

Cell – The Fundamental Unit of Life.

Cell : Structural and functional unit of living organism is called as cell.

Cytology : Branch of Biology that deals with study of cell is called as cytology.

Cytologist : The person who studies cell is called as cytologist.

Discovery of cell : Robert Hooke in 1665, an English Scientist discovered cell in cork of a bark. He observed thin slices of bark in microscope and found that there are some compartment like structures or honeycomb like structures ,such structures are further named as cell.

Cork cells are dead cells.

Robert Hooke – Father of cytology.

Robert Hooke – Discovers the cell

Robert Hooke – Discovers the dead cell

Anton Von Leeuwenhoek – Discovers first living cell.

Classification of Organism on the basis of number of cells :

- a. **Unicellular organism :** Organism with only one cell in their body is called as unicellular organism. E.g : Diatom, Amoeba etc
- b. **Multicellular organism :** Organism with many cells in their body is called as Multicellular organism.E.g : Higher organism.

Size of cell : Size of cells ranges from 0.1 micrometer to 1 m .

Smallest cell : Mycoplasma (0.1 micrometer)

Longest cell : Nerve cell

Largest cell : Egg of an Ostrich(18 cm)

Shape of Cell : Cells occurs in different forms and shape and hence they are considered to be Polymorphic.

Cell – Organelle : Different components of cell is called as Cell organelle.

E.g : Nucleus, Mitochondria, Golgi- Complex, Endo-Plasmic reticulum, Plasma membrane etc.

Protoplasm : The colourless material comprising the living part of cell, including the cytoplasm, nucleus, and other cell organelle is called as protoplasm.

- **Eu-karyotic Nucleus** : (Along with this refers Classroom notes and diagram)
- It is commonly called as **Brain of cell**.
- It was discovered by **Robert Brown**.
- Usually there is only one nucleus in one cell but rarely number varies.
- **Occurance** :It is found in every living cell but absent in RBC, Bacteria , tracheids ,vessels etc.

Classification of cell on the basis of number of Nucleus :

1. **Mono-Nucleated cell** : One nucleus. E.g. Parenchyma
2. **Bi-Nucleated cell** : Two nucleus. E.g Polar nucleus, Venter canal cell
3. **Poly-Nucleated cell** : Many nucleus. E.g Muscle cell
4. **Enucleated cell** : No nucleus. E.g . RBC, Tracheids

Classification of cell on the basis of position of Nucleus :

1. **Centric cell** : Nucleus lie in centre
2. **Ecentric cell** : Nucleus does not lie in centre.

Structure of Nucleus :

- 1.Small rounded body in cell is called as nucleus. It is externally bounded or covered by membrane called as nuclear membrane. Nuclear membrane is divided as outer nuclear membrane and inner nuclear membrane. Both membranes are lipo-proteinous in nature and having diameter of 80 \AA . In between two membrane there lies space called as peri- nuclear space which measures about 120 \AA . Nuclear membrane is not continuous . It shows small aperture in it called as nuclear pore which are hexagonal or octagonal in shape.
2. Inside the nuclear membrane there lies granular material called as Nucleoplasm. It contains Chromatin fibres, Nucleolus , carbohydrates , proteins , ions etc.
- 3.**Chromatin fibres** are threads like structure found scattered through out nucleoplasm.These chromatin fibres during cell division undergoes condensation and gets converted to **chromosomes**. Chromatin fibres are composed of **DNA and proteins**.
- 4.Small rounded body in nucleoplasm is called as nucleolus, It is commonly called as **Ribosomal factory**.

Functions:

- 1.All the activities of cell is controlled by nucleus.
- 2.It helps in cell division
- 3.it protects and stores genetic material.
- 4.The nucleolus present in nucleus helps in **ribosomal production**.

- **Mitochondrion** : (Along with this refers Classroom notes and diagram)
- It is commonly called as **Power house of cell**. It is concerned with production of energy currency of body called as ATP i.e Adenosine Tri Phosphate
- It was discovered by **Kolliker and Benda**.
- **Number** : Usually number of mitochondria depends on activities of cell, more the activity more is number of mitochondria.

Amoeba	: 50000 mitochondria
Egg of Frog	: 250000 mitochondria
Egg of Sea Urchin	: 300000 mitochondria
Cells of liver of Rat	: 1500- 2000 mitochondria
- **Shape of Mitochondrion** : It occurs in different forms and shape and hence considered to be Polymorphic.
- **Occurance** : It is found in every living cell but absent in RBC, Bacteria , tracheids , vessels etc.

