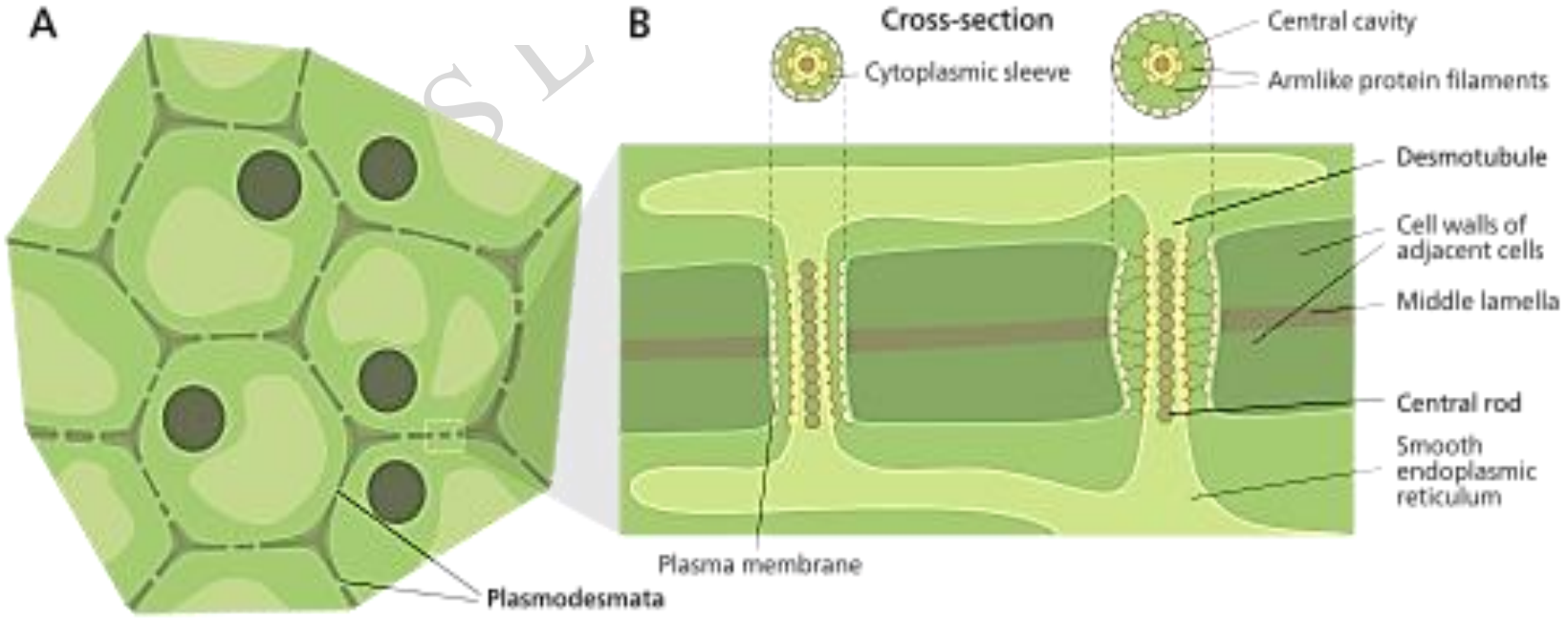
- Gr. *desmos*= ribbon, ligament.
- It is roughly cylindrical, membrane-lined channel with a diameter of 20-40nm.
- Running from cell to cell through the centre of most plasmodesmata is a narrower cylindrical structure called *desmotubule*.
- The number of plasmodesmata per μm^2 ranges from 1-15.
- They allow the passage of macromolecules less than 800 Da.



