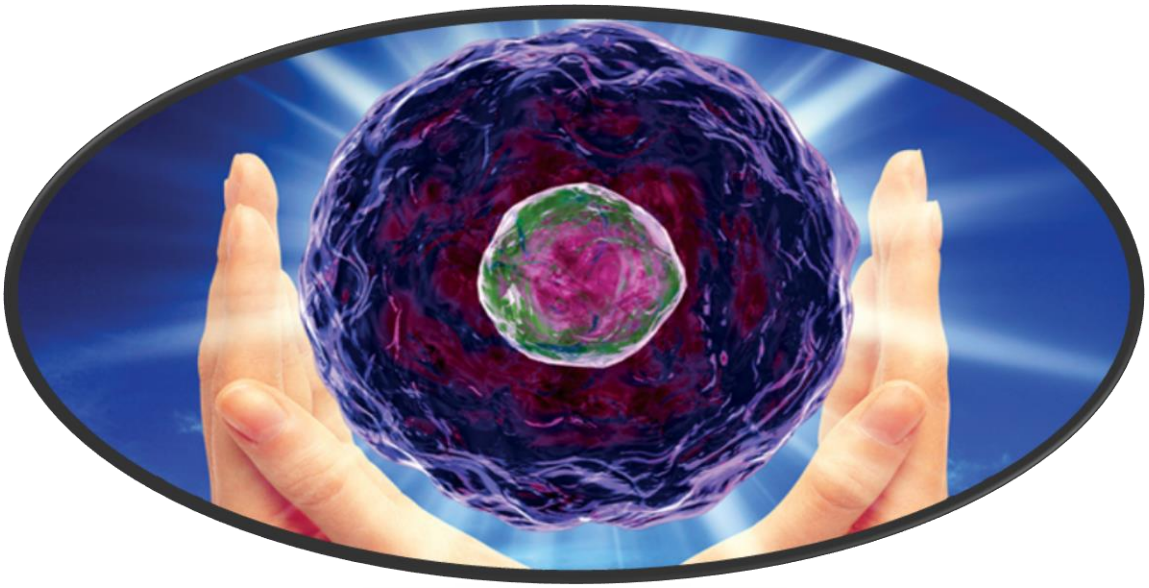
AL-Zahraa University for Women
College of Health and Medical Techniques
Anesthesia Department

Structure of cell



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Components of the cell

The major components of the cell are (1) cell membrane, (2) cytoplasm, and (3) nucleus It is represented in Fig 1.

