

# \* Cell : The Unit of Life \*



Robert Hooke - Discovered Cell (Dead cell)

Book micrographia

Anton von Leeuwenhoek - Discovered living cell

Robert Brown - Discovered nucleus

## \* Cell Theory

→ Schleidan (1838) → plants made of cells.

→ Schwann (1839) → Animals made of cells

→ Plants have cell wall & plasma membrane.

→ Virