

THE CELL

CONTENTS

- **Histroy**
- **Unicellular & Multicellular Organism**
- **Ultra Structure of Cell**

HISTORY

In 1665, Robert Hooke observed the cell in a cork slice with the help of a primitive microscope. He saw that cork resembled the structure of a honey comb consisting of many little compartments.

Robert Hooke called these boxes cells. Cell is a Latin word for 'little room.'

UNICELLULAR & MULTICELLULAR ORGANISM

All living organisms are made up of one or more cells. On the basis of cell number, organism are grouped into 2 categories -

◆ Unicellular organisms :

- Organism in which a single cell make the whole body. For example, Amoeba, Paramecium, bacteria & Chlamydomonas.

◆ Multicellular organism :

- Organism in which body contains more than one cell. For example - Plante, animals & fungi.

◆ Cell Size :

- The size of different cells ranges between broad limits.
- Some plants and animals cells are visible to the naked eye.
- Most cells are visible only with microscope.
- The prokaryotic cells usually range between 1 to 10 μm .
- The eukaryotic cells usually range between 10 to 100 μm .
- *Amoeba proteus* may reach a diameter of 0.5 mm.
- The smallest cells are those of *Mycoplasma laidlawii* (0.1 μ in diameter) or PPLO (pleuro pneumonia like organism).
- The largest cell is egg of an Ostrich.

◆ Cell Shape :

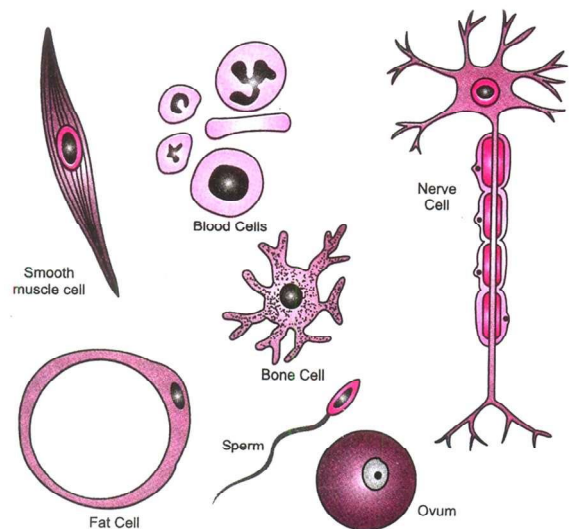


Figure : VARIOUS CELLS FROM THE HUMAN BODY

- The shape of cell may be variable or fixed.
- Variable shape occur in *Amoeba*, WBC etc.
- Fixed shape occur in most plant and animals.
- Cells may be diverse shapes such as polyhedral (8, 12 or 14 sides) spherical (e.g. eggs of mainly animals), spindle shaped (Smooth muscle fibres), elongated (e.g. Nerves cells) so on.

▶ ULTRA STRUCTURE OF CELLS

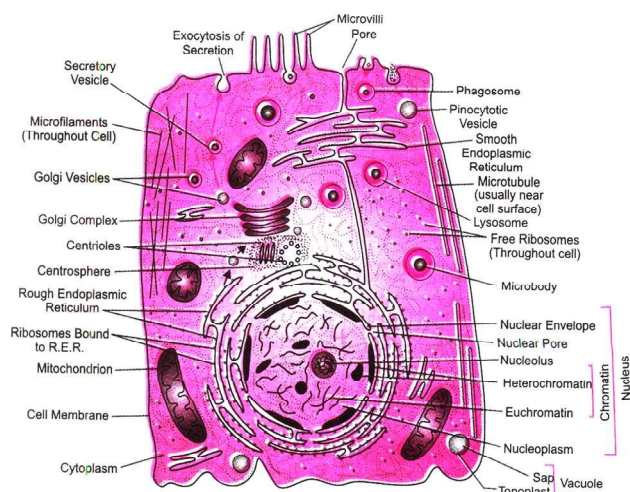


Figure : AN ANIMAL CELLS AS SHOWN BY AN ELECTRON MICROSCOPE. THIS MICROSCOPE MAGNIFIES THE OBJECTS 600,000 TIMES.

