

The Fundamental Unit of Life Chapter Notes

• Cell is the structural and functional unit of an organism because a cell in itself is the smallest part of an organism which is capable of functioning independently and can carry out the fundamental duties of life like reproduction, metabolism (photosynthesis and/or respiration).

• Organisms which are made up of one cell are called unicellular organisms, eg Amoeba, Paramecium.

(Q.)What purpose do vacuoles serve in an amoeba?

(Ans) Amoeba has food vacuoles that store food temporarily and contractile vacuole for removal of extra water..

• Organisms which are made up of many cells are called Multicellular organisms, eg Hydra, Earthworm Man etc.

• Cell was discovered by Robert Hooke in 1665, in a cork slide [bark of tree] using self developed primitive microscope.

(Q.)Name the structure in which the cells were observed for the first time.

(Ans) Cells were observed for the first time in a slice of cork.

• " Cell " means a compartment.

• Living cell was first observed by Leeuwenhoek in a drop of pond water.

• Cell theory was proposed by Schleiden and Schwann –

Postulates of the cell theory

1) All living beings are made up of cells

2) The function of an organism as a whole is the result of the functions of the constituent cells.

3) All cells arise from pre existing cells. (By Rudolf Virchow – '*Omnis Cellula e Cellula*),

4) .All cells are alike in structure and metabolic activities.

• Cells are of two types

1) Prokaryotic cells eg Bacteria, Blue Green Algae

2) Eukaryotic cells eg Plant cells and Animal cells

Prokaryotic and Eukaryotic Cells

- The main difference between these two cell types is that Prokaryotic (primitive nucleus) cells do not have a nuclear membrane.
- The nuclear material of Prokaryotes consists of a single chromosome and lies in the cytoplasm.
- In prokaryotes, the nuclear region in the cytoplasm is called nucleoid.
- Membrane-bound organelles are absent in all prokaryotes.
- Prokaryotic cells are found in bacteria and cyanobacteria (blue-green algae).

Structure of Eukaryotic cell

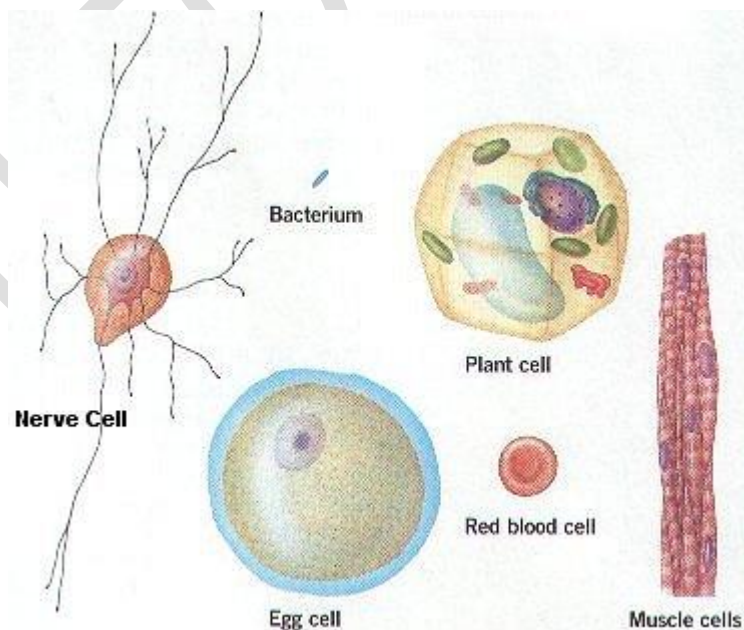
- Cells vary in shape and size. They may be oval or drop like(Chlamydomoans), spherical (egg) , rectangular (Epidermal cells), polygonal (Epithelial cells), spindle shaped (Smooth muscle fibre), irregular (WBC), rod-shaped (Bacilli)or totally irregular like the nerve cell.
- The variation in the shape of the cells is due to the function they have to perform as part of the tissue or an organ system.
- Mycoplasmas, a bacteria has the smallest cell of the size of 0.1 micron i.e. ten thousandth part of a millimetre.

(Q.)Why do cells have different shapes?

Give an example to support your answer.

(Ans)

Cells have different shapes to perform different functions. Example: Nerve cells are long and branched to carry signals from one part of the body to other and white blood cells are irregular in shape in order to engulf the pathogens in the body.



(Q.)Why do we stain the small components of section, before seeing under the microscope? Name a stain.

(Ans) Staining with coloured dyes makes the parts clearly visible. The dyes react with cellular components to give colour to the components. Eosin is a stain which gives a red orange colour.

