

The Fundamental Unit of Life

Cell is the basic structural and functional unit of living organisms.

Cell biology /cytology is the study of cells.

History of cell:-

- In 1665, **Robert hook** discovered the cell.
- In 1674, **Anton von leeuwenhoek** discovered the free living cells in ponds water.
- **Robert Brown** discovered the nucleus in the cell.
- **Purkinje** coined the term 'protoplasm' for the fluid content of the cell.
- **Schleiden** and **Schwann** proposed the cell theory.
- In 1855, **Rudolf Virchow** said that all cells arise from pre – existing cells.
(Omnis cellula- e- cellula)

Types of cell:-

On the basis of nuclear organization

Prokaryotic cell:- Single celled that lack nuclear membrane.

Eukaryotic cell:- Cell have a well defined nuclear membrane.

Cell- Shape:- Most cells have a definite shape

Ex: Muscles cell – Spindle shape, RBC- Oval, Nerve cell-Elongated

Some cells of may not have any definite shape.

Ex: Amoeba ,Leucocytes

Size:-Smallest cell- Mycoplasm (0.1 to 0.5 micrometre)

Some cells are 0.5 mm to 100cm in size.

Structural organization of a cell

Cell have three major functional regions:Cell membrane or plasma membrane, nucleus and cytoplasm

Plasma membrane (PM):-

*Outermost covering of the cell which separates the contents of cell from its external environment.

*Made up of organic molecules called lipids molecules and protein molecules

*PM is selectively membrane, i.e ; it allows entry and exit of only selected substances.

*Bounds the semi fluid content of the cells.

*Protects the cell from injury.

Process by which movement of substance occurs:-

Diffusion:- The movement of molecules of a substance from a region of their higher concentration to a region of lower concentration.

Importance:-

- Exchange of gases between the cells as well as between the cell and its outside environment
- Transpiration
- Aroma of flowers

Osmosis:- The movement of water molecules from a region of high water concentration through a semi permeable membrane to a region of low water concentration.

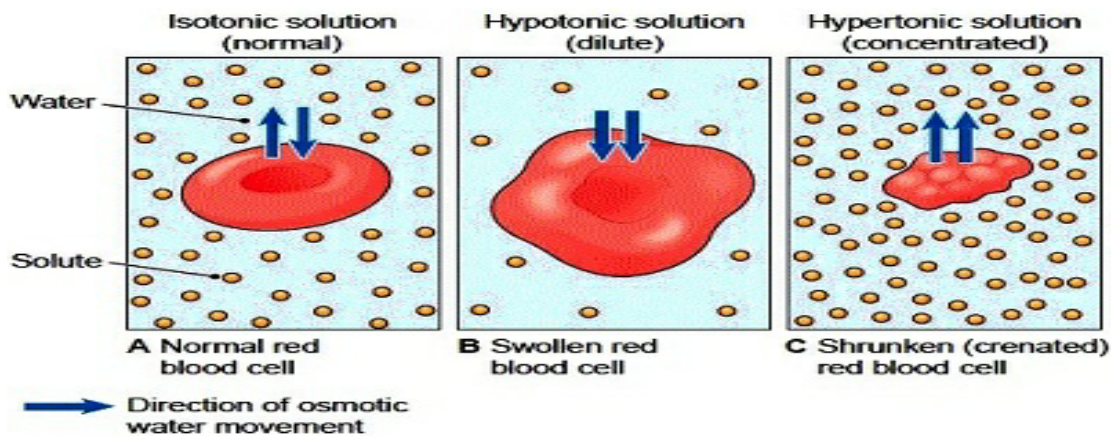
Importance:-

- Entry of soil water into root
- Cell to cell movement of water
- Living cells remain turgid
- Opening and closing of stomata

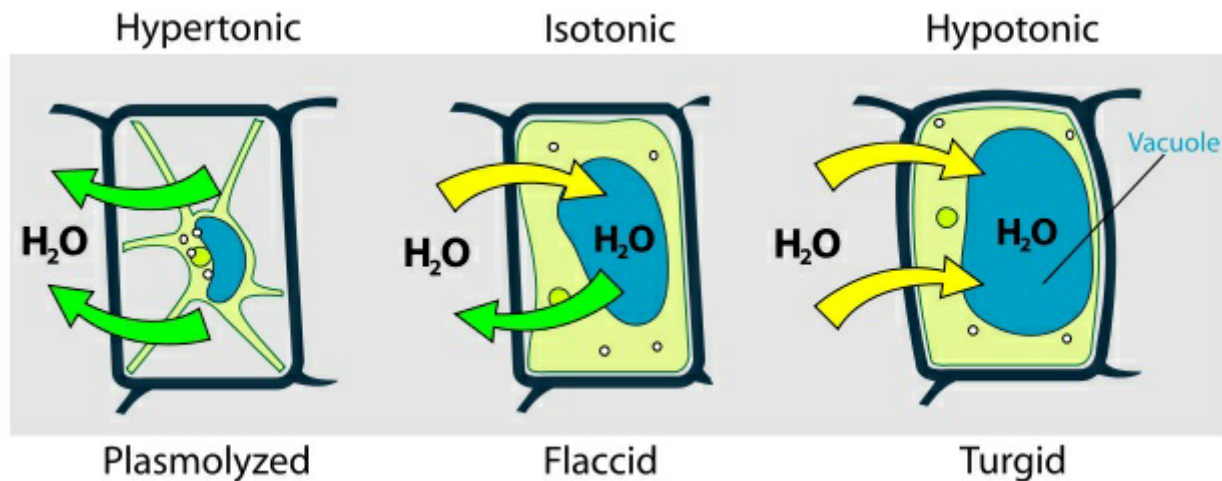
Types of solution and their effect on cell

