

Cell is the Fundamental, Structural and Functional Unit of Life.

Reason : The cell is called the "structural and functional unit" of life, because all living beings are made up of cells. Cell provides the basic structure to various body parts of an organism and are essential for performing various life processes required for sustaining life.

Postulates of Cell theory :

The cell theory was proposed by two scientists – **Matthias Schleiden** and **Theodor Schwann** and was further expanded by **Rudolf Virchow** by suggesting that all cells arise from pre-existing cells.

1. Cell is the structural unit of all living things.
2. Cell is the basic functional unit of life.
3. All cells come from preexisting cells.

PROKARYOTIC CELLS : –

The primitive type of cells in which the nuclear material is not enclosed in the nuclear membrane.

- They do not have membrane-bound cell organelles.
- Have smaller ribosomes (**70S**)
- A single circular DNA is present

Example : bacteria and archaea

EUKARYOTIC CELLS : –

The cells with truly evolved nucleus, i.e. nuclear material is enclosed within the nuclear membrane.

- They have most of the membrane-bound organelles.
- Have larger ribosomes (**80S**)
- Several lengths of linear DNA is present, wound around histone proteins

Example : higher plants and animals

PROKARYOTIC CELLS

- Nuclear material is not enclosed within the nuclear membrane.
- Membrane bound organelles are absent.
- Centrioles are absent.
- Cell wall is present.
- Smaller ribosomes present.

EUKARYOTIC CELLS

- Nuclear material is enclosed within the nuclear membrane
- Membrane bound organelles are present.
- Centrioles present in animal cells.
- Cell wall present only in plant cells.
- Both Smaller and larger ribosomes present.

CELL ORGANELLES : –

Specialized structures within a cell that have one or more specific functions to perform in the cell.

RIBOSOMES (protein factories) : –

Ribosomes are non-membranous minute granular structures composed of **RNA** and proteins.

- **Location** : Ribosomes are scattered freely in the cytoplasm of both eukaryotic and prokaryotic cells or attached to the membranes of endoplasmic reticulum in eukaryotic cells. Ribosomes are also present in cell organelles like nucleus, mitochondria and chloroplasts.
- **Function** : Ribosomes are the sites of **protein synthesis**.

Ribosomes are called protein factories of the cell

Ribosomes are the only cell organelle, involved in the synthesis of protein by gathering and assembling different types of amino acids into protein chains. Therefore, they are called the protein factory of the cell.

MITOCHONDRIA : –

Mitochondria are self-replicating cell organelles that occur in various shapes, but usually spherical or rod-shaped double membranous structures. The inner membrane is folded inwards to form finger like projections called **cristae**.

- **Cristae** Increase the available surface area to enhance the productivity of cellular respiration.
- Mitochondria contain their **own ribosomes** (70 S) for synthesis of respiratory enzymes.
- Mitochondria have their **own DNA**, which help for their **replication** when needed.

Location : Mitochondria are found in all eukaryotic cells, i.e. both plant and animal cells.

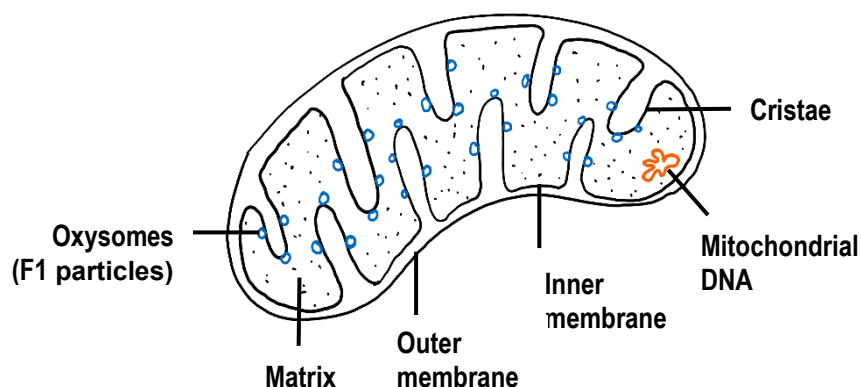
Function : Mitochondria are **sites where cellular respiration occur** to release energy.