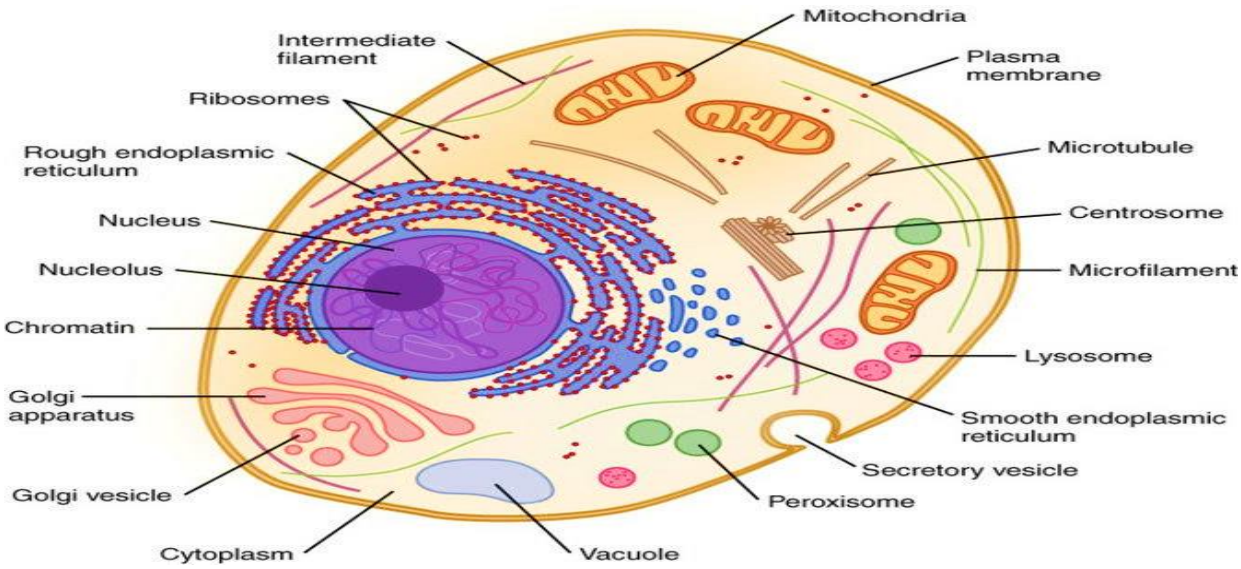

Figure1:- The shape and structure of cell .

1- Cell membrane (Plasma membrane)

Each cell has a limiting boundary, the cell membrane, plasma membrane or plasmalemma. It is a living membrane, outermost in animal cells but internal to cell wall in plant cells.

It is flexible and can fold in (as in food vacuoles of Amoeba) or fold out (as in the formation of pseudopodia of Amoeba).

The plasma membrane is made of proteins and lipids and several models were proposed regarding the arrangement of proteins and lipids. The fluid mosaic model proposed by Singer and Nicholson (1972) is widely accepted. It is represented in Fig 2.

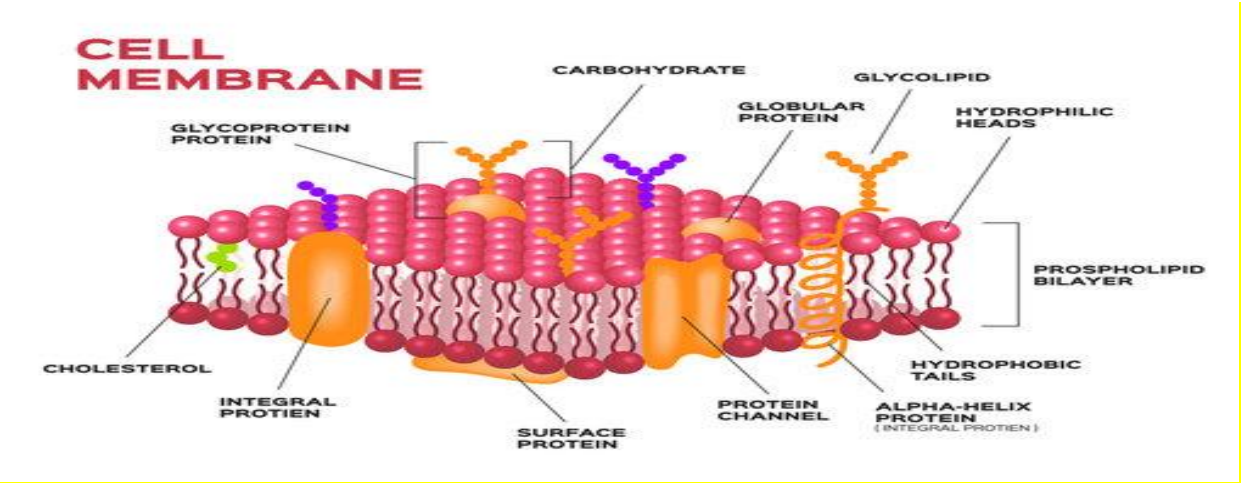

Figure 2:- The structure of cell membrane.

According to the fluid mosaic model

(i) The plasma membrane is composed of a lipid bilayer of phospholipid molecules into which a variety of globular proteins are embedded.

(ii) Each phospholipid molecule has two ends, an outer head hydrophilic i.e. water attracting, and the inner tail pointing centrally hydrophobic, i.e. water repelling

(iii) The protein molecules are arranged in two different ways:

(a) Peripheral proteins or extrinsic proteins: these proteins are present on the outer and inner surfaces of lipid bilayer.

