THE EUKARYOTIC CELL

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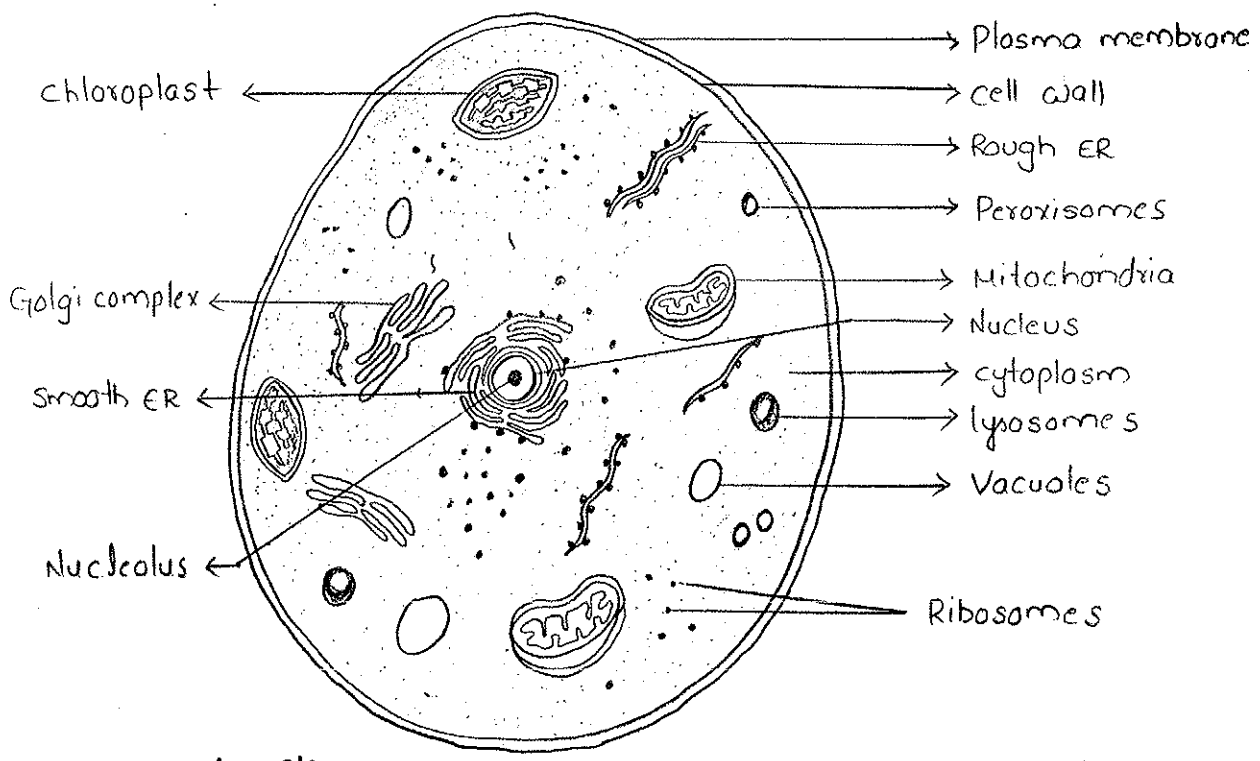
Eukaryotic organisms include algae, protozoa, fungi, plants and animals. The Eukaryotic cell is typically larger and structurally more complex than Prokaryotic cell.



Flagella and Cilia :

Many types of Eukaryotic cells have projections that are used for cellular locomotion (or) for moving substances along the surface of the cell. These projections contain cytoplasm and are enclosed by the plasma membrane.

⇒ If the projections are few and are long in relation to the size of the cell, they are called **"Flagella"**.

