Chapter =03

Cell Structure and Functions

Cell is the basic structural and functional unit of life.

TECHNIQUES USED IN CELLS BIOLOGY:

To know the structure and functions of cells etc., and cell organelles some of the techniques will be discussed here in brief.

1- CELL FRACTIONATION:

In cell fractionation cell organelles isolated from cell based upon their size and density in order to study the structure and chemical nature of organelles. It is very useful for electron microscopy of cell components.

1: Homogenization 2: Sedimentation

HOMOGENIZATION:

- It involves the grinding of large number of cells in a suitable medium with correct pH. ionic composition and temperature.
- It is the formation of a homogenous mass of cells.
- In plants enzyme pectinase is added to digest middle lamella.
- This can be done in a homogenizer, mortar, pestle or blender.
- This procedure gives rise to uniform mixture of cells which is then centrifuged.

SEDIMENTATION

- Setting down of cell organelles on the basis of size and density in centrifugation under the influence of centrifugal force.
- Small organelles required high gravitational force.
- It is done by the machine called centrifuge (rotation up to 60,000 cycles per minute).
- This machine can spin the tubes at very high speed.
- In the beginning, low speed applied for heavy and bigger organelles separation such as nuclei which settle down as sediment.
- Smaller organelles still present in supernatant (fluid).
- Poured supernatant into another tube for further isolation by centrifugation.
- After that, high speed applied for light and smaller organelles separation.

2- DIFFERENTIAL STAINING:

- Staining technique is used in cell's structure study.
- In staining different colors used for applying on cell organelles in order to distinguish them from one another.

• Different cell or organelles get different staining just because of their chemical composition.

For example, WBCs are of different types hence different stain is required in order to distinguish them from each other.

3- MICRODISSECTION:

Dissection under the microscope for isolation of specific cells is called microdissection. This technique is used for the study of embryonic cells, to determine the role of different chemicals on the development process, and for the treatment of tumour and cancer.

4- TISSUE CULTURE:

• Growth of cell or tissues on chemically defined nutrient medium under sterile conditions is called tissue culture.
• It is done in test tube or petri dish.
• First used in plants for production of identical plants because each cell of plants is totally potential.
• In 1958 Steward grew complete carrot plant from phloem cells in a medium containing sugar, minerals, vitamins and plants hormones.
• Phloem cells start division and form callus.
• Callus is a group of undifferentiated cells.
• Callus differentiate into shoot and root.

• In animals this technique is used for the observations of cells abnormality such as cancer.

5- CHROMATOGRAPHY:

Chromatography is a technique used for the separation of different chemical compounds from a mixture such as proteins, amino acids and pigments. There are four types of chromatography. Paper chromatography, thin layer chromatography, gas chromatography and high performance liquid chromatography.

PAPER CHROMATOGRAPHY: It is simple and widely used technique. It involves two phases.

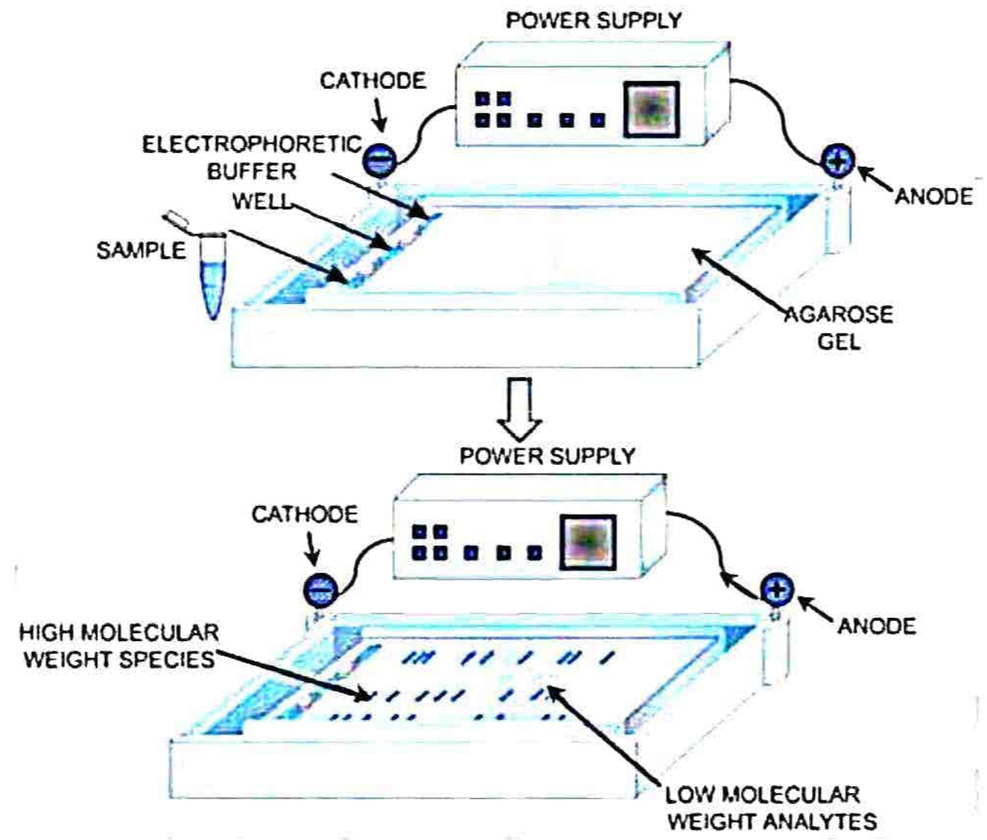
STATIONARY PHASE: which is cellulose filter paper.

MOBILE PHASE: is a solvent in which sample mixture is dissolved. When the solvent travels over the paper, the mixture sample begins to separate as dots on paper according to their rate of movement. Small molecules move at high speed and large molecules move at slow speed.

6- ELECTROPHORESIS:

• This technique utilizes a gel medium for separation of fragments.
• Gel medium contain Acrylamide.
• It is done under the influence of electric field.
• When voltage applied to apparatus the molecules migrate through the electric field.
• Gel consist of permeable matrix like sieve through which molecules travel when current is applied.
• Gel is suspended in between electrolyte solution and electrodes.
• At one end positive electrode and on another end negative electrode is present.
• The negative charge molecules will move towards positive electrode and positive charge molecule will move towards negative electrode.

• Velocity of fragments movement is inversely proportional to size. Therefore, small fragments move faster than larger.
• In this way all the fragments are separated in the gel after some time.
• In electrophoresis charge bearing molecules separated according to their size, shape, molecular weight. E.g. DNA, RNA, Protein.



7- SPECTROPHOTOMETER:

• Spectrophotometer is a technique which is used to determine the absorbance of different wavelengths of light by a particular chemical compound or a photosynthetic pigment.
• Because each compound absorbs visible light at different wavelength. For this purpose, the spectrophotometer is used.
• This instrument uses a light beam which passes through sample solution that absorb light of certain wavelength. •This absorbed wavelength is measured by spectrophotometer.
• It is used to determine growth of bacteria. rate of photosynthesis and minute quantity of DNA.

8- MICROSCOPY:

Microscopy is a technique to see object that cannot see by naked eye. The study of cell or tissue under the microscope is called microscopy. There are three attributes of microscopy such as magnification, resolution and contrast.

MAGNIFICATION:

• Magnification is the capacity of an optical instrument to increase to increase the size of an object than its original size.
• The increase in apparent size of an object is called magnification. .
• It can be calculated by multiplying the power of eye piece with power of object
• Different microscope has different magnification power such as the magnification power of light microscope is 10,000X.
• It is represented by X.

RESOLUTION:

• Distance between two closest points is called resolution or separation between two adjacent object is called resolution.
• Human naked eye can separate objects which are 0.1 mm apart while the size of a cell is 30-40 micrometre.

• So the minimum capacity of a lens to differentiate between two closest points is called resolution power.