Components of the cell

Cell wall

- The cell wall is present only in plant cells. It is made up of cellulose.
- Its function is to give strength and rigidity to the cell.

- It is living and Permeable and allow every substance to enter and exit.
- Cell wall between two adjacent cells is joined by middle lamella.
- Middle lamella is made up of Calcium pectate.
- Cell wall may get depositions of substances like Lignin , Suberin etc, which make it impermeable.

(Q.)Why plant cell have cell wall?

Ans: Plant cells need protection against variations in temperature, high wind speed, atmospheric moisture, etc. They are exposed to these variations because they cannot move. That's why they have cell wall.

Cell Membrane (Plasma membrane)

- It is present in both plant and animal cells.
- It is living, elastic and made of proteins and phosphor lipids (fats).
- Its function is to provide a mechanical barrier for the protection of the inner cell contents and to regulate the exchange or transport of substances in and out of the cell
- It is called selectively permeable as it allows only some substance to enter and exit in and out the cell.
- The most accepted model of Plasma membrane is the "Fluid Mosaic Model" given by Singer and Nicholson.

Transport across Plasma membrane[Passive transport]

Osmosis – it is movement of solvent (water)particles from the region of its higher concentration[hypotonic Solution] to the region of its lower concentration [hypertonic solution]across a semi permeable membrane till it reaches equilibrium.

Diffusion – It is the movement of solute particles from the region of their higher concentration to the region of their lower concentration till it reaches equilibrium.

Effect on cell in different kinds of solutions

When an animal cell is placed in a hypertonic solution, it will undergo exo osmosis and will shrink.

- If an animal cell is placed in a hypotonic solution it will it will undergo endo osmosis and will swell (become turgid) and will burst.

- Plant cell when placed in hypertonic solution undergoes exo osmosis, and only the cytoplasmic content of the cell shrinks, the shape does not change due to the rigid cell wall. Such a cell is called **Plasmolysed cell**.

- A plasmolysed cell if placed in water or hypotonic solution regains its turgidity and gets deplasmolysed.

- Plant cell in hypotonic solution undergoes endo osmosis, becomes turgid but does not burst due to the rigid cell wall.

What are the Significance of Osmosis and diffusion?

- Guard cells undergo endo osmosis resulting in to opening of stomata.
- Root hair absorb soil water by endo osmosis where as Gaseous exchange takes place by diffusion.

Transport across Plasma membrane [Active Transport]

- It require energy
- ATP (Adenosine Tri Phosphate) is used as the source of Energy.
- **Endocytosis** – taking in of big particles which can not cross the plasma membrane.
- **Phagocytosis**- the process by which cells engulf solid food particles, also known as cell eating.(*Amoeba* takes in food by this process)
- **Pinocytosis** – The process by which cells take in liquid substances, commonly known as cell drinking.
- **Exocytosis** – it is the process of throwing out of the undigested food by the cell , commonly known as cell vomiting.

Cytoplasm

- The fluid part of the cell between the cell membrane and the nuclear membrane is called the cytoplasm.
- The cytoplasm consists of the matrix and specialized living structures called the organelles.
- The matrix is a transparent semi fluid substance.
- Cytoplasm act as a seat of many metabolic activities.It stores raw material.
- It also helps in distribution of nutrients and metabolites.
- Cytoplasm also shows circular movement called cyclosis, which helps in proper distribution of substances.

Q. Who coined the term protoplasm?

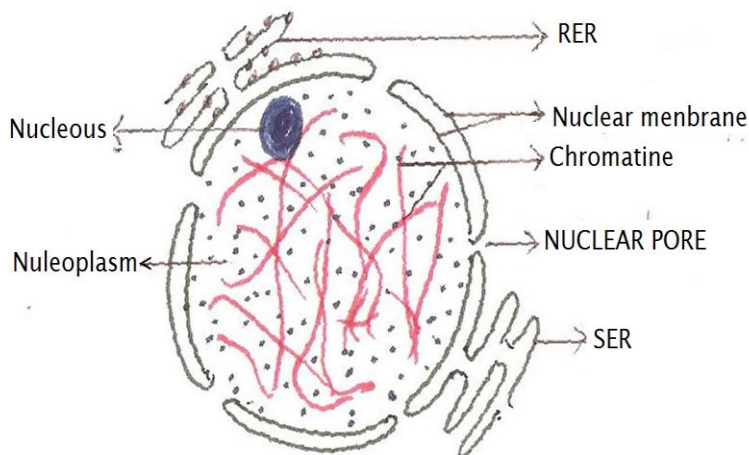
Ans : J.E. Purkinje

(Q.)What are cell organelles?