(b) Integral proteins or intrinsic proteins: These proteins penetrate the lipid bilayer partially or wholly.

Cell membrane functions

(i) The plasma membrane encloses the cell contents.

(ii) It provides cell shape (in animal cells) e.g. the characteristic shape of red blood cells, nerve cells, and bone cells.

(iii) It allows transport of certain substances into and out of the cell but not all

substances so much it is termed ‘selectively permeable.

Transport of small molecules (such as glucose, amino acids, water, mineral ions etc).

Cell wall

In bacteria and plant cells the outermost cell cover, present outside the plasma membrane is the cell wall about which we shall study now.

Bacterial cell wall is made up of peptidoglycan. Given below is the structure and function of the plant cell wall.

(a) Structure

- Outermost non-living layer present in all plant cells.
- Secreted by the cell itself.
- In most plants, it is chiefly made up of cellulose but may also contain other
- chemical substances such as pectin and lignin.
- The substance constituting the cell wall is not simply homogeneous but it consists of fine threads or fibers called microfibrils.
- It may be thin (1 micron) and transparent as in the cells of onion peel. In some
- cases it is very thick as in the cells of wood.

(b) Functions

1. The cell wall protects the delicate inner parts of the cell.
2. Being rigid, it gives shape to the cell.
3. As it is rigid, it does not allow distension of the cell, thus leading to turgidity of the cell that is useful in many ways.
4. It freely allows the passage of water and other chemicals into and out of the cells.
5. There are breaks in the primary wall of the adjacent cells through which cytoplasm of one cell remains connected with the other. These cytoplasmic strands which connect one cell to the other one are known as plasmodesmata.
6. Walls of two adjacent cells are firmly joined by a cementing material called middle lamella made of calcium pectinate.

Cytoplasm:-

The cytoplasm of eukaryotic cell is located between the cell membrane and nuclear membrane, while in prokaryotic cells the cytoplasm fills the whole space bounded by the cell membrane.

The cytoplasm of both eukaryote and prokaryote cells consists of a gelatinous liquid known as cytosol. The cytosol is made up of a mixture of colloidal proteins which include: enzymes, carbohydrates, small protein molecules, ribosomes and ribonucleic acid (RNA).

Functions

1. Cytoplasm contains molecules such as enzymes which are responsible for breaking down waste and also aid in metabolic activity.
2. Cytoplasm is responsible for maintaining cell shape.
3. Products of cellular respiration and the genetic material of the cell are present in the cytoplasm.
4. Cytoplasm acts as the medium for the movement of molecules between the organelles.
5. Cytoplasm contains the ions that help maintain osmotic balance inside the cell.

Mitochondria and chloroplast - the energy transformers

Mitochondria (found in plant and animal cells) are the energy releasers and the chloroplasts (found only in green plant cells) are the energy trappers.
Mitochondria (Singular = mitochondrion)
Appear as tiny thread like structures under light microscope. Approximately 0.5- 1.00 μm (micrometer)
Number usually a few hundred to a few thousand per cell (smallest) number is just one as in an alga, Micromonas .
Structure: The general plan of the internal structure of a mitochondrion observed by means of electron microscope is shown in Fig. 3, Note the following parts.