CONTRAST:

• Being different from something else.
• Contrast is defined as the difference in light intensity between the image and the adjacent background relative to overall background.
• In order to study transparent objects or specimen phase contrast microscope is used.
• Light microscope cannot differentiate between transparent specimen so, staining and fixing of material is required.

9- MICROMETRY:

Micrometry is the measurement of the size of objects under microscope. It involves two micrometres.

a- OCULAR MICRO METER:

• Ocular micrometre is a glass disc with 100 equal divisions with no absolute values.
• It is placed in the eye piece of microscope.

b- STAGE MICRO METER:

• This is glass slide with an exact scale, like a miniature transparent ruler.
• Ocular micro meter is calibrated by using stage micro meter.
• By super imposing the image of ocular micro meter and stage micro meter it is calibrated so, the size of any object viewed under the size of any given object viewed under the microscope can be estimated.

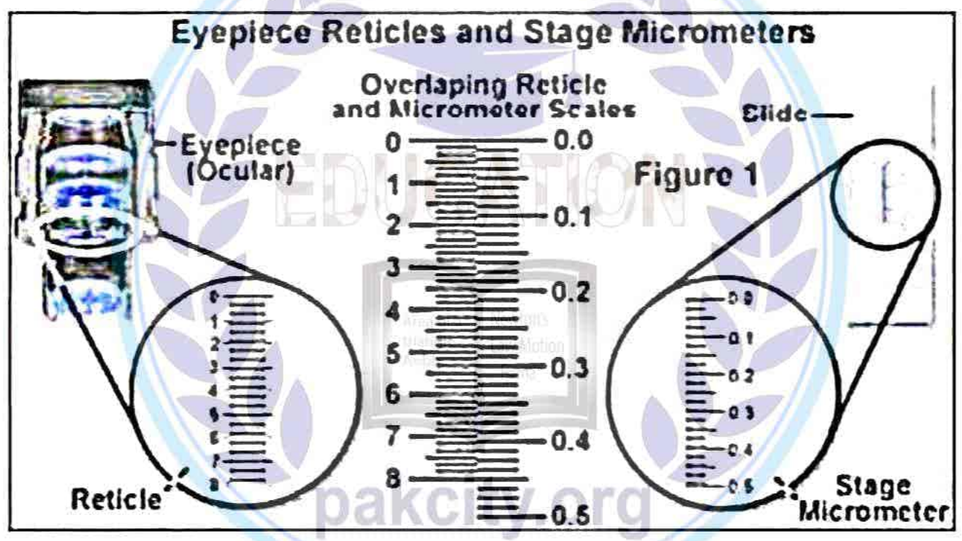


Figure 1

CELL WALL:

• In plants, fungal and bacterial cells cell membrane is surrounded by cell wall.
• Cell wall is non-living structure.
• The protoplasm of the cell secretes cell wall.
• Plants cell wall is made up of cellulose. Bacterial cell wall is made up of peptidoglycan (murrain).
Fungal cell is made up of chitin.
Cell wall is composed of three main layers.
i. Middle lamella.
ii. Primary cell wall.
Iii.Secondary cell wall.

i. MIDDLE LAMELLA:

It is first layer to be formed between primary cell walls. It is made up of pectin and sticky gel like Mg and Ca salts. It holds the adjacent cells together.

ii. PRIMARY CELL WALL:

- Primary cell wall is a true cell wall formed in newly growing cells during cell division.
- Primary cell wall is thin and slightly flexible.
- Primary cell wall is composed of cellulose microfibrils, running through the matrix of other polysaccharides like hemicellulose and pectin.
- The micro fibrils show a crisscross arrangement in layers one above the others. This feature gives the cell great strength.

iii. SECONDARY CELL WALL:

- Secondary cell wall is formed between the primary cell wall and plasma membrane only in sclerenchyma cell.
- The plant cells possessing secondary cell wall are generally dead and provide support for the plant.

The secondary cell wall develops only when the cell has reached maximum size i.c., completes its growth because it is very much thick and rigid therefore it does not allow further growth.

- The secondary cell wall consists of cellulose, hemicelluloses, lignin, inorganic salts and waxes.
- Its cellulose microfibrils also show crisscross arrangement.
- Lignin cements and anchors cellulose microfibrils together and it is mainly responsible for rigidness.

FUNCTION OF CELL WALL:

- Cell wall provides definite shape and mechanical support to the cell.
- It acts like a skeletal framework.
- Cell wall acts as permeable structure and allowing water and solutes in cell.

PLASMA MEMBRANE OR CELL MEMBRANE:

Plasma membrane is the boundary of protoplasm and present in all living prokaryotic and eukaryotic cells. Plasma membrane is also called cell membrane or plasmalemma or cell surface membrane. It controls the passage of materials into and out of the cell.

CHEMICAL COMPOSITION OF PLASMA MEMBRANE:

- Plasma membrane is composed of double layer of phospholipid in which protein found imbedded.
- Phospholipid bilayer arrange in such a way that their hydrophobic ends face each other while hydrophilic end appeared on the surface.
- Steroids, cholesterol sterol, glycoprotein and glycolipid are present into the phospholipid bilayer at some intervals.
- In some animals, cholesterol comprises 50% of plasma membrane.
- Chemically cell membrane consists of proteins 50%, lipids 50% and 5-10% of carbohydrates (glycolipid and glycoprotein).

STRUCTURE OF PLASMA MEMBRANE:

Two models explain the structure of plasma membrane i.e. sandwich model and fluid mosaic model.

a- SANDWICH MODEL

According to sandwich model, lipid bilayer sandwich between protein layers. This basic structure is called unit membrane.

b- FLUID MOSAIC MODEL

This model was proposed by singer and Nicolson in 1972. According to this model, lipid molecules present in fluid state and can rotate and move laterally. Proteins molecules are also found partially or wholly embedded in this layer in such a way as ice bergs in the sea. Protein molecules are of two types;

Integral protein/intrinsic protein:

wholly embedded within the phospholipid bilayer and function as channel protein.

Peripheral protein/extrinsic protein:

partially embedded within phospholipid bilayer and function as cell marker.

FUNCTION OF PLASMA MEMBRANE:

- Plasma membrane protect the cytoplasm.
- Plasma membrane also regulates the transport of solute and solvent in and out of cell.
- It maintains a suitable pH and ionic concentration within the cell for enzyme activity.
- Plasma membrane regulate the fluidity in unfavourable condition.
- Plasma membrane regulates cell's interaction with its environment by controlling transport of material across the cell such as obtain nutrient, secrete useful substances and excrete toxic substances.
- Some of proteins in the plasma membrane function as channel protein and carrier protein and help in the transport of substances.
- Some proteins of plasma membrane act as enzyme.
- Some proteins act as antigen such as R^H factor.
- Plasma membrane contain receptors in their surface, which control the attachment with specific molecules such as hormones.

ROLE OF PLASMA MEMBRANE IN REGULATING CELL'S INTERACTION WITH ITS ENVIRONMENT:

Plasma membrane regulates cell's interaction with its environment by controlling transport of material across the cell such as obtain nutrient, secrete useful substances and excrete toxic substances.

Transport is mainly of two types, passive and active transport.

i. **Passive transport:** diffusion and osmosis from high to low concentration without energy.

ii. **Active transport:** diffusion and osmosis from low to high concentration by using energy.

There are two more process which also explain the transport of material.

i. Endocytosis: bulk intake of materials by enfolding of membrane. Endocytosis may be

a. Phagocytosis: intake of solid materials.

b. Pinocytosis: intake of liquid materials

ii. **Exocytosis:** exit of material by exfolding of membrane.

ROLE OF GLYCOLIPID AND GLYCOPROTEIN AS CELL SURFACE MARKERS:

- Mostly glycolipids and glycoprotein act as cell surface markers.
- They are involved in cell to cell recognition and sticking the correct cells together in tissues.
- It helps in identification during immune response.
- It acts as receptor.
- It also determines blood group.

