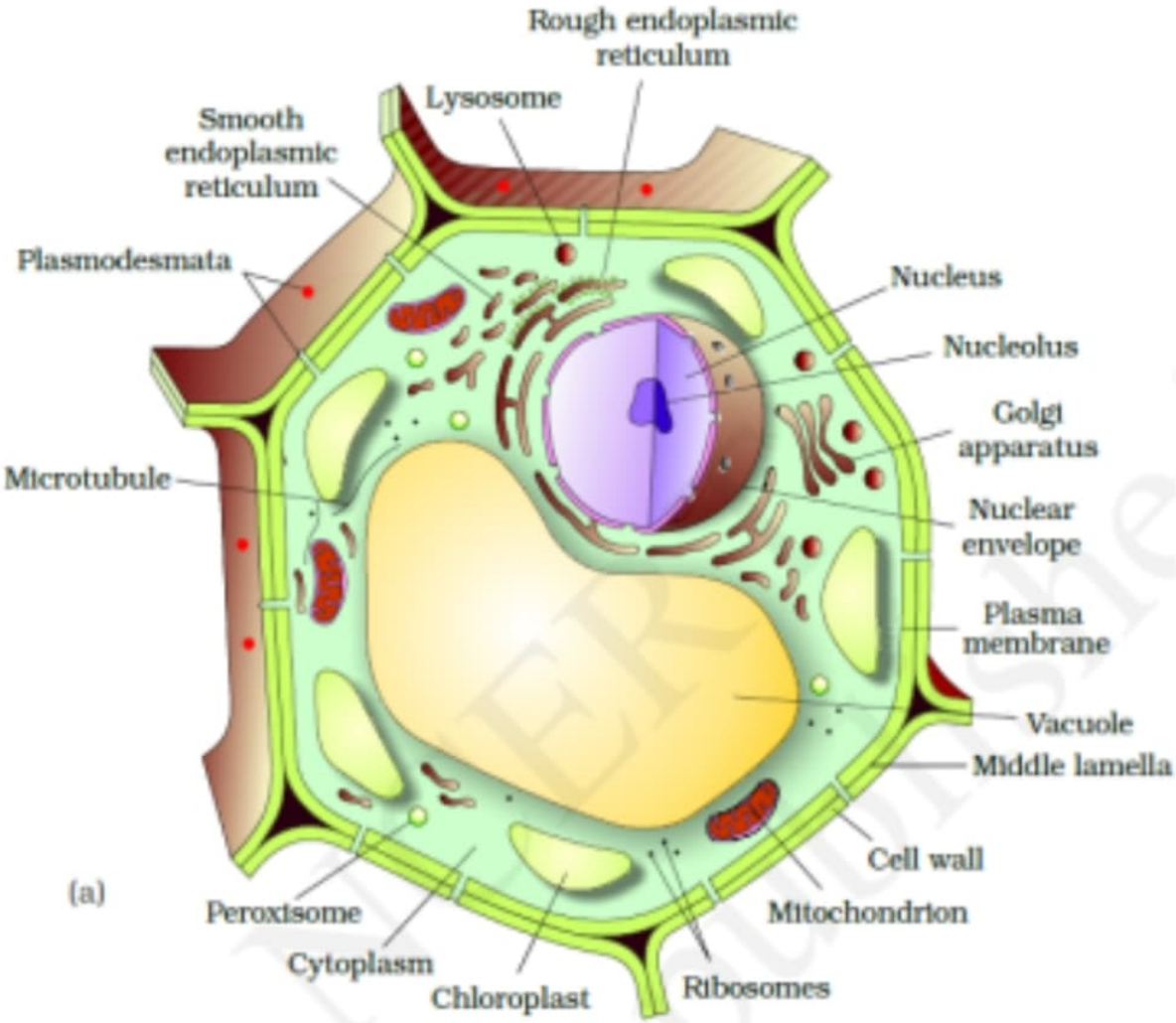
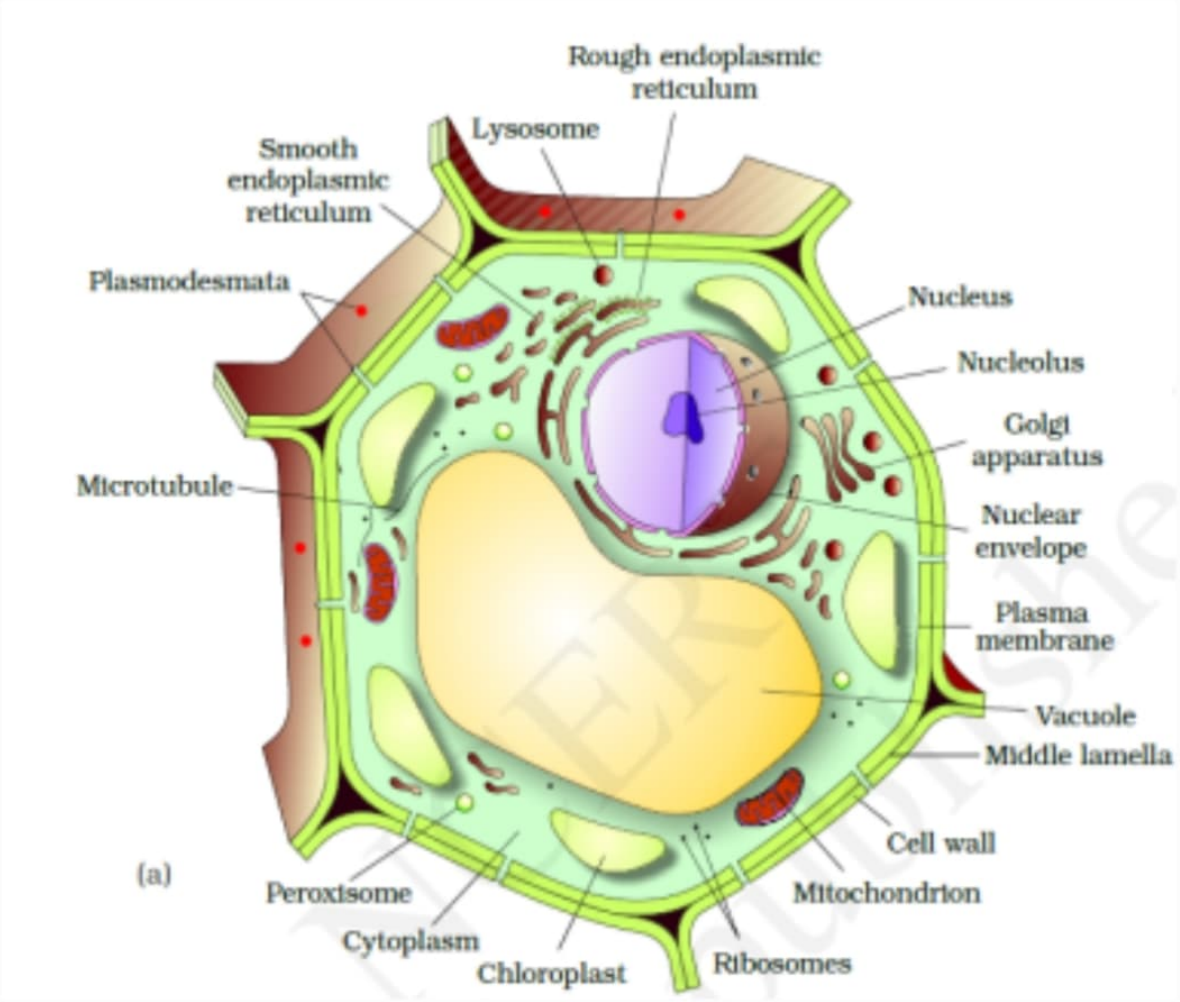
