

STRUCTURE AND FUNCTIONS OF CELL AND ITS ORGANELLES

BY

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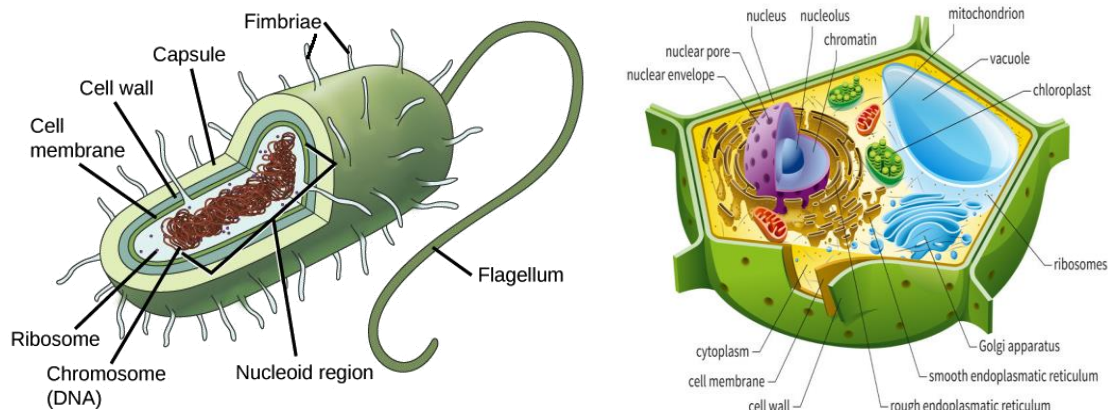
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HISTORY: ♣

1. Robert Hooke (1665)- First observed presence of cell in piece of cork.
2. Anton von Leeuwenhoek (1675) – First observed living cells through his own made microscope.
3. Robert Brown (1831)- Observed Nucleus in the protoplasts of all cells.
4. M.J. Schleiden (1838) and Theodor Schwann (1839) - proposed CELL THEORY It explains that 1. Cell is the structural unit 2. Cell is the functional unit and 3. All the biochemical reactions occur within the cell in any organism.
5. J.E. Purkinje (1839)- Coined the term protoplasm to the gelatinous fluid found in living cells.
6. Hugo von Mohl (1846) - redefined the term protoplasm as a tough, slimy, glandular semi fluid substance within cell.
7. Rudolf Virchow (1855)- proposed Cell line Age theory (Omnis cellula e cellula) i.e. All living cells arise only from pre-existing cells.
8. Hanstein (1880)- called cell without cell wall is protoplast.
9. Fleming (1882) in described somatic cell division and applied the term Mitosis, and Strasburger (1882) described mitosis in plant cell and coined the terms cytoplasm and nucleoplasm.

Based on the presence or absence of the nucleus, all the living organisms were classified into two types viz. Prokaryote(Bacteria, Mycoplasma, Cyanibacteria, PPLO's) and Eukaryotes (Protist, Fungi, Plants, Animals).



Prokaryotic Cell

Eukaryotic Cell

Prokaryotic cell	Eukaryotic cell
1. Naked circular DNA is present. No histone proteins. No chromosomes and also no nuclear envelope.	1. DNA is present in chromosomes which are enveloped with nuclear membrane.
2. Cell wall made up of Muramic acid and Diaminopimilic acid.	2. Cell wall made up of cellulose, hemicellulose, pectin.
3. Membrane bound	3. Membrane bound organelles absent. organelles (Mitochondria, chloroplast etc.,) present.
4. 70s ribosomes present.	4. 80s ribosomes present.
5. Reserve food material is poly β -hydroxybuterate.	5. Reserve food materials or starch or glycogen.
6. Respiratory enzymes are attached to plasma membrane.	6. Respiratory enzymes are in mitochondria.
7. Cell division takes place through binary fission.	7. Cell division takes place through mitosis.