Energy released during cellular respiration is stored in the form of energy rich compound **ATP**.

- **ATP – Adenosine triphosphate** is the source of energy for use and storage at the cellular level in all living organisms.

Mitochondria are known as the powerhouses of the cell.

Mitochondria help in **cellular respiration** to provide the chemical energy (**ATP**) necessary to regulate various cellular activities. Hence are known as the **powerhouses** of the cell.



ENDOPLASMIC RETICULUM : –

Endoplasmic reticulum is an irregular network of double membranous tubules whose inner end connected to nuclear membrane and outer end connected with the cell membrane.

- The ER has two forms, the **rough ER** and the **smooth ER**.
- The **rough ER** has ribosomes studded to its outer surface, whereas the **smooth ER** without ribosomes.

Location :

→ Endoplasmic reticulum is distributed within the cytoplasm of all eukaryotic cells and is continuous with plasma membrane on the outside and nuclear membrane on the inside.

Functions :

- Endoplasmic reticulum acts as a **supporting frame work** for cell.
- Endoplasmic reticulum serves as a pathway to **transport** materials from one part of the cell to the other.
- **Rough ER** has ribosomes on it, so it helps in synthesis of proteins.
- **Smooth ER** responsible for the synthesis of essential lipids such as phospholipids and cholesterol.

GOLGI APPARATUS (Golgi Complex) : –

Golgi bodies, are made up of a series of flattened membrane-bound stacks derived from old endoplasmic reticulum and consists of hollow tubules (cisternae), vesicles and minute vacuoles.

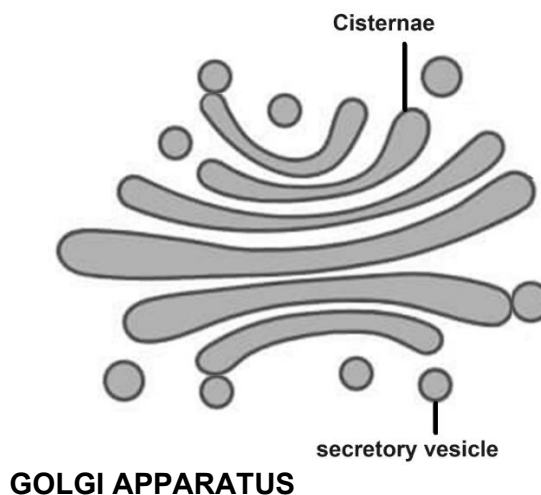
Location :

- Golgi bodies are located in the cytoplasm next to the endoplasmic reticulum near the nucleus in most of the eukaryotic cells.

Functions :

- Golgi bodies are responsible for synthesis, processing, modifying, packaging and secretion of different types of proteins, lipids, enzymes and hormones.
- Golgi bodies help in formation of **acrosome** in human sperm cell.
- Golgi bodies in plant cells contain smaller and more scattered groups of cisternae and vesicles more specifically known as **dictyosomes**.

Dictyosomes modify proteins, polymerize sugars to polysaccharides, and then package these materials for delivery to the destinations within the cell.



LYSOSOME : –

Lysosomes are small vesicles of spherical shape surrounded by a single membrane and arise from the Golgi apparatus

Location :

→ Lysosomes are seen scattered in the cytoplasm of all eukaryotic cells, generally they are pinched off from the vesicles of Golgi complex whenever required by the cell.

Function :

- Lysosomes contain various digestive enzymes that function in intracellular digestion.
- Lysosomes contain hydrolytic enzymes, enabling the cell to destroy foreign substances like pathogens which are engulfed during phagocytosis by neutrophils.
- Hydrolytic enzymes in lysosomes digest cartilages during formation of bones.

Prokaryotic cells do not have lysosomes.