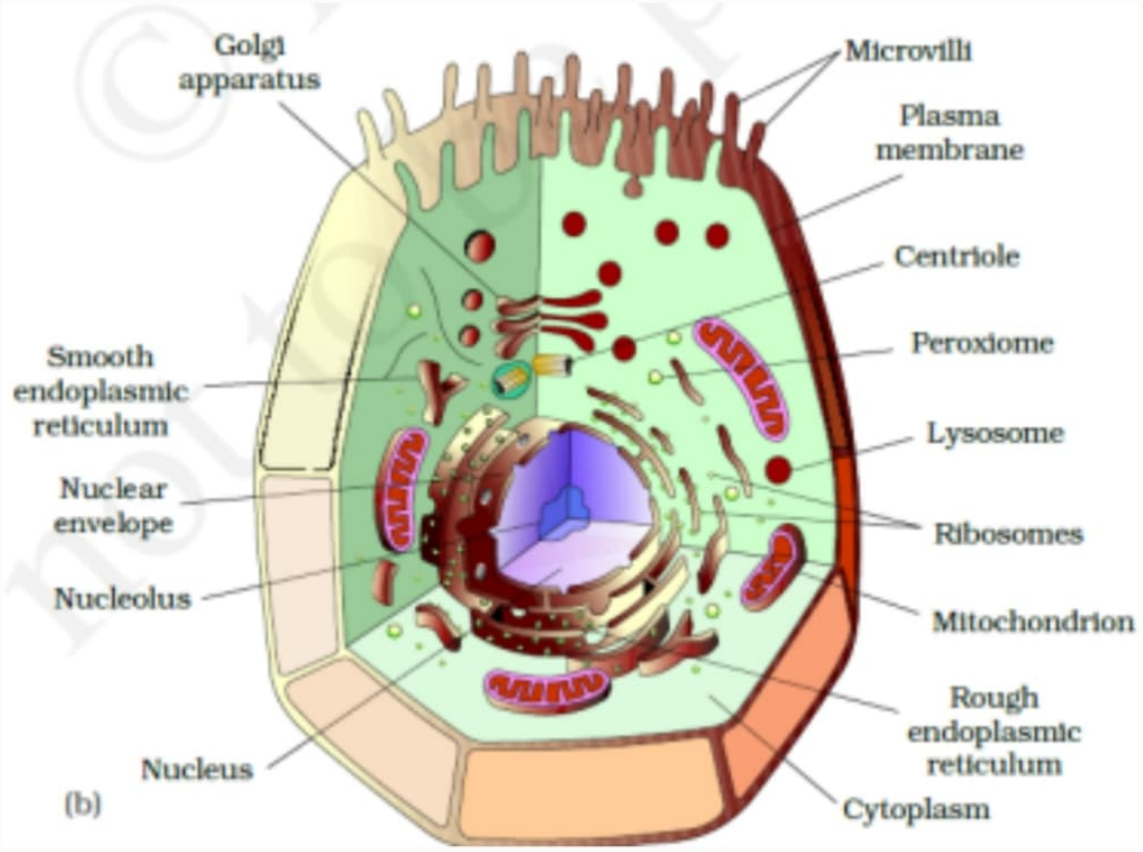
Eukaryotic Cell