Structure of Plant Cell:

1. Plant cell was discovered by Robert Hooke.
2. Components of cell wall A) Matrix: 30-60% water, 2-8% pectin, 5-15% hemicellulose, 1- 2% glycoprotein and 0.5-3% lipid. B) Fiber: Mainly composed of cellulose.
3. Living cells consists two parts in it i.e. Middle lamellae and Primary cell wall. Whereas xylem and sclerenchyma (dead cells) consists secondary wall also.
4. Middle lamellae: It is chemically composed of calcium pectate and small amount of magnesium pectate.
5. Primary wall has elastic nature due to loosely arrangement of cellulosic fibers in matrix. 6. Secondary wall consists lignin, suberin thickenings. It has S1-S3 layers.

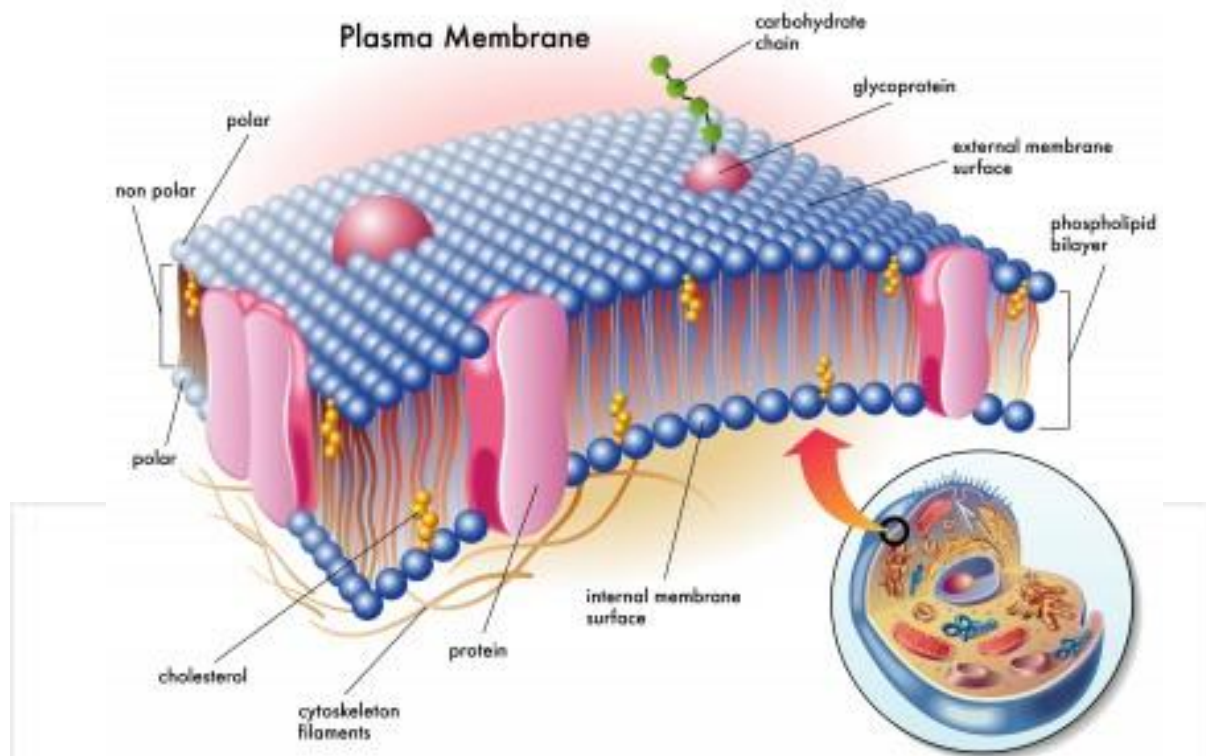
FUNCTIONS: –

It gives definite shape to the cell. –It protects protoplast. –It allows transport of water and minerals.

Cell Membrane or Plasma Membrane:

Structure:

1. Protoplasm of all cells surrounded by cell membrane also called as plasma membrane or plasmalemma.
2. It is chemically composed of phospholipids, proteins and carbohydrates.
3. Singer and Nicholson proposed fluid mosaic model to explain the semi-permeability nature of cell membrane.



