CELL : THE UNIT OF LIFE

CELL - INTRODUCTION

INTRODUCTION

- The presence of basic unit of life i.e. cell makes a living organism different from non-living organisms.
- The organisms, which are composed of a single cell, are called as unicellular organisms while the organisms, which are made up of multiple cells, are called as multicellular organisms.
- **Unicellular organisms are capable of**
  - **(a) Independent existance**
  - **(b) Performing the essential functions of life.**
- The structure, which is less than a cell, does not ensure independent existance.
- Cell is a basic unit of life and it is considered as structural and functional unit of an organism. **Robert Hooke (1665)** discovered cell. He first observed the cell in a piece of dead cork cells. He described cell in his book **"Micrographia".**
- **Leeuwenhoek (1674)** first observed animal (living) cell and used the term **"Animalcule**" for it.
- The study of cell structure is called **cytology.** The study of cell structure, function and reproduction is called **Cell biology.**
- **Robert Hooke is known as 'Father of cytology'.**
- **Knoll and Ruska invented electron microscope and by this invention all structural details of this cell could be revealed.**

CELL THEORY

- **In 1838, Matthias Schleiden, a German botanist, examined a large number of plants. He concluded that all plants are made up of different cells which make tissue.**
- **Theodore Schwann (1839), a British Zoologist, studied different types of animal cells and plant tissue. He concluded that animal cells have thin outer layer, which is today known as plasma membrane.Based on his studies of plants, he concluded that presence of cell wall is a unique**

character of plant cell. Schwann proposed the hypothesis that the bodies of animals and plants are composed of cells and products of cells.

Matthias Schleiden and Theodore Schwann jointly proposed cell theory in 1839. Its main features are as follows

(i) All living organisms consist of cells and their products.
(ii) All cells are structurally and metabolically similar.
(iii) Cells perform vital activities of an organism.
(iv) Each cell is unit of heredity.

Objections

1. Bacteria and cyanobacteria do not bear nucleus and membrane bound cell organelles.
2. Viruses are acellular and do not contain cellular machinery.
3. RBCs and sieve tube cells live without nucleus.
4. Protozoans and many thallophytes have a uninucleate differentiated body that cannot be divided into cells. They are acellular.
5. This theory did not explain as to how new cells were formed.

MODERN CELL THEORY

It is also known as cell doctrine or cell principle.

1. All living organisms are made up of cells having cytosol, nucleus, organelles and a covering membranes.
2. Functions of living organisms are the sum total of the activities of their cells.
3. Cell can survive independantly but organelles cannot do so.
4. It is unit of structure, function and heredity.
5. Life exist in cells.
6. Growth of an organism is due to increase in size and number of cells.
7. New cell arises from pre existing cells “Omnis cellula-e cellula”. It is called cell lineage theory. This concept was given by Rudolf Virchow (1855). The final shape to cell theory was given by Rudolf Virchow.

AN OVERVIEW OF CELL

- The onion cell which is a typical plant cell, has a distinct cell wall as its outer boundary and just within it is the cell membrane.
- Cells that have membrane bound nuclei are called eukaryotic whereas cells that lack a membrane bound nucleus are prokaryotic.
- In both prokaryotic and eukaryotic cells a semi-fluid matrix called cytoplasm occupies the volume of the cell.
- The cytoplasm is the main arena (zone) of cellular activities in both the plant and animal cells.

  Various chemical reactions occur in it to keep the cell in the 'living state'.

- Besides the nucleus the eukaryotic cells have other membrane bound distinct structures called organelles like the endoplasmic reticulum (ER), the golgi complex, lysosomes, mitochondria, microbodies. The prokaryotic cells lack such membrane bound organelles.
- Ribosomes are non-membrane bound organelles found in all cells both eukaryotic as well as prokaryotic cell. Within the cell, ribosomes are found not only in the cytoplasm but also within the two organelles chloroplasts (in plants) and mitochondria and on rough ER.
- Animal cells contain another non-membrane bound organelle called centriole which helps in cell division.