CYTOPLASM:

The living matter of a cell is called protoplasm. In eukaryotic cells it can be divided into cytoplasm and nucleoplasm.

- The term cytoplasm was first used by the Rudolf von Kolliker in 1868.
- Cytoplasm is the region between nuclear membrane and plasma membrane.
- Cytoplasm is divided into Cytomel and cytosol.
- Cytomel is more viscous and found near the plasma membrane while cytosol is less viscous and found near the nuclear membrane.

CHEMICAL NATURE AND METABOLIC ROLE OF CYTOPLASM:

- Cytoplasm is a granular liquid."
- Chemically cytoplasm contains 90% water.
- Cytoplasm forms a solution that contain all the fundamental biochemical of life such as salts, sugar, amino acids, fatty acids, nucleotides, vitamins, hormones and inorganic ions.
- Others are large molecules such as proteins which form the colloidal solutions.
- Cytoplasm contains sub-cellular structures called organelles, microfibrils that from the cytoskeleton.
- Cytoskeleton provide support, stiffness and help in movement of single celled organisms.
- A circular streaming movement can also be observed in cytoplasm due to contractile activity of microfilaments.
- This is called cyclosis which is responsible for distribution of cell contents in cytoplasm.
- Metabolic pathways generally occur in the cytosol which includes protein synthesis, glycolysis and Krebs cycle etc.
- Cytogel is usually concerned with storage of useful compounds.
- It is also involved in molecular modification and detoxification.

CYTOPLASMIC ORGANELLES:

In the cytoplasm of a eukaryotic cells various sub-cellular structure are found which deals with the different specific functions. These structures are called which are given bellow in details.

ENDOPLASMIC RETICULUM (ER):

An interconnected network of tube like close sacs extended from the nuclear membrane to plasma membrane throughout the cytoplasm of eukaryotic cell.

Types of endoplasmic reticulum

a- Rough Endoplasmic Reticulum

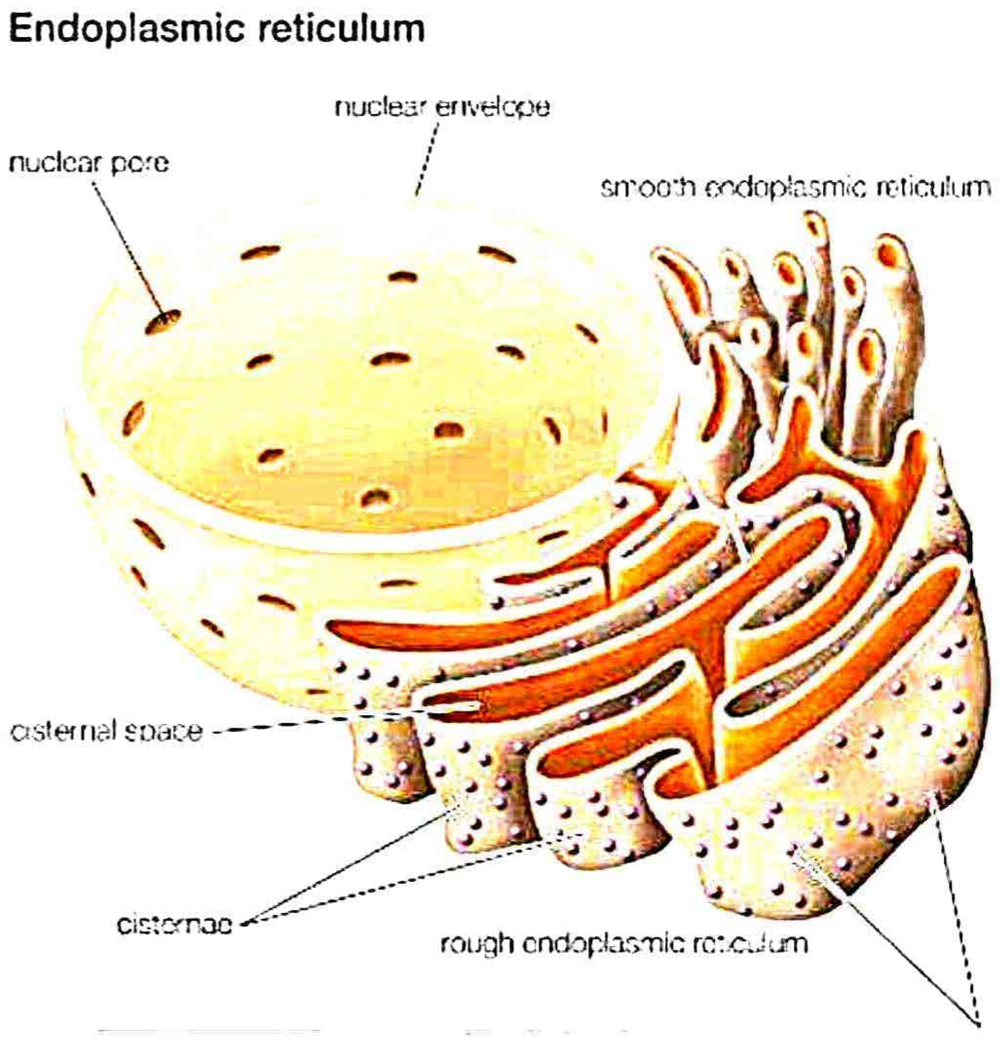
b- Smooth Endoplasmic Reticulum

Most cells contain both types of endoplasmic reticulum. However, skeletal muscle cells have smooth ER more, where these are called sarcoplasmic reticulum.

Ribosomes

a- Rough Endoplasmic Reticulum

- Rough ER has ribosome attached to the sides facing the cytoplasm and has rough appearance under electron microscope.
- Rough ER mainly concerned with the events of protein synthesis (translation) due to the association of ribosome.



b- Smooth Endoplasmic Reticulum

- Smooth ER is continuous with the rough ER.
- Since, ribosomes are not attached to it, therefore it has smooth appearance under electron microscope.
- Smooth ER function in oil, phospholipids and steroids synthesis so it is mainly found adipose cells, interstitial cells and glycogen storing cells of liver and muscles.
- It also provides mechanical support to cell.

Function of endoplasmic reticulum:

Frame work:

It forms the structural frame work of the cell that provides the support.

Metabolism:

Smooth ER function in many metabolic processes such as metabolism of carbohydrate.

Detoxification:

Detoxification of drugs and poison especially in the liver cells.

Synthesis: It takes part in the synthesis of lipid including oil, phospholipids and steroids.

Storage: It stores Ca^{++}which help in muscles contrition.

Transport:

Smooth ER also transport various cellular products within the cell or out of the cell e.g. protein from rough ER are also transported to the Golgi complex through smooth ER.