Structure of Mitochondrion :

1. It is externally bounded or covered by membrane called as mitochondrial membrane. Mitochondrial membrane is divided as outer mitochondrial membrane and inner mitochondrial membrane. Both membranes are lipo-proteinous in nature and having diameter of 80 A°. In between two membrane there lies space called as peri- mitochondrial space which measures about 120 A°
2. Inside the mitochondrial membrane there lies granular material called as inner chamber or matrix. It contains DNA, ribosomes , carbohydrates , proteins , ions etc.
3. The inner membrane is not continuous but shows number of folding in it called as cristae. F1 or oxysome particles or elementary particles are seen over cristae.
4. Mitochondria are self replicating autonomous body present in cytoplasm.

Functions:

1. It helps in production of energy rich ATP molecules.
2. Energy required by sperm for its movement is provided by mitochondria.
3. Excess of mitochondria present in egg is converted to nutritious yolk
4. The steps of aerobic respiration like Krebs's Cycle or Electron Transport System occurs in mitochondria.

- **Plastids** : (Along with this refers Classroom notes and diagram)
- It is commonly present in plants only. It is concerned with production of food in plant body and also related with colours in plants.
- It was discovered by **Konstantin in 1905**.
- **Number** : Usually number of Chloroplast in a cell ranges from 20 to 40 but sometimes there values ranges upto 1000.

- **Shape of Chloroplast :** It occurs in different forms and shape and hence considered to be Polymorphic.
- **Occurance :** It is found in every living cell but absent in RBC, Bacteria , tracheids ,vessels etc.

Structure of Chloroplast :

1. It is externally bounded or covered by membrane called as Peristomial membrane. Peristomial membrane is divided as outer Peristomial membrane and inner Peristomial membrane. Both membranes are lipo-proteinous in nature and having diameter of 80 A°. In between two membrane there lies space called as peristomial space which measures about 120 A°.
2. Inside the Peristomial membrane there lies granular material called as Stroma or matrix. It contains Grana, Inter grana lamellae, DNA, ribosomes , carbohydrates , proteins , ions etc.
3. Grana is composed of number of parallel units called as thalakkoid. Each granal unit is joined by other by inter grana lamellae. Within each thalakkoid there is rounded bodies called as quantasomes. Each quantasomes contains 230 to 300 chlorophyll molecules.
4. Chloroplast is also self replicating autonomous body present in cytoplasm.

Functions:

1. Chloroplast helps in preparation of food by photosynthesis.
2. Chloroplast helps in trapping of sunlight for photosynthesis.
3. Chromoplast gives characteristic colour to fruits and flowers.
4. Coloured plastids helps the flowers to attract the insects for pollination.

Endo-Plasmic Reticulum : (Along with this refers Classroom notes and diagram)

- Network like structure present in cytoplasm is called as endoplasmic reticulum.
- It was discovered by **Porter and Kalmann**.

Occurance : It is found in every living cell but absent in RBC, Bacteria , tracheids ,vessels etc.

Structure :

Electron microscopic studies shows that E.R is composed of -

1. **Cisternae:** These are tubular parallel structures lying one above the others. They are in the group of 10 to 12. The space within a cisterna is called as intra cisternal space and space between two cisternae is called as inter cisternal space. These cisternae are joined by vertical clamps.
2. **Vesicles :** The small rounded bodies present by side of cisternae is called as vesicles.
3. **Tubules :** These are fine branched structure present by side of cisternae .

Types of Endoplasmic Reticulum :

1. **Rough or Granular E.R :** The ER which shows ribosomes over it is called as rough ER
2. **Smooth or Agranular ER :** The ER which don't have ribosomes over it is called as Smooth ER.

Functions of ER :

- 1.It acts as secretary, storage and circulatory system of cell.
- 2.It gives mechanical support to cells.
- 3.It helps in detoxification.
- 4.It helps in intra cellular conduction of impulses.
- 5.It helps in formation of plasma membrane.
- 6.It helps in transport of protein produced by ribosomes.
- 7.It helps in formation of Vitamin A in Retinal cells.

Golgi Complex : (Along with this refers Classroom notes and diagram)

- It is commonly called as packaging material.
- It was discovered by **Camello Golgi**.

Occurance :It is found in every living cell but absent in RBC, Bacteria , tracheids ,vessels etc.

Structure :

Electron microscopic studies shows that GC is composed of -

- 1.**Cisternae:** These are tubular parallel structures lying one above the others. They are in the group of 10 to 12. The space within a cisterna is called as intra cisternal space and space between two cisternae is called as inter cisternal space. These cisternae shows parallel fibres in them.
- 2.**Vesicles :** The small rounded bodies present by side of cisternae is called as vesicles.
- 3.**Tubules :** These are fine branched structure present by side of cisternae .
- 4.**Golgian vacuoles :** Extremely large rounded bodies around it is called golgian vacuoles. There functions are still unknown.