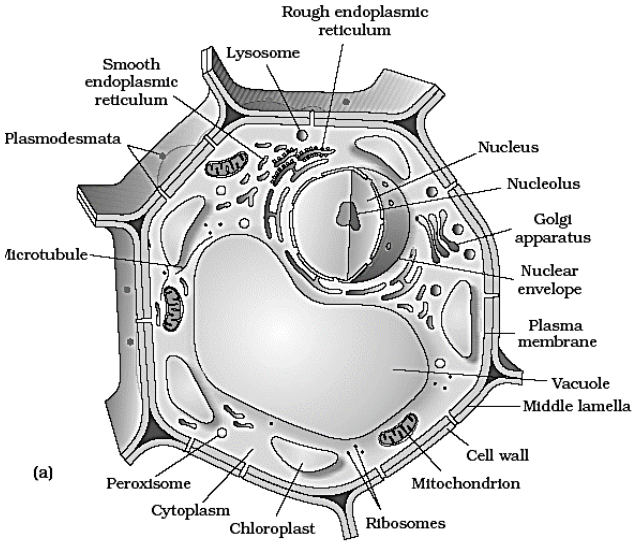
SIZE AND SHAPE OF CELL

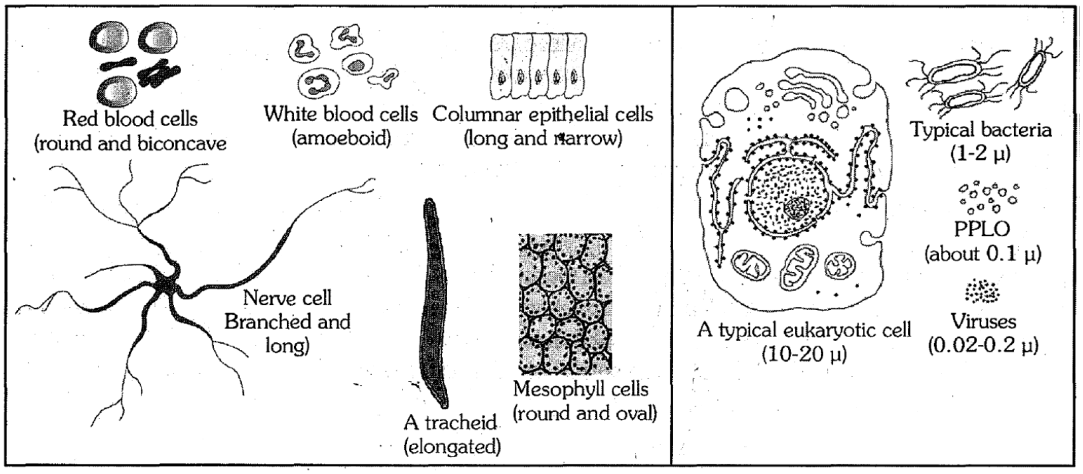
Size :

- Cell differ greatly in size, shape and activities.
- Mycoplasma (Smallest cells) Only 0.3 μm in length
- Bacteria = 3 to 5 μm
- Largest isolated single cell = egg of an ostrich.
- Human red blood cell ≈ 7.0 μm in diameter
- Nerve cell = longest cell

Shape:

- The shape of the cell may vary with the function they perform.
- They may be disc-like, polygonal, columnar, cuboid, thread like or even irregular.





CELL ORGANISATION:

On the basis of nucleus, two types of cells are present –

PROKARYOTIC CELLS

- The prokaryotic cells are represented by bacteria, blue-green algae, mycoplasma or PPLO (Pleuro Pneumonia Like Organisms). They are generally smaller and multiply more rapidly than the eukaryotic cells.
- The organisation of the prokaryotic cell is fundamentally similar even though prokaryotes exhibit a wide variety of shapes and functions.

EUKARYOTIC CELLS

- The eukaryotes include all the protists, plants, animals and fungi. In eukaryotic cells there is an extensive compartmentalisation of cytoplasm through the presence of membrane bound organelles.
- Eukaryotic cells possess an organised nucleus with a nuclear envelope. In addition eukaryotic cells have a variety of complex locomotory and cytoskeletal structures. Their genetic material is organised into chromosomes.
- All eukaryotic cells are not identical. Plant and animal cells are different as the former possess cell walls, plastids and a large central vacuole which are absent in animal cells. On the other hand, animal cells have centrioles which are absent in almost all higher plant cells.