T.S.of a plant cell

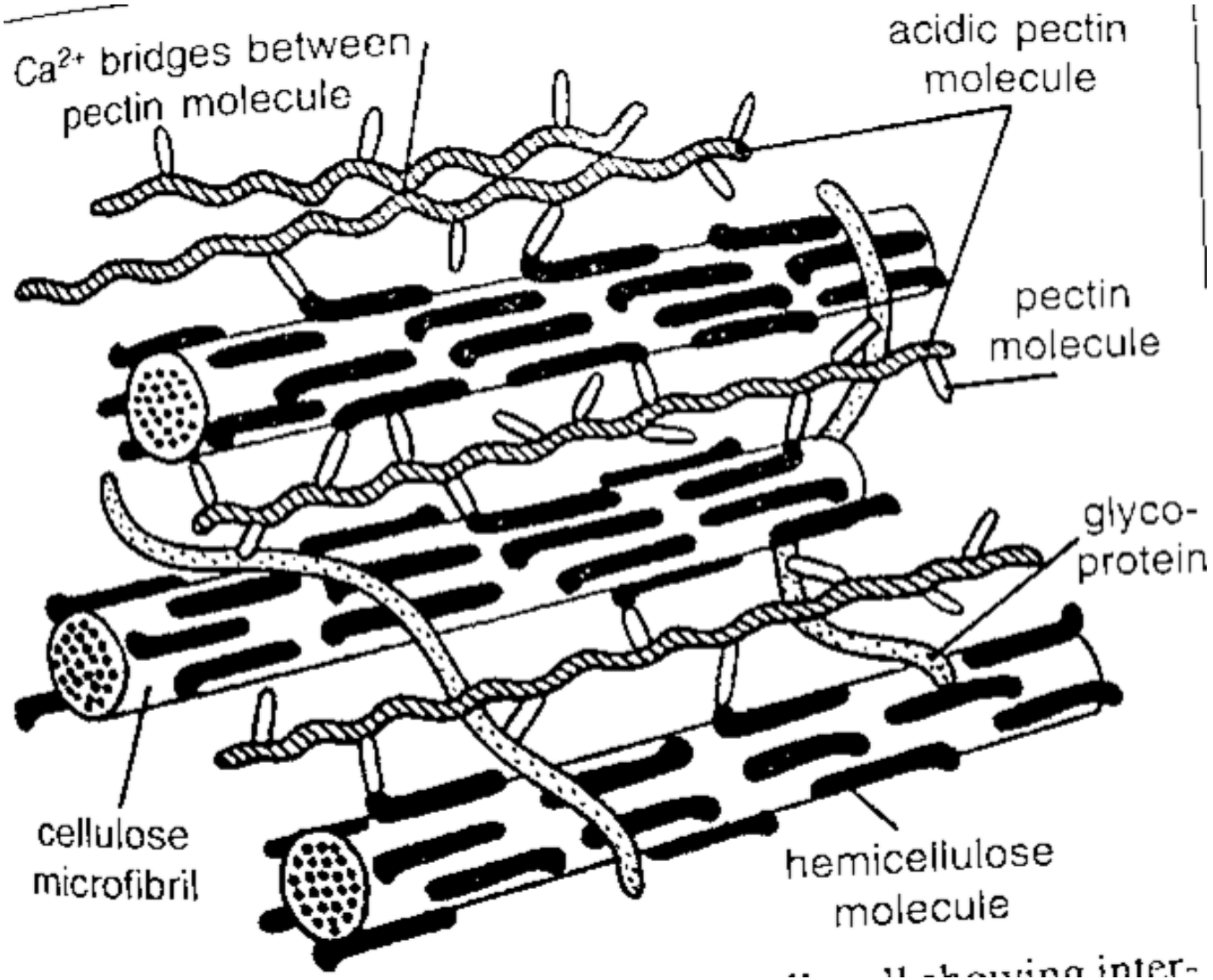


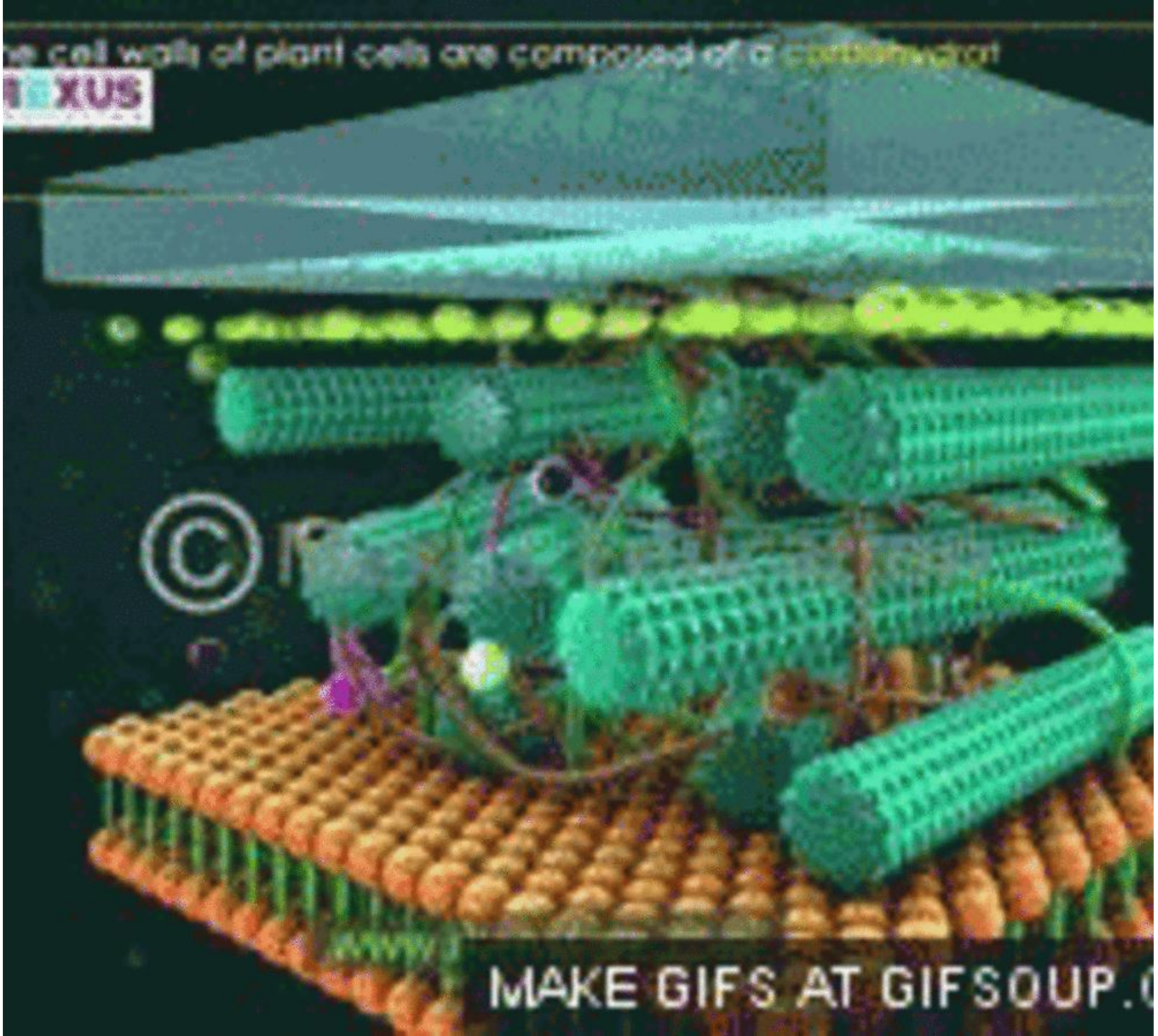
L.S. Cell walls of two adjacent cells

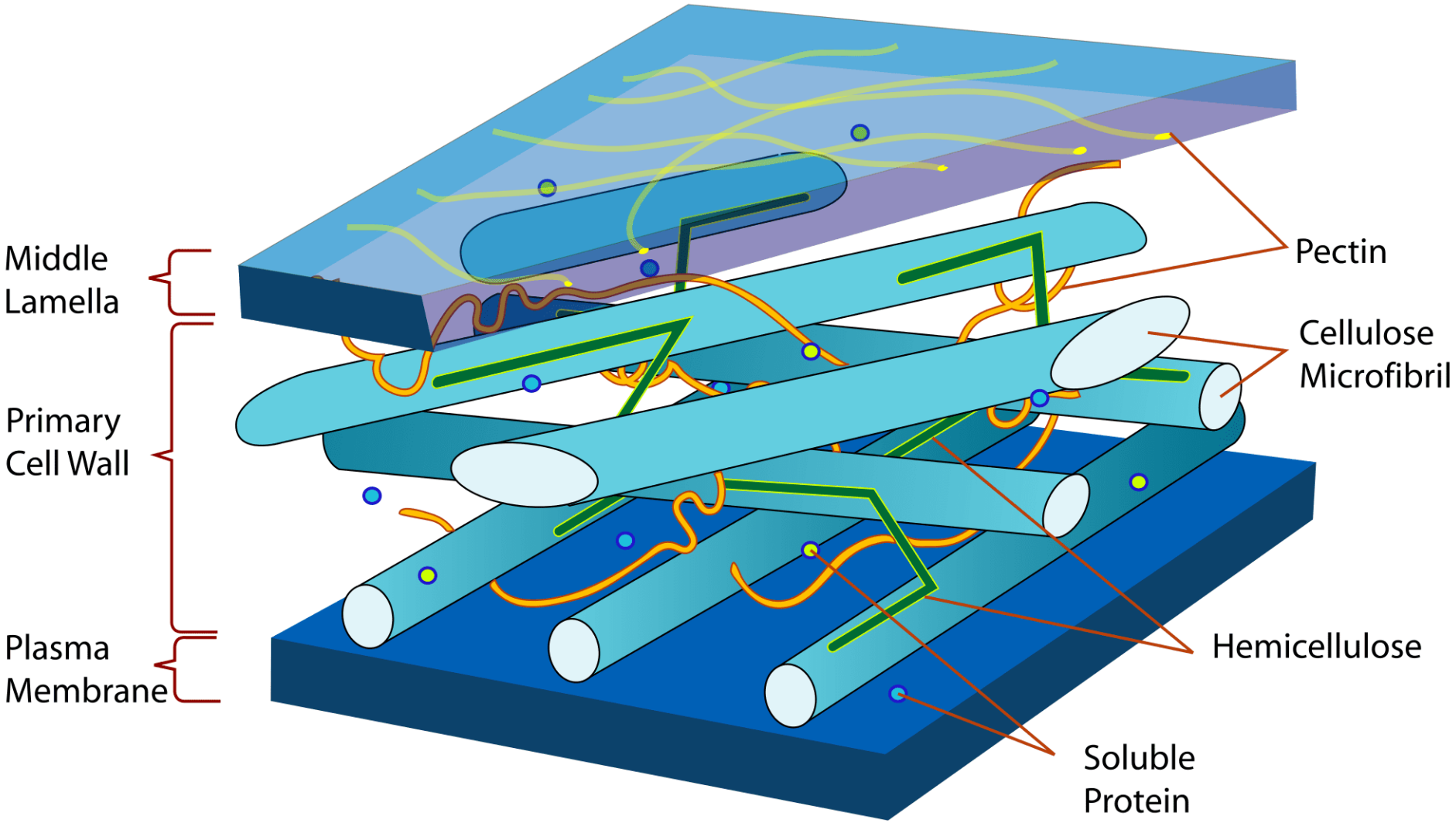


Ultra-structure of Cell wall

- Primary cell wall- the fibres and matrix molecules are cross-linked by covalent bonds and non-covalent bonds forming highly complex structure.
- The hemicellulose molecules are linked by H-bonds to the surface of the cellulose micro-fibrils.
- Hemicellulose linked to acidic pectin by short neutral pectin molecules.
- Cell wall glycoproteins are tightly to form a complete matrix of frame work.


Ca^{2+} bridges between pectin molecule
acidic pectin molecule
pectin molecule
glyco-protein
cellulose microfibril
hemicellulose molecule


MAKE GIFS AT GIFSOUP.


Middle
Lamella
Primary
Cell Wall
Plasma
Membrane
Pectin
Cellulose
Microfibril
Hemicellulose
Soluble
Protein