This is due to the fact that lysosomes are formed by the endoplasmic reticulum as well as Golgi bodies and prokaryotes do not have membrane bound cell organelles.

Lysosomes are present in plant cells but are very uncommon.

This is due to the fact that in plants, the function of lysosomes is performed by the vacuoles and cell walls, which prevent foreign substances from entering the cell.

Lysosomes are known as the suicidal bag of the cell

If the cell is old or damaged, then one of the lysosomes bursts and release some digestive enzymes. The released enzymes then digest their own cell and ultimately the cell dies. Hence, lysosomes are called **suicide bags** of the cell.

CENTROSOME : –

Centrosomes are membrane-free cell organelles with two **centrioles** arranged at right angles to each other.

Centrioles are cylindrical shaped small structure made of nine microtubules located in the clear cytoplasm of animal cells.

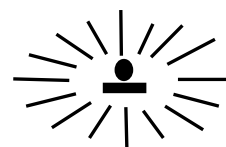
- Centrioles are involved in organizing microtubules in the cytoplasm during cell division.

Location :

Centrosome is located in the cytoplasm usually close to the nucleus in animal cells.

Function :

Centrosome divides and migrates to opposite poles of the cell during cell division and are involved in the formation of the asters and spindle fibers which initiate the cell division.



PLASTIDS : –

Plastids are double-membrane cell organelles in different shapes, found in the cells of plants and algae. Plastids are responsible for manufacturing and storing of food.

Three types of plastids are :

1. **Chloroplasts** → used for photosynthesis.
2. **Chromoplasts** → used for pigment synthesis and impart colour to flowers and fruits.

Xanthophyll's	: Yellow to Orange shades	} INSOLUBLE IN WATER
Carotenes	: Orange to Red shades.	
Lycopene	: Red	
Anthocyanins	: Purple	– WATER-SOLUBLE

* Anthocyanins are found in the cell vacuoles, mostly in flowers and fruits.

3. **Leucoplasts** → non-pigmented plastids for storing starch granules.

CHLOROPLASTS –

Chloroplasts are double membrane cell organelles in green plant cells, they contains thylakoids with the green pigment chlorophyll and ground substance called stroma.

- **Thylakoids –**

Thylakoids are membrane bound flattened disc - like structures within the chloroplasts and contain a green pigment chlorophyll for trapping sunlight. Thylakoids serve as the site of light dependent reactions of photosynthesis.

- **Grana (singular granum) –**

Grana are the layers of stacks of thylakoids that serve as the sites of light dependent reactions of photosynthesis.

- **Stroma –**

Stroma is a dense fluid ground substance within the chloroplast and lies outside the thylakoid membranes.

Stroma serves as the site of light independent reactions.

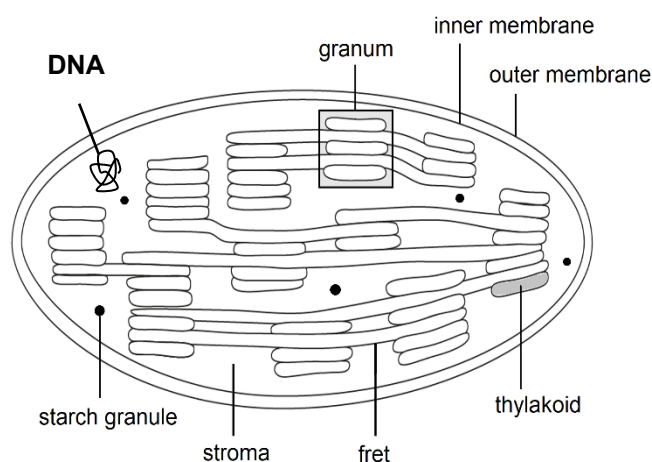
- **Chlorophyll –**

Chlorophyll is a green colour pigment, present in all green plants.

Chlorophyll helps to trap energy from sunlight during photosynthesis.