Isotonic(Iso-Same)	Hypertonic(Hyper-Higher)	Hypotonic(Hypo-Lower)
Concentration of water on either side of PM is the same	The outside solution has higher solute concentration than inside the cell	The outside solution has lower solute concentration than inside the cell

No movement of water	Water molecule move from inside to outside of the cell(Exosmosis)	Water molecule move from outside to inside of the cell(Endosmosis)
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Plasmolysis:- Shrinkage of the protoplast(cell content) of a cell from its cell wall under the influence of a hypertonic solution.



Cell Wall:- It is an outer, rigid, protective, supportive and semi transparent covering of plant cells only. It is made up of cellulose.

Function:-

- Provides a definite shape to the cell
- Protects PM and internal structures from the attack of pathogen and mechanical injury
- Provides rigidity to the cell

Nucleus:-

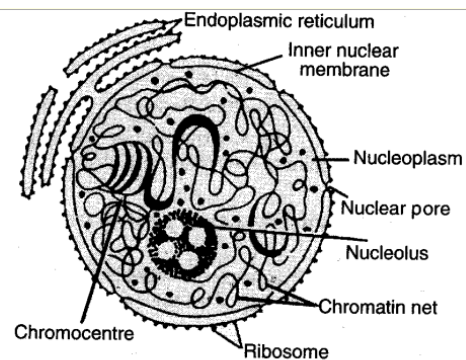
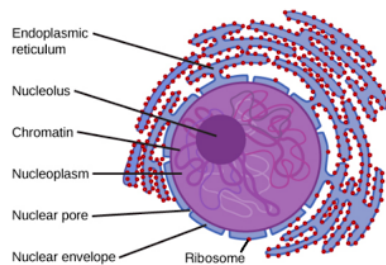


Fig. Eukaryotic nucleus

A dense, centrally located spherical cellular component. The nucleus contains:

Nuclear envelope:- It is a double membraned structure, and contains a large number of pores. The nuclear pores controls the transfer of substances from inside the nucleus to its outside, i.e. to cytoplasm.

Nucleoplasm:- It is transparent , semi –fluid and contains a large number of enzymes which are required for synthesis and functioning of DNA, RNA, etc.

Chromatin network:-Chromatin is thread like structures which condense and form chromosome. Chromosome are composed of DNA molecules and proteins

Nucleolus:-Dense ,round structure attached to a chromatin fibre at specific region.It is rich in RNA and protein molecules.

Functions:-

- The nucleus controls cell metabolism and other activities of the cell.
- Nucleus plays a central role in cellular reproduction.
- It is concerned with the transmission of hereditary traits from parent to offspring.

Cytoplasm(Cytosol):- The space between the plasma membrane and the nucleus is filled by a homogeneous , translucent , colloidal liquid called cytoplasm. It consist of various inorganic molecules , such as water, salts, organic compounds, proteins, nucleic acids, and a variety of enzymes.

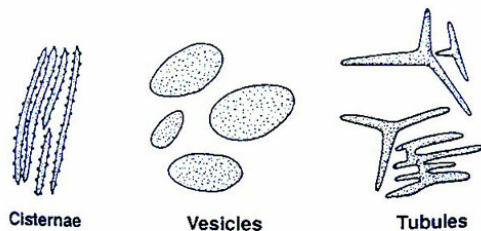
Functions:-

- It helps in intracellular distribution of molecules , enzymes and nutrients.
- It helps in exchange of materials between different cell organelles.
- Biosynthesis of nucleotides, proteins and fatty acids take place in the cytoplasm.
- Breaking down of glucose take place in the cytoplasm.

