

## Chapter - 8

# Cell : The Unit of Life

### Points to Remember

**Cell Theory :** Cell Theory was formulated by Scheleiden and Schwann, and was modified by Rudolf Virchow. Cell theory States.

- (A) All living organisms are composed of cells and products of cells.
- (B) All cells arise from pre-existing cells.

**Cell :** Cell is the structural and functional unit of life.

#### Prokaryotic Cell

- Generally small sized (1–10  $\mu\text{m}$ )
- Well defined nucleus absent
- Membrane bounded cell organelles absent
- DNA without histone covering  
*e.g., Bacteria, Mycoplasma, Blue green Algae*

#### Prokaryotic Cell

- Gram positive bacteria
- Bacteria that take up gram Stain. *e.g., Bacillus*

#### Eukaryotic Cells

- Generally large sized (5–10  $\mu\text{m}$ )
- Well defined nucleus present
- Membrane bounded cell organelles present
- DNA with histone covering  
*e.g., Amoeba, Euglena and other higher organism*

#### Cell envelope

- Gram negative bacteria
- Bacteria do not take up gram stain  
*escherichia coli*

### Modification of cell envelope

- Slime layer : Glycocalyx in form of loose sheath.
- Capsule : Glycocalyx in form of thick and tough sheath.
- Mesosomes : Extension of plasma membrane. These can be in the form of vesicles, tubules and lamellae.

**Functions :** Cell wall formation, DNA replication and distribution to daughter cells, respiration, secretion processes, to increase surface area of plasma membrane and enzyme content.

- **Flagella :** Extension of cell wall. It is composed of three structure—filament, hook and basal body. They help in motility of bacteria.
- **Pili and fimbriae :** Surface structure of some bacteria which attaches them to rocks in streams and to host tissues.

**Genetic Material :** It is not covered by nuclear envelope. In addition to the genomic DNA (the single chromosome/circular DNA), many bacteria have small circular self replicating, double stranded DNA which is called as plasmid, plasmid contain genes like antibiotic resistance.

### Eukaryotic cells

Possess an organized nucleus with nuclear envelope and have a variety of complex locomotory and cytoskeletal structures.

**Cell Membrane**—Singer and Nicolson (1972) gave ‘fluid mosaic model’. According to this the quasi-fluid nature of lipid enables lateral movement of proteins within the overall bilayer; two types of proteins (Peripheral and integral proteins) with cholesterol, glycolipids and glycoproteins. Erythrocyte membrane has 52% protein and 40% lipids.

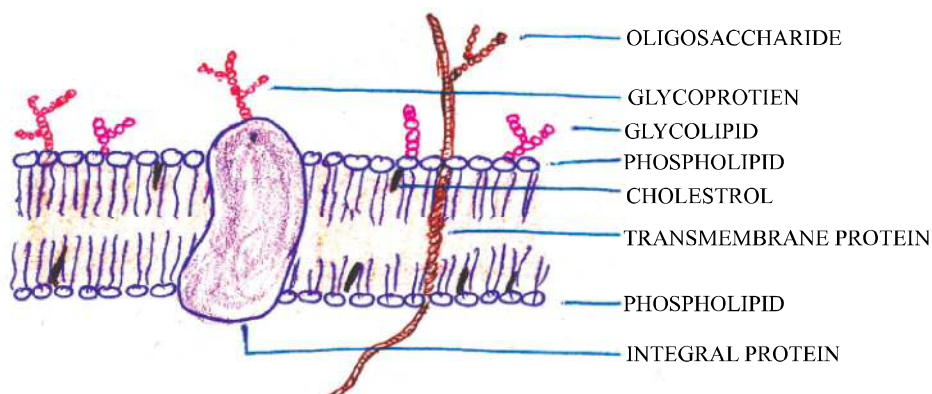
**Function**—It is semi permeable and helps in transport of molecule across it.