- Eukaryotic cells are present in Protista, Plants, Animals, and Fungi. Cytoplasm is divided into compartments due to presence of membrane-bounded organelles.
- The cells contain well-organized nucleus with nuclear membrane. The genetic materials are arranged in chromosomes.
- Plants cells differ in having cell wall, plastids, and large central vacuole as compared to animal cells. Animal cells have centrioles, which are absent in plant cells.





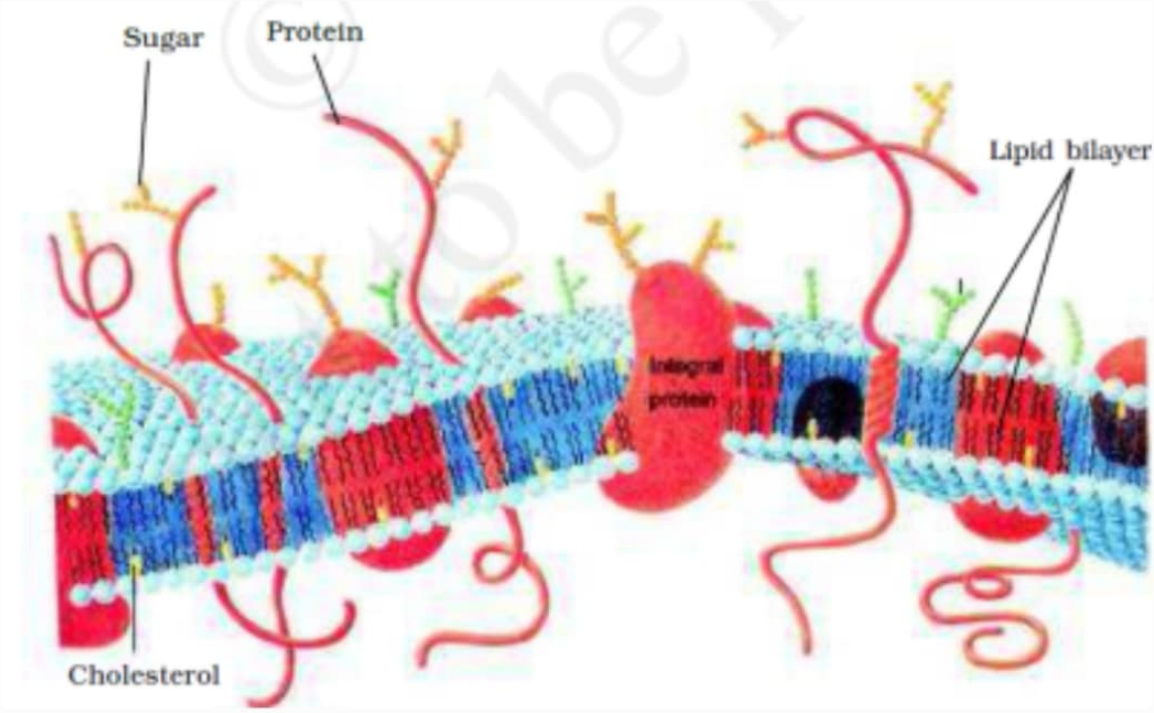
Plant cell



Animal cell

Animal cell

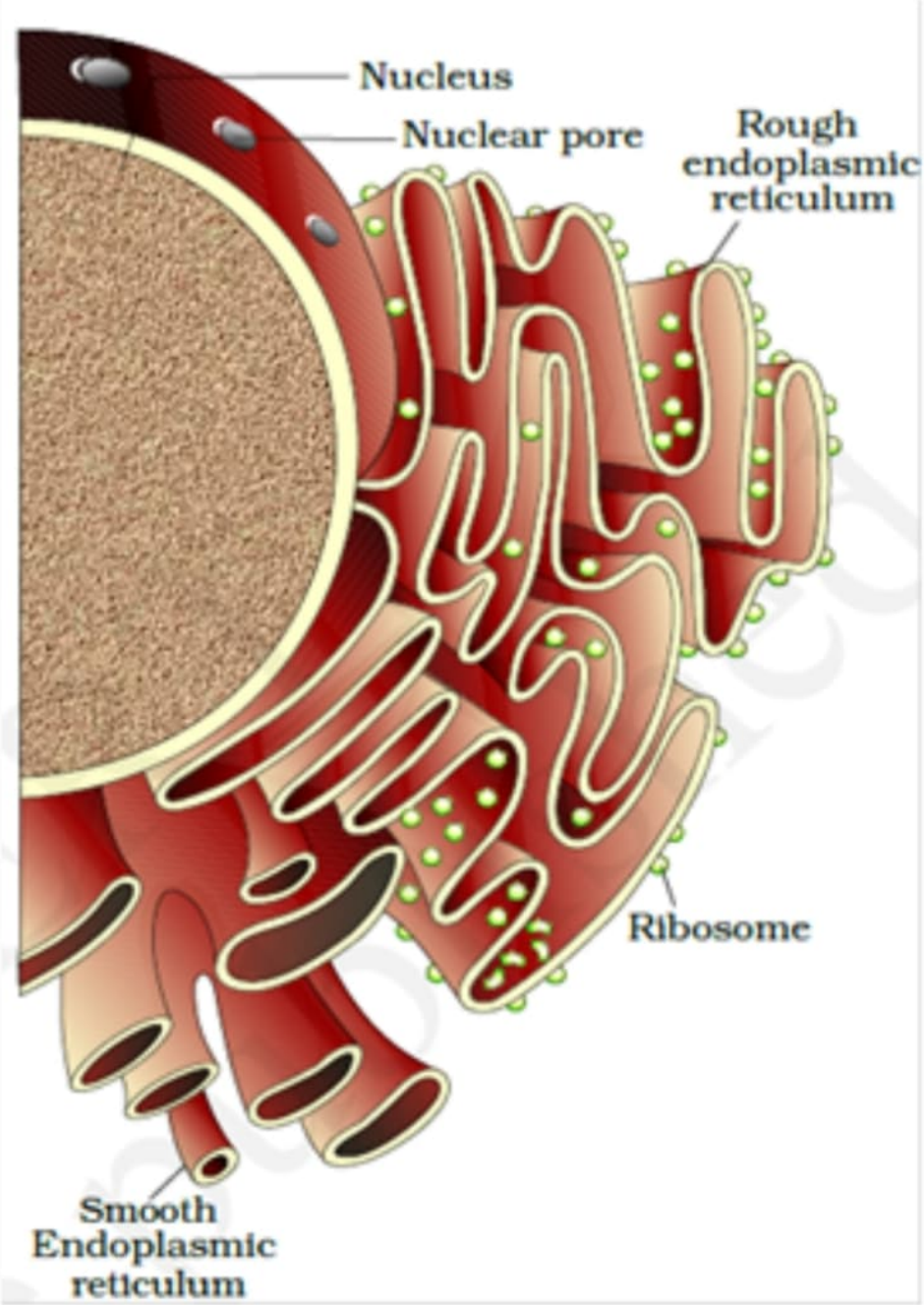
- Cell **membrane** is composed of lipids that are arranged in bilayer. The lipid component is mainly composed of phosphoglycerides. Later it was found that protein is also present in cell membrane. Ratio of protein and lipids varies in different cells.
- Membrane protein may be integral or peripheral. Integral protein remains buried in membrane but peripheral protein lies on the surface.
- Singer and Nicholson (1972) proposed **fluid mosaic model.** According to this model, the quasi-fluid nature of lipid enables lateral movement of protein within the bilayer of lipids.



