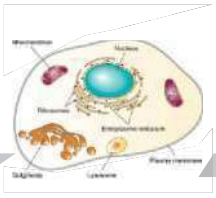


Chapter - 8

Cell : The Unit of Life

Cell : The unit of life

Basic Unit of Life ← **CELL** → Two Types

- Prokaryotic → No nuclear membrane and no membrane bound cell organelles. Eg. bacteria
- Eukaryotic → With nuclear membrane and membrane bound cell organelles. Eg. human cell

Cell wall (plant cell)	**Cell Membrane**	**Cytoplarm**	**Nucleus**	**Vacuoles (Plant Cell)**
Outermost covering of plant cell, made up of cellulose	Made of phospholipid bilayer and proteins	Fluid present between Nucleus and Cell membrane	Consists of nucleoplasm and nuclear membrane	Store house of water, nutrients mineral salts, waste

Contains cell organelles

Endo membrane System	Mitochondria	Plastids	Ribosomes	Cytoskeleten	Cillia and Flegella	Centrosome Centriole
ER, golgi apparatus, lysosomes and vacuoles have co-ordinated function so form endo membrane system	Double membranous structure, produce energy in the form of ATP, divides by fission, has its own DNA and ribosomes	Found in plant cell & euglenoids contain pigments & classified as chloroplasts and chromoplasts leucoplasts has DNA & ribosomes	Granular structures, made of DNA and protein, acts as protein factories	Proteinaceous structures made of microtubule, microfilaments & intermediate filaments, provide mechanical support, motility and maintain shape of cell	Cilia are smaller hair like out growths and flagella are larger both help in locomotion	Form basal body of cilia and flagella, and spindle fibers during cell division of animal cells

- ER – Network of tiny tubular structures scattered in cytoplasm, which divide intracellular space into two compartments. They are of two types-SER and RER
- Golgibodies – Flat disc shaped sacs or cisternae, stacked parallel to each other, near nucleus.
- Lysosomes – Membrane bound vescicles formed by packaging in Golgi apparatus

Points to Remember

Cell Theory : Cell Theory was formulated by Schleiden and Schwann, and was modified by Rudolf Virchow. Cell theory states that :

(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 μm)
- Well defined nucleus absent
- Membrane bound cell organelles absent
- DNA without histone protein e.g., Bacteria, Mycoplasma, Blue green Algae

Eukaryotic Cells

- Generally large sized (5–10 μm)
- Well defined nucleus present
- Membrane bounded cell organelles present
- DNA with histone protein e.g., Amoeba, *Euglena* and other higher organism

Gram Positive Bacteria

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

Gram Negative Bacteria

- Bacteria do not take up gram stain e.g., *Escherichia coli*

PROKARYOTIC CELL :

Modification of cell envelope

- Cell envelope consists of tightly bound 3 layered structure – Outermost Glycocalyx followed by cell well and plasma membrane
- Glycocalyx in form of loose sheath, is called slime layer
- Glycocalyx in form of thick and tough sheath, is called capsule

- 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 from cell wall. It is composed of three structures – filament, hook and basal body. It help in motility of bacteria.
- Fimbriae and Pili : Surface structure of some bacteria which attaches them to rocks in streams; to host tissues, and conjugating partners respectively.

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.

Ribosomes : Associated with plasma membrane of prokaryatic cell, site of protein synthesis. Several ribosomes may attach to a single mRNA and form a chain called polyribosomes or polysomes. They translate mRNA into Proteins.

Inclusion Bodies : Stores reserve material, lie freely in cytoplasm not bound by any membrane. e.g. phosphate granules, cyanophycean granules and glycogen granules.