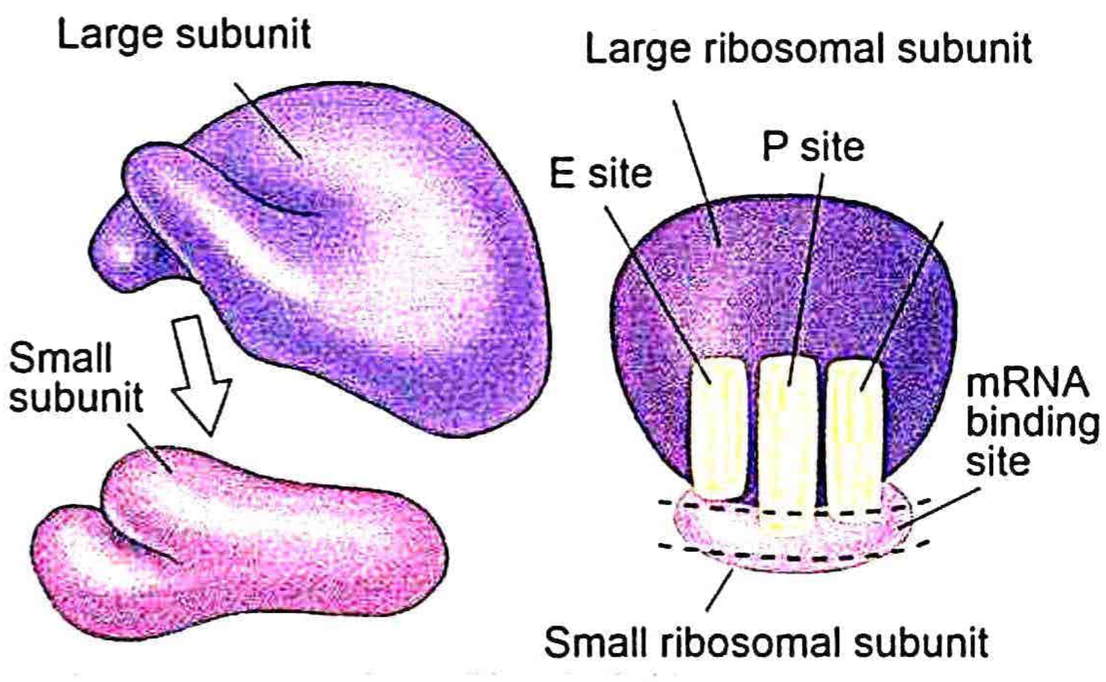
Ribosome:

- They are named as ribosome because they contain high concentration of RNA.
- Ribosomes are roughly spherical, granular, non-membranous bodies found in both eukaryotic as well as prokaryotic cells.
- However, eukaryotic ribosomes are larger and characterized as 80S ribosomes while the prokaryotic ribosomes are slightly smaller and are characterized as 70S ribosome
- S means Svedberg unit or sedimentation coefficient.
- In the prokaryotic cells it is dispersed in the cytoplasm while in the eukaryotic cells it is found attached to endoplasmic reticulum.
- It is also found in mitochondria and chloroplast.
- Eukaryotic ribosome composed of two subunits of different size.
- The larger one (60S) is dome shaped and smaller one (40S) is cap shaped.
- Two subunits on attachments forms 80S, attached by Mg^{++} and salt bonds.
- Mg^{++} form bond between phosphate group of RNA and amino group of amino acid

- Chemically ribosome is made up of 40% RNA and 60% protein.
- Ribosomes are known as protein factories.

GOLGI BODIES:

- Golgi apparatus was discovered by Italian biologist Camillo Golgi in 1898.
- It is found in all Eukaryotic cell.
- Golgi bodies consist of stacks of flattened, membrane bound sacs called Cisterna.
- Connected with Cisterna are vesicles called Golgi vesicles.
- These cisternae along with vesicles are called Golgi complex.
- Golgi complex inter connected at one end if forming Conex called Cis-face, While forming concave face called tran-face.

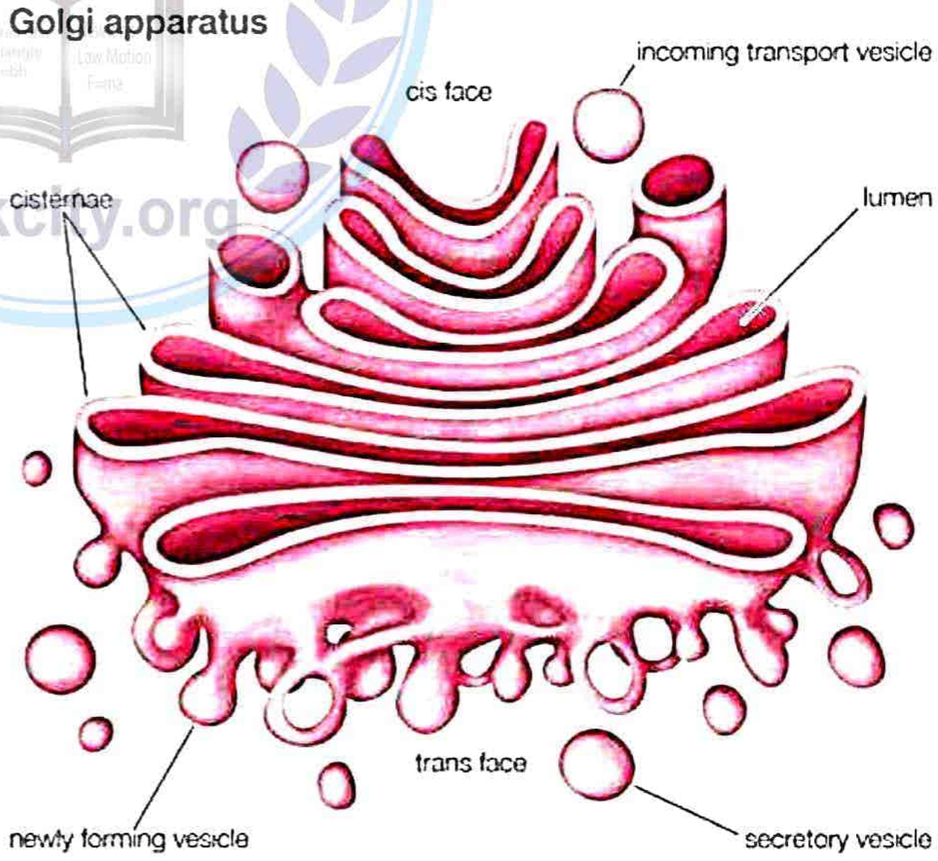


FUNCTIONS:

- The most important function of Golgi apparatus is processing of cell secretion, that's why they are found in glandular cells.
- They recives proteins from RER via SER and then into golgi vesicles where there protein are modified.
- They are also involved in the formation of lysomes, peroxisomes & glyxisomes. It is also involved in the formation of different conjugated molecules.
- Many polysaccharide Like Cellulose, Chitin are the product of golgi bodies.

LYSOMES:

- These are spherical, single, membrane bounded bodies & originated by Golgi bodies.
- The are found in cytoplasm & contain hydrolytic enzymes.



TYPES OF LYSOMES:

PRIMARY LYSOMES:

Before starting its function, newly formed lysosomes are primary Lysosomes. They contain 40 types of hydrolytic enzymes.

SECONDARY LYSOSOMES:

After functional state they are attach with ingested material like endosome perform endocytosis, phagosome perform Phagocytosis & Auto Phagosomes, Auto Phagocytosis.

FUNCTION:

- They perform digestion of material in cell by phagocytosis & also called cell eating process.
- They also destroy foreign particles.
- They contain variety of enzymes which maintain metabolic balance of cell.

APOPTOSIS:

- Some time body destroy old cells or unwanted cells at embryonic stage a/c to their genetic information this process call opoptosis.
- During this self destruction Lysosome is ruptured & release hydrolytic enzymes.
- Due to this chemical break down start in cell called lysis.
- Now cell destroy itself by digesting its own macro molecules. That's why Lysosomes also called "Sucidal Sac" and process is called "Autolysis".

LYSOSOMAL STORAGE DISEASE:

Lysosome contain enzyme which maintain metabolic balance of cell. If cell do not synthesize these enzyme due to heredity & Congenital reason. These enzyme substrate accumulates in cell & organs. Due to this metabolic imbalance occur at child hood These types of disease are called Lysosomal Storage disease.

More than 30 types of disease are reported but some of them are given below.

1. TAYSACHS DISEASE:

It is a dangerous disease. It causes blindness and mental retardation. Due to this disease death of baby may occur by the age of three years.

2. GAUCHER'S DISEASE:

This disease causes mental retardation in infants. Due to this disease liver and spleen become enlarged and erosion of long bones takes place i.e. bones are damaged.

3. KRABBE'S DISEASE:

This disease causes loss of myelin, mental retardation. It may cause death of baby by the age of two years.