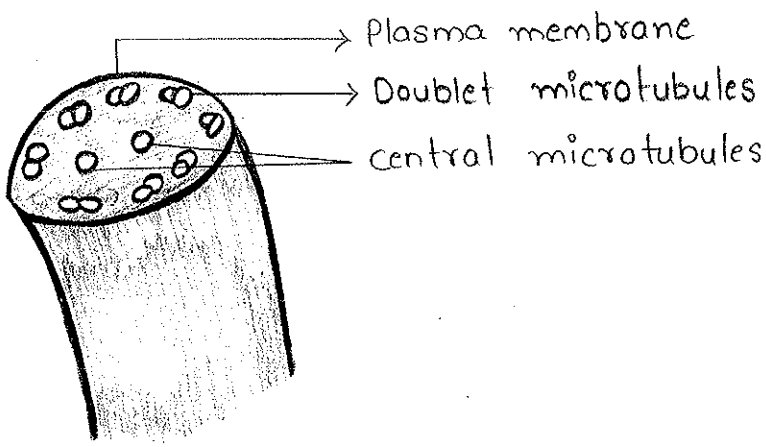
⇒ If the projections are numerous and short, they are called **"Cilia"**.

→ Algae of the genus Euglena use Flagellam for locomotion.

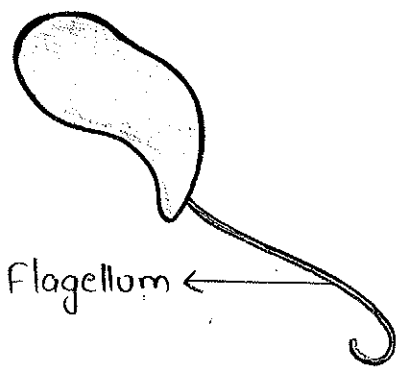
→ Protozoa, such as Tetrahymea use cilia for locomotion.

→ Flagella and cilia are anchored to plasma membrane by a basal body, & both consist of 9 pairs of micro-tubules arranged in a ring, plus 2 another micro-tubules in the center of the ring, an arrangement called a 9+2 Array.

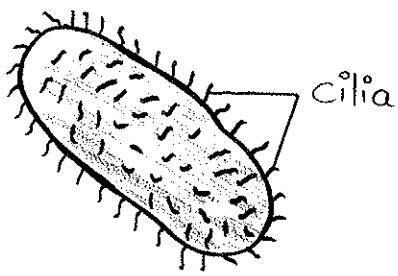
→ Microtubules are long, hollow tubes made up of protein called "Tubulin".



INTERNAL STRUCTURE OF FLAGELLUM SHOWING 9+2 ARRANGEMENT OF MICROTUBULES



ALGAE WITH ITS FLAGELLUM



PROTOZOAN WITH CILIA

Cell wall and Glycocalyx :

→ Most Eukaryotic cells have cell walls, although they are much simpler than those of Prokaryotic cells.

→ Many Algae have cell walls consisting of polysaccharide cellulose (as do all plants).

→ Cell walls of some **Fungi** also contain cellulose, but in most fungi the principal structural component of the cell wall is the **Polysaccharide chitin**, a polymer of N-acetyl glucosamine (NAG) units.

→ The cell wall of yeasts contain the **polysaccharides** glucan and **mannan**.

→ **Protozoa** do not have a **typical cell wall**, instead, they have a flexible outer protein covering called a **Pellicle**.

→ In other, Eukaryotic cells, including animal cells, the plasma membrane is covered by **Glycocalyx**, a layer of material consisting substantial amounts of sticky carbohyd-rates.

→ Glycocalyx strengthens the cell wall surface, helps attach cells together, & may contribute to cell-cell recognition.

Plasma (cytoplasmic) Membrane :

→ Eukaryotic membranes contains carbohydrates, which serve as attachment sites for bacteria & as receptor sites that assume a role in, functions as cell-cell recognition.

→ Eukaryotic plasma membranes also contain **Sterols**, complex lipids not found in prokaryotic plasma membrane.

→ Sterols seems to be associated with the ability of membranes to resist lysis resulting from increased osmotic pressure.

→ Eukaryotic cells can use a mechanism called **Endocytosis**. This occurs when a segment of plasma membrane surrounds a particle (or) large molecule, encloses it & bring into cell.

→ Two important types of endocytosis. They are :

i) Phagocytosis
ii) Pinocytosis

➡ During **Phagocytosis**, cellular projections called **Pseudopods** engulf particles and bring them into cell.

→ Phagocytosis is used by **WBC** to destroy bacteria and foreign substances.

➡ In **Pinocytosis**, the plasma membrane folds inward, bring-ing extracellular fluid into cell, along the substances which are dissolved in fluid.