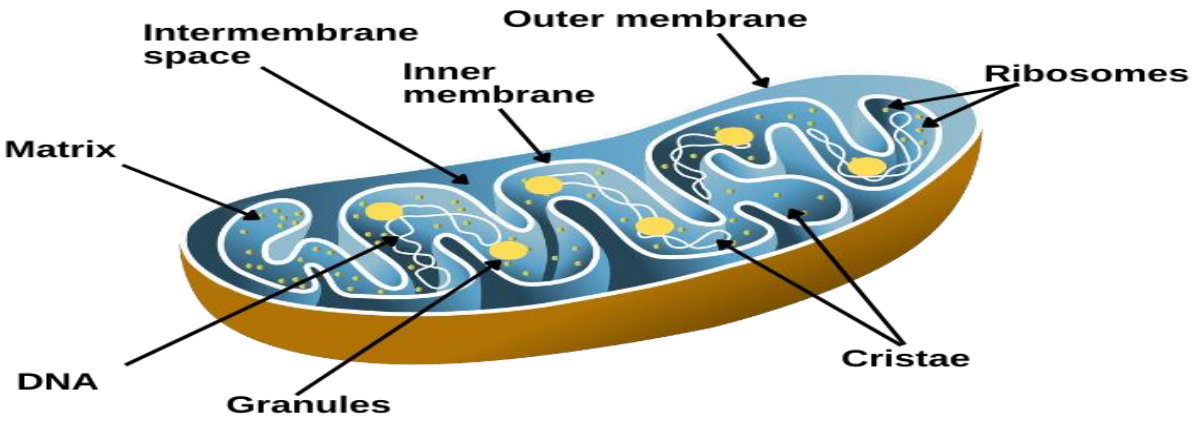

Figure 3 :-The structure of Mitochondria.

- Wall made up of double membrane

-The inner membrane is folded inside to form projections called ‘cristae’ which project into the inner compartment called the ‘matrix’.

Function

Oxidises pyruvic acid (breakdown product of glucose) to release energy which gets stored in the from of ATP for ready use. This process is also called cellular respiration. That is why mitochondria are called the 'power house' of a cell.

A highly simplified flow-chart of the fate of glucose to release energy is shown in Fig.4.

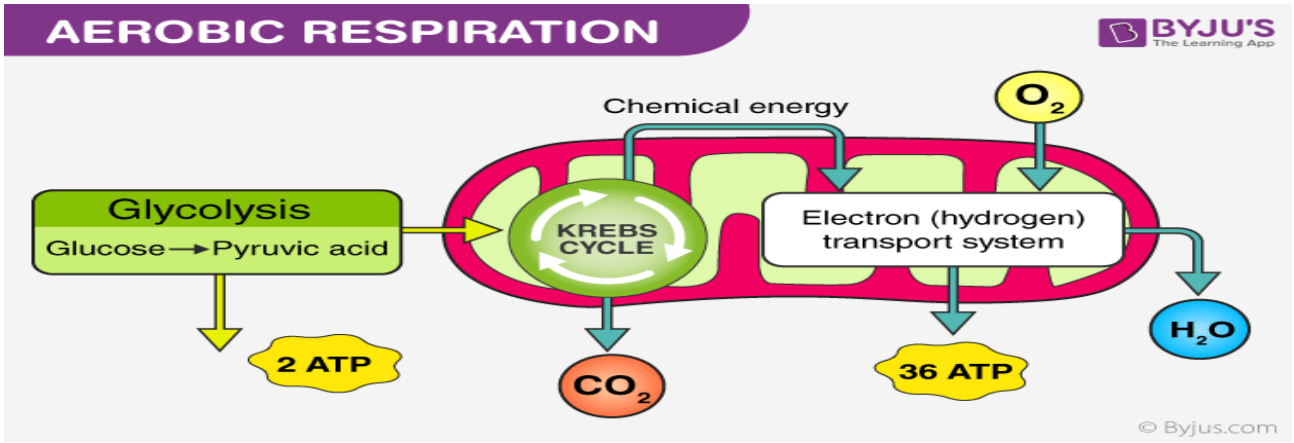

Figure 4:- The Aerobic respiration in cell.

Plastids

Plastids are found only in a plant cell. These may be colorless or colored. Based on this fact, there are three types of plastids.

(i) Leucoplast - white or colorless

(ii) Chromoplast – blue, red, yellow etc.

(iii) Chloroplast – green

Chloroplast

- Found in all green plant cells in the cytoplasm.
- Number 1 to 1008 (how so definite)
- Shape: Usually disc-shaped or laminate as in most plants around you. In some
- ribbon - shaped as in an alga Spirogyra or cup-shaped as in another alga Chlamydomonas.
- Structure: the general plan of the structure of a single chloroplast has been shown in Fig. 5.