Functions of Cell Wall

- Protects the cell from attack of pathogens, mechanical injury.
- Provides rigidity and shape and also helps in cell expansion.
- Plasmodesmata present in the wall help to produce a protoplasmic continuity.
- Walls prevent bursting of plant cells by inhibiting excessive endosmosis.
- Cutin and suberin of the cell wall reduce the loss of water through transpiration.
- Walls of sieve tubes, tracheids and vessels are specialized for long distance transport.

VACUOLE

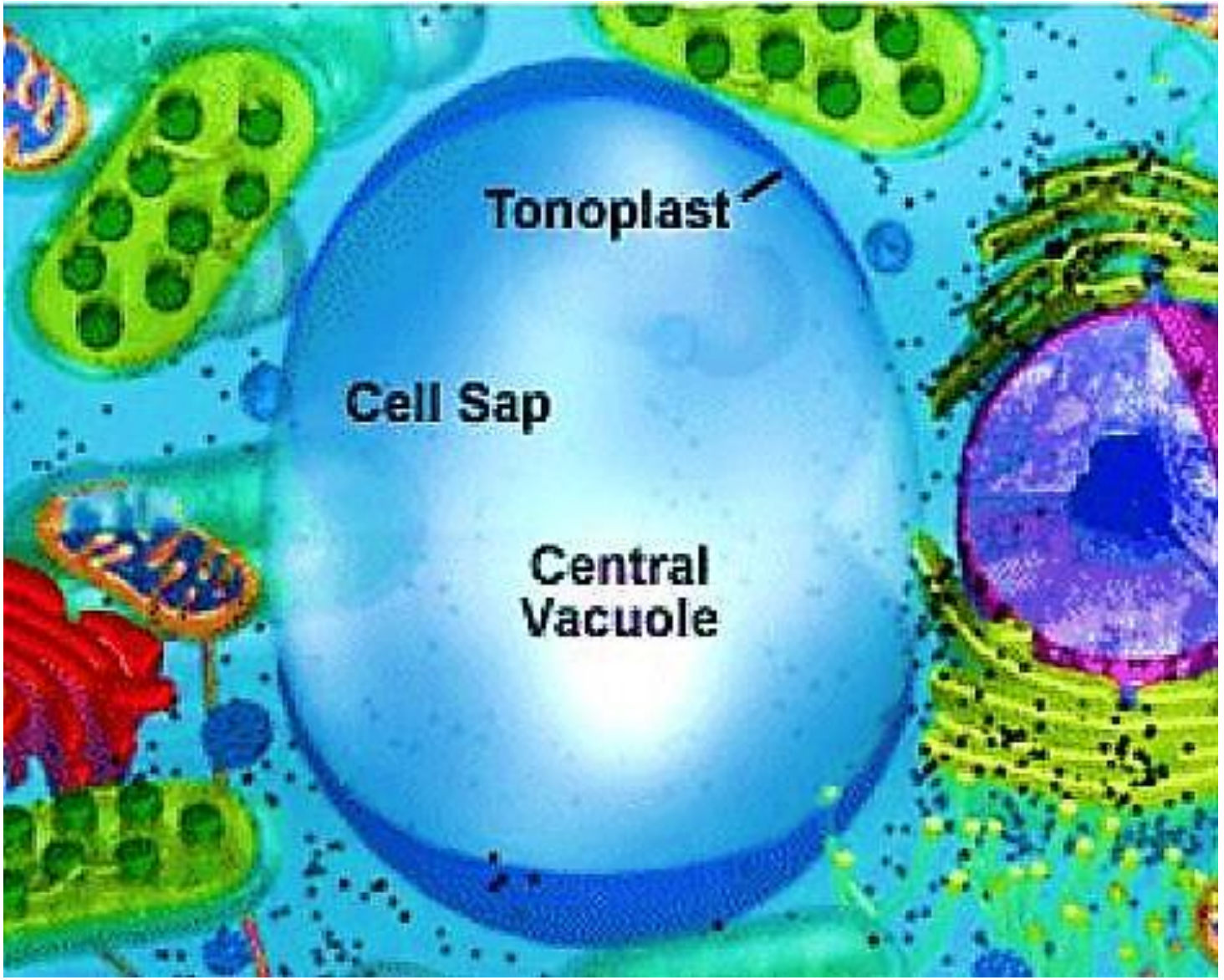
- It is one of the components of the endomembrane system.
- The vacuole is the membrane-bound space found in the cytoplasm. It contains water, sap, excretory product and other materials which not useful for the cell.
- The vacuole is bound by a single membrane called *tonoplast*.
- In plant cells the vacuoles can occupy up to 90 per cent of the volume of the cell.