Functions :

- 1.It helps in formation of Lysosomes.
- 2.Acrosomes present over head of sperm is made up of GC
- 3.After cell division GC plays vital role in formation of cell plate.
- 4.It helps in formation of many enzymes and chemicals.
- 5.It helps in storage of various components and also helps in packaging of material.

Lysosomes : (Along with this refers Classroom notes and diagram)

Lysosomes are the digestive bodies found usually in animals but found very rarely in plant cell. It is also called as **Suicidal bodies or suicidal bags**.

Discovery: Duve in 1955

Structure : Lysosomes are rounded objects but in plants they are irregular in appearance. It is externally bounded by single lipo-proteinous membrane. This membrane shows presence of stabilizer in it . Inside the lysosomes there are many digestive enzymes like nuclease, lipase, phosphorylase etc.

Polymorphism in Lysosomes :

1. **Primary lysosomes :** The normal lysosomes along with enzymes are called as primary lysosomes.
2. **Secondary lysosomes :** Primary lysosomes along with food in it is called as secondary lysosomes.
3. **Residual body:** Lysosomes with digestive waste is called as Residual body.
4. **Autophagic vacuole :** The lysosomes which has a tendency to kill its own cell is called as autophagic vacuole. It bursts and releases enzymes which kills the cell and hence called as suicidal body.

Functions :

1. During starvation the reserved food material is digested by lysosomes i.e it helps in intra cellular digestion.
2. When any cell organelle die, it is digested by lysosomes and thus maintains cleanliness in cytoplasm.
3. When any extra cellular particles comes within cell, then it is digested by lysosomes.
4. The lysosomes helps in metamorphosis , it helps to convert tadpole into adult.

Vacuoles : (Along with this refers Classroom notes and diagram)

Vacuoles are rounded or irregular structures found both in plants and animals. In plants they are of larger size than in animals.

It is believed that vacuoles are discovered by Anton Von Leeuwenhoek.

Structure : Vacuoles may be rounded irregular structure. It is externally covered or protected by single lipo-proteinous membrane called as Tonoplast. Internally it stores various components.

Types of vacuoles :

1. **Water Vacuoles :** It stores water
2. **Food Vacuoles :** It stores food
3. **Gas Vacuoles :** It stores gas
4. **Storage vacuoles :** It stores chemicals, pigments, and other components.

Function:

1. It helps in storage of various components.
2. It helps in maintaining turgidity of cell.

Ribosomes : (Along with this refers Classroom notes and diagram)

Ribosomes are commonly called as protein factory. These are small rounded bodies found in every living cell including bacteria. It is also seen in cell organelle like mitochondria and chloroplast.

It was discovered by **Palade**.

Each ribosomes are made up of two parts i.e smaller sub unit and larger sub unit. The two sub units are joined by Mg^{++} concentration.

Types of Ribosomes :

1. **70 S ribosomes :** It is found in mitochondria, chloroplast, bacteria and also free in cytoplasm of all living cells.
2. **80 S ribosomes :** It is found attached to surface of ER

Note: S – Swedberg's Constant or Sedimentation Coefficient.

Function:

1. It helps in protein synthesis.
2. Protein formed by ribosomes helps in growth, enzyme production, hormone production etc

Structure of Bacterial cell or Prokaryotic cell :

(Along with this refers Classroom notes and diagram)

The Bacterial cell was discovered by Anton Von Leeuwenhoek. The cell which contains primitive nucleus or poorly developed nucleus is called as prokaryotic cell and such nucleus is called as prokaryotic nucleus.

Occurrence : It is seen everywhere , in air , soil, water, animals , plants etc.

Shape: Polymorphic

Bacillus - Rod Shape

Coccus -Rounded

Spirillum -Spiral

Vibrio -Comma shape

Number : A single drop of water contains 50000 million bacteria

Size : Its average size is 0.5 micrometer to 1.5 micrometer

Weight : 5 billion bacteria weighs 1mg

Structure :

Externally it is covered by protective layer called as cell wall. The cell wall of bacteria shows presence of N-acetyl glucosamine, n-acetyl muramic acid and Peptidoglycan. Internal to cell wall there lies plasma membrane which is lipoproteinous in nature and it shows folding at one point called as mesosomes. Mesosomes secrete enzymes which help in respiration. Inside cell granular cytoplasm is present .It contains Bacterial DNA, 70S ribosomes, ions, enzymes , microtubules etc. On one side of cytoplasm bacterial chromosomes are present. The bacterial chromosome is also called as prokaryotic nucleus or Bacterial DNA. The locomotory organ of Bacteria is flagella or cilia. There may be one or many flagella. The Flagella arises from a blepharoplast granule. Cilia also acts as locomotory organ. External to cell wall there lies outgrowth called as Pili. It helps in attachment to other bacteria during reproduction.