(Ans) Small components of the cell present in the protoplasm are called cell organelles e.g. itochondrion,Golgibodies and ribosomes etc.

Nucleus

- It is found in all eukaryotic cells except mature mammalian RBC, Sieve tubes and sieve cells.



- This is a prominent, spherical or oval structure found at the centre of the cell.
- Number of nucleus per cell is generally one but 2 in *Paramecium* (Binucleate), many in Skeletal muscle fibres (multinucleate)
- It is the controlling centre of all cell activities and has been called the brain of the cell.
- It regulates all metabolic and hereditary activities of the cell

The nucleus is composed of the following structures:

Nuclear membrane

- This is a double-layered membrane which separates the nucleoplasm from the cytoplasm.
- The nuclear membrane has minute pores which allow the selective transfer of material between the nucleoplasm and the cytoplasm.

Nucleoplasm

- Within the nuclear membrane, completely filling up the space,
- It is a clear, semi-solid, granular substance or matrix called the nucleoplasm.
- The nucleolus and the chromatin network lie suspended in the nucleoplasm.

Nucleolus

- This dense, spherical granule found in the nucleus contains RNA (ribonucleic acid) which is responsible for protein synthesis in the cytoplasm.

(Q.)Who discovered the nucleus in the cell?

Ans: Robert Brown in 1831 discovered the nucleus in the cell.

Chromatin network

- These are very fine thread-like, coiled filaments uniformly distributed in the nucleoplasm.
- At the time of cell division, the chromatin becomes thick and ribbon like and are known as chromosomes.
- The chromosomes contain genes, which are composed of DNA (deoxyribonucleic acid).
- Genes are responsible for storing and transmitting hereditary characteristics from one generation to another

(Q.)Where are chromosomes found in a cell? State their function.

Ans: Nucleus contains thread-like structures called chromosomes.

Function: Chromosomes carry genes and help in inheritance or transfer of characters from the parents to the offspring.

Cell Organelles

Cell-organelles are membrane bound structures found in cytoplasm, performing special functions.

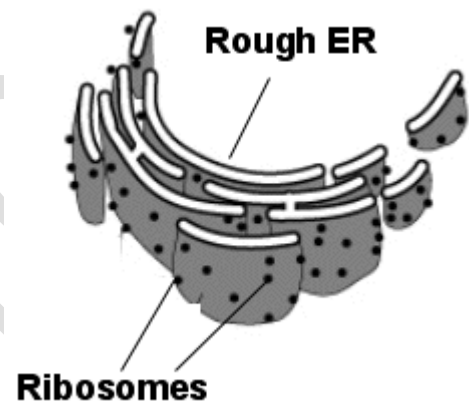
- Endoplasmic Reticulum (ER)
- Golgi Apparatus
- Mitochondria
- Plastids
- Lysosomes
- Ribosomes
- Centrosome

Endoplasmic Reticulum (ER)

This is a complex network of interconnected cisternae, tubules and vesicles, the lumen of which is filled with fluid.

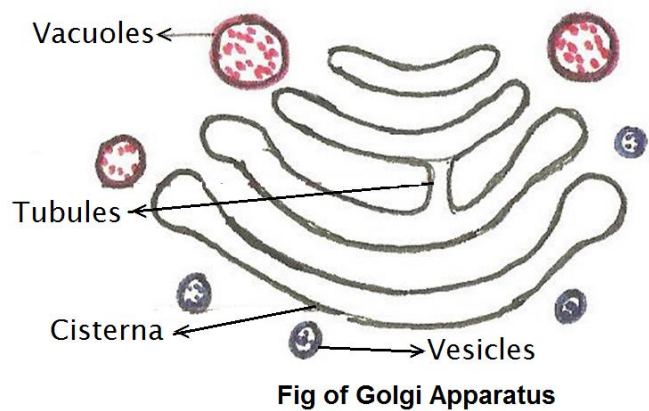
• Two types of endoplasmic reticulum are -

- **SER** - Tubes with a smooth surface are called smooth endoplasmic reticulum.
- SER mainly contains tubules.
- SER helps in synthesis / secretion of lipids, cholesterol, hormones like testosterone, progesterone etc.
- They also help in detoxification (removal of toxic substances like drugs etc)
- **RER** - Tubes with ribosomes attached are known as rough endoplasmic reticulum.
- RER mainly contains cisternae and vesicles
- The functions of the rough endoplasmic reticulum is to synthesize proteins
- They also help in transport of these proteins.
- ERs provide a pathway for the distribution of nuclear material from one cell to the other
- They also form the skeletal framework of the cell.