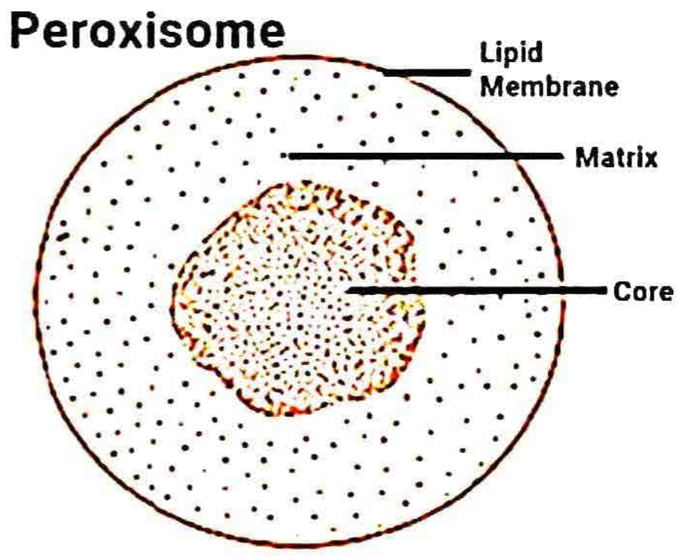
PEROXISOME:

- Peroxisome are single membrane bounded organelles & smaller size than Lysosome.
- They develop from Golgi bodies & contain variety of enzyme like Peroxidase, Catalase glycolic acid etc.

FUNCTION:

- They are mainly involve in detoxification of alcohol; alcohol oxidized into (H_2O_2) than H_2O by an enzyme catalax.
- In animals they are involved in Lipid metabolism Fatty acid oxidize to Phospholipid.
- They also produce & export Cholesterol & Plasmalogen. + Plasmalogen are found in heart & brain tissues.
- They are also found in liver cells of Camel & Kangroos & other reptiles to store reserve food & water.

• In plants they convert glycolate during photo respiration in to a acid glycin by the help of enzyme called glycolic acid oxidase.

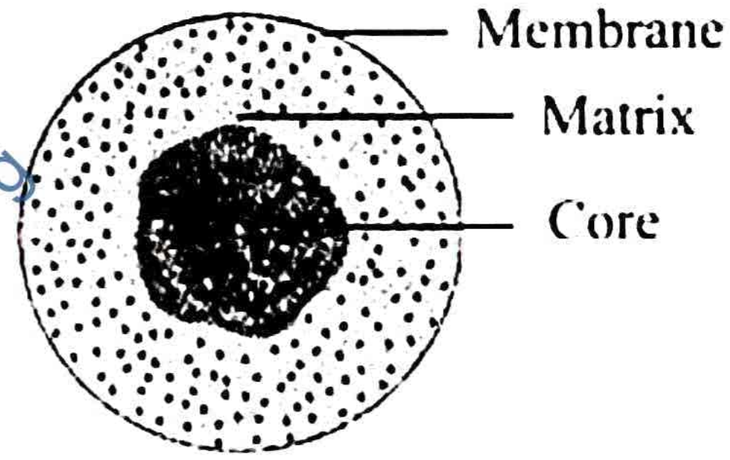


GLYOXOSOME:

• They are single membrane bounded specialized peroxisome & oxygenated from golgi bodies.
• They have single layer enclosed in granular stroma.
• They are found in falls storing tissue like seed endosperm.

FUNCTION:

• They contain enzyme which initiate fatty acid in to sugar.
• In germinating seed this process takes place in cyclic manner called Glyoxlate cycle.



Glyoxysomes

MITOCHONDRIA: (Chondriosome):

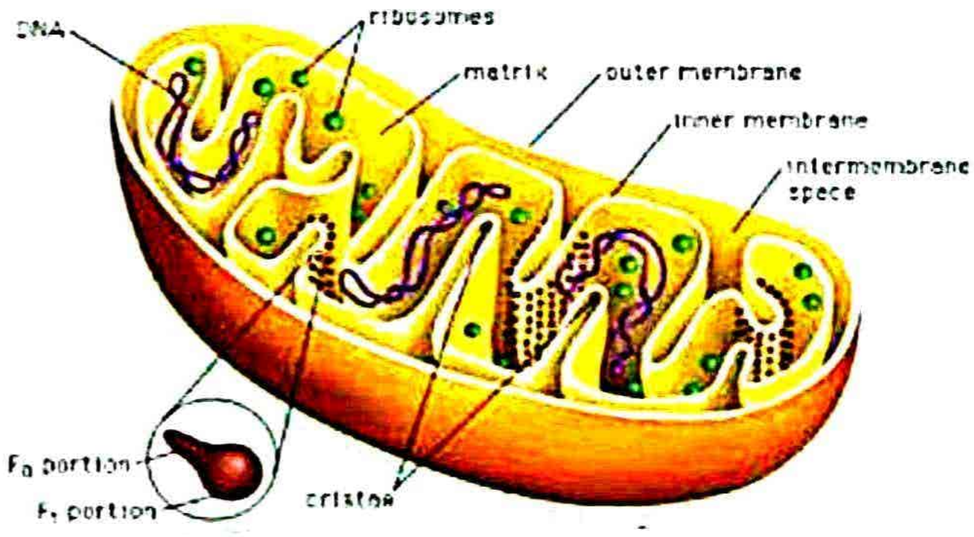
Mitochondria are bean shaped or ganells, present in eukaryotic cell. They are the centre of aerobic respiration & consider as power house of cell.

STRUCTURE:

• Each mitochondria about 0.5 to 1.0mm in diameter & about 10um long.
• It double membrane bounded organells.
• The outer membrane is smooth and having pores Like sieve made up of protein called porins.
• Inner membrane is folded and infolded into inner chamber called Matrix.
• Inner membrane has folding to increase surface are called cristae.

FUNCTION:

• In mitochondria ATPase, Cytochrome, NAD, FAD are present.
• These molecules are serve as electron carries & metabolized carbohydrates, Fats, & protein into CO_2 & H_2O & Librate energy in the form of ATP.
• It has its own DNA & ribosomes, indicate that protein are synthesized in it.
• Matrix help in several metabolic process Lik kreb's cycle, aerobic respiration & Fatty acid metabolism.
• Due to the presence of its on DNA it serve as Self replicating & semi-autonomous organells.



PLASTIDS:

"They are double membrane bonded organells, present is plants & algal cells".

TYPES OF PLASTIDS:

On the basis of presence or absence and type of pigments, plastids are classified into.

i. Proplastids ii. Leucoplasts iii. Chromoplast iv. Chloroplast

PROPLASTIDS:

- Proplastids are young, immature and developing plastids.
- They are self-replicating organelles.
- They divide and redivide in meristematic cells and distributed to different cell types.
- When they mature, they may be develop into leucoplast.

CHLOROPLAST:

- They are discoid, membrane bounded organelles present in photosynthesis plant cells.
- It has it own DNA, indicate that is self replicating & semi-autonomous organelles.
- They contain chlorophyll which give green colour to plants and carry photosynthesis.
- It help in oxygen supply & storage of starch.

CHROMOPLAST:

- They are present in petals of flowers & fruits.
- They contain different pigment except chlorophyll.
- They are responsible for colour in flowers, fruits.
- They help in pollination & dispersal of seed.

LEUCOPLAST:

- They are colorless & develop in the absence of light.
- They are found in all underground parts and storage organs of plants.
- They stored food material as carbohydrates, lipid and proteins.

They are of three types.

i. Amyloplast: store carbohydrate (starch).
Ii. Proteioplast: store protein.
iii. Elaioplast: store Lipid.

STRUCTURE OF CHLOROPLAST:

- DNA presence indicate that it is self replicating and semi-autonomous organells.
- They are discoid, membrane bounded structure.
- Chloroplast vary in their shape (spheroid, ovoid, discoid).
- Electron microscope shows consist of three main component.