#### Passive transport

- Transport of molecules from higher to lower concentration.
- It do not utilise energy (ATP).  
*e.g., diffusion*

#### Active transport

- Transport of molecules from lower to higher concentration
- It utilises energy (ATP)  
*e.g., Na<sup>+</sup>/K<sup>+</sup> ATPase Pump.*



**Fluid Mosaic Model of Plasma Membrane**

**Cell Wall** is non-living rigid structure which gives shape to the cell and protects cell from mechanical damage and infection, helps in cell-to-cell interaction and provides barrier to undesirable macromolecules.

Cell wall of algae is made of cellulose, galactans, mannans and minerals like calcium carbonate. Plant cell wall consists of cellulose, hemicellulose, pectins and proteins.

**Middle lamella** is made of calcium pectate which holds neighbouring cells together.

**Plasmodesmata** connect the cytoplasm of neighbouring cells.

### **Endoplasmic Reticulum (ER)**

Consists of network of tiny tubular structure. ER divides the intracellular space into two distinct compartments—luminal (inside ER) and extra luminal (cytoplasm).

(i) Rough Endoplasmic Reticulum (RER) :

- Ribosomes attached to outer surface.

**Function :** ● Involved in protein synthesis and secretion.

(ii) Smooth Endoplasmic Reticulum (SER) : ● Lack ribosomes.

**Function** ● Site for synthesis of lipid.

**Golgi apparatus :** First observed by Camillo Golgi (in 1898)

Consist of cisternae stacked parallel to each other. Two faces of the organelle are convex/cis or forming face and concave/**trans** or maturing face.

**Functions :** Performs packaging of materials, to be delivered either to the intra-cellular targets or secreted outside the cell. Important site of formation of glycoproteins and glycolipids.

### **Lysosomes :**

Membrane bound vesicular structures formed by the process of packaging in the golgi apparatus. Contain hydrolysing enzymes (lipases, proteases, carbohydrases) which are active in acidic pH. Also called 'Suicidal Bag'.

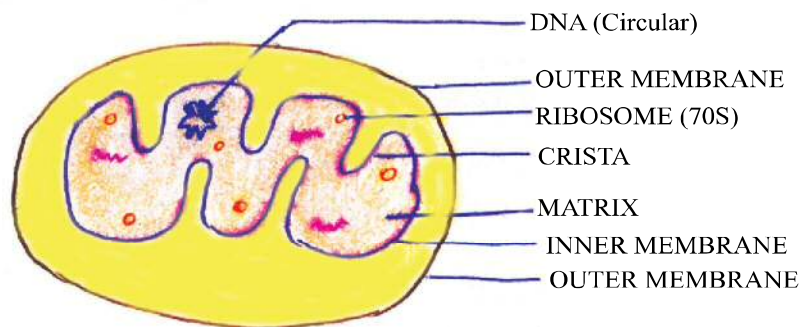
**Function :** Intracellular digestion.

**Vacuoles :** Membrane bound space found in the cytoplasm. Contain water, sap, excretory product, etc. In plant cell, vacuole occupies 90% of space.

**Function :** In plants **tonoplast** (single membrane of vacuole) facilitates transport of ions and other substances.

Contractile vacuole for excretion in *Amoeba* and food vacuoles formed in protists for digestion of food.

**Mitochondria :** Double membraned structure. Out membrane smooth and inner membrane forms a number of infoldings called cristae The inner compartment is called matrix. The cristae increase the surface area.