- The main function of plasma membrane is the transport of molecules across it.

Active Transport	Passive Transport
1. The transport involves an expenditure of energy by the cells. 2. It occurs against the concentration gradient. 3. It is a rapid process.	1. The cells do not spend energy in passive transport. 2. This transport is always along the concentration gradient. 3. It is comparatively slow process.

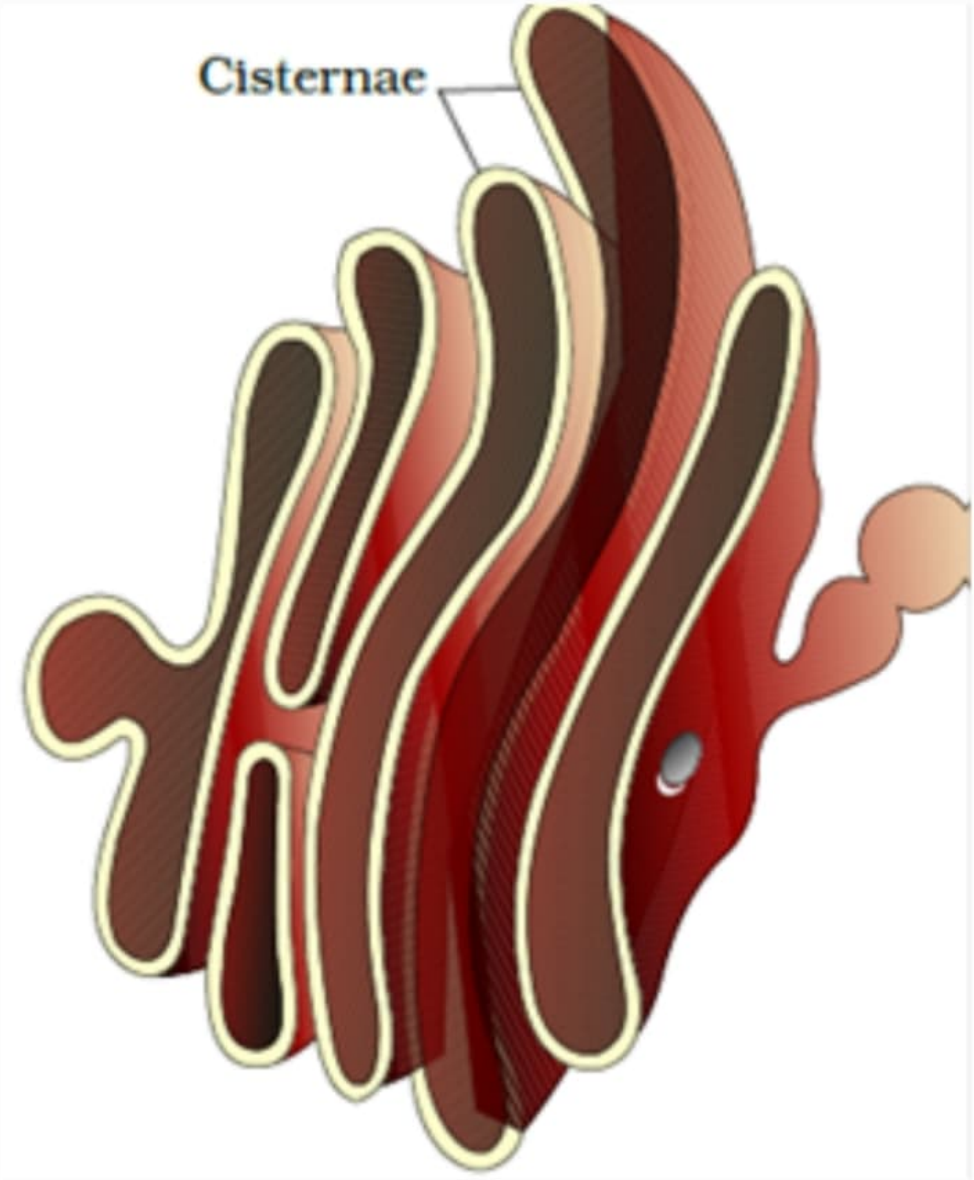
- The movement of water from higher concentration to lower concentration by diffusion is called **osmosis**.
- Cell wall is present in plant cells and fungi. Algae have cell wall made up of cellulose, galactans and minerals like calcium carbonate. In other plants, it consists of cellulose, hemicellulose, pectin, and proteins.
- Primary cell wall of young plant is capable of growth, which diminish in mature cells. Secondary cell wall is formed on inner side of the cells.
- Plasmodesmata connects the cytoplasm of neighboring cells.