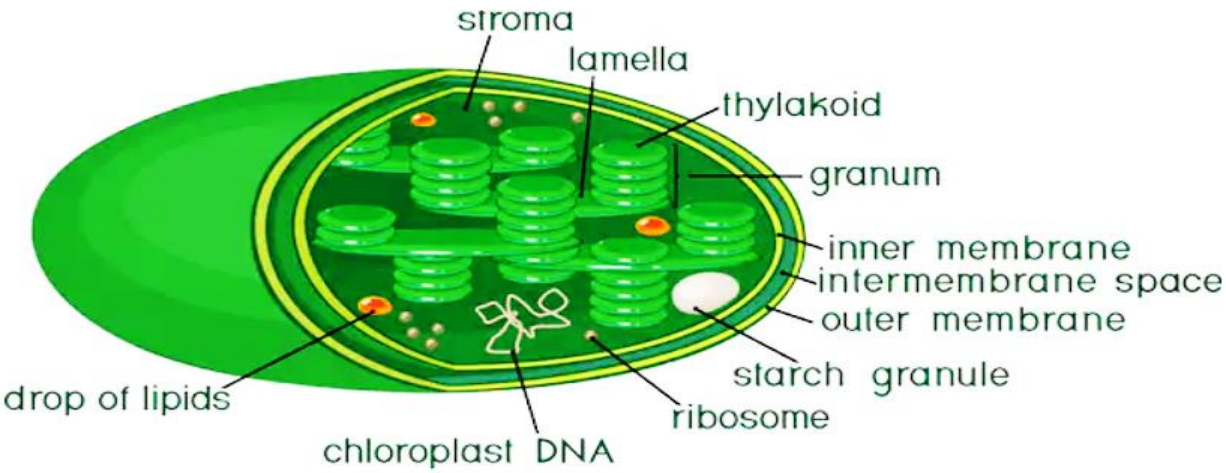

Figure. 5. Structure of a single chloroplast.

Note the following parts:

- ☒ Wall made up of double membrane i.e. outer membrane and inner membrane numerous stack-like (piles) groups or grana (singular = granum) are interconnected by lamellae.
- ☒ Sac-like structures called thylakoids placed one above the other constitute a granum.
- ☒ Inside of the chloroplast is filled with a fluid medium called stroma.
- ☒ Function: chloroplasts are the site of photosynthesis (production of sugar, from carbon dioxide and water in the presence of sunlight).

Endoplasmic reticulum (ER), golgi body and ribosomes

The Endoplasmic reticulum (ER) and Golgi body are single membrane bound structures. The membrane has the same structure (lipid-protein) as the plasma membrane but ribosomes do not have membranes. Ribosomes are involved in synthesis of proteins in the cell, Golgi bodies in secreting and the ER in transporting and storing the products. These three organelles operate together.

Fig. 6. show the diagram of ER and Golgi body as seen under an electron microscope. Note the ribosomes present in the ER.