Golgi Apparatus

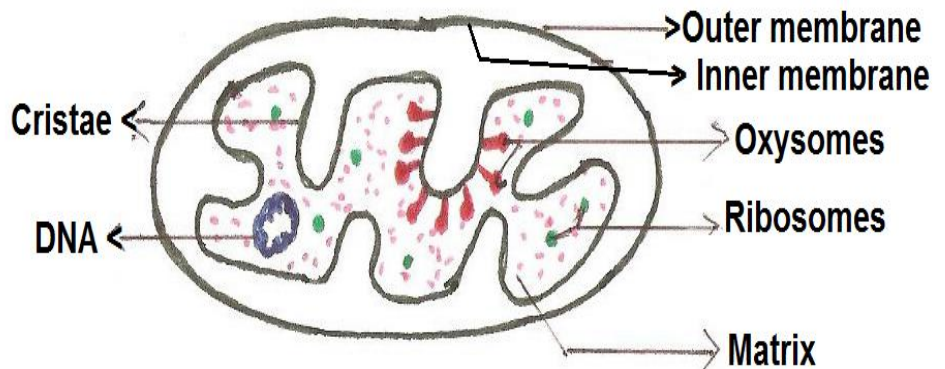
- Also known as Golgi Complex or Golgi Bodies, named after the scientist Camillo Golgi who discovered them.
- They consist of tiny, elongated, flattened sacs called cisternae, which are stacked parallel to one another along with some vacuoles and clusters of vesicles.
- The Golgi body is usually found close to the nucleus.
- The function of the Golgi Body is to secrete certain hormones and enzymes.
- It also forms lysosomes which contain digestive enzymes. (packaging of enzymes)
- They also help in yolk formation in eggs.
- They form the acrosome of the sperm.



Mitochondria

- They are found in all eukaryotes but absent in mature mammalian RBC and prokaryotes.
- These may be sausage shaped, cylindrical, rod-shaped or spherical and distributed in the cytoplasm.
- Each mitochondrion is bound by a double membrane.

- Outer membrane is smooth
- The inner membrane is folded into finger like structures called cristae, which increase the surface area of the membrane.
- On the crista are found knob like structures called Oxysomes which help in ATP synthesis.



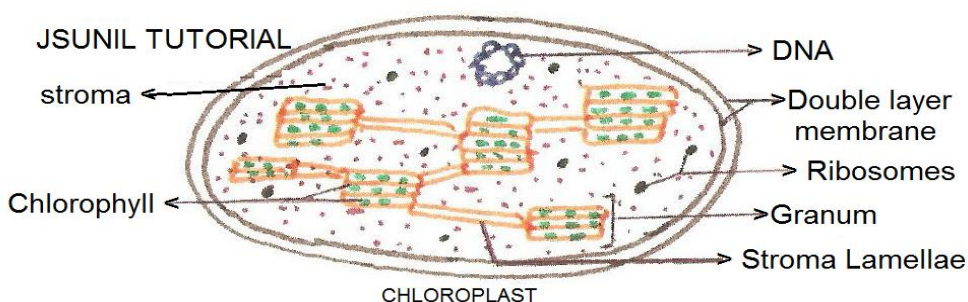
- In the mitochondria the sugar (glucose) is finally broken down during cellular respiration to release energy.
- The energy thus released is stored as high-energy chemicals called ATP
- The body cells use the energy stored in ATP for synthesis of new chemical compounds and other activities
- Hence, mitochondria are termed as the “power house” of the cell.

Plastids

- These organelles are found only in plant cells.
- Plastids are of three types

A) Chloroplasts

- They are green and found in leaves.
- The green colour is due to the presence of chlorophyll.
- They are double membrane structures,
- Matrix is called Stroma.
- In the stroma are membrane bound structures called thylakoids.
- These thylakoids are stacked to form a granum.
- Many grana are found in stroma and they are interconnected by stroma lamellae.
- Stroma also contains ribosomes and DNA so Chloroplasts are also called **Semi autonomous organelle**
- The function of the chloroplast is to trap solar energy for photosynthesis.
- They synthesize carbohydrate(glucose) by photosynthesis so called the kitchen of the cell.
- Light reaction of photosynthesis takes place in grana and dark reaction (Calvincycle) in stroma.



(Q.) Explain why chloroplasts are found only in plant cells?