- **Endoplasmic Reticulum** are the tubular structure scattered in the cytoplasm.

1. Rough endoplasmic reticulum bears ribosomes on its surface. RER is involved in protein synthesis and secretion.
2. Smooth endoplasmic reticulum does not bear ribosomes on its surface. SER is involved in lipid synthesis and steroidal hormones.

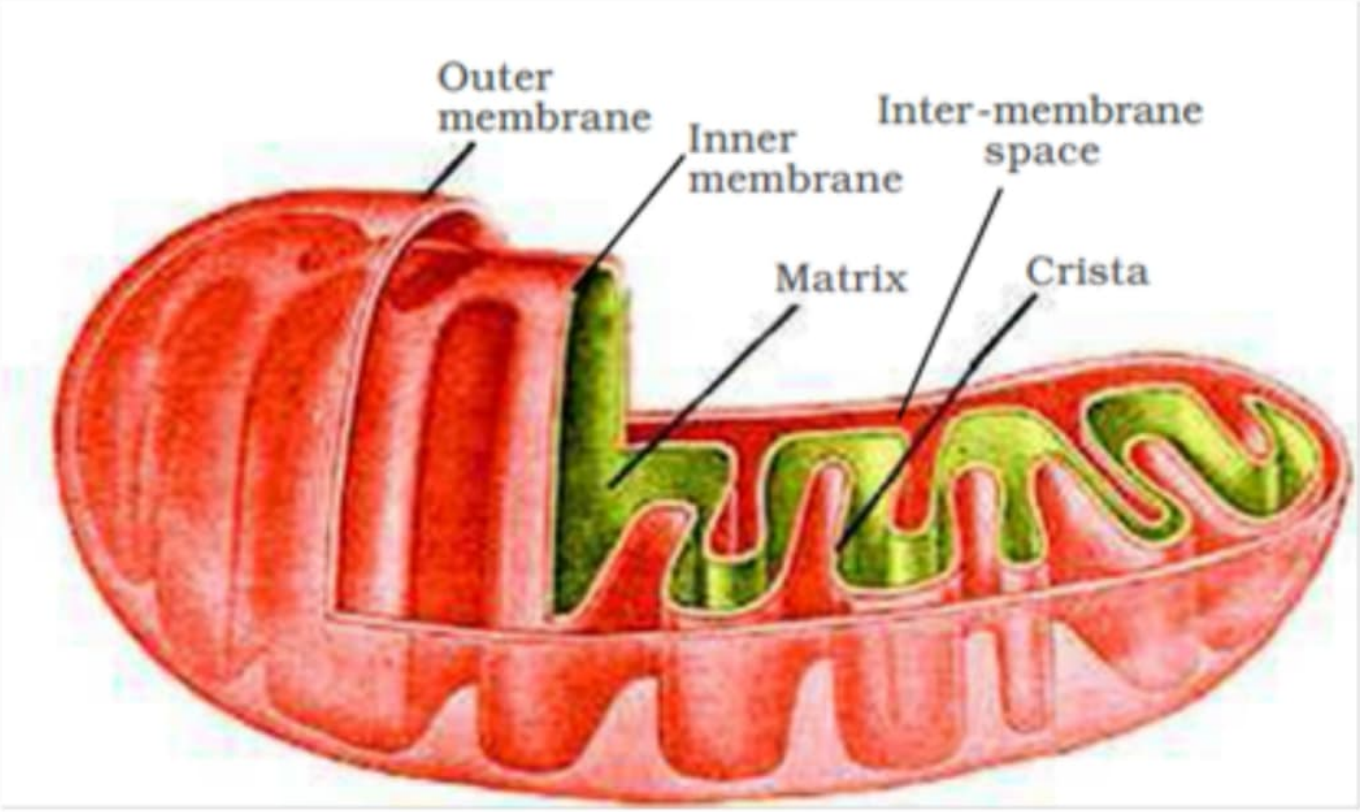
- **Golgi apparatus** was first observed by Camillo Golgi in 1898 near nucleus. They consist of many flat, disc-shaped sacs or cisternae stacked parallel to each other.
- Golgi apparatus performs the function of packaging of materials and its transportation. A number of protein synthesized by ribosomes are modified in cisternae of Golgi apparatus. Golgi apparatus is the site for synthesis of Glycoproteins and glycolipids.



- Lysosomes are membrane-bound vesicular structures formed by the process of packaging in the Golgi apparatus. They are rich in hydrolytic enzymes- lipase, protease, carbohydrases active at acidic PH. These enzymes are capable of digesting carbohydrates, proteins, lipids, and nucleic acids.