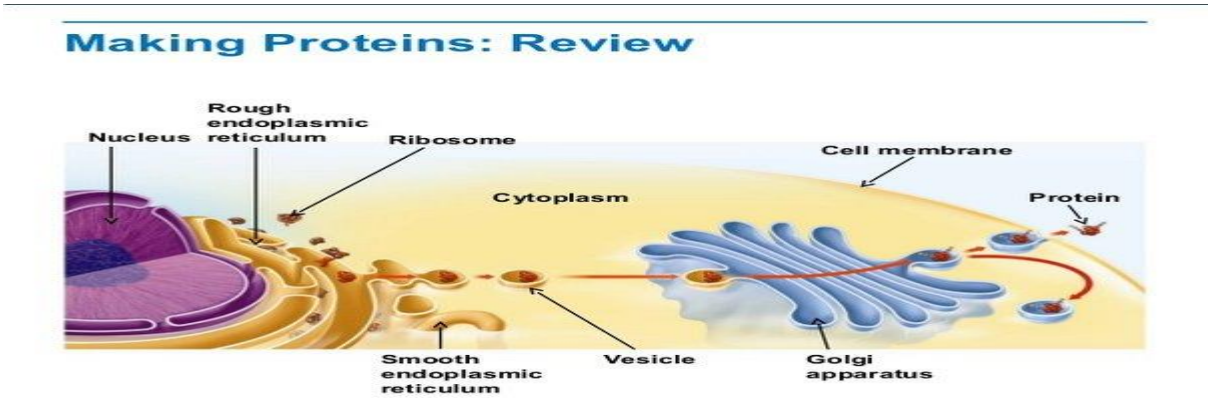

Figure 6:- The Golgi apparatus and Rough endoplasmic reticulum.

The microbodies (tiny but important)

These are small sac-like structures bounded by the single membranes. These are of different kinds of which we will take up three, exp. lysosomes, peroxisomes and glyoxysomes .

1 .Lysosomes (lysis = breaking down; soma = body)

Lysosomes are present in almost all animal cells and some non-green plant cells, Fig. 7. They perform intracellular digestion.

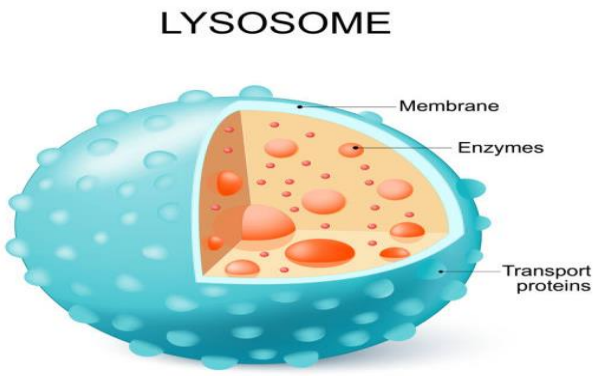

Figure7:- The Ribosome structure.

The main features of lysosomes are as follows:-

(i) Membranous sacs budded off from Golgi body.

(ii) May be in hundreds in a single cell.

(iii) Contain several enzymes (about 40 in number)

(iv) Materials to be acted upon by enzymes enter the lysosomes.

(v) Lysosomes are called “suicidal bags” as enzymes contained in them can digest the cell’s own material when damaged or dead.

Peroxisomes

Found both in plant and animal cells. Found in the green leaves of higher plants .They participate in oxidation of substrates resulting in the formation of hydrogen peroxid.

- ☒ They often contain a central core of crystalline material called nucleoid
- ☒ composed of urate oxidase crystals, Fig. 8. show the diagram of peroxisomes.
- ☒ These bodies are mostly spherical or ovoid and about the size of mitochondria and lysosomes.
- ☒ They are usually closely associated with ER.

- ☒ They are involved in photorespiration in plant cells.
- ☒ They bring about fat metabolism in cells.

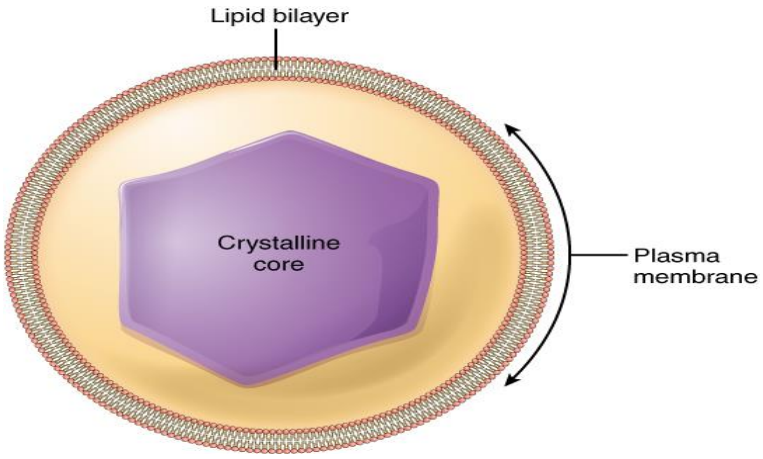

Figure. 6:- show the diagram of Peroxisomes.