VACUOLE

- In *Amoeba* the contractile vacuole is important for *osmoregulation* and *excretion*.
- In many cells, as in protists, food vacuoles are formed by engulfing the food particles.
- In plants, the *tonoplast* facilitates the transport of a number of ions and other materials against concentration gradients into the vacuole, hence their concentration is significantly higher in the vacuole than in the cytoplasm.

VACUOLE

- The structural importance of the plant vacuole is related to its ability to control *turgor pressure.*
- Vacuoles also often store the pigments, but also can release molecules that are poisonous, odoriferous, or unpalatable to various insects and animals, thus discouraging them from consuming the plant.



Structure of Plant Vacuole

PLASTIDS

- "*Plastids are large cytoplasmic organelles, they synthesize and store carbohydrate*".
- Greek, *plastikas*= formed or moulded.
- Discovered by Ernst Haeckel and coined by Schimper in 1885.
- Depending upon presence and absence of pigments- two types;

  1 Chromoplast

  2. Leucoplast

Chromoplast

- Gk: *chromos=colour*;
- Contain various pigments (yellow, orange and or red pigments).
- Chromoplasts are found commonly in flowers and fruits.

Subdivided into 3 types based on pigments present in them;

1. Chloroplast: green colour- chlorophyll pigments- found in higher plants and green algae.
2. Phaeoplast: dark brown colour- fucoxanthin pigments- found in brown algae, diatoms and dino-flagellates.
3. Rhodoplast: red colour- phycoerythrin- red algae.

Chloroplasts

- Chloroplasts are organelles found in plant cells and other eukaryotic organisms that conduct *photosynthesis*.

Chromoplasts

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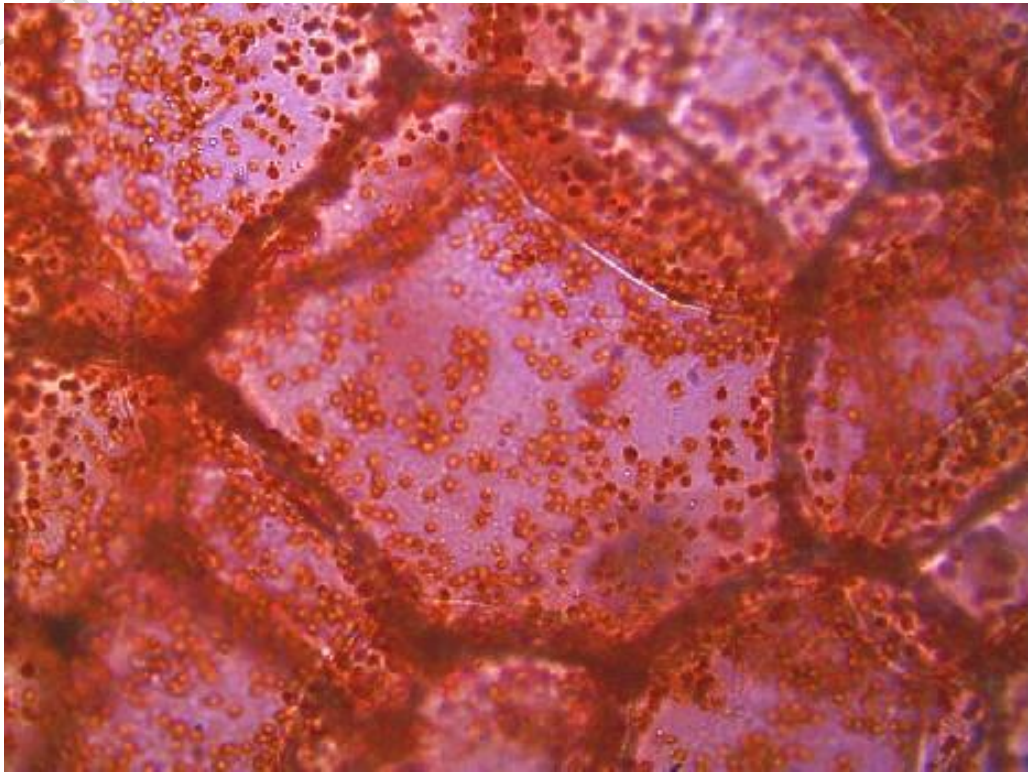
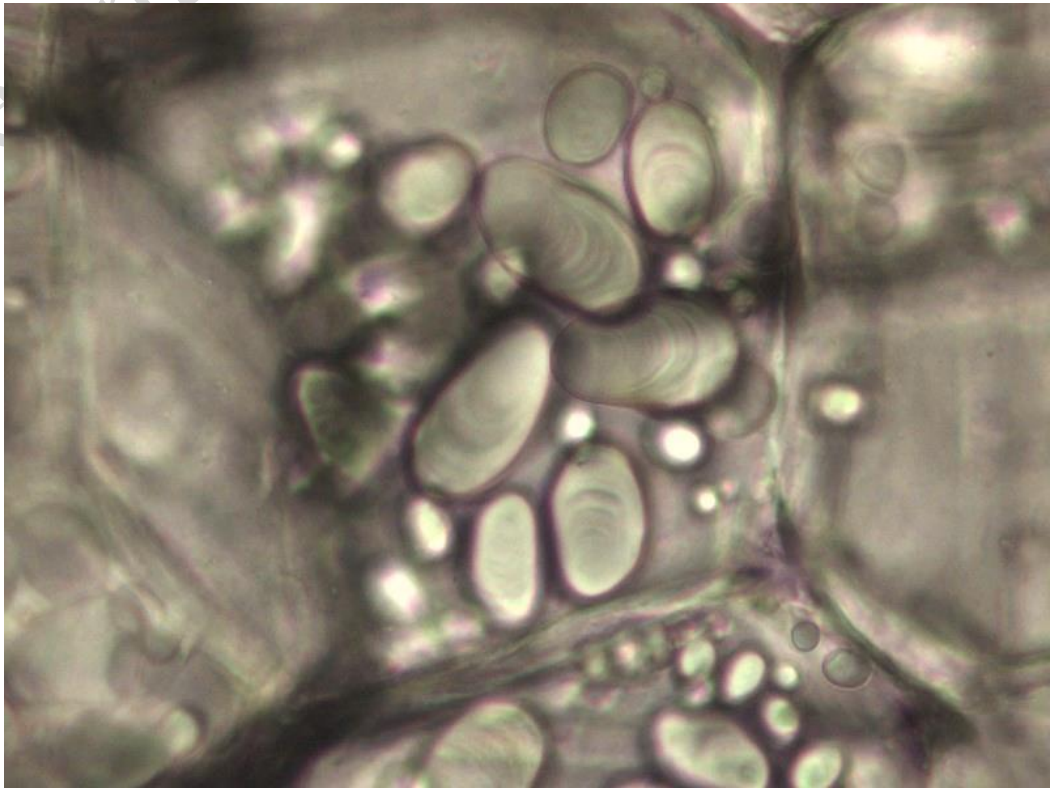


Leucoplast

- Gk: *leucos*= white, colourless
- Non-pigmented plastids
- Store food materials (starch, oils and proteins).
- Do not involve in synthesis.