- **Vacuoles** are membrane-bound space found in cytoplasm containing water, sap and excretory product. They are bound by single membrane. They form contractile vacuole and food vacuole in many organisms.

- **Mitochondria** is double membrane-bound structure with the outer membrane and inner membrane dividing its lumen in two compartments. The inner membrane forms a number of infoldings called **cristae** towards the matrix.



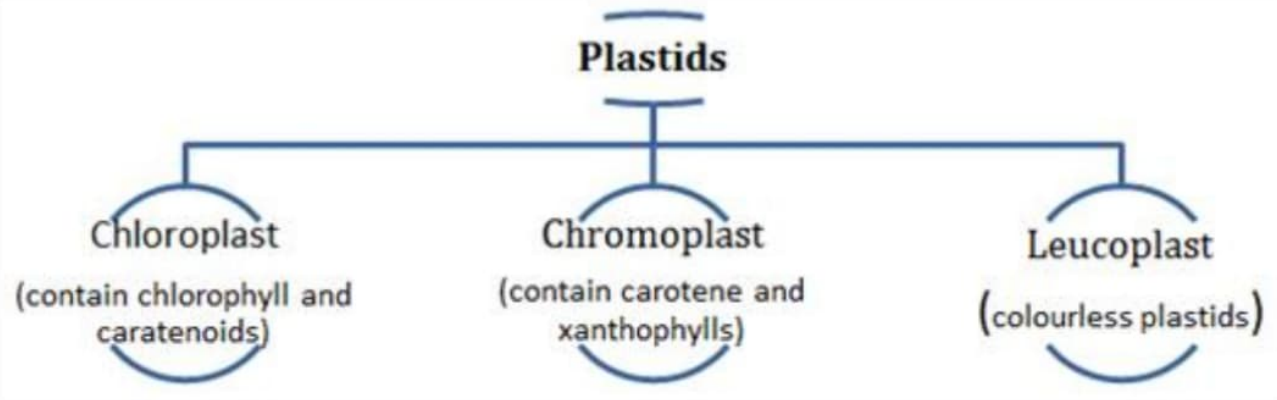
- Two membranes have their own specific enzyme.
- Mitochondria are sites for aerobic respiration. They produce cellular energy in form of ATP so, they are called **power house** of the cells. The matrix of mitochondria also contain circular DNA molecules, a few RNA molecules, ribosomes and components of protein synthesis.

8.5.8 Cilia and Flagella

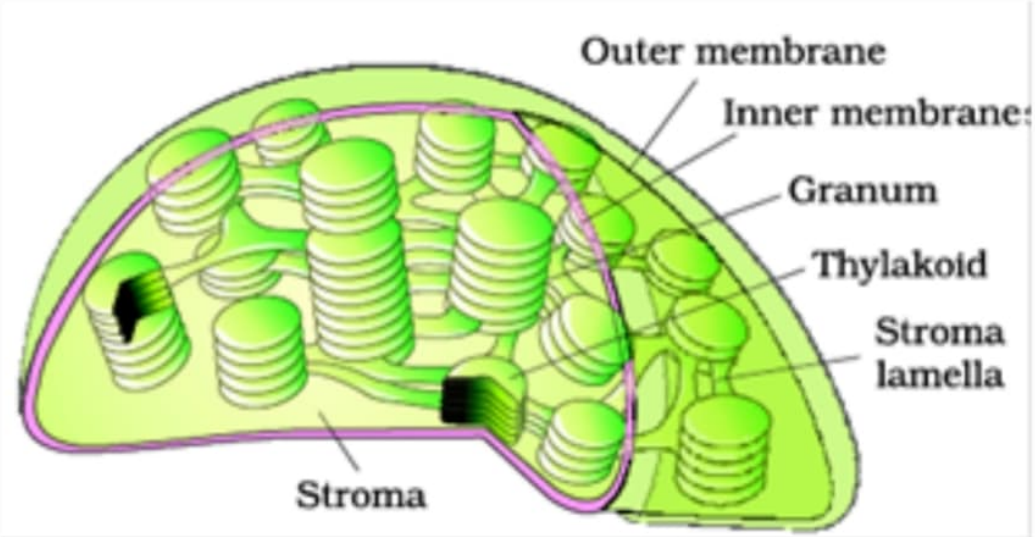
Cilia (sing.: cilium) and flagella (sing.: flagellum) are hair-like outgrowths of the cell membrane. Cilia are small structures which work like oars, causing the movement of either the cell or the surrounding fluid. Flagella are comparatively longer and responsible for cell movement. The prokaryotic bacteria also possess flagella but these are structurally different from that of the eukaryotic flagella.

The electron microscopic study of a cilium or the flagellum show that they are covered with plasma membrane. Their core called the **axoneme,** possesses a number of microtubules running parallel to the long axis. The axoneme usually has nine doublets of radially arranged peripheral microtubules, and a pair of centrally located microtubules. Such an arrangement of axonemal microtubules is referred to as the 9+2 array (Figure 8.10). The central tubules are connected by bridges and is also enclosed by a central sheath, which is connected to one of the tubules of each peripheral doublets by a radial spoke. Thus, there are nine radial spokes. The peripheral doublets are also interconnected by linkers. Both the cilium and flagellum emerge from centriole-like structure called the basal bodies.