Chlorophyll contains **Mg** as metallic element.

- Chloroplasts contain their own **DNA** which help in their self-replication when needed.

**Location :**

Chloroplasts are found in plant cells present in all green parts of plants, generally in leaves.

Function : Chloroplasts help in photosynthesis.

- **The survival of the heterotrophs depends directly or indirectly on the chlorophyll.**

The survival of the heterotrophs depends directly or indirectly on the chlorophyll, because the chlorophylls are capable of trapping energy from sunlight (radiant energy) for preparing food for their own self and for the heterotrophs. Even if a heterotroph is strictly carnivorous and does not eat plants, it must eat animals that eat plants to survive.

- **Chloroplast replicate by itself. Give reason**

Chloroplasts contain their own genetic material (DNA), hence they can self-replicate and form more copies of them when required.

NUCLEUS : –

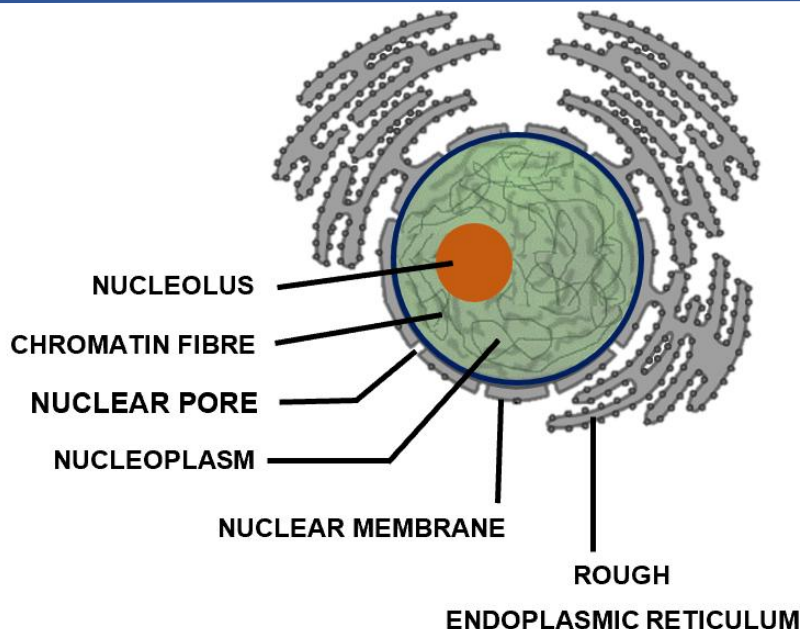
Nucleus is a largest membrane bound cell organelle mostly spherical in shape and contain a network of thread like structures called chromatin fibers and a nucleolus suspended in the nucleoplasm.

Location :

- Nucleus is suspended in the cytoplasm of all eukaryotic cells.
In animal cells, the nucleus is located in the central place of the cell.
In plant cells, the nucleus is pushed to one side to accommodate large food vacuole.

Function :

- Nucleus contains the cell's hereditary information which controls various functions of the cell.
- Nucleus is responsible for coordinating many of the important cellular activities such as protein synthesis, cell division, growth and most of other important functions.



NUCLEOPLASM –

Nucleoplasm is the jellylike substance within a cell nucleus and contain the nucleolus and chromatin fibers.

CHROMATIN FIBERS –

Chromatin fibers are long thread like mass of hereditary material located in the nucleus of all eukaryotic cells and composed of 40% DNA and 60 % histone proteins.

Chromatin fibers condense during cell division to form chromosomes.

CHROMOSOME –

A condensed and organized structure of histone proteins coiled by a **DNA** molecule with genes that carry heredity information.

Located within the nucleus of all eukaryotic cells and visible only during cell division.

NUCLEOLUS –

A small, spherical, dense protein body located in a cell nucleus suspended in nucleoplasm.

Function :

- Nucleolus help in synthesis of ribosomal RNA from proteins, hence it is involved in assembling and producing ribosomes.
- Dictates ribosomes to synthesize various kinds of proteins.