Leucoplast

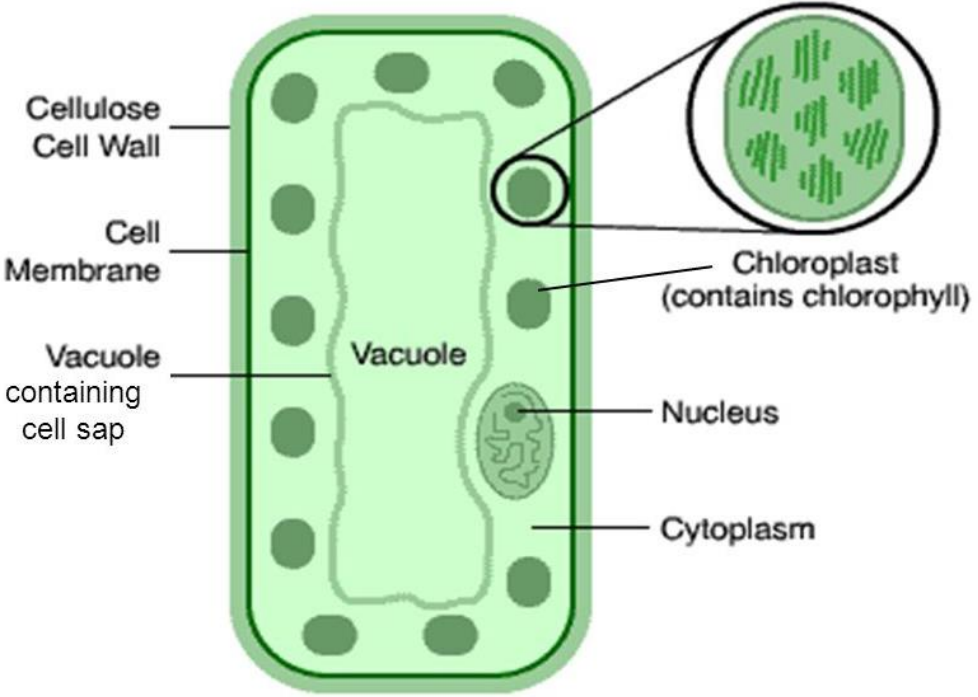
- Gk: *leucos*= white, colourless
- Non-pigmented plastids
- Store food materials. Do not involve in synthesis.

Subdivided into three types;

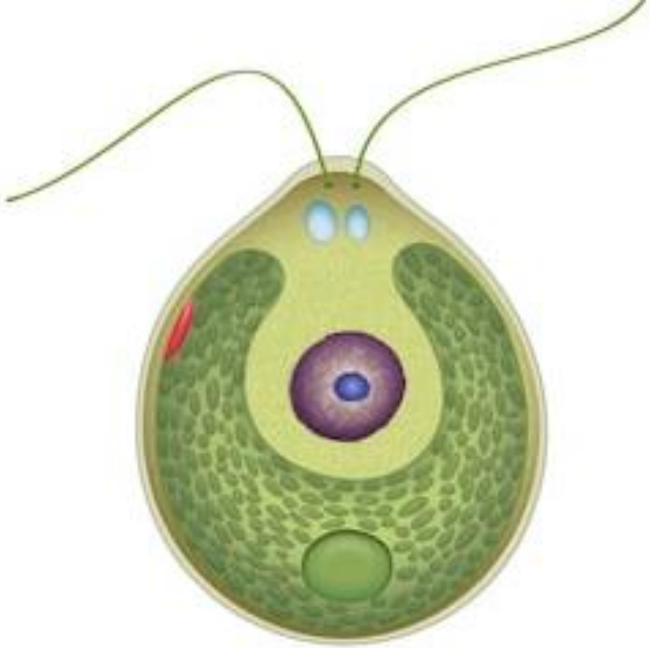
1. Amlyloplast: starch- found in tubers, cotyledons and endosperm
2. Elaioplast: oils and fats- found in the epidermal cells.
3. Aleuroplast: proteins - found in seeds and nuts.

Chloroplasts

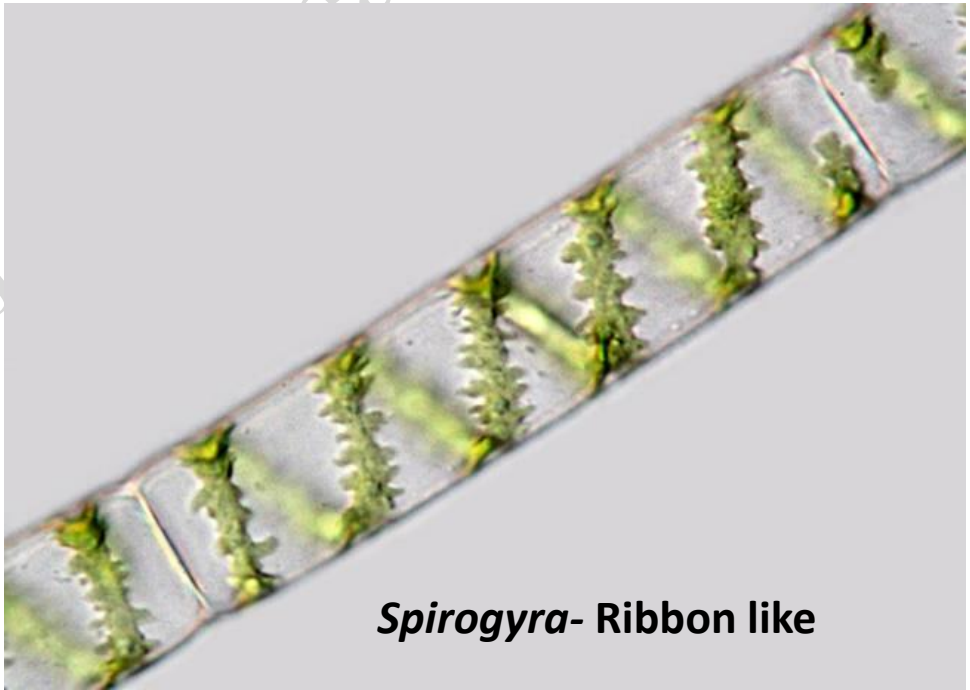
- Chloroplasts are organelles found in plant cells and other eukaryotic organisms that conduct *photosynthesis*.
- Shape: Chloroplast varies in shape. They are spheroid or ovoid or discoid in mesophyll cells of higher plants. Cup-shaped as in *Chlamydomonas* and ribbon like spirally coiled as in *Spirogyra*.