→ Pinocytosis is one of the ways viruses can enter animal cells.

Cytoplasm :

→ The cytoplasm of Eukaryotic cells encompasses the substance inside the plasma membrane & outside the Nucleus.

→ Cytoplasm is found in various cellular components & cystol is the fluid portion of cytoplasm.

→ Eukaryotic cytoplasm has a complex internal structure consisting of exceedingly small rods (micro filaments and intermediate filaments) and cylinders (microtubules), they together form **Cytoskeleton**.

→ **Cytoskeleton** provides supports & shape & assists in transporting substances through the cell.

→ The movement of eukaryotic cytoplasm from one part of cell to another, which helps distribute nutrients & move the cell over a surface, called **Cytoplasmic streaming**.

Ribosomes :

→ These are attached to the outer surface of the Rough Endoplasmic Reticulum and are called as **Ribosomes**, which are found free in cytoplasm.

→ Ribosomes are somewhat larger & denser than those of Prokaryotic cells.

→ These eukaryotic ribosomes are **80S ribosomes**, each of which consists of a **large 60 S** subunit containing **three molecules** of rRNA and a **smaller 40S** subunit with **one molecule** of rRNA

→ **Chloroplasts & mitochondria contains 70S ribosomes**

→ Some ribosomes are called **Free Ribosomes**, are unattached

to any structure in cytoplasm. Free ribosomes synthesis proteins used inside the cell.

→ Some Ribosomes are called **Membrane bound Ribosomes** attached to nuclear membrane and Endoplasmic reticulum.

→ Sometimes 10 - 20 ribosomes join together in a string like arrongement called a **Polyribosome**.

ORGANELLES :

Organelles are structures with specific shapes and specialized functions. They include the following :

* Nucleus
* Endoplasmic Reticulum
* Golgi Complex
* Lysosomes
* Vacuoles
* Mitochondria
* chloroplasts
* Peroxisomes
* Centrosomes

Nucleus :

→ Nucleus is the most characteristic Eukaryotic organelle.

→ It is usually spherical (or) oval, is frequently the larger structure in the cell

→ It consist of cell's hereditary information **DNA**.

→ Nucleus is surrounded by a double membrane called **Nuclear Envelope**. Both membranes resemble the plasma membrane in structure.

→ Tiny channels in the membrane called **nuclear pores** allow the nucleus to communicate with the cytoplasm.

→ Nuclear pores control the movement of substances between the nucleus & cytoplasm.

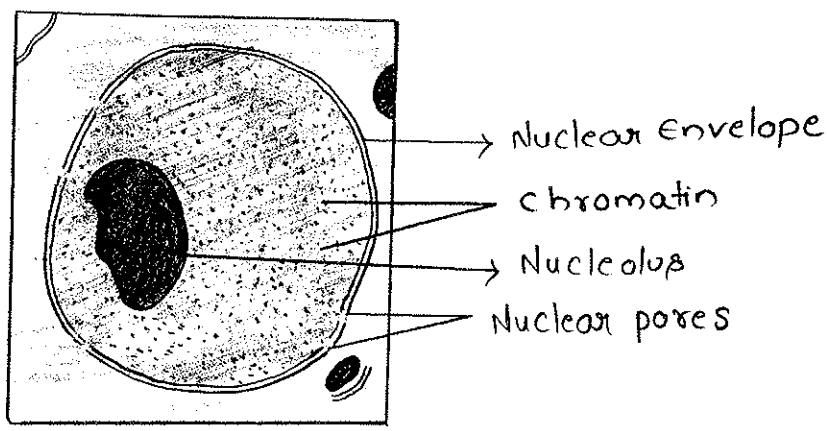
→ Within the nuclear envelope are one (or) more spherical bodies called **Nucleoli**.

→ The cell's DNA, which is combined with several proteins, including some basic proteins called **Histones** and **non-histones**.

→ The combination of about **165 base pairs** of DNA and **9 molecules of histones** is referred to as a **nucleosome**.

→ When cell DNA is not reproducing, the DNA & its associated proteins appear as a thread like mass called **chromatin**.

→ During nuclear division, the chromatin coils into shorter and thicker rod like bodies called **chromosomes**.