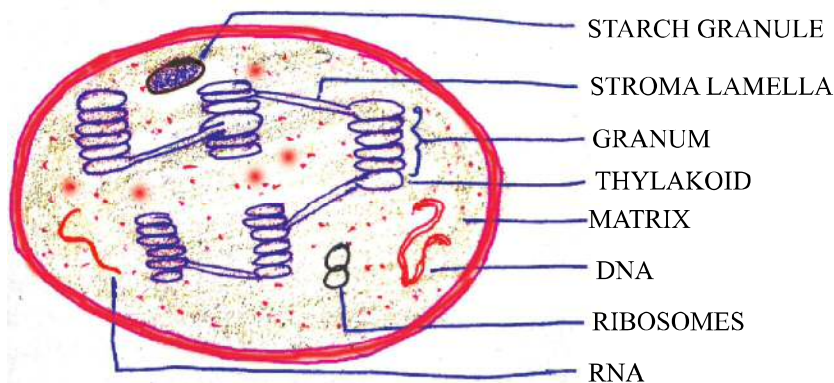
Mitochondria

**Function :** Sites of aerobic respiration. Called 'power houses' of cell as produce cellular energy in the form of ATP. Matrix possesses single circular DNA molecule, a few RNA molecules, ribosomes (70S). It divides by binary fission.

**Plastids :** Found in plant cells and in euglenoides. Chloroplasts, chromoplasts and leucoplasts are 3 types of plastids depending on pigments contained.

Types of Plastids		
Chloroplast (green coloured plastids) contains chlorophyll, double stranded DNA and 70S ribosomes	Chromoplast carotenoid (fat soluble) carotens (give colour to plant parts) Xanthophylls. Others (Yellow, red, orange)	Leucoplast Amyloplast (Starch) Elaioplasts (oil + fat) Aleuroplast (store proteins)

**Function :** Site of photosynthesis, and imparts colours to fruits and flowers.



Chloroplast

## Ribosomes

Composed of RNA and proteins; without membrane. Eucaryotic ribosomes are 80S. S = Svedberg's unit)

**Function :** Site of protein synthesis.

**Cytoskeleton :** Network of filaments.

Proteinaceous structure in cytoplasm made up of microtubules and micro filaments.

**Function :** Mechanical support, motility, maintenance of the shape of the cell.

### Cilia and Flagella

Cilia are small structures which work like oars which help in movement.

Flagella are longer and responsible for cell movement. They are covered with a plasma membrane. Core is called **axoneme** which has 9 + 2 arrangement of axonemal microtubules.

## Centrosome and Centrioles

Centrosome contains two cylindrical structures called centrioles. Surrounded by amorphous pericentriolar material. Has 9 + 0 arrangement. Centrioles form the basal body of cilia or flagella and spindle fibres for cell division in animal cells. They produce spindle apparatus during cell division.

**Nucleus :** With double membrane with perinuclear space and nuclear pores; has Chromatin, nuclear matrix and nucleoli (site for rRNA synthesis). (Named by Robert Brown – 1831)

**Chromatin** DNA + nonhistone proteins. (Named by Flemming)

**Nucleoplasm** – Nucleolus + Chromatin

**Nuclear membrane**—It is with perinuclear space and nucleopores.

**Chromosomes**—DNA/RNA + Histone protein/Nonhistone protein.

**Centromere :** Primary constriction—disc is known as kinetochores.

No nucleus in Erythrocytes (RBC) of mammals and sieve tubes in vascular plants.

**Chromosomes (on basis of position of centromere) :**

**Metacentric :** Middle centromere.

**Sub-metacentric :** Centromere nearer to one end of chromosomes.

**Acrocentric :** Centromere situated close to its end.

**Telocentric :** Has terminal centromere.

**Satellite :** Some chromosomes have non-staining secondary constructions at a constant location, which gives the appearance of small fragment called satellite.

## Questions

### Very Short Answer Questions

(1 mark each)

1. Name the parts of bacterial flagella.
2. Name the nutrient stored in (i) elaioplasts (ii) aleuroplasts
3. Name the scientist who first saw and described a live cell.
4. What are plasmids ?
5. Name the scientist who first explained that new cells arose from pre-existing cells (*Omnis cellule-e-cellula*)
6. What is the composition of plasma membrane of human erythrocyte.
7. Eukaryotic ribosomes are 80S. What does 'S' stand for ?
8. Write the function of cytoskeleton in a cell ?