Ans: Plants prepare their food by their own. Chloroplasts provide green colour (Chlorophyll) to leaves, which is essential to photosynthesis. Animals do not prepare their food by their own. That's why chloroplasts are found only in plant cells.

B) Chromoplasts

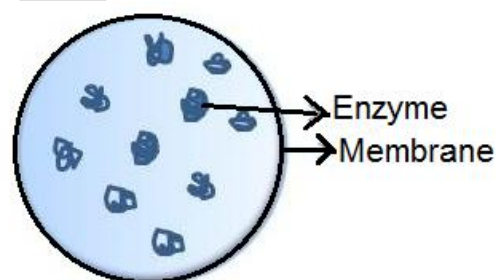
- They contain yellow, orange and red, and found in flowers and fruits.
- Chromoplasts impart colour to flowers to attract insects for pollination.

C) Leucoplasts

- They are colourless and found in roots, seeds and underground stems.
- Leucoplasts store food in the form of carbohydrates, fats and proteins.

Lysosomes

- These are tiny, spherical, sac-like structures scattered all over the cytoplasm.
- Their main function is digestion.
- They contain powerful digestive enzymes capable of digesting all organic material, and hence called "digestive bags".
- Lysosomes present in white blood cells are capable of digesting bacteria and viruses.
- During starvation, lysosomes digest proteins, fats and glycogen in the cytoplasm, and supply energy to the cell.
- They are also capable of digesting worn out cell organelles, or even digesting the entire damaged cell containing them. Hence, called "suicide bag".



Lysosome Structure

Ribosomes

- These are spherical, granular particles which occur freely in the matrix or remain attached to the rough endoplasmic reticulum.
- Ribosomes contain RNA (Ribosomal RNA) and proteins.
- Their function is synthesizing proteins so called "Protein factories" or "Engine of the cell".

Centriole

- The centriole is found **only in the animal cell**.
- This is found in the cytoplasm near the outer surface of the nucleus.
- The centrioles play an important role during cell division.

Vacuole

- Found in all eukaryotic cells
- Small and many in animal cells
- Big and few in plant cells
- Their membrane is known as tonoplast
- They are filled with cell sap (water, mineral, sugar etc)
- Food vacuoles store food. Contractile vacuoles help in osmoregulation (water balance)
- Vacuole Functions - storage + provide turgidity

(Q.)Name two-cell organelles, which have DNA apart from nucleus. Ans : (1) Plastids (2) Mitochondria

(Q.)Name the non - living parts of a cell.

Ans: 1.Cell wall (plants only) 2.Vacuoles 3.Granules (cell inclusions)

(Q.)What will happen if the organization of a cell is damaged due to certain physical or chemical reasons?

(Ans) When the organization of a cell gets damaged, Lysosomes will burst and their enzymes will eat up their own cell organelles. Therefore, Lysosomes are also known as the suicidal bags of the cell.

(Q.)Write any four differences between the plasma membrane and cell wall.

Plasma Membrane	Cell Wall
1. It is made up of lipids and protein.	1. It is made up of cellulose.
2. It is living.	2. It is dead.
3. Present in both plant and animal cell.	3. Found exclusively in plant cell.
4. It regulates entry and exit of molecules in and out of the cell.	4. Cell wall provides structural strength to the plants.

(Q.) Differentiate the terms: (i) Hypotonic (ii) Isotonic (iii) Hypertonic

(Ans) (i) If a medium surrounding the cell has a higher water concentration than that of the cell, the cell will gain water by osmosis. Such a solution is known as a hypotonic solution.

(ii) If a medium has exactly the same water concentration as that of the cell, there will be no net movement of water across the cell membrane. Such a solution is known as an isotonic solution.

(iii) If a medium has a lower concentration of water than the cell, meaning that it is a very concentrated solution, the cell will lose water by osmosis. Such a solution is known as a hypertonic solution.

(Q.)If the nucleus is removed from the cell what will happen to the cell?

(Ans) The cell will lose its control and fail to regulate the cellular activity and therefore it will not divide further.

(Q.)Write the main functions of a vacuole.

(Ans) It maintains osmotic pressure, thus helps in maintaining and regulating turgidity and flaccidity of the cell. It also is the site of storage of compounds and waste materials.

(Q.)How is cytoplasm different from nucleoplasm?

(Ans) CYTOPLASM	NUCLEOPLASM
1. It encloses nucleus and itself is bounded by cell membrane.	1. It is the space within the nuclear envelope
2. It contains cell organelles and cell inclusions.	2. It has transparent semi solid, granular substance or matrix called the Nucleoplasm.