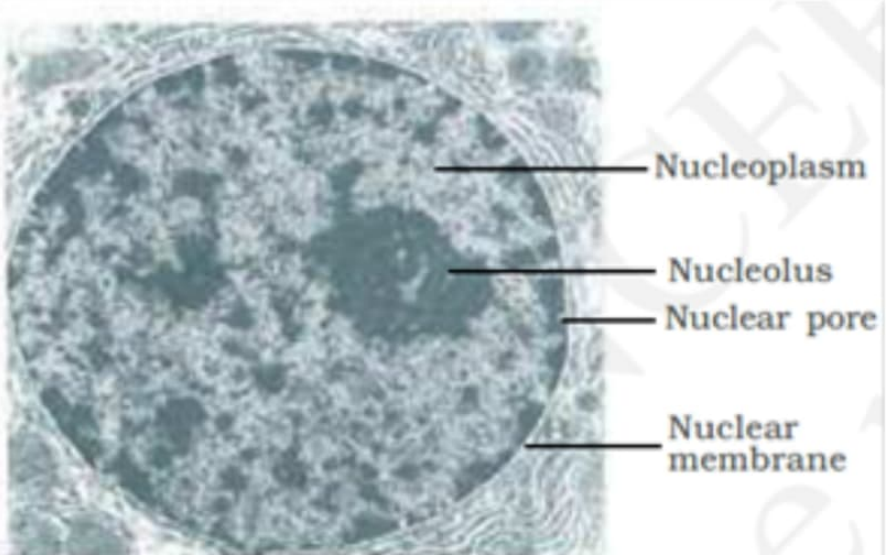
- **Plastids** are found in plant cells and in Euglenoids.



- Chloroplast contains chlorophyll that traps solar energy for photosynthesis. Chromoplast provides yellow, orange and red colours to different parts of plants.
- Leucoplasts are colourless plastids that store food, amyloplasts (carbohydrates), elaioplasts (oils) and aleuroplasts (proteins).
- Chloroplasts are double membrane structures. The space limited by inner membrane is called stroma. Thylakoids are present in stroma as stacks like the piles of coins called grana.



- Stroma contains enzymes for synthesis of protein and carbohydrates. Double strand circular DNA and ribosomes are also present in stroma.
- Eukaryotic cells have **80S ribosomes**. They have granuler structure with two subunits.
- **Centrosome** is an organelles containing two cylindrical structures called centrioles. Each centrioles is made up of 9 fibrils of tubulin protein. Central part of centriole is called hub and peripheral fibrils are called spokes.
- **Nucleus** has highly extended, elaborate nucleoprotein fibers called chromatin, nuclear matrix, and nucleoli. The outer membrane is continuous with endoplasmic reticulum and bears ribosomes.
- The chromatin materials change into chromosome during active cell division. It consists of DNA and histone proteins.
- Every chromosome has a primary constriction or the centromere, on the sides of which disc-shaped kinetochores are present.



You may recall that the interphase nucleus has a loose and indistinct network of nucleoprotein fibres called chromatin. But during different stages of cell division, cells show structured **chromosomes** in place of the nucleus. Chromatin contains DNA and some basic proteins called **histones**, some non-histone proteins and also RNA. A single human cell has approximately two metre long thread of DNA distributed among its forty six (twenty three pairs) chromosomes. You will study the details of DNA packaging in the form of a chromosome in class XII.

Every chromosome (visible only in dividing cells) essentially has a primary constriction or the **centromere** on the sides of which disc shaped structures called **kinetochores** are present (Figure 8.12). Centromere holds two chromatids of a chromosome. Based on the position of the centromere, the chromosomes can be classified into four types (Figure 8.13). The **metacentric** chromosome has middle centromere forming two equal arms of the chromosome. The **sub-metacentric** chromosome has centromere slightly away from the middle of the chromosome resulting into one shorter arm and one longer arm. In case of **acrocentric** chromosome the centromere is situated close to its end forming one extremely short and one very long arm, whereas the **telocentric** chromosome has a terminal centromere.