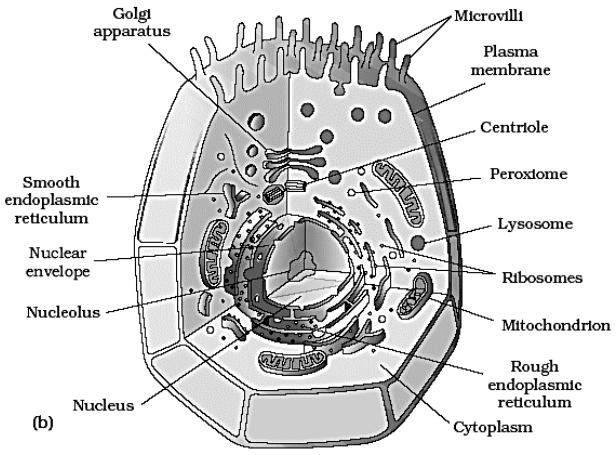


Figure: Diagram showing : (a) Plant cell (b) Animal cell

Differences between Prokaryotic and Eukaryotic Cell			
S.No	Prokaryotic Cell	S.No	Eukaryotic Cell
1	The Cell size is small (0.1–5.0 m.) They multiply rapidly.	1	The cell size is comparatively larger (5–100 m). They multiply slowely than Prokaryotic cell.
2	A prokaryotic cell has one envelope organisation.	2	A eukaryotic cell has two envelope organisation.
3	An organized nucleus is absent. Instead a nucleoid is found.	3	An organized nucleus is found. It is differentiated into nuclear envelope, chromatin, one or more nucleoli and nucleoplasm.
4	Cell wall, if present, contains muramic acid.	4	Cell wall, if present, muramic acid is absent
5	DNA is naked, it means histones absent	5	DNA is found with histones.
6	DNA lies freely in the cytoplasm.	6	Most of the cell DNA is found in the nucleus. A small quantity is also found in the plastids and mitochondria.
7	DNA is circular or organised into a single chromosome.	7	Nuclear DNA is linear whereas Extra nuclear DNA is circular. Genetic material is organised into chromosomes.
8	Transcription and translation take place in the cytoplasm.	8	Transcription occurs in the nucleus while tanslation takes place in the cytoplasm.
9	Cytoplasm does not show cyclosis.	9	Cytoplasm usually shows cyclosis.
10.	No extensive compartmentalisation of cytoplasm.	10.	Extensive compartmentalisation of cytoplasm through the presence of membrane bound organelles.

11	Membrane bound organelles like Mitochondria, Golgi apparatus, ER, lysosomes and other microbodies are absent.	10	Mitochondria, ER, Golgi apparatus and microbodies including lysosomes present in cell of organisms.
12	Microtubules and microfilaments are commonly absent.	11	Mircrotubules and microfilaments present.
13	Gametes are not formed, since sexual reproduction and meiosis are absent.	12	Gametes are formed either directly or through meiosis, as sexual reproduction is found in the life cycle.
14	A spindle apparatus is not formed during division.	13	A spindle apparatus is produced during nuclear division.
15	70S types of Ribosomes are found.	14	Ribosomes are of 80S types. 70S ribosomes are found in mitochondria and plastids.
15	Centriole is also absent	15	Centriole is present in animals and lower plants
16	e.g.Bacteria, Cyanobacteria, Mycoplasma and PPLO (Pleuro Pneumonia like organisms)	16	e.g.Protists, Fungi, Plants and Animals.

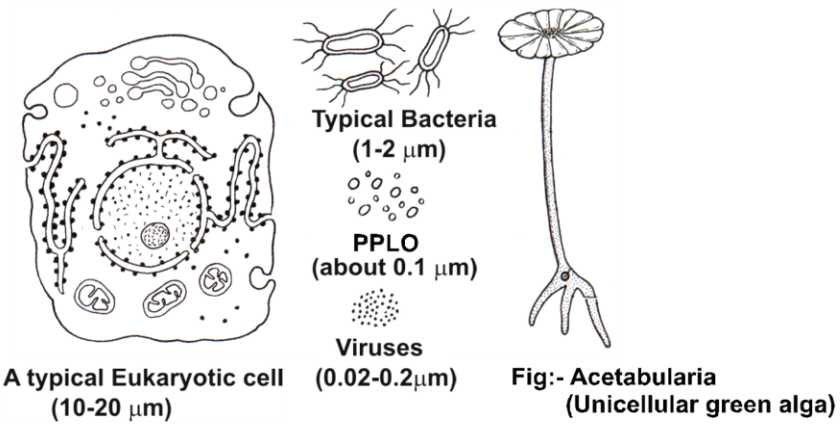


Fig:- Comparison of unicellular organisms with typical eukaryotic cell

Note: Dodge recognised mesokaryotic organisation in dinoflagellates.

Mesokaryotic cell: Histone protein absent but nucleus with nuclear membrane present. Chromosomes are condensed and visible even in interphase. e.g. Dinoflagellates.