****** Protoplasm is the living component of the cell containing cytoplasm and the nucleus in a living cell.**

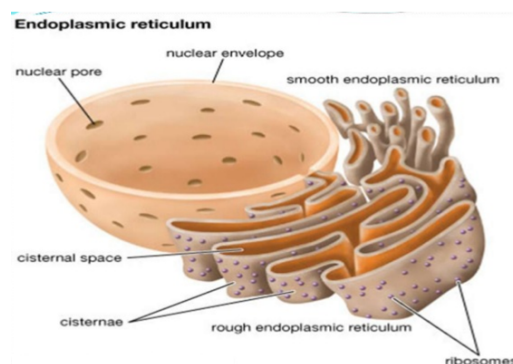
*******Cell organelles are “small organs” of the cell and are found embedded in the cytosol. They form living part of the cell and each of them has a definite shape , structure and function.**

Endoplasmic Reticulum(ER):-ER is an interconnected network of membrane – lined tubes and sheets that run through the cytoplasm. ER occurs in three forms : cisternae (Closed fluid- filled sacs), vesicles and tubules.



Various Morphological forms of Endoplasmic Reticulum

ER is absent in the red blood cells of mammal.



Types of ER:-

Rough ER:-Ribosomes attached on its surface for synthesizing proteins. RER is very well developed in plasma cells, fibroblasts, goblet cells etc.

Smooth ER:- Ribosomes are absent and is meant for secreting lipids. SER is found in liver cells, interstitial cells, adipose cells, muscle cells, etc.

Function:-

- ER gives rigidity to cell and acts as a skeletal framework of cell.
- ER provides a pathway for the distribution of materials from one cell to the other as well as between the cytoplasm as well as the nucleus.
- SER plays an important role in the biosynthesis of glycolipids, phospholipids, and cholesterol which are used in the formation of plasma membrane.
- RER is responsible for the formation of proteins. Lipids together with some proteins help in the formation of PM through a process known as membrane biogenesis.
- SER of liver of vertebrates helps in **detoxification**.

Ribosomes:- Dense, spherical and granular particles. Ribosome consist of ribonucleic acid and proteins. Ribosome is absent in mature sperm and RBCs. They are also found in the mitochondria and plastids.

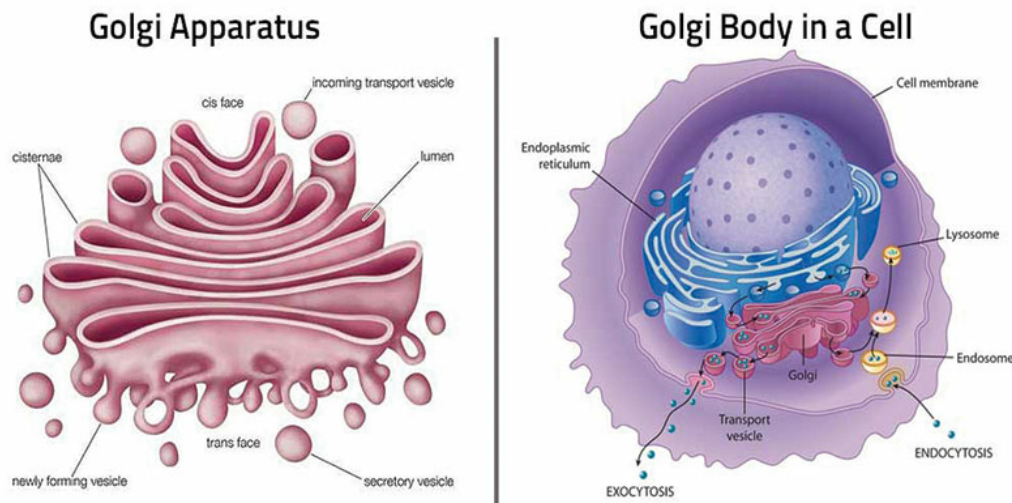
In prokaryotic cell, they freely occur in cytoplasm.

In eukaryotic cells, they occur freely in the cytoplasm as well as attached to the outer surface of RER.

Function:- Help in protein in synthesis.

Golgi Apparatus:- Discovered by Camillo Golgi. Golgi apparatus is absent in bacteria, blue green algae, mature sperms & RBC of mammal and other animals.

Golgi apparatus consists of a set of membrane -bound ed, fluid filled vesicles, vacuoles and flattened cisternae.



Golgi apparatus exists as an extensive network near the nucleus in the animal cells. In plant cells, golgi apparatus also consists of many freely scattered sub units called dictyosomes.

Function:-

- Helps in the storage, processing and packaging of various cellular secretions.
- Helps in secretion of enzymes , proteins, cellulose, hormones etc.
- Helps in formation of lysosomes.

Lysosomes:- Lysosomes are simple tiny spherical sac like structures evenly distributed in the cytoplasm. Each lysosome is a small vesicle surrounded by a single membrane and contains powerful enzymes. These enzymes are capable of digesting or breaking down all organic materials. Lysosomal enzymes are made by RER.