Mesophyll Cell- Discoid



***Chlamydomonas*- Cup –shaped**



***Spirogyra*- Ribbon like**

Chloroplasts

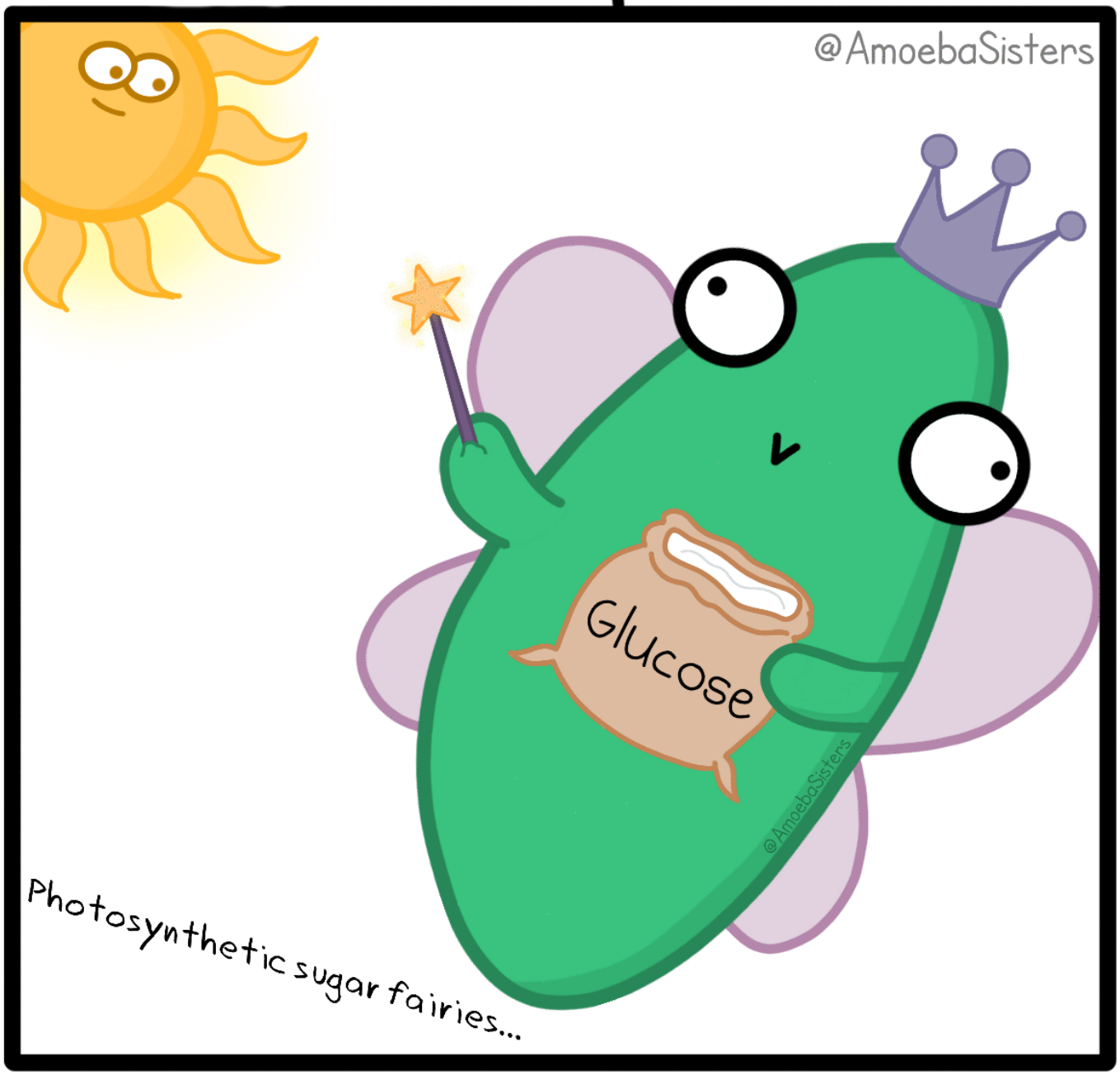
Size: Varies from species to species. But remains constant for a given cell type.

- In higher plants, it is 5-10µm in length and 2-4µm in thickness.
- Chloroplasts of plants growing in shady places are larger in size.

Number: Varies from plant to plant, but it remains constant for a given plant.

- One in unicellular organisms- *Chlamydomonas*
- 15-20- mesophyll cells, about 100 – Wheat and *Arabidopsis*

Chloroplast



Glucose synthesizers of the cell

Chemical composition of Chloroplast

Chloroplast contains proteins, lipids, carbohydrates, DNA, RNA, 70S ribosomes carotenoids, chlorophyll pigments and minerals.

Structure of Chloroplast

- Bounded by a double membrane called the chloroplast envelope- outer and inner membrane
- Between the two there is a space called *periplastdial space/ inter-membrane space* - 10-20 nm
- In addition, a third internal membrane system, called the thylakoid membrane.
- Thylakoid membrane forms a network of flattened discs called *thylakoids*, which are frequently arranged in stacks called grana/ granum. Each granum has about 10-20 thylakoids.