Cilia and flagella (the organelles for motility)

(i) Some unicellular organisms like Paramecium and Euglena swim in water with the help of cilia and flagella respectively.
(ii) In multicellular organisms some living tissues (epithelial tissues) have cilia. They beat and create a current in the fluid in order to move in a given direction e.g. in the wind pipe (trachea) to push out the mucus and dust particles.
(iii) Cilia beat like tiny oars or pedals (as in a boat) and flagella bring about whiplash like movement.
(iv) Both are made up of contractile protein tubulin in the form of microtubules.
(v) The arrangement of the microtubules is termed as 9 + 2, that is, two central microtubules and nine duplet sets surrounding them, Fig. 9. show the diagram of structure of Cilla and flagella.

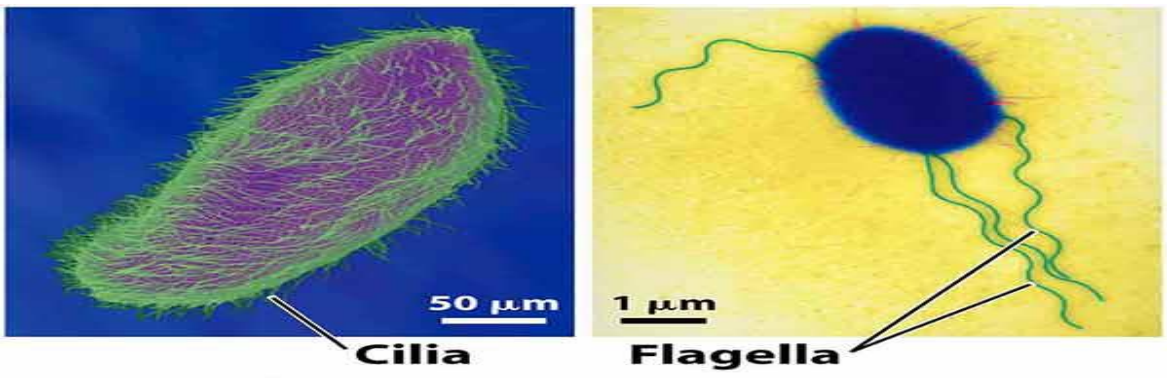

Figure. 9. show the diagram of structure of Cilla and flagella.

Table1:- Compare between the Cilla and Flagella.

	Flagella	Cilia
1. Parts	Basal plate, basal body, rootlets, and shaft	Basal body, rootlets, basal plate and shaft
2. Shaft microtubule organization	The nine pairs of microtubules are arranged in a ring pattern around the two central microtubules (9+2 array)	The nine pairs of microtubules are arranged in a ring pattern around the two central microtubules (9+2 array)
3. Basal body microtubule organization	Nine triplet microtubules without central microtubules (9 + 0 array)	Nine triplet microtubules without central microtubules (9 + 0 array)
4. Length	Long (150μ)	Short (5-10μ)
5. Density	Few/ countable	Numerous
6. Motion	Whipping motion, slow	Rotational, fast
7. Function	Locomotion	Locomotion, feeding and filtering substances

Nucleus

General structure of the nucleus, Fig. 10. show the diagram of structure of Nucleus

(i) It is the largest organelle seen clearly when the cell is not dividing.

(ii) It stains deeply, is mostly spherical, WBC have lobed nuclei.

(iii) It is mostly one in each cell (some cells have many nuclei)

(v) Double layered nuclear membrane having fine nuclear pores encloses nucleoplasm which contains chromatin network and a nucleolus.