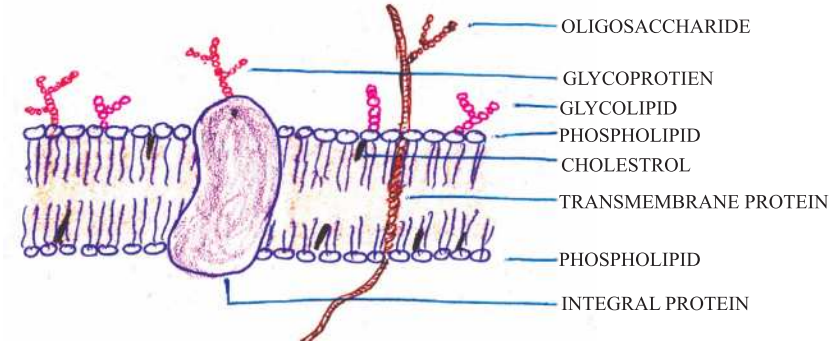
Eukaryotic cells

Possess an oragnized 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 glycoporteins. Erythrocyte membrane has 52% protein and 40% lipids.

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

Passive transport	Active transport
• Transport of molecules from higher to lower concentration.	• Transport of molecules from lower to higher concentration
• It does not utilise energy (ATP). e.g., diffusion	• It utilises energy (ATP) e.g., Na^+/K^+ 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 but inter connected.

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 optimally active at acidic pH. Also called 'Suicidal Bag'.

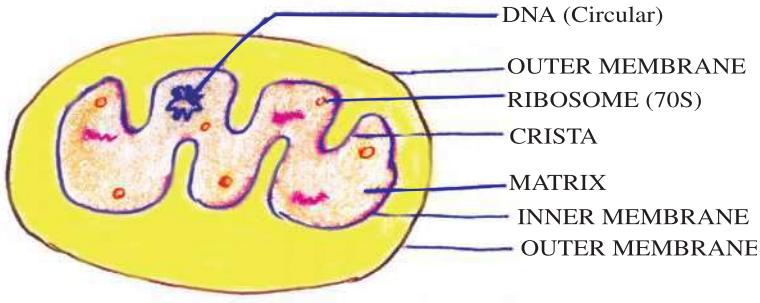
Function : Intracellular digestion.

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

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

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

Mitochondria : Double membranous structure. Outer 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

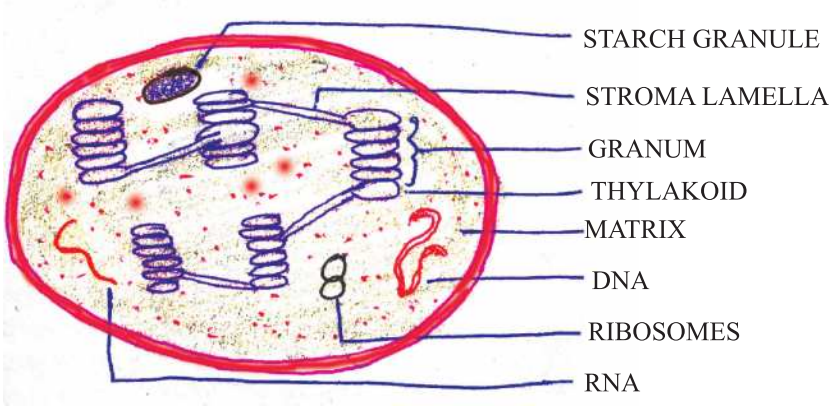
Function : Sites of aerobic respiration. Called 'power houses' of cell as produce cellular energy in the form of ATP. Matrix possesses single circular DNA molecule, a few RNA molecules, ribsomes (70S). It divides by binary fission.

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)	**Chromoplast**	**Leucoplast** (Colourless plastids)
• Contain chlorophyll, and carotenoids double stranded DNA and 70S ribosomes. • Trap light energy for photosynthesis	• Carotenoid pigments (fat souble) like Carotene, Xanthophylls and Others. • Gives the part of plant a yellow orange and red colour	• 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. Eukaryotic ribosomes are 80S. S = Svedberg's unit)

Function : Site of protein synthesis.

Cytoskeleton : Network of filaments.

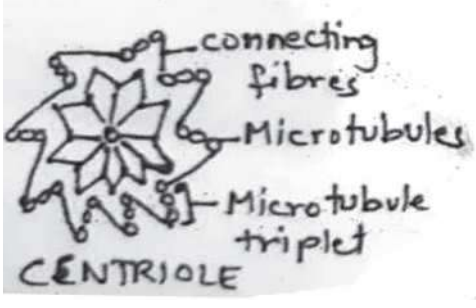
Proteinaceous structure in cytoplasm made up of microtubules and micro filaments.