FUNCTIONS:

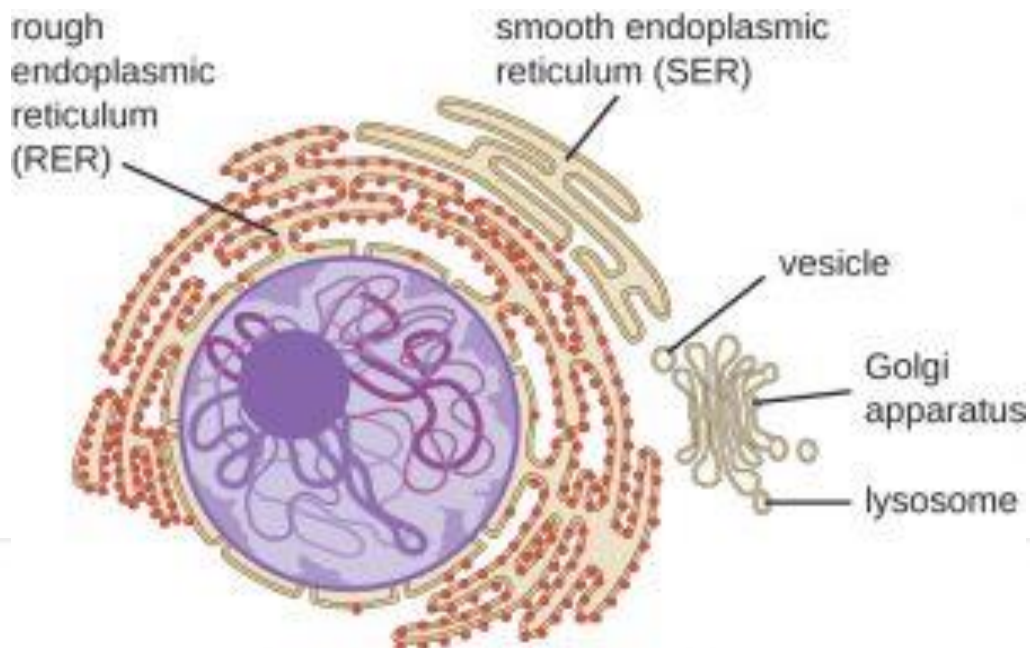
1. Protects protoplasm of the cell.
2. It freely allows water, whereas other materials are selectively permeable.
3. There are two types of transport. A. Passive Transport. B. Active transport.
4. Endocytosis and Exocytosis also takes place.

Cytoplasm-Structure:

1. The space between the plasma membrane and the nucleus is filled by cytoplasm. It is amorphous, translucent, homogeneous colloquid.
2. It is semi-liquid state. It composed of water (65%), protein (18%), Fat(10%), carbohydrate (5%), other organic (1%) and inorganic (1%) compounds.
3. All biochemical reactions takes place here. 4. It is composed of matrix and organelles.

Endoplasmic Reticulum:

1. It was discovered by Albert Claude and Keith Porter (1945).
2. It extends from nuclear membrane to plasma membrane.
3. There are two types of ER. 1. Rough ER. 2. Smooth ER.
4. Rough ER: It consists ribosomes on it's surface.
5. Smooth ER: It doesn't consists ribosomes on its surface. 6. It is composed of flattened cisternae.



Endoplasmic reticulum

Functions:

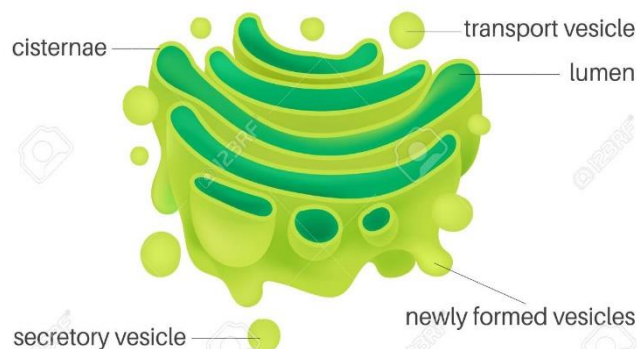
Major part of the cytoskeleton.

1. On Rough ER manufacturing of proteins takes place along with the ribosomes. RER involves in post-translational modification such as glycosylation.
2. Smooth ER is supposed for the synthesis of lipids, especially those to be used in making membranes. It is the site of detoxification.
3. Vesicles from these membranes transport to the golgi apparatus.
4. Golgi complex and lysosomes are made from ER.