Functions

- Maintains the cell in a working order.
- Co-ordinates the activities of other cell organelles.
- Takes care of repair work.
- Participates directly in cell division to produce genetically identical daughter cells. This division is called mitotic cell division.
- Participates in production of meio-gametes and meiospores through another type of cell division called meiotic cell divisioin.

The parts of a nucleus are given here:

Nuclear membrane

- Double layered membrane is interrupted by large number of nuclear pores.
- Membrane is made up of lipids and proteins (like plasma membrane) and has ribosomes attached on the outer membrane which make the outer membrane rough.
- The pores allow the transport of large molecules in and out of nucleus, and the membranes keep the hereditary material in contact with the rest of the cell.

Chromatin

- Within the nuclear membrane there is jelly like substance rich in proteins.
- In the karyolymph, fibrillar structures form a network called chromatin fibrils,which gets condensed to form distinct bodies called chromosomes during cell divisionThe number of chromosomes is fixed in an organism. During mitotic cell division chromosomes divide in a manner that the daughter cells receive identical amounts of hereditary matter.
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Nucleolus

- Membrane less, spheroidal bodies present in all eukaryotic cells except in sperms and in some algae.
- Their number varies from one to few, they stain uniformly and deeply.
- It has DNA, RNA and proteins.
- Store house for RNA and proteins; it disappears during early phase of cell cycle and reappears after telophase in the newly formed daughter nuclei.
- Regulates the synthetic activity of the nucleus.
- Thus nucleus and cytoplasm are interdependent, and this process is equal to nucleo – cytopalsmic interaction.

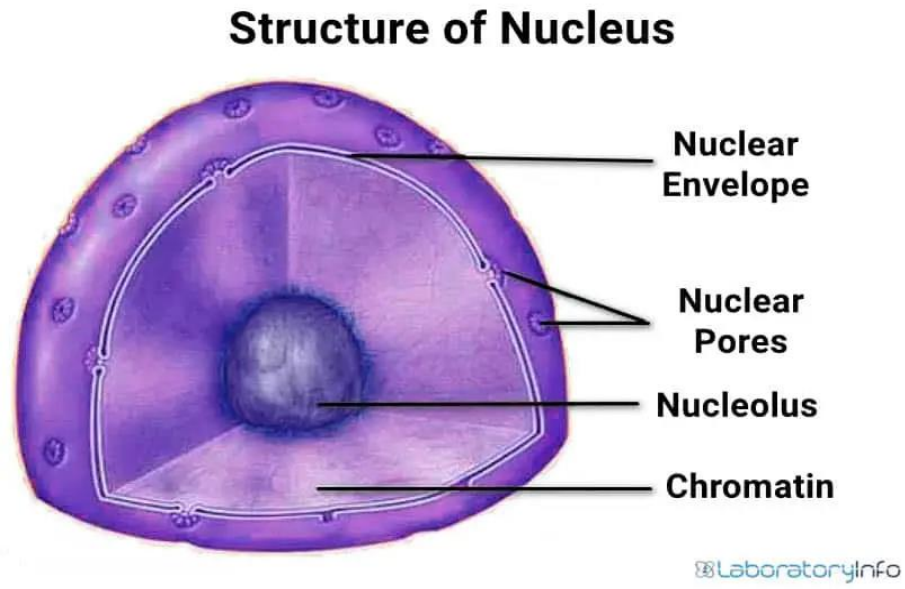

Figure. 10. show the diagram of structure of Nucleus

Q1 Mention any two advantages of the extensive network of endoplasmic reticulum.

(i) …….. (ii)……...……

Q2 .What is the function of peroxisomes in cells

Q3.Why cannot the cell survive without the nucleus?

Q4. .Explain the following terms:

(a) chromatin network..... .....

(b) chromosomes.....

Q5 .What is the function of the nucleolus in the cell?

Q6.What is a cell organelle?

Q7 .Why is mitochondrion called the “power house” of the cell?

Q 8 .State two similarities between mitochondria and chloroplasts.

Q9 .Which plastid is green in color?

Q10 .Give two functions of the plant cell wall.