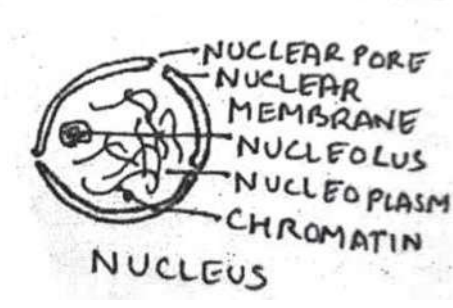
Function : Mechanical support, motility, maintenance of the shape of the cell.

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. Made up of nine evenly spaced peripheral

fibrils of tubulin protein (9+0). Centrioles form the basal body of cilia or flagella and spindle fibres for cell division in animal cells. They produces spindle apparatus during cell divison.

Nucleus : Double membranous with perinuclear space and nuclear pores; has Chromatin, nuclear matrix and nucleoli (site for rRNA synthesis). (Named by Robert Brown – 1831) Perinuclear space : Space between two parallel membrains of nuclear envelope.

Chromatin DNA + nonhistone proteins. (Named by Fleming)

Nucleoplasm – Nucleolus + Chromatin

Nulear membrane—It is with perinuclear space and nucleopores.

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

Centromere : Primary constriction in every chromosome

Kinetochores : Disc shaped structure on the sides of centsomere.

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

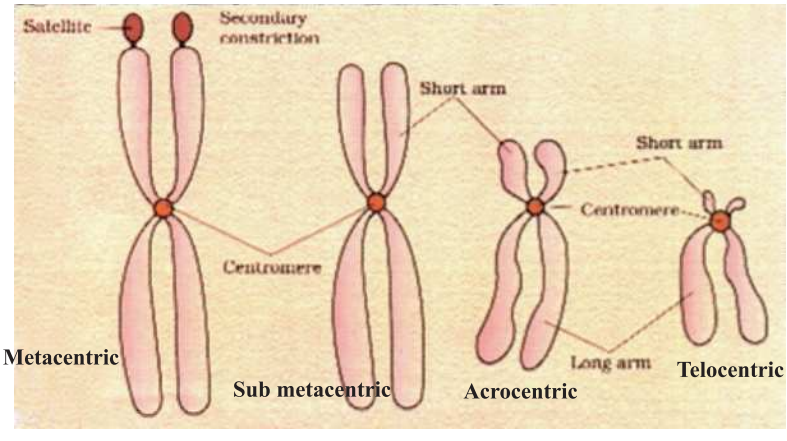
Chromosomes (on basis of position of centromere) :

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 constrictions at a constant location, which gives the appearance of small fragment called satellite.

Questions

(SRT) Select Response Type Question (1 mark each)

1. Name the parts of bacterials flagella.
   (a) Filament, hook, basal body
   (b) Basal body, nucleus, hook
   (c) Filament, hook, cytoplasm
   (d) Hook, microtubule, axoneme
2. Name the nutrients stored in elaiopiasts & aleuroplasts respectively.
   (a) Fats and oils & proteins (b) Fats & proteins
   (c) Proteins & Fats and oil (d) Starch & proteins
3. Name the scientist, who first saw and described a living cell.
   (a) Anton Von Leeuwenhoek (b) Robert Brown
   (c) Robert Hooke (d) Singer Nicolson

CONSTRUCTED RESPONSE TYPE (CRT)

Very Short Answer Questions (1 mark each)

4. What are plasmids ?
5. Name the scientist who first explained that new cells arose from pre-existing cells (Omnis cellula-e-cellula)
6. What is the composition of plasma membrane of human erythrocyte.
7. Eukayotic 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 in 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 prokaryoters are of 70 S type ribosomes and while of eukaryotes are of 80 S type as well as 70 S types.
    (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

(SRT) Select Response Type Question (1 mark each)

1. (a) Filament, hook, basal body.
2. (a) Elaioplasts : fats and oils.
   Aleuroplasts : proteins.
3. (a) Anton Von Leeuwenhoek

CONSTRUCTED RESPONSE TYPE (CRT)

Very Short Answers (1 mark each)

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'.
11. Refer 'Points to Remember'.
12. Refer 'Points to Remember'.
13. Refer 'Points to Remember'.
14. Refer 'Points to Remember'.
15.