THE ENVELOP:

- The envelop is formed by double membrane.
- An outer membrane is smooth and permeable.

• An Inner membrane which is semipermeable.

THE STROMA:

• The inner membrane eclore a semi fluid material called stroma.
• It contain various enzyme, DNA,RNA, ribosomes (FOS), ATP & NADP etc.

THE GRANA/THYLAKOIDS:

• In stroma stack of hollow membranous sace are embedded called Grana.
• Individualy each sac called Thylakoids.
• Thylakoid membrane contain green pigment & other pigment Like Xanthophylls and Carotens.

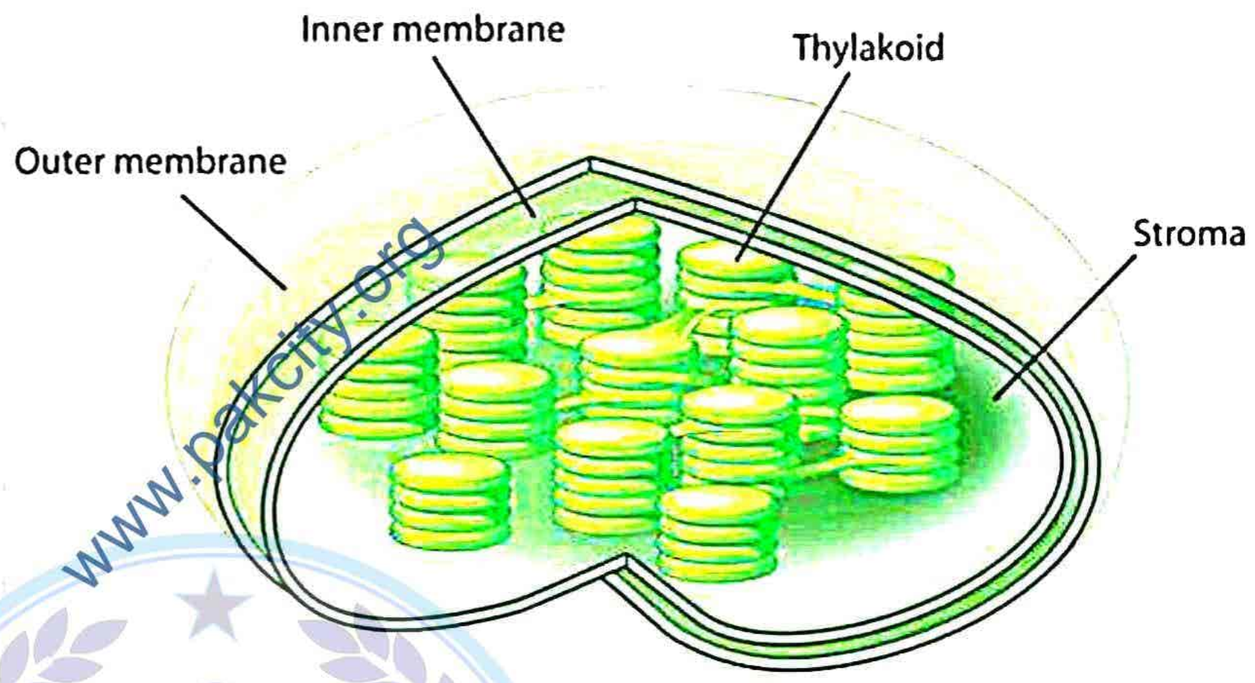
INTEGRANA:

• It is another thylakoid which connect grana with each other called Integrana.
• Integrana are colorless due to absence of pigment.

How Chloroplasts Serve as Energy Converting Organelles:

1. Chloroplasts have an ability to convert solar energy into the chemical/food energy by the process of photosynthesis and are called site of photosynthesis.
2. Chloroplasts is a chlorophyll containing organelles and bounded by double layer and consists of three parts:
   a. A surrounding double membrane.
   b. A liquid called stroma.
   c. A set of sacs like structure called thylakoids.
3. The chloroplasts capture sunlight during photosynthesis and transfer it into the molecule present in thylakoid membrane.
4. This molecule transfer energy to A.T.P and other energy carrier molecule and diffuse in stroma compounds by the combination of CO_2.

In this way chloroplasts are considered as energy-saving organelles.



CYTOSKELETON:

"Cytoskeleton is a network of different protein fibers which provide three dimensional shape to cell".

FUNCTION:

In Eukaryotic cells the cytoskeleton help to

• Maintain the cells shape.
• Cause the cells and its organells to move. Carry out chromosome movement during cell division.

TYPES OF CYTOSKELETON:

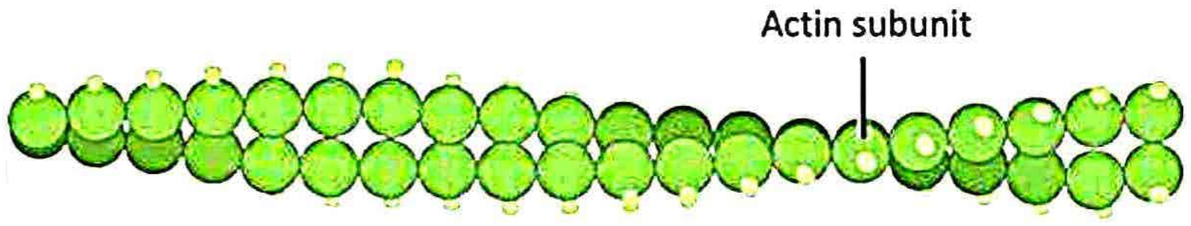
There are three types of cytoskeleton elements found in cells.

a) Microfilament.
b) Microtubules.
c) Intermediate filament.

MICROFILAMENT:

- They are also known as Actin Fibres & are solids stand about 7mm in diameters.
- They are involved in the internal movement of cells like cyclosis.
- In animals cells, especially Muscles cells, They are found in the form of Myofibrills.
- They help in contracting & relaxation of Muscles.
- They also perform function of change in cell shape, division of cytoplasm. Movement of pseudopodia etc.

MICROTUBULES:



- They are long, unbranched & cylindrical structure about 25mm in diameter.
- They are composed of tubulin protein.
- Tubulin protein subunits arranged in 13 column. Each column is called Proto filament.
- They form spindle fibres & help the movement of chromosome during cell division.
- Help in the movement of organelles in cytoplasm & movement of cilia and flagella.

INTERMEDIATE FILAMENTS:

- They are solid stands and have diameter in b/w microfilament & microtubules i.e. 8- 10 mm.
- The basic protein subunit of the filament is vimentin.
- They are involved in determination of cell shape,

provide mechanical support to plasma & nuclear membrane. Help for attachment of muscle cell & support nerve cell process. (Axon)