### Short Answer Questions–I

(2 marks each)

9. What are nuclear pores ? State their function.
10. State the cell theory.
11. Differentiate between active and passive transport.
12. Differentiate between RER and SER.
13. List two functions of golgi apparatus.
14. List two functions of mesosome.
15. Differentiate between the electron microscopic structure of cilia/flagella and centriole.
16. Give the specific terms for the following :
  - (a) Cluster of ribosomes found in cytoplasm
  - (b) Extensive infolding to the inner membrane of mitochondria
  - (c) Stacks of closely packed thylakoids
  - (d) Stalked particles on the inner membrane of mitochondria
17. (a) Write the function of inclusion bodies in prokaryotic cells ?
  - (b) Where are they present ?
  - (c) Give two examples of inclusion bodies.

### Short Answer Questions–II

(3 marks each)

18. With the help of labelled diagram explain the 'fluid mosaic model' structure of cell membrane.
19. Differentiate between a prokaryotic and eukaryotic cell.
20. What are lysosomes ? How are they formed ? Write their functions.
21. Give the structural details of an eukaryotic nucleus along with its diagram.

22. The ribosomes of prokaryotes are of 70 S type ribosomes and 80 S type while of eukaryotes are of 80S type.
- (a) Give the composition of 70 S type ribosomes and 80 S type ribosome (two sub units, from each of them are made of)
  - (b) Name two cell organelles of eukaryotic cells which have their own independent ribosomes of 70 S type

### Long Answer Questions

(5 marks each)

23. (a) Give the structural details of mitochondria.  
(b) Draw its diagram.  
(c) Why is it called 'powerhouse of the cell' ?
24. (a) Diagrammatically represent the types of chromosomes based on the position of centromere.  
(b) What does chromatin contain ?  
(c) What is perinuclear space ?

## Answers

### Very Short Answers

(1 mark each)

1. Filament, hook, basal body.
2. Elaioplasts : fats and oils.  
Aleuroplasts : proteins.
3. Anton Von Leeuwenhoek
4. The small circular DNA, outside the genomic DNA of bacteria.
5. Rudolf Virchow.
6. 52% proteins, 40% lipids.
7. Sedimentation coefficient (Svedberg unit)
8. Mechanical support, motility, maintenance of shape of cell.

### Short Answers-I

(2 marks each)

9. Minute pores present in the nuclear envelope; provide passage for movement of RNA and proteins between nucleus and cytoplasm.
10. Refer 'Points to Remember'.
12. Refer 'Points to Remember'.
13. Refer 'Points to Remember'.
14. Refer 'Points to Remember'.



- | 15.  | <b>Flegella/Cilia</b>   | <b>Centriole</b>                                      |
|------|---|---|
| (i)  | Possess (9 + 2) pattern of axoneme<br>microtubules enclosed by a membrane | : Possess (9 + 0) pattern,<br>membrane less organelle |
| (ii) | Each tubule is doublet  | : Each tubule is a triplet                            |
16. (a) Polyribosome/Polysome  
(b) Cristae  
(c) Grana  
(d) Fo–F<sub>1</sub> particles ...
17. (a) Reserve materials are stored,  
(b) They are free in the cytoplasm  
(c) *e.g.*, Phosphate granules, cyanophycean granules, glycogen granules.

### Short Answers–II

(3 marks each)

18. Refer page no. 131–132, NCERT, Text Book of Biology for Class XI.
19. Differences in nucleus/chromosomes/mesosome/membrane bound cell organelles/ribosomes/compartments in cell.
20. Refer page no. 134 NCERT, Text Book of Biology for Class XI.
21. Refer page no. 138, NCERT, Text Book of Biology for Class XI.
22. (a) 70 S ribosomes have 50 S and 30 S sub units; 80S ribosomes have 60 S and 40 S sub units.  
(b) Mitochondria and chloroplast.

### Long Answers

(5 marks each)

23. Refer page no. 134-135, NCERT, Text Book of Biology for Class XI.
24. Refer page no. 138–139, NCERT, Text Book of Biology for Class XI.