Endoplasmic Reticulum :

→ Endoplasmic Reticulum [ER] is an extensive network of flattened membraneous sacs (or) tubules called **cisterns.**

→ The ER is continous with the nuclear envelope.

→ Most Eukaryotic cells contain two distinct, but inter-related forms of ER that differ in structure & function.

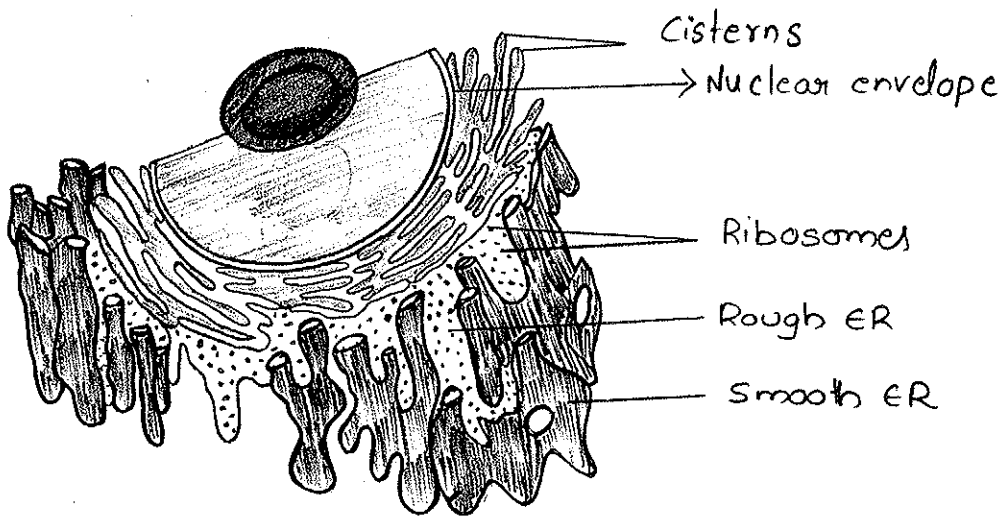
→ The outer surface of rough ER is studded with ribosomes, helps in protein synthesis.

→ Smooth ER extends from rough ER to form a network of membrane tubules.

→ Smooth ER doesn't have ribosomes on outer surface.

→ Smooth ER synthesize phospholipids, fats & steroids like estrogen & progesterone and testosterone.

→ In liver, smooth ER help in release of Glucose into blood stream.



Golgi complex :

→ The proteins synthesized by the ribosomes attached to rough ER are ultimately transported to other regions of the cell.

→ The first step in transport pathway is through an organelle called **Golgi complex**.

→ It consists of **3 to 20 cisterns** that resemble a stack of **Pita bread**.

→ The cisterns are often curved, giving Golgi complex a cup like shape.

→ Proteins synthesized on rough ER surrounded by a portion of ER membrane, which eventually buds from the membrane surface forms **Transport Vesicle**.

→ The proteins are modified & move frome one cistern to another via **transfer vesicles**.

→ Cisterns modifies the proteins to form glycoproteins, glyco-lipids & lipoproteins.

→ Some proteins leave the cisterns in **secretory vesicles**.

→ Some **processed proteins** leave the cisterns in vesicles called **storage vesicles**.

Lysosomes :

Lysosomes are formed form Golgi complex and look like membrane enclosed spheres.

→ lysosomes are lack of internal structure and have single membrane.

→ They contain powerful digestive enzymes, helps in break-down of various molecules. They can kill bacteria (or) digest bacteria that enter the cell.

→ Human WBC, which use phagocytosis to ingest bacteria, contain large number of lysosomes.

→ lysosomes are also known as **Suicidal bags of cell.**

Vacuoles :

→ A vacuole is a space (or) cavity in cytoplasm of cell that is enclosed by a membrane called **Tonoplast.**

→ In plant cell, vacuoles may occupy **5 to 90%** of the cell volume, depending on type of cell.

→ Vacuoles may take up water, enabling plant cells to increase in size & also providing rigidity to leaves and stems.

Mitochondria :

→ Mitochondria is a suasage shaped organelle appear throughout the cytoplasm of most Eukaryotic cells.