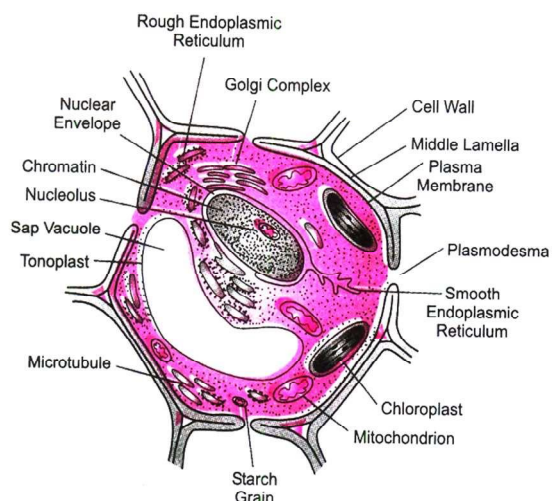


Figure : A PLANT CELL AS SHOWN BY AN ELECTRON MICROSCOPE

◆ Plasma Membrane :

Introduction :

- Cell surface in all the cells is enclosed by a living membrane which is called cell membrane by **C. Nageli** and **C. Kramer** (1855).

Historical Account :

- **J.Q. Plower** (1931) coined the term **Plasmalemma** for cell membrane.

Ultrastructure :

- *Plasma membrane* forms outer covering of each cell.
- It is present in both plant and animal cells.
- Plasma membrane is a living, thin, delicate elastic, selectively permeable membrane.
- It separates contents of a cell from the surrounding medium.

◆ Fluid Mosaic Model :

- In 1972, **Singer Nicolson** proposed this model. According to this, cell membrane consists-two layers of phospholipid molecules, phospholipid & protein molecules are arranged as a mosaic.
- Phospholipid molecules have their polar heads directed outward non polar tail pointing inward.
- The proteins are of **two types** :
- Peripheral and integral. Peripheral proteins are located superficially while integral proteins are embedded in the phospholipid matrix. The protein monolayer have elasticity & mechanical support to the lipid matrix.

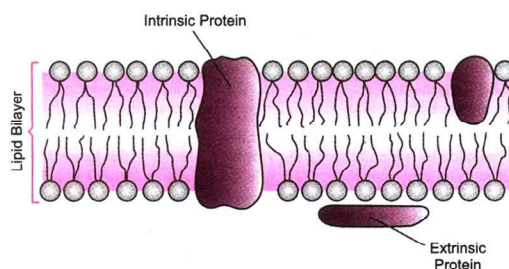


Figure : STRUCTURAL DETAIL OF PLASMA MEMBRANE ACCORDING TO FLUID MOSAIC MODEL

📄◆ **Functions of Plasma Membrane :**

- The main function of plasma membrane is to regulate the movement of molecules inside and outside the cell.
- It allow the movement of gaseous substance from high concentration to low concentration which known as diffusion.
- Water also obeys the law of diffusion . The movement of water molecule through a selectively permeable membrane is called osmosis.
- The flexibility of cell membrane also enables the cell to engulf in food, which is also known as endocytosis. For example – in Amoeba

◆ **Cell wall :**

- In plants, one another rigid is called 'Cell wall'. It is made up of cellulose which provide structural strength to plant.

◆ **Function of cell wall :**

- It maintains the shape of cell.
- It protect the cells from mechanical injury & prevents their desiccation.
- It provide mechanical support against gravity. It is due to rigid cell walls that the aerial part of plant are able to keep erect & expose their leaves to sunlight.
- Cell walls permit the cells to with stand very dilute external media without bursting.

◆ **Nucleus :**

- It is the most important part of cell which control all the activities of cell.

◆ **Structure of Nucleus :**

- The nucleus has a double layered covering called nuclear membrane.
- The nuclear membrane has pores inside the nucleus to its outside, that is, to the cytoplasm.
- The nucleus contains chromosomes, which are visible as rod-shaped structures only when the cell is about to divide.

- Chromosomes are composed of DNA and protein.
- Functional segments of DNA are called genes.
- In a cell which is not dividing, this DNA is present as part of chromatin material.

◆ **Function of nucleus :**

- It play a important role in cellular reproduction.
- DNA contain the information necessary for constructing & organizing cells.
- Nucleoid - In some organisms nuclear region of cell may be poorly defined due to the absence of nuclear membrane. Such an undefined nuclear region called nucleoid.

Note :

- **Prokaryotic cell** - Cell which do not have well defined nuclear region . called prokaryotic cells.
Pro - Primitive
Karyon - nucleus
- **Eukaryotic cells** - Cells which have well defined nuclear region, called eukaryotic cells.
- Along with nucleus membrane, prokaryotic cells lack most of cell organells.

◆ **Cytoplasm :**

- The fluid & semifluid matrix of a cell between the nucleus & the plasma membrane, containing various organelles is called cytoplasm.