Nucleus is the most prominent organelle in the cell and known as brain of the cell.

The nucleus is referred to as the brain of the cell as it contains genetic information, which directs the synthesis of proteins and regulate various cellular processes such as differentiation, growth, metabolism, cell division, reproduction, etc.

Enucleated cells	: human red blood cells / platelets
Multinucleated cells	: the skeletal muscle cells of mammals / certain types of fungi
Multi-lobed nucleus	: human neutrophils

DIPLOID CELL –

Diploid cell is a cell that consists of two sets of chromosomes, one set from each parent.

Diploid cells are generally represented as **2n**, where **n** stands for the number of chromosomes.

In humans, **2n = 46**. i.e. 2 sets of **23** chromosomes

- Autosomes (non-sex chromosomes) = 22 pairs
- Sex chromosomes = 1 pair (23rd pair, X and Y chromosomes)

HAPLOID CELL –

Haploid cell is a cell (gamete) that contains one complete set of chromosomes.

Haploid cells are generally represented as **n**, where **n** stands for the number of chromosomes.

In humans, **n = 23**. i.e. one set of 23 chromosomes.

- **Gametes** are haploid cells.
- Male gamete (sperm cell) = **22 + X** or **22 + Y**
- Female gamete (egg cell) = **22 + X**

CELL WALL

1. Cell wall is the non-living part of cell
2. Present in plant cells, bacteria and fungi.
3. Made up of cellulose in plant cells.
4. Generally porous or freely permeable.
Allows the free passage of ions and small molecules in and out of the cell.

Function :

1. Gives mechanical strength and rigidity to the plant cells.
2. Maintains the cell shape in plant cells, bacteria cells and fungi.
3. Cell wall resists the water pressure in plant cells and gives mechanical strength to the plant body.

CELL MEMBRANE

1. Cell membrane is the living part of cell.
2. Present in all types of cells.
3. Made up of lipoprotein bilayers
4. Selectively permeable.
Regulate the entry of selected ions and molecules to pass in and out of the cell.

Function :

Encloses the protoplasm and protects the content of cell.
Maintains the cell shape in animal cells.

Cell membrane is semi permeable and controls in and out movements of substances.

PLANT CELL

1. Consists of cellulose cell wall surrounding the plasma membrane.
2. Cytoplasm is present as a thin lining along the cell wall.
3. Large and prominent food vacuoles are present.
4. Plastids are present.
5. Centrosome is absent.

ANIMAL CELL

1. Cell wall is absent and the limiting membrane is plasma membrane.
2. Cytoplasm is dense and it occupies a major portion of the cell.
3. Vacuoles are absent, if present they are small.
4. Plastids are absent.
5. Centrosome is present.

CYTOPLASM :

Cytoplasm is the jelly-like fluid that fills the gap between the nuclear membrane and the cell membrane. Cytoplasm is made up of mostly water, various enzymes, fatty acids, sugars, amino acids and mineral ions.

→ All the cell organelles inside the cell are suspended in cytoplasm.

→ The outer, clearer layer of cytoplasm is called ectoplasm

→ The inner, granular part of the cytoplasm is called as endoplasm.

Function of Cytoplasm :

1. Plays an important role in maintaining the shape and consistency of the cell.
2. The site of many vital biochemical reactions crucial for maintaining life.
3. Carries certain vital functions like respiration (glycolysis) and cytokinesis.
4. Provides a medium to accommodate the cell organelles.

CELL ORGANELLES

1. Membrane bound living structures present in the cytoplasm of a cell.
2. Cell organelles perform definite metabolic functions in a cell.