→ Mitochondria consist of a double membrane similar to the structure of plasma membrane

→ The outer mitochondrial membrane is smooth, but the inner membrane is arranged in series of folds called **Cristae**

→ The center of the mitochondrion is a semifluid substance called the **Matrix**.

→ Some proteins that function in cellular respiration, including the enzyme that makes ATP, are located on the cristae of the inner mitochondrial membrane.

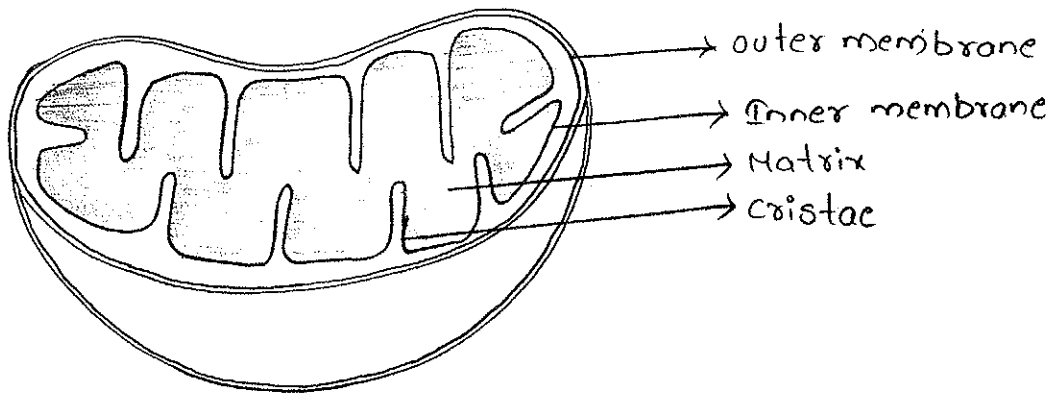
→ Metabolic steps involved in cellular respiration concentrated with matrix.

→ Mitochondria is often known as **Power Houses of the cell** because of their central role in ATP production.

→ Mitochondria contain 70S ribosomes, & some DNA of their own.

→ Machinary necessary to replicate, transcribe & translate the information encoded by their DNA.

→ Mitochondria can reproduce more (or) less on their own by growing & dividing in two.



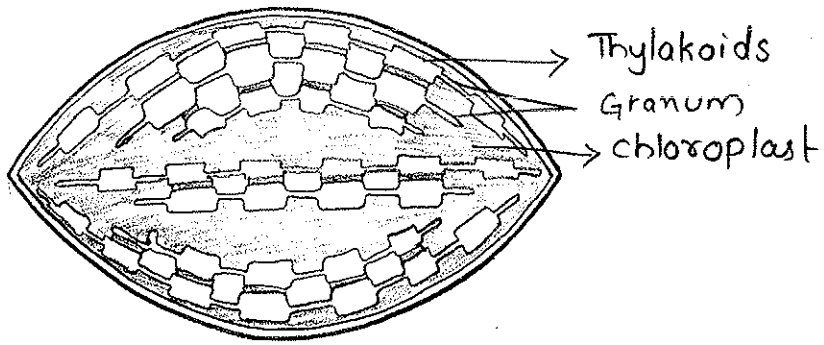
Chloroplasts :

→ Algae & green plants contain a unique organelle called a chloroplast.

→ It consist of both the pigment **chlorophyll** and the enzymes required for light gathering phases of **Photosynthesis**

→ The chlorophyll is contained in flattened membrane sacs called **Thylakoids**, and the stalks of thylakoids are called as Grana.

→ chloroplast contain 70S ribosomes, DNA, & enzymes involved in protein synthesis.



Peroxisomes :

→ Organelle similar to lysosomes in structure, but smaller are called Peroxisomes.

→ It contain one (or) more enzymes that can oxidise various organic substances.

→ Peroxisomes contain an enzyme called **Catalase**, which decomposes H_2O_2.

→ The generation & degradation of H_2O_2 occurs within the same organelle.

→ Peroxisomes protect other parts of cell from toxic effects of H_2O_2.

Centrosome :

→ The centrosome, located near to the nucleus, consists of two components. They are :

i) Pericentriolar area

ii) Centrioles

→ The pericentriolar material is a region of cystol composed of a dense network of small protein fibers.

→ The pericentriolar material is a pair of cylindrical structures called centrioles.