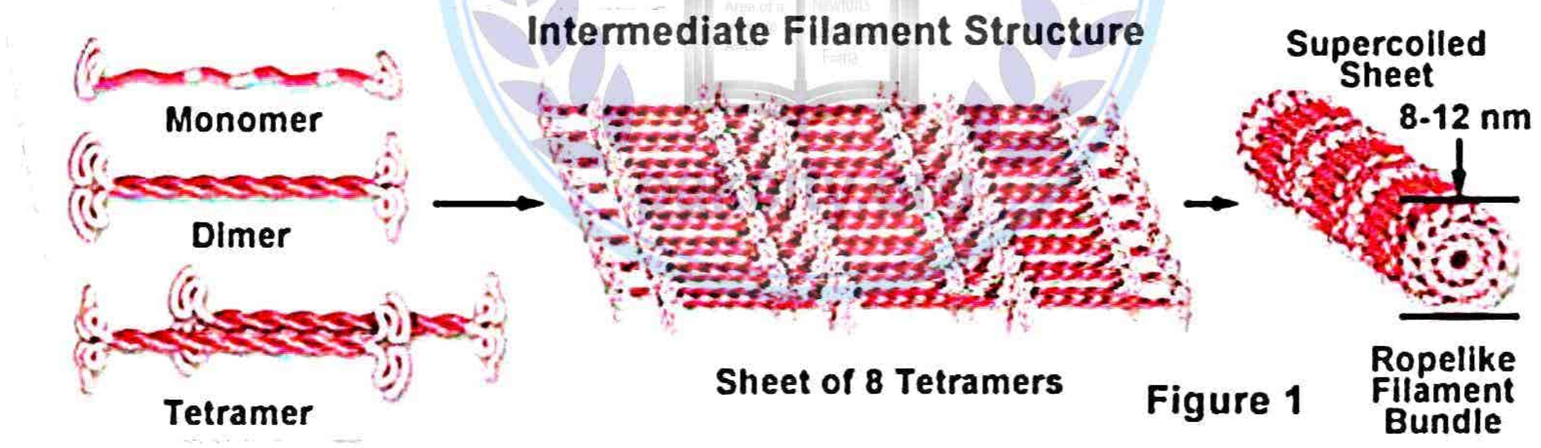


Figure 1

CILIA & FLAGELLA:

- "Cilia and flagella are hair like projection on the surface of cell.
- There is no clear morphological or physiological difference b/w them except that of size.
- They are originate from their basal bodies embed in cytoplasm.
- They are consist of axoneme enclosed in spiral sheath of cytoplasm.
- Axoneme made of bundle of 11 Longitudinal fibrils or microtubules.

FUNCTION:

- Create water current, food current.

- Act as sensory organ.
- Help in movement.

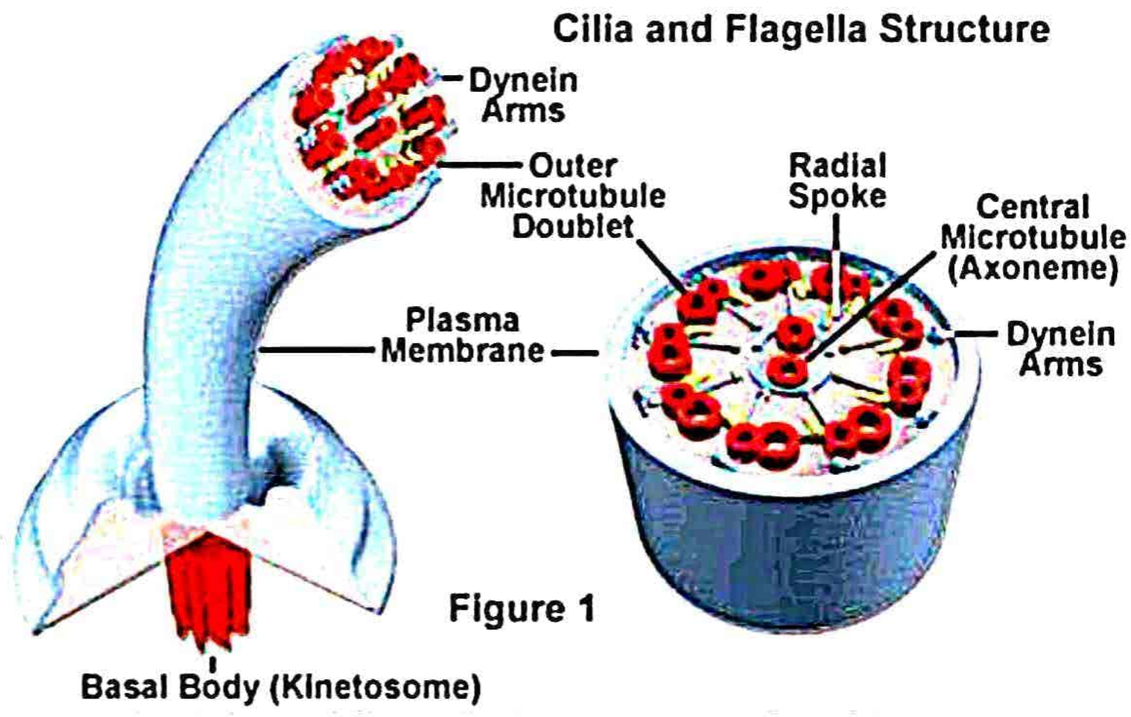


Figure 1

MOVEMENT MECHANISM OF CILIA AND FLAGELLA:

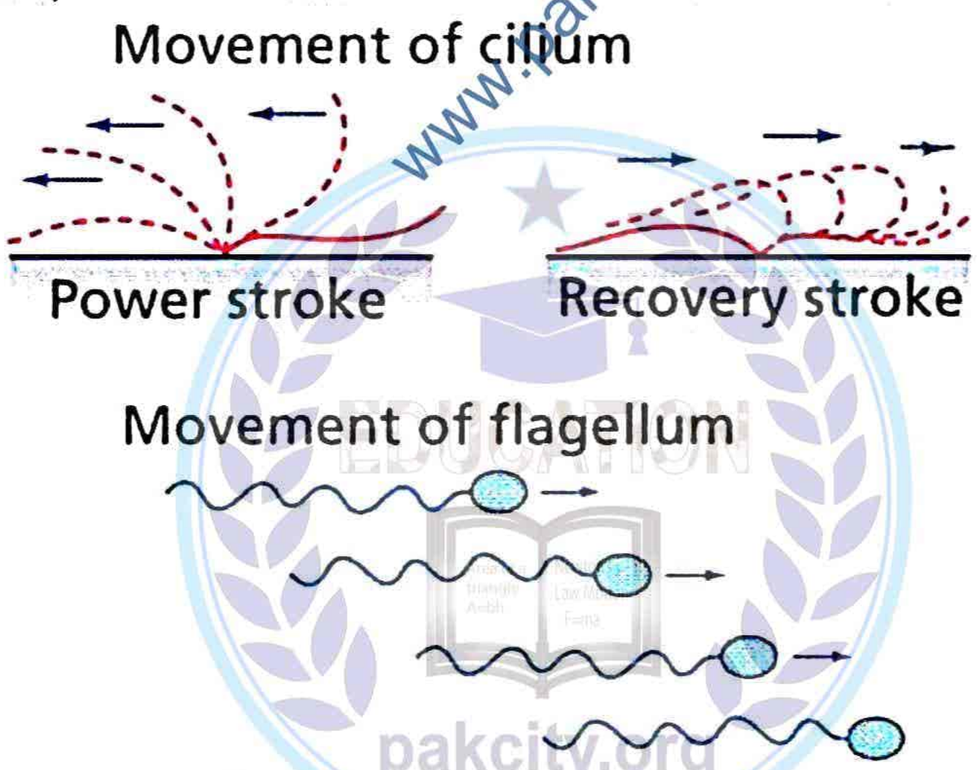
MOVEMENT OF CILIA:

In 1955 Bradford suggested that the movement of cilia is due to sliding of double fibrils in 2 groups one after the other.

i. **EFFECTIVE STROKE:** Five out of nine double fibrils (5/9) contract simultaneously. As a result cilium bends or shortnes. It is called effective stroke.
ii. **RECOVERY STROKE:** 4 out of nine double fibrils (4/9) contract and cilium becomes straight. It is called recovery stroke.

MOVEMENT OF FLAGELLA:

A flagellum causes movement by the passage of rapid successive waves of bending from the attached to the free end. Flagellar movement of human sperms propel them forward within the fluid medium of the female reproductive tract.



Difference Between Cilia And Flagella	
Cilia	**Flagella**
The number of cilia is comparatively more (typically ranges in the thousands).	The number of flagella is comparatively less (usually ranges from 1 to 8).
Cilia are usually shorter in length.	Flagella are comparatively longer in length.
Beating pattern of cilia is very complicated - Can move in a wide range of motions.	Beating pattern of flagella involves circular, wave like or propeller-like motion.
Found in eukaryotic cells.	Found in prokaryotic cells and eukaryotic cells.
Cilia are of two types: Non-motile cilia and Motile cilia.	Flagella are of three types: Bacterial flagella, Archaeal flagella and Eukaryotic flagella.