Golgi apparatus:

1. It was first discovered by Camillo Golgi (1898). It is also called as dictyosomes.
2. The major parts of the Golgi complex are cisternae, tubules, vesicles.
3. The cisternae have a distinct convex 'cis' (forming face) and concave 'trans'(maturing face).

Golgi apparatus

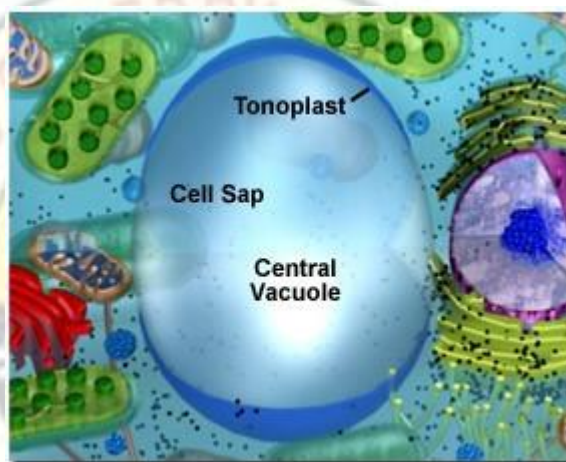


FUNCTIONS:

1. Modification and synthesis of the carbohydrate component of glycoproteins and glycolipids takes place.
2. The Golgi apparatus uses cisternae to modify proteins and lipids that built in the ER and export through its trans face to the outside of the cell or to another organelle or it may undergo maturation to become lysosomes.
3. In plant cell it manufactures pectins and other polysaccharides for the formation of cell wall.

Vacuole:

1. Young plant cell consists numerous small vacuoles, whereas mature cell consists a single big central vacuole.
2. It is filled with cell sap.
3. It is bound by single membrane called tonoplast.

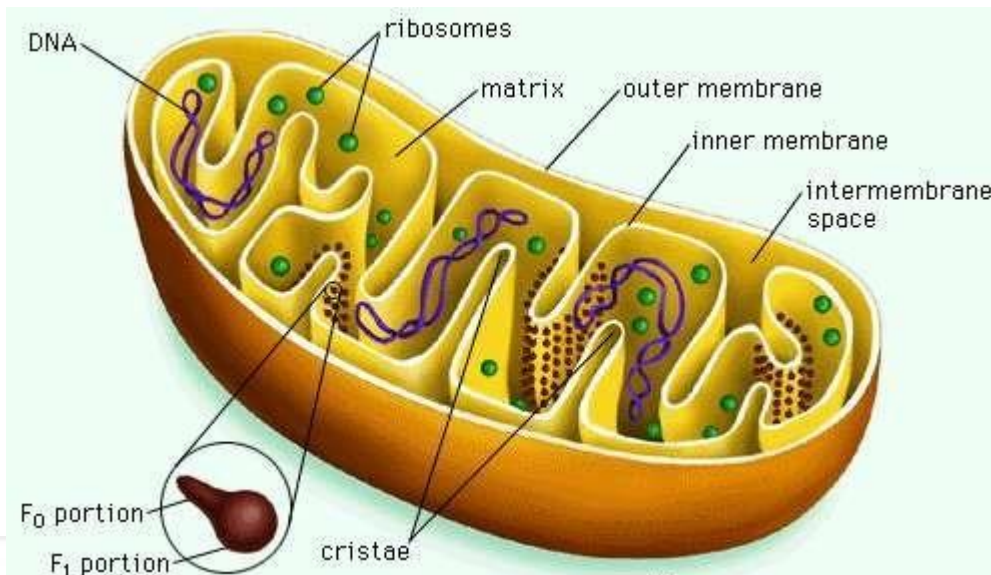


FUNCTIONS:

1. It is filled with fluid containing mineral salts, sugars, amino acids, proteins, waste products and water soluble anthocyanin pigments.
2. They often store toxic compounds(Secondary metabolites). It is used for the plant's defense and they are released when the cell is injured by an herbivore or fungus.
3. It helps in osmotic adjustment. 4. Plant vacuoles are also sites of intracellular digestion.