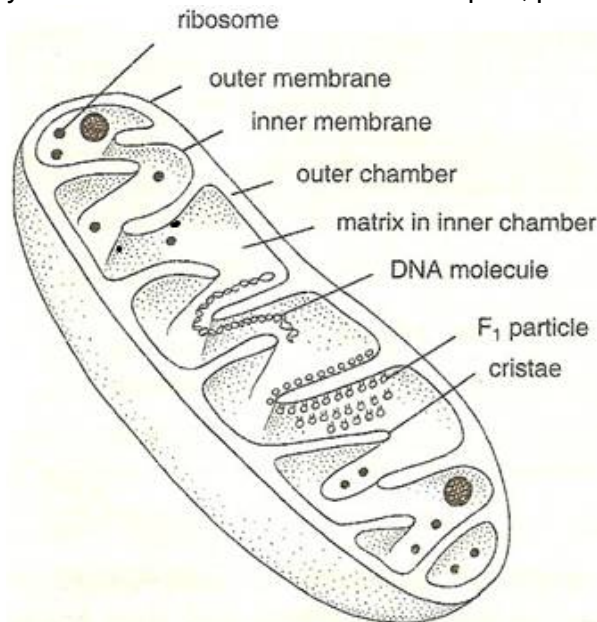
Function:-

- Help in intracellular digestion.
- Provide energy during starvation by controlled breakdown of stored food.
- Help in waste disposal from the cell.
- In case the cell get damaged, lysosomes burst and release the enzymes , which digest their own cell. Hence, they are called suicide bags of the cell.

Mitochondria:- Mitochondria are sausage shaped cell organelles covered by a double membrane envelope. Outer membrane is smooth and porous, while inner membrane is given out into folds called cristae. These folds create a large surface area for the generation of ATP(Adenosine

triphosphate) during respiration. Mitochondria release energy in the form of ATP molecules. Mitochondria are also known as the power houses of the cell.

The cavity of the mitochondria is filled with lipids, proteins, circular DNA and ribosomes.



Function:-

Mitochondria are sites of cellular respiration.

Mitochondria are able to make some of their own proteins; so, they are regarded as **semi autonomous** organelles. (The organelle which contains their own DNA and reproduce independently of the nucleus)

Plastids: Plastids occur in most plant cells. Plastids contain many membrane layers embedded in a material called the stroma. Plastids also have their own DNA & ribosomes.

There are three types of plastids:-

Chromoplast (coloured plastid) :- provide colour to flowers and fruits.

Leucoplast (colourless plastid) :- Store starch, oils and protein granules.

Chloroplast (Green plastid) :- Chloroplast has a colourless ground matrix, stroma and a membranous system, grana. Each granum has membrane-bound sacs called thylakoids. Thylakoids of chloroplast possess photosynthetic green pigment, i.e., chlorophyll. Stroma contains a variety of photosynthetic enzymes, starch grain, DNA & ribosome.

During photosynthesis, light reaction takes place in granum and dark reaction takes place in stroma.

Function:-

- Chloroplast- photosynthesis
- Chromoplast- Pollination
- Leucoplast- Storage

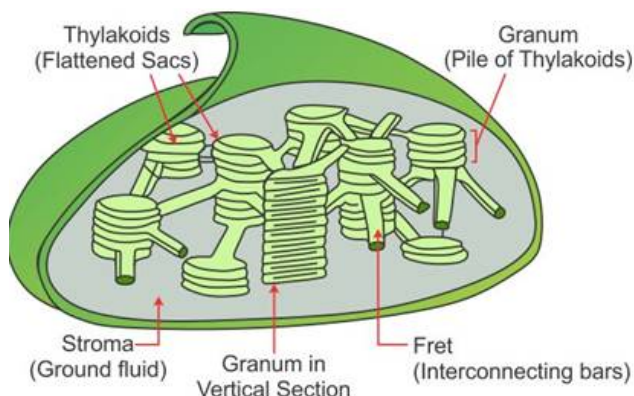


Diagram of chloroplast

Vacuoles: These are fluid-filled membrane-bound spaces. Vacuoles are storage sacs for liquid or solid contents. They are bound by a membrane known as tonoplast.

In animal cell, vacuole stores water, glycogen and proteins

In protozoa, vacuole stores ingested food, digests and helps in excretion

In plant cell, vacuole is filled with cell sap which is a watery solution rich in sugars, amino acids, proteins, minerals and metabolic waste.

Function:-

- Help to maintain the osmotic pressure in a cell.
 - Provide turgidity & rigidity to the plant cell.
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- ❖ Peroxisomes are small single membrane spherical cell organelles containing powerful oxidative enzymes.
 - ❖ Centrosomes consist of two small granules called centriole. Present only in animal cell. Help in spindle formation during cell division.