Mechanism of Movement of cilia & flagella.

CENTRIOLS:

- They are non membranous, short, barrel shaped structure of microtubules.
- They are mainly found in animals and lower plants.
- During cell division they appear near nucleus, that why called centrosome.

FUNCTION:

- They play important role during cell division.
- Just before cell division they duplicate & each pain migrate to opposite side of nucleus & form spindle fibres. (Astral rays).
- They also form basal body (Kinetosome) which form cilia and flagella.

VACUOLE:

- They are non protoplasmic liquid filled sac like structure.
- In plant cell it is large called central vacuole.
- In plant cell it is surrounded by membrane called tonoplast.
- Tonoplast is selectively permeable membrane.

FUNCTION:

- In plants it store cell sap & act as store house of cell.
- It maintain turgor pressure inside plant cell.
- Turgor pressure maintain rigid structure of plants.
- In unicellular they help in excretion & called contractile vacuole.

NUCLEUS:

- It is the largest & most easily seen of the organelles within the eukaryotic cell.
- It commonly spherical in shape. Nucleus consist of four main components.
- Nucleus was discovered by Robert brown.

i. Nuclear membrane ii. Nucleoplasm iii. Nucleolus iv. Chromosomes

NUCLEAR MEMBRANE:

• Nuclear membrane is formed by double membrane.
• Chemical composition of nuclear membrane is similar to that of plasma membrane & consist of lipid & protein.
• Nuclear membrane is pores & composed of specialized transport protein called Nucleoporins.
• Certain substance allow to pan in and outside of cell through these pores.

NUCLEOPLASM:

• Nucleoplasm is the transparent semifluid ground substance formed by the mixture of proteins, enzyme, nucleotides, histone & non histone protein & some metal ions.

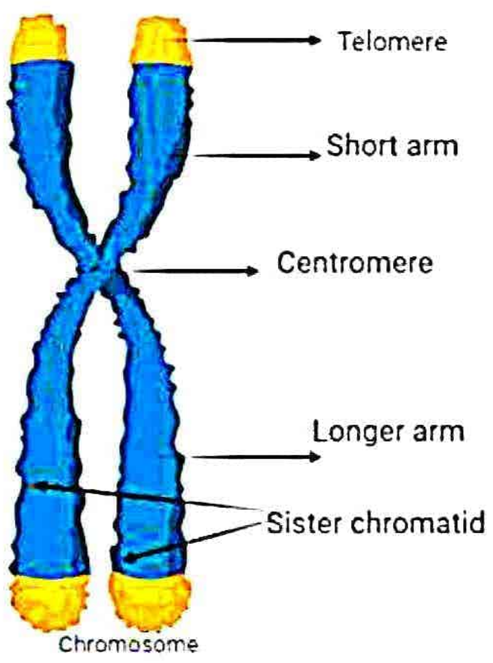
NUCLEUS:

• The nucleolus is darkly stained visible body within the nucleous.
• Nucleolus has no membrane.
• It is composed of some DNA & different types of RNA.
• They are responsible for protein synthesis.

CHROMATIN NETWORK:

• Nucleus contain network of genetic material called chromatin network or nuclear reticulum.
• During cell division chromatin network coiled & condensed called chromosomes.
• Chromosomes contains heredity units called genes.
• The position of gene on chromosomes called gene locus.
• Number of chromosomes in species vary

e.g. Fruit fly = 8 chromosomes
Sweat pea = 14 chromosomes
Corn cells = 20 chromosomes
Human = 46 chromosomes



CHROMOSOMES:

"Chromosomes are condensed visible structure produced during cell division from chromatin network".

i. Arm ii. Centromer

The part of chromosome from chromatids to centromere is called Arm. The chromatids or Arms are joined at constriction called centromere.

Types of Chromosomes on the basis of Centromere:

There are three types of chromosomes on the basis if centromere:

1. Telocentric
2. Acrocentric
3. Sub-metacentric
4. Meta-centric


Telocentric


Acrocentric

Telocentric:

These are the rod-shaped chromosomes.
These have centromere at their proximal end.

Acrocentric:

These are rod-shaped chromosomes, but the centromere is b/w two chromatids in such a manner that one arm is short and another is long.

Sub-metacentric

Sub-Metacentric:

These are J or L shaped chromosomes. In these chromosomes centromere is present in center in such a manner that two unequal arms are formed.

Metacentric:

These are v-shaped chromosomes. In these Chromosomes centromere is present almost in the Centre and two equal arms are formed.

Metacentric

Functions of Nucleus:

1. The nucleus controls all the vital activity of cell.
2. It produces chromosomes during cell division.
3. It directly takes part in cell division and reproduction.
4. It produces DNA and RNA which helps to transfer hereditary characteristics from one cell to another cell.

Difference Between Prokaryotes and Eukaryotes

Prokaryotes	Eukaryotes
These organisms are simple ones. They do not have true nucleus i.e. their nucleus is without nuclear membrane and nucleolus. It is called nucleoid.	These organisms are the advanced ones. They contain true nucleus.
They lack plastids, mitochondria and golgi apparatus i.e. membrane bound organelles are absent.	They contain plastids, mitochondria and golgi apparatus. They contain all kind of organelles.
The genetic material is not associated with Histone protein, so no true chromosome is Present.	Eukaryotic cells contain Histone protein with DNA, so true chromosomes are present.
They contain mesosomes.	They do not contain mesosomes.
Examples are: Bacteria, blue green algae	Examples are: Plants, Animals, and Fungi

Difference Between Lysosome And Vacuoles

Lysosome	Vacuoles
They are small spherical bodies few micrometer in size.	They are spherical and cavity like bodies containing liquid.
Their size is very small.	In animals they are small and in plants they unite to form large vacuoles.
They destroyed unnecessary particles.	In plant cell sometimes they act as lysosomes and contain hydrolytic enzymes.
They destroyed unnecessary particles.	In plant cell sometimes they act as lysosomes and contain hydrolytic enzymes.

Difference Between Cell Wall And Cell Membrane

Cell Wall	Cell Membrane

It is found in plant cell, bacterial, fungal and algal cells, but absent in animal cells.	It is found in all types of living organisms.
It is not directly around the cytoplasm.	It is just around the cytoplasm.
It is thick, made up of primary, secondary walls and middle lamella.	It is a thin layer.
It is composed of cellulose, hemicellulose and lignin compounds.	It is composed of proteins and lipids.
It is permeable in nature, helps in diffusion.	It is semi-permeable in nature, helps in osmosis.

Difference Between Osmosis And Diffusion

Osmosis	Diffusion
It is the movement of solvent molecules from higher to lower concentration.	It is the movement of different kinds of molecules (gas, solid and liquid) from higher to lower concentration.
It occurs through a semi-permeable membrane	It can occur through permeable or sometimes semi-permeable membrane.
It is a free movement only for solvent molecules.	It is a free movement without any restriction.

Difference Between Animal Cell And Plant Cell

Animal Cell	Plant Cell
Cell wall is absent around these cells.	A proper cell wall is present around these cells.
These cells contain centriole.	The primitive plant cells have centriole. In higher cell centriole is absent.
In these cells vacuoles are small sized.	In these cells large vacuoles are present.
These cells contain lysosomes.	These cells do not contain lysosomes.

Difference Between Resolution And Magnification

Resolution	Magnification
Resolution is the capacity to separate adjacent object.	Magnification is the means to increase size of the object.
Resolution is maintained upto certain magnification.	By increasing magnification resolution is decreased.
Resolution improves as the wavelength of illumination becomes shorter.	Magnification improves with the focal length of lense.