◆ **Cell organelles :**

- Small membrane bound structures, which perform a lot of chemical activities to support the function & structure of a cell, called cell organelles -
- Some important cell organelles are following -

◆ **Endoplasmic Reticulum :**

- The endoplasmic reticulum (ER) is noticeable only with an electron microscope.

◆ Structure :

- The ER is an extensive network of intracellular membrane-bound tubes and that occupies most of the cytoplasm in almost all eukaryotic cells. The membranes of this system are lipoprotein in nature similar in structure to the plasma membrane. The ER is more prominent in young and dividing cells as compared to older cells. It is absent in prokaryotic cells.

◆ Types. The ER is of two types :

- **Rough endoplasmic reticulum (RER)**
- **Smooth endoplasmic reticulum (SER)**
- **Rough Endoplasmic reticulum (RER).** These appear rough under a microscope because of the presence of a large number of grain-like ribosomes over their cytoplasmic surface. The ribosomes are the sites of protein synthesis. Thus, RER is engaged in the synthesis and transport of proteins. Generally, RER is more abundant in the deeper part of cytoplasm near the nucleus where it is connected with the outer membrane of the nuclear envelope. RER is well developed in the cells that synthesize and secrete proteins.
- **Smooth Endoplasmic Reticulum (SER).** It consists mainly of tubules and vesicles. It is free of ribosomes and is more abundant near the peripheral part of the cytoplasm where it may be attached to the plasma membrane. The SER helps in the synthesis of fat or lipid molecules. It is, therefore, well developed in the cells that secrete lipids.

◆ Functions :

- **Support.** The ER acts as supporting skeletal framework of the cell and also maintains its form.
- **Transport of materials.** The ER facilitates transport of materials from one part of the cell to another.
- **Exchange of materials.** The ER helps in the exchange of materials between the cytoplasm and the nucleus.

- **Localization of organelles.** It keeps the cell organelles properly stationed and distributed in relation synthesis.
- **Surface for protein synthesis.** The RER offers extensive surface on which ribosomes carry protein synthesis.
- **Surface for synthesis of other substances.** The SER provides surface for the synthesis of lipids including phospholipids, cholesterol and steroid hormones.
- **Packaging.** The proteins formed on ribosomes pass into ER lumen where they are modified. Then, the modified proteins move into the transitional area where the ER buds off transport vesicles carrying the proteins to the Golgi apparatus. Here, they are further processed and packaged into secretory vesicle for export by exocytosis at the plasma membrane. Examples of secretory proteins include, mucus, digestive enzymes and hormones.
- **Detoxification.** The SER brings about detoxification in the liver, i.e., it converts harmful materials (drugs, insecticides, pollutants and poisons) into harmless substances for excretion by the cell.
- **Formation of organelles.** The SER produces Golgi apparatus, lysosomes and vacuoles.
- **Membrane formation.** Plasma membrane and other cellular membranes are formed by ER.

◆ Golgi Complex :

Introduction :

- Golgi bodies are absent in prokaryotic cells. Golgi complex is found in all eukaryotic cells except RBCs.

Historical Account :

- **Camillo Golgi** (1898), a zoologist, observed Golgi bodies in the form of a network in nerve cells of barn owl.

Ultrastructure :

- It is also called **Golgi complex** or **Golgi apparatus** or **Dictyosome** (in plants cell).

- It is made up of cisternae.
- Golgi bodies are interconnected with the tubules.

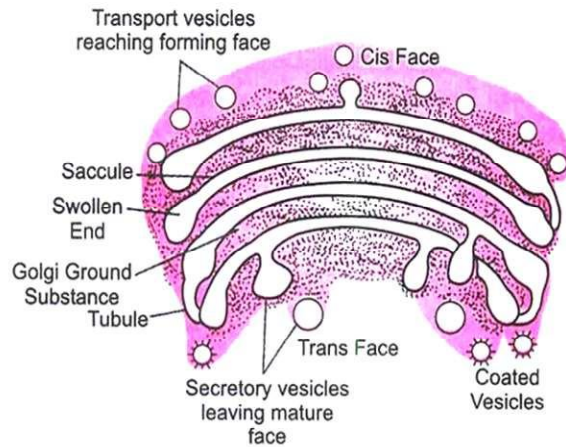


Figure : GOLGI APPARATUS IN SECTION

◆ Functions of Golgi Apparatus :

- The main function of Golgi apparatus is secretory.
- It produces vacuoles or secretory vesicles which contain cellular secretions like enzymes, proteins, cellulose etc.
- Golgi apparatus is also involved in the synthesis of cell wall, plasma membrane and lysosomes.