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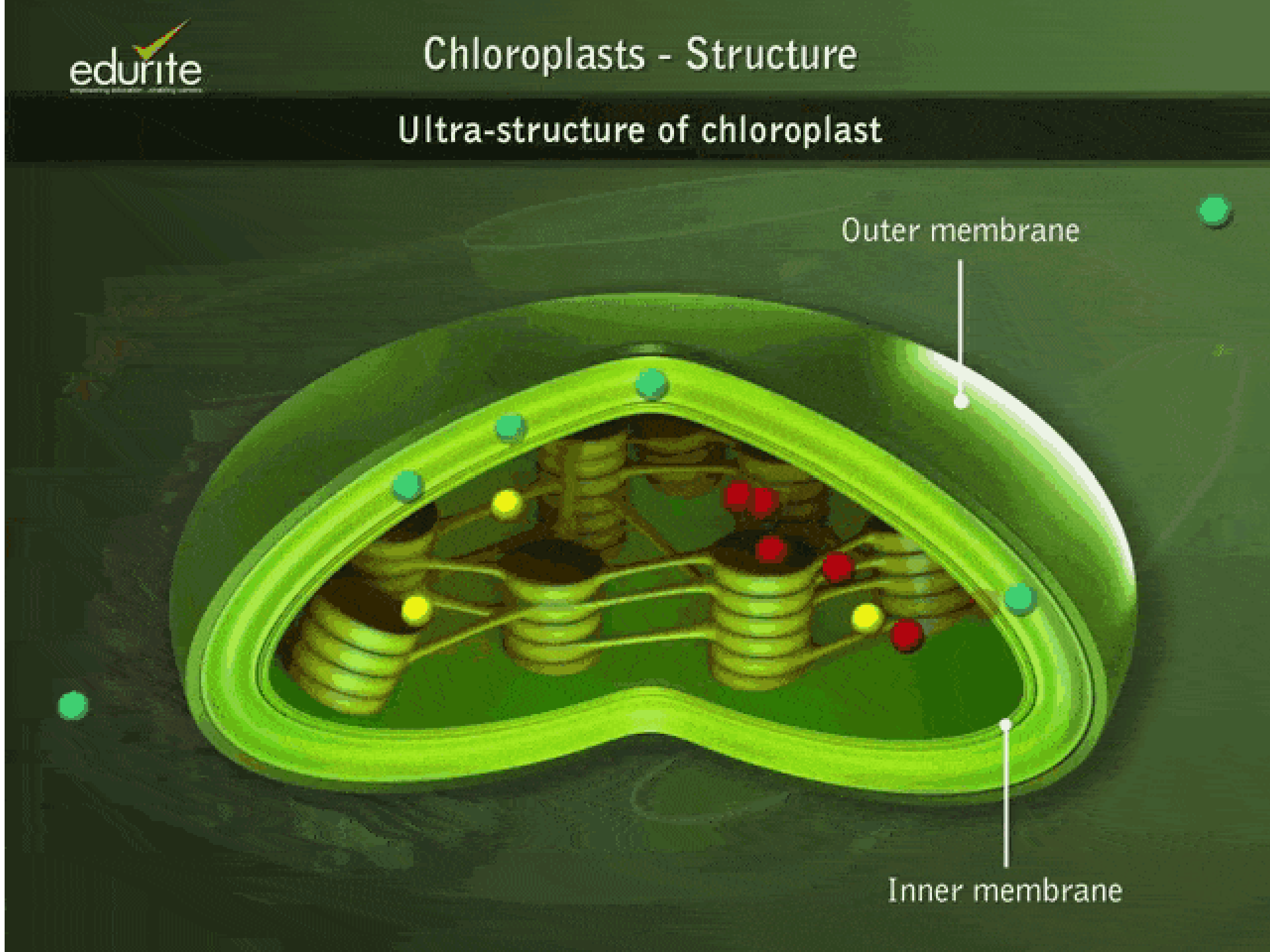
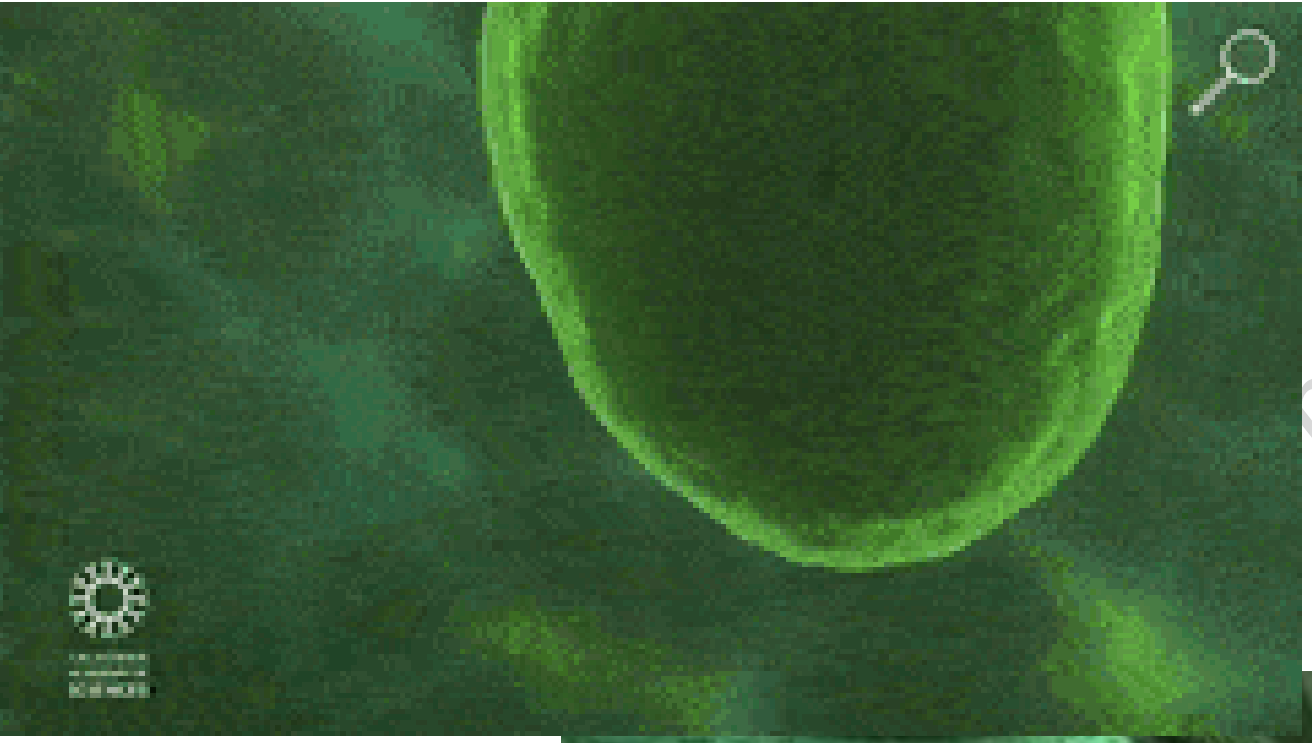
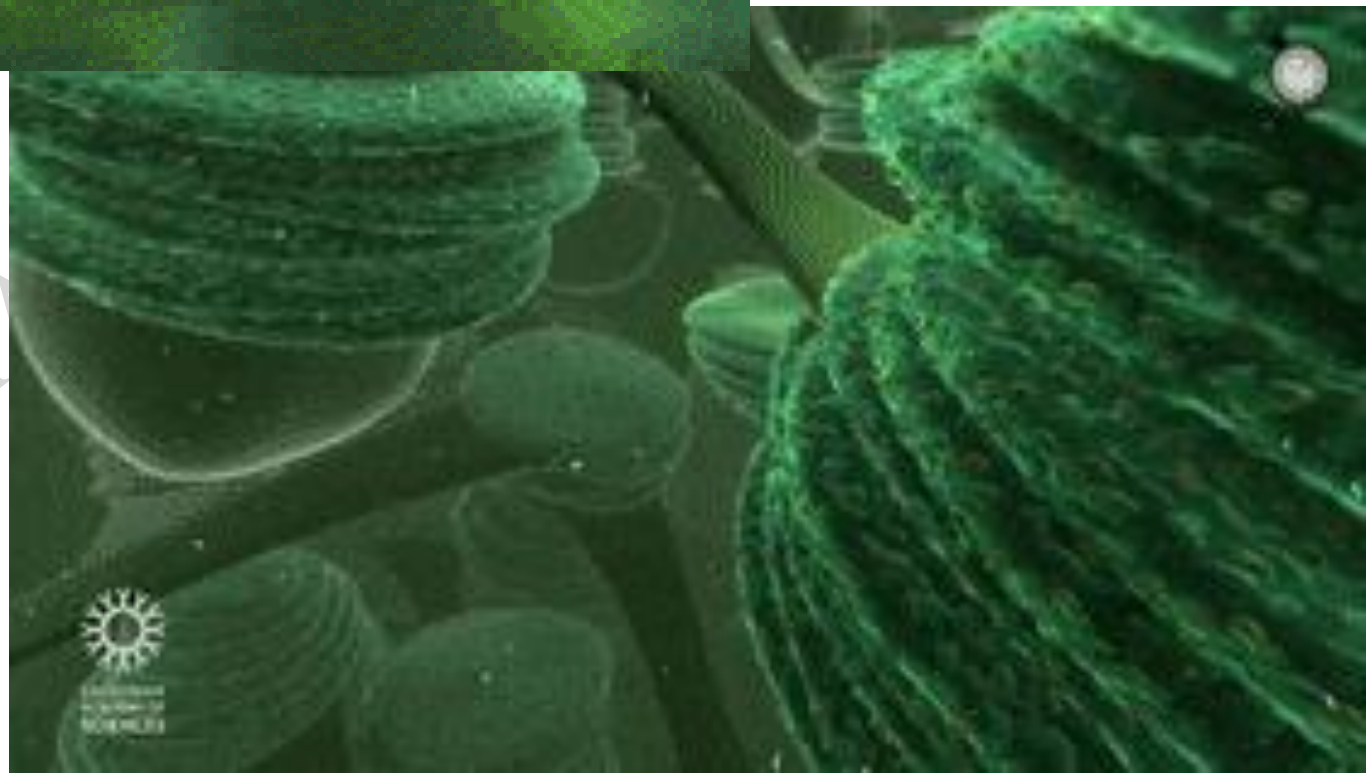
Chloroplasts - Structure