Cell wall : (Along with this refers Classroom notes and diagram)

It is basic characteristic feature of plant cell. The outer boundary of cell is called cell wall. Its presence indicates cell of plant. The structure of cell wall shows:

1. **Primary cell wall :** It is the outermost layer of cell wall. It is made up of cellulose. In Parenchyma there is only primary cell wall.

2. **Secondary cell wall:** It lies inside the primary cell wall. It is composed of hemi cellulose, pectose and lignin material. It is found in Tracheids , Vessels etc.

3. **Tertiary cell wall :** It is formed due to deposition of chemical substance called as Xylose. It is found in Gymnospermic vessels. Gap between two neighboring cell is called as middle lamella. Electron microscopically the cell wall shows micro-fibrils of cellulose mixed in or spread in matrix.

Function:

1. It provides protection to cell.
2. It also gives rigidity to cell.

Plasma membrane or Cell membrane : (Along with this refers Classroom notes and diagram)

It is the outermost membrane found in animal cell but in plants cell around plasma membrane there is cell wall. It is found in every living cell including bacteria.

Structure of plasma membrane :

PM is lipo-proteinous in nature i.e made up of lipids and proteins. It is tri-laminar in nature and shows P-L-P arrangement. The lipid layer is packed between two protein layer. Each protein layer measures about 25 A in diameter whereas lipid layer measures about 30 A . Each lipid molecule have two ends that is hydrophilic and hydrophobic. Hydrophilic end forms bond with protein and is water loving . Hydrophobic end is water hating and lie towards each other .

Modification of PM :

1] **Plasmodesmata :** The junction between two cell is called as plasmodesmata. It is formed by PM

2] **Microvilli :** In cells of nephron, small intestine etc. there is presence of number of folding over cell and is called as microvilli . It is also formed by PM

Function-

1] **Protection** – As PM is the outer most membrane in animal cell ,it provides protection

2] **Elasticity-** Plasma membranes provide elasticity to cell it helps in contraction and enlargement of cell

3] **Conduction of impulses** –PM of nerve cell helps in conduction of electrical impulses from one point to other

4] **Osmosis** –Movement of water from higher water concentration to lower water concentration is called as osmosis . Gaining of water by cell is called as endosmosis and .Losing of water by cell is called exo osmosis

Condition 1-If the concentration of external solution surrounding the cell is same like concentration of cell then such solution is called as isotonic solution . Here cell neither gain nor lose the water . Here cell size remains same.

Condition 2-If the concentration of external solution surrounding the cell is higher than concentration of cell then such solution is called as hypertonic solution . Here cell lose the water to surrounding medium . Here cell size decreases

Condition 3-If the concentration of external solution surrounding the cell is lower than concentration of cell then such solution is called as hypotonic solution . Here cell gains the water from surrounding medium . Here cell size increases

5)**Diffusion** –Movement of ions molecule or solute particles from higher concentration to lower concentration is called diffusion

If the cell loses the component than it is called exo cytosis and if the cell gains the component than it is called endo cytosis .

6)**Permiability** : PM is of three different nature i.e

Impermeable membrane : Allows only gases to pass

Semi permeable membrane : Allows water to pass

Selective permeable membrane : Allows selective ions to pass

7)**Hormone receptors** : PM also acts as receptor to hormones

s.n	Plant Cell	s.n	Animal Cell
1	Cell wall present	1	Cell wall absent
2	Larger vacuoles	2	Smaller vacuoles
3	Plastid present	3	Plastid absent
4	Nucleus not in centre	4	Nucleus lie in centre
5	Centrosome absent	5	Centrosome present
6	Usually large in size	6	Usually small in size

s.n	Eukaryotic Nucleus	s.n	Prokaryotic nucleus
1	Well developed well organized nucleus is present	1	Well developed well organized nucleus is absent
2	Nuclear membrane present	2	Nuclear membrane absent
3	Nucleoplasm present	3	Nucleoplasm absent
4	Nucleolus present	4	Nucleolus absent
5	Genetic material lie in nucleoplasm	5	Genetic material lie in Cytoplasm

Cell Theory :

It was proposed by M.J. Schleiden and T.Schwaann. Robert Virchow Modify this theory as

1. All living organism are made up of cells.
2. Cell is a structural and functional unit of life.
3. All living organism arises from pre-existing cells.
4. Every living organism starts its life from a single cell

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