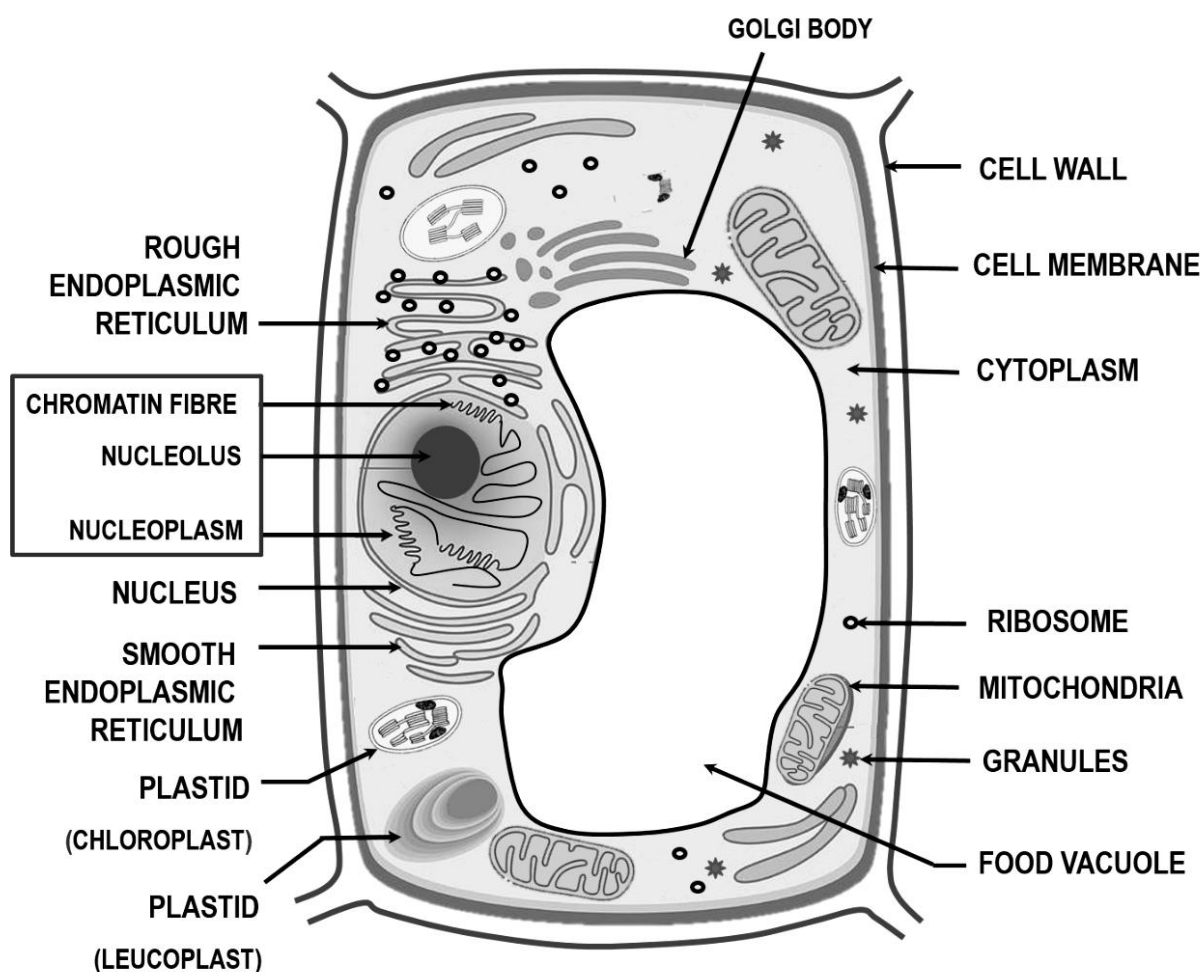
CELL INCLUSIONS

1. Chemical products or non-living structures scattered in the cytoplasm of a cell.
2. Cell Inclusions are the products of the metabolic reactions in a cell.

PROTOPLASM :

The protoplasm is generally referred to as all living components of the cell, like cell membrane, cytoplasm and cell organelles.

Protoplasm carryout all essential functions responsible for life processes of a cell.

PLANT CELL

ANIMAL CELL