Ultra-structure of chloroplast

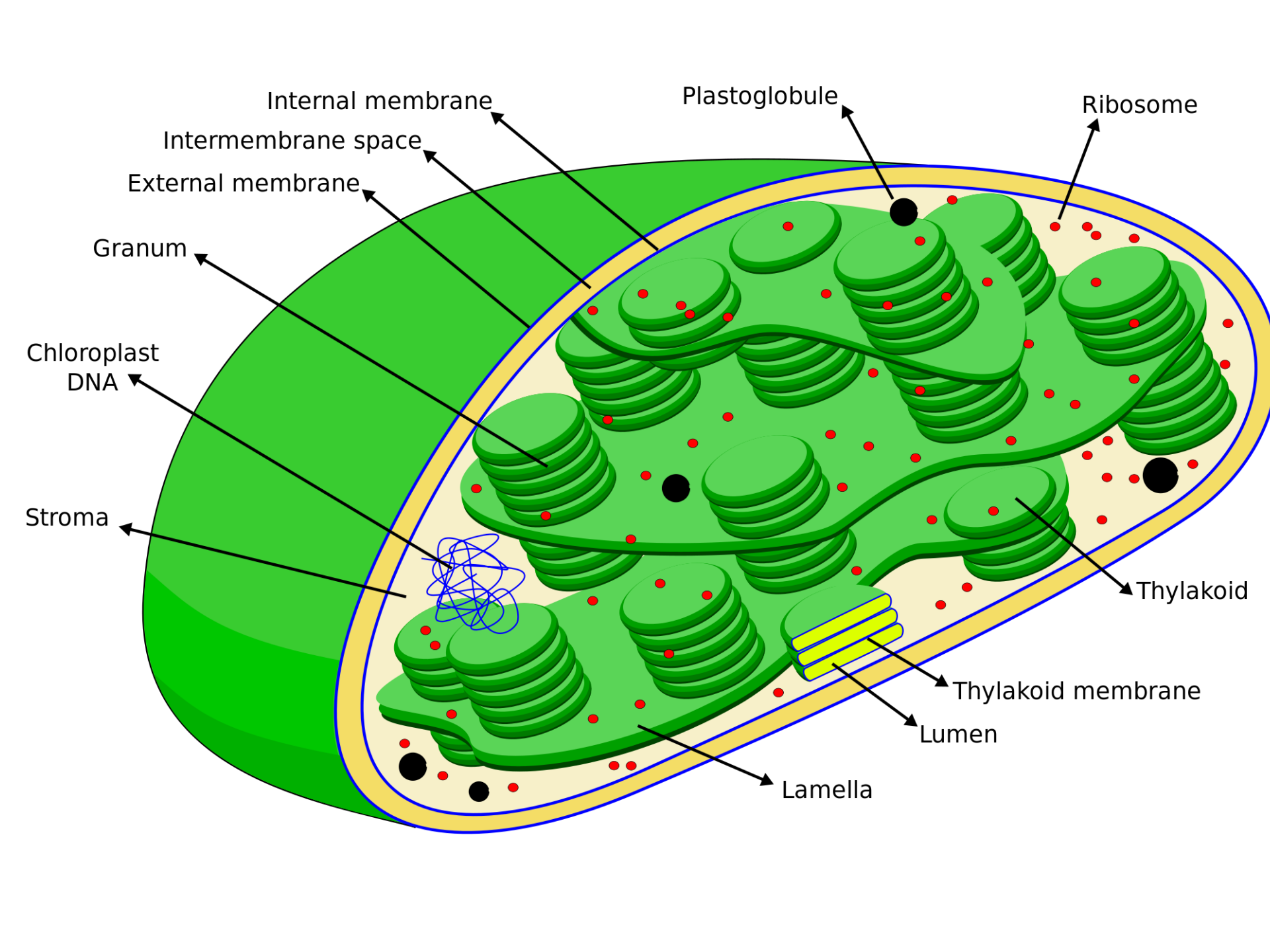






Structure of Chloroplast

- Grana are interconnected by branching membranous tubules called *frets (stromal lamellae*).
- Stroma is the internal matrix of chloroplast
- A thylakoid has a *flattened disk shape*. Inside it is an empty area called the thylakoid space or lumen. Photosynthesis takes place on the thylakoid membrane.
- Embedded in the thylakoid membrane are antenna complexes, consists of the light-absorbing pigments, including chlorophyll and carotenoids, as well as proteins that bind the pigments. These complexes are called as *quantosomes*.


Internal membrane
Intermembrane space
External membrane
Granum
Chloroplast DNA
Stroma
Plastoglobule
Ribosome
Thylakoid
Thylakoid membrane
Lumen
Lamella

Functions of Chloroplast

- Protein Synthesis -since it has its won DNA and ribosomes.
- Starch Storage- temporarily store starch during the day time in the pyrenoids which is a starch forming organelle.
- Oxygen Supply- Chloroplasts utilize carbon dioxide for photosynthesis and release oxygen.
- Photosynthesis takes pace in the thylakoid membrane and stroma.
- Photorespiration
- Extra-nuclear inheritance- The DNA in the chloroplast serves as an extra-nuclear genetic material for the transmission of few characters.