	Flegella/Cilia		Centriole
(i)	Possess (9 + 2) pattern of axoneme microtubules enclosed by a membrane	:	Possess (9 + 0) pattern, membrane less organelle
(ii)	Each tubule is doublet	:	Each tubule is a triplet

16. (a) Polyribosome/Polysome (b) Cristae
    (c) Grana (d) Fo–F_1 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 'Point to remember'.
19. Differences in nucleus/chromosomes/mesosome/membrane bound cell organelles/ribosomes/compartments in cell.
20. Refer 'Point to remember'.
21. Refer 'Point to remember'.
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 chloropolast.

Long Answers (5 marks each)

23. Points to remember.
24. Points to remember.

Case Based :

25. Read the following and answer the question given below:

    It is thought that life originated on earth around 4 billion years ago. The endosymbiotic theory states that some of the organelles in today's Eukaryotic cells were once prokaryotic microbes. In this theory the first eukaryotic cell was probably an *Amoeba* like cell which ingested prokaryotic cells which survived within these amoeba host cells. Both organisms established symbiotic relationship. Mitochondria is formed when bacteria capable of aerobic respiration were ingested, chloroplast formed when photosynthetic bacteria were ingested. They eventually lost their cell wall and much of their DNA.

Some evidences which support this theory are :

- Mitochondria and chloroplast have their own circular DNA, just like prokaryotes.

- Both have 70s type of ribosomes.
- Both are of the same size as prokaryotic cells and divide by binary fission.
- Both are covered by double layered and contain respiratory enzymes on their inner surface.

Mitochondria and chloroplasts are semiautonomous organelles as they have their own DNA and ribosomes. They can synthesise some of their proteins on their own.

(i) Which feature have the prokaryotes lost during their evolution into mitochondria and chloroplast?

(a) Cytoplasm (b) Nucleus

(c) ER (d) Cell wall

(ii) Theory of endosymbiosis explains the :

(a) origin of organelles in eukaryotes

(b) how bacteria live

(c) how species evolve

(d) origin of multicellular life

(iii) Host cell received _____ from its endosymbiont and endosymbiont received _____ from its host :

(a) Energy & shelter (b) Shelter and energy

(c) Motility and reproduction (d) Reproduction and motility

(iv) Which of the following evidence support endosymbiotic theory. Select all that which applies :

(A) Chloroplasts and mitochondria have their own small circular DNA like prokaryotes

(B) They divide by binary fission

(C) 70s type of ribosomes in tem

(D) Respiratory enzymes on their inner surface

(a) A & B (b) A, B & C

(c) A, B, C & D (d) B, C, & D

Assertion and Reason type Questions (1 mark each)

In each of the following questions, two statements are given, one is Assertion and other is Reason. Mark the correct answer as :

(a) Both assertion & reason are true, and the reason is the correct explanation of the assertion.

(b) Both assertion and reason are true, but the reason is not the correct explanation of the assertion.

(c) Assertion is true but reason is false.

(d) Both the assertion & reason are false.

26. **Assertion :** Specialization of cells is useful for organisms.

Reason : It increases the operational efficiency of an organism.

27. **Assertion :** Eukaryotic cells contain membrane bound organelles.

Reason : Prokaryotic cells do not contain membrane bound organelles.

28. **Assertion :** Mitochondria and chloroplast are semi autonomous organelles.

Reason : They are formed by the division of preexisting organelles as well as contain their own DNA but lack protein synthesizing machinery.

Answers:

Ans. 25. (i) (d) Cell wall

(ii) (a) Origin of organelles in eukaryotes

(iii) (a) energy and shelter

(iv) (c) A, B, C and D

Ans. 26. (a) Both assertion & reason are true, and the reason is the correct explanation of the assertion.

Ans. 27. (b) Both assertion and reason are true, but the reason is not the correct explanation of the assertion.

Ans. 28. (c) Assertion in true but reason is false.