Mitochondria:

1. It was first discovered by Kolliker (1840). Richard Altmann (1890) called them as 'bioblasts'. The term mitochondria was coined by Carl Benda (1898).
2. It is enveloped with two membranes. Inner membrane shows foldings which are called as cristae.
3. The space between two membrane is called as intermembrane space.
4. F0-F1 particles/oxysomes (site of ATP formation) are attached on cristae.
5. DNA, 70s ribosomes, respiratory enzymes are present in matrix.



6.

FUNCTIONS:

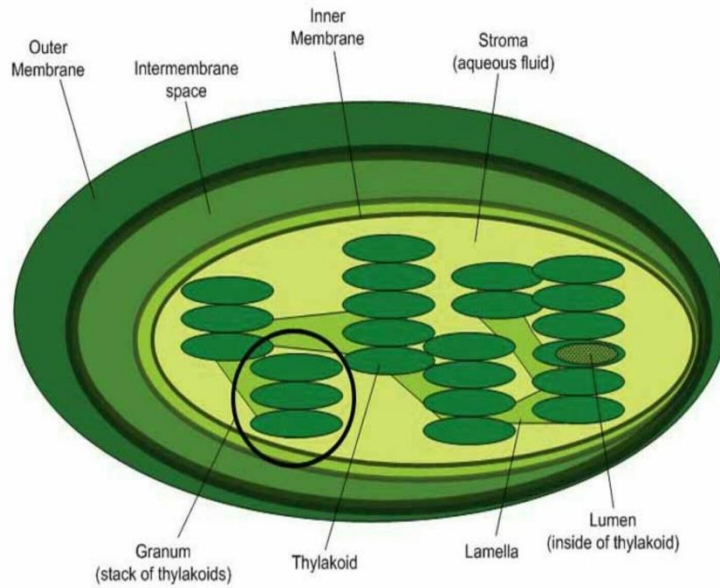
1. These are the powerhouses of cell, as they are site of ATP formation.
2. They are the sites of synthesis of certain amino acids like glutamic acid, aspartic acid.
3. Oxidation of fatty acids.

Plastids:

1. The term plastids was introduced by E. Haeckel(1866) and first studied by Schimper (1885).
2. Plastids are 3 types. Chloroplast (green colour). Chromoplast (Other than green) Leucoplast (colourless es oils and fats)- 3 types 1. amyloplasts (stores starch) 2. Elioplasts – (stores oils and fats)3. Eleuoplasts (stores proteins)
3. Chloroplasts are located in mesophyll cells of leaves and are lens-shaped. These are enveloped with 2 membranes. Space between outer and inner membranes is called periplastidial space.
4. Within the chloroplast flattened membrane extends from one end to other end are called thylakoid. Stalks of thylakoid are called Grana and thylakoids which connects grana are called stroma thylakoid.
5. Along with membranous structure, chloroplast is filled with semi fluid like matter i.e. called as stroma. Stroma contains photosynthetic enzymes, circular DNA and 70s ribosomes.

FUNCTIONS:

1. Photosynthetic pigments occur on thylakoid membrane. Hence, light reaction takes place in grana. Carbon fixation takes place in stroma.
2. Starch/oil/proteins are stored in leucoplasts.
3. Chromoplasts impart colour to the flowers and fruits.

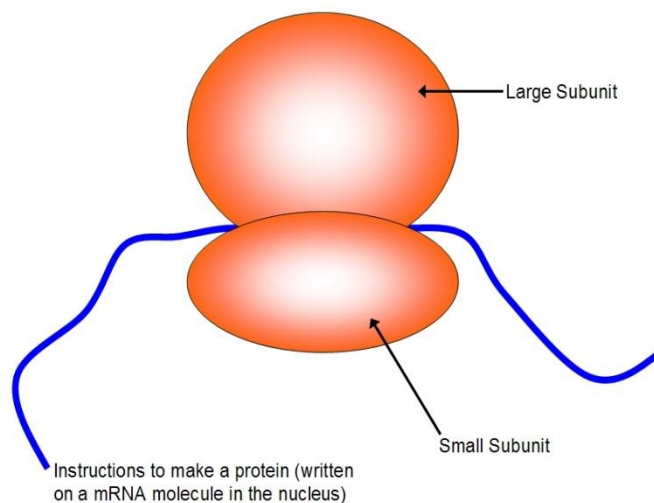


Plastid

RIBOSOMES:

1. These are first observed by George Palade (1955)
2. Most of the ribosomes are found attached to the ER and remaining are exists freely in cytoplasm.
3. Nucleolus is the site of ribosome biogenesis.
4. 2 types of ribosomes are found. 1. 70s (in mitochondria and chloroplast). 2. 80s (in cytoplasm).
5. Ribosomes are made up of 2 sub units with no envelop. It consists only proteins and ribosomal RNA. Hence they are also called as Ribonucleo proteins (RNP).

Ribosome diameter = 10 nm



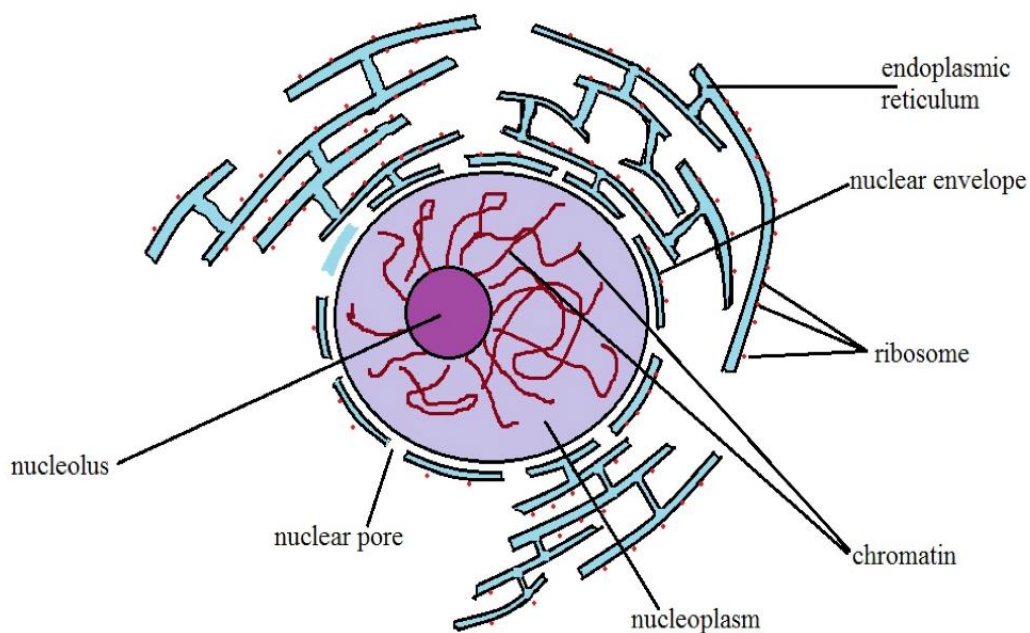
FUNCTION: They are the site of protein synthesis.

LYSOSOMES:

1. These originate from Golgi body and were discovered by Christian de Duve.
2. They are found in fungi and root tip cells of maize and cotton.
3. They are single membrane-bound organelles.
4. They contain acid hydrolases(HYDROLYTIC DIGESTIVE ENZYMES). The maker enzyme is acid phosphatase.

Nucleus:

1. First discovered by Robert Brown. It contains 4 parts. a) Nuclear membrane: It is double membrane punctured by several pores called nuclear pores. Macromolecules transport through these pores.
2. Nucleoplasm: It is dense and contain DNA, RNA polymerases, lipids, minerals. and non-histone chromosomal proteins.
3. Nucleolus: It was discovered by Fontana and term was given by Bowman. It contain calcium ions, r-RNA. But lacks DNA.
4. Chromatin network: Chromatin term was given by W. Flemming. During cell division chromatin condense to form chromosomes. Within chromosomes there were DNA, RNA and histone proteins.



Nucleus

FUNCTIONS:

1. Nucleus is the controlling centre of cytoplasmic activities (CELL BRAIN).
2. Performs cell maintenance and cell replication.
3. Ribosomes are synthesized in nucleolus.

-----The end-----