◆ Lysosomes :

Introduction :

- Lysosomes are generally found in the cytoplasm of animal cells. Lysosomes exhibit polymorphism.

Historical Account :

- The term **lysosome** was introduced by **De Duve** in 1955.

Ultrastructure :

- It is also called **demolition squads, scavengers, cellular house keepers and suicidal bags**.
- Lysosome are simple tiny spherical sac like structures evenly distributed in the cytoplasm.
- Lysosome is small vesicle surrounded by a **single membrane** and contains powerful enzymes.

◆ Functions of Lysosomes :

- Lysosomes serve as intracellular digestive system, hence called **digestive bags**.
- Lysosomes also remove the worn out and poorly working cellular organelles by digesting them to make way for their new replacement.

◆ Mitochondria :

Introduction :

- A single mitochondrion is present in unicellular green alga, *Microsterias*. Number of mitochondria varies from **50–50,000** per cell. Mitochondria of a cell are collectively known as **chondriome**.

Historical Account :

- **C. Benda** (1897) gave the name Mitochondria (Mitos, thread + Chondrion, granules).
- Term 'Bioplast' for mitochondria was used by **Altman**.

Ultrastructure :

- Mitochondria are rod shaped organelles, bounded by a double membrane envelope.
- The outer membrane is smooth, the inner membrane surrounds a central cavity of **matrix**. Central cavity is filled with gel like substances

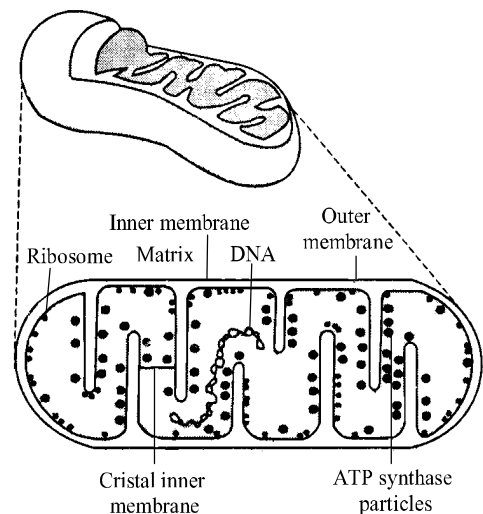


Figure : MITOCHONDRIA

- Inner membranes folds are called cristae, these folding are tubular and called **microvilli**.
- Mitochondria contain electron transport systems aggregated into compact structure. **F₁ particles or oxysome**, tennis racket like bodies on inner membrane involved in oxidation & phosphorylation.
- Kreb's cycle occurs in mitochondria.
- Each particle is made up of base, stalk and head.

◆ **Functions of Mitochondria :**

- Mitochondria are called **power plants** or **power houses** or **cellular furnaces**.
- Synthesis of ATP (**Adenosine Tri-phosphate**) in mitochondria is called **oxidative phosphorylation**.
- Mitochondria as place of cellular respiration was first observed by **Hogeboom**.

◆ **Plastids :**

Introduction :

- Plastids are organelles enclosed by a double membrane found in all plants.

Historical Account :

- **E.Heckel** (1865) gave the term plastid. Plastids are largest cell organelles.

Ultrastructure :

- Plastids occur in most plant cells and are absent in animal cells.

- Plastids are self replicating organelles like mitochondria i.e. they have the power to divide.
- **Schimper** divided plastids into three types :
 - (a) **Chromoplast** - Coloured plastids (except green colour)
 - (b) **Chloroplast** - Green coloured plastids
 - (c) **Leucoplast** - Colourless plastid.
- Plastids also have double membrane but no cristae.

◆ **Functions of Plastids :**

- Chloroplasts trap solar energy and utilized it to manufacture food for the plant.
- Chromoplast impart various colour of flower to attract insect for pollination.

◆ **Vacuoles :**

- Vacuoles are storage sacs for solid or liquid contents. Vacuoles are small sized in animal cells while plant cells have very large vacuoles. The central vacuole of some plant cells may occupy 50-90% of the cell volume.

◆ **Function :**

Vacuoles perform following functions :

- They are storage sacs of the cell. The stored material may be solid or liquid food or toxic metabolic by-products or end products of cells.
- In some unicellular organisms, specialized vacuoles maintain water balance of the body (osmoregulation).
- In plants, they provide turgidity and rigidity to the cells.