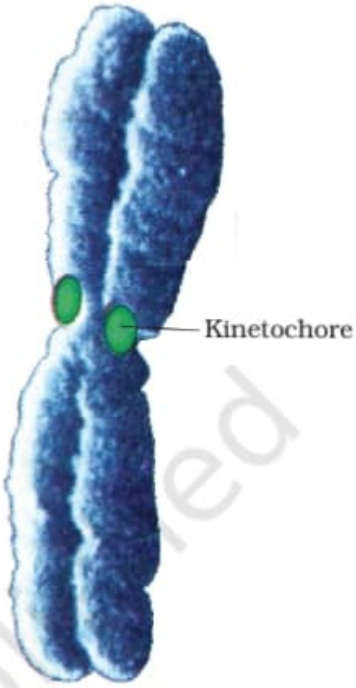


Figure 8.12 Chromosome with kinetochore

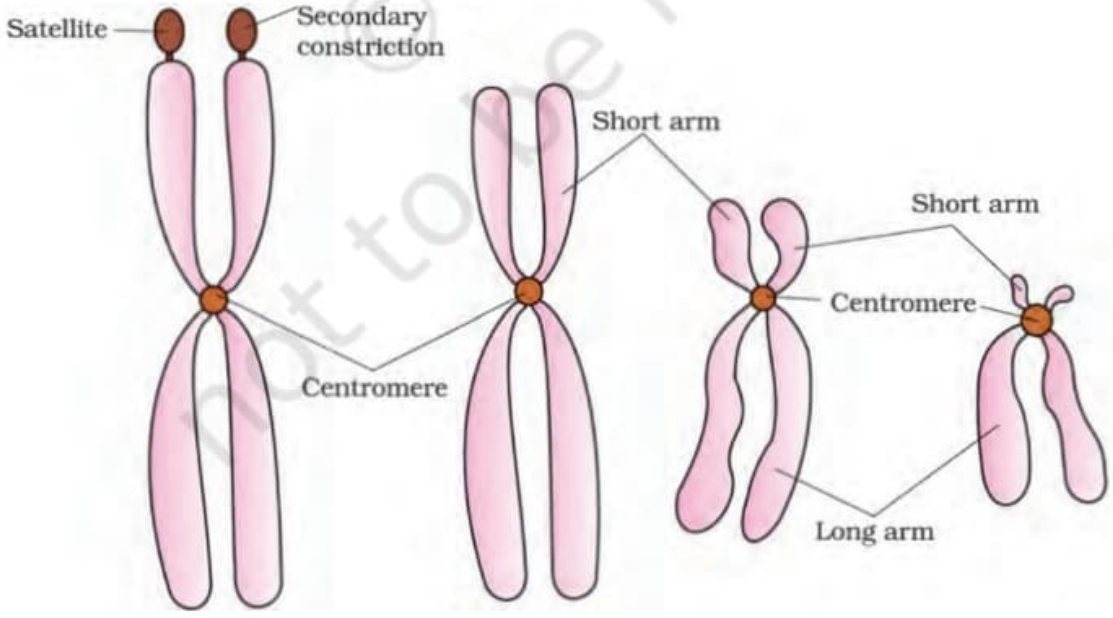
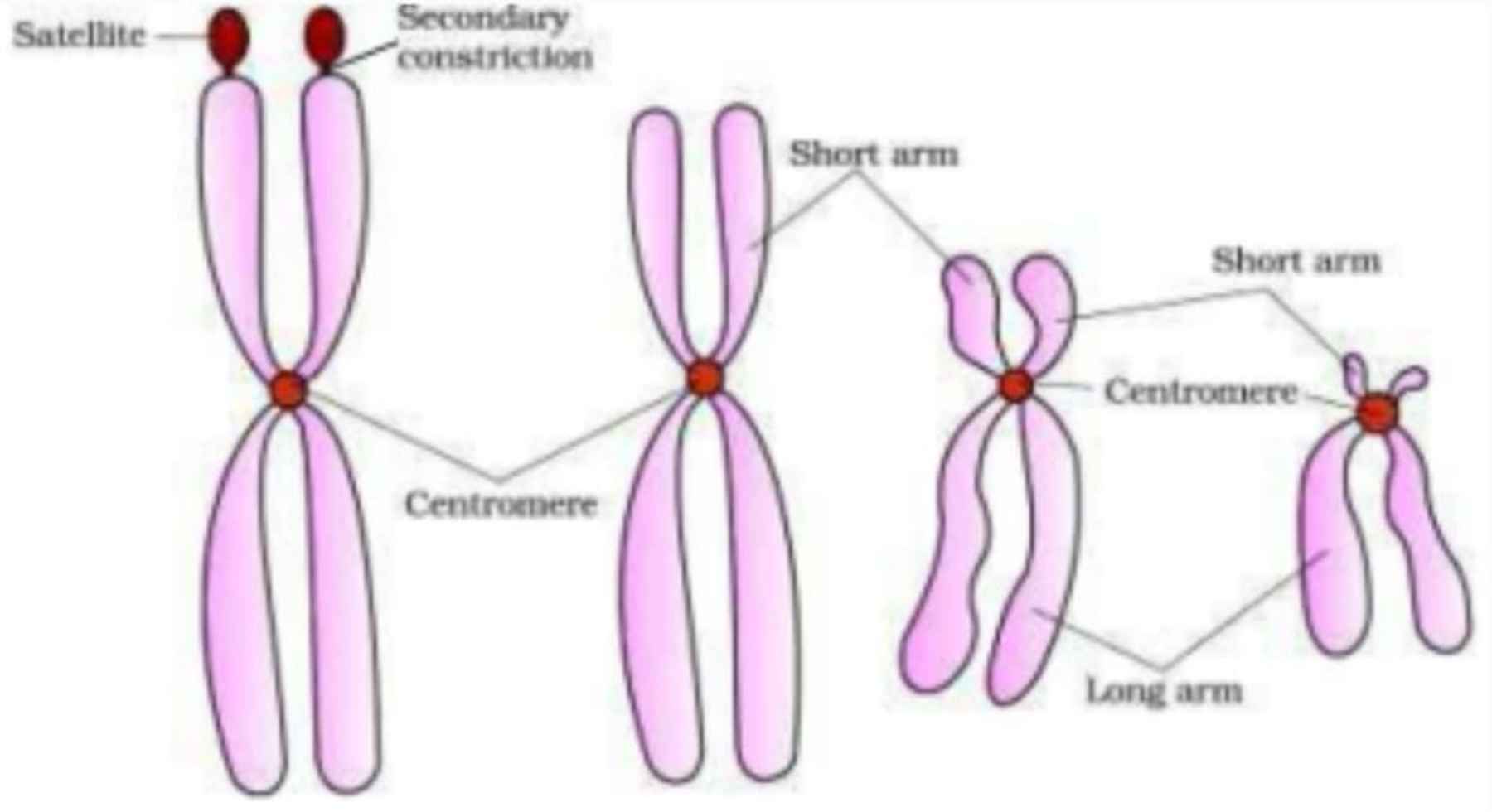


Figure 8.13 Types of chromosomes based on the position of centromere



Some chromosomes have non-staining secondary constriction at certain location. This gives a small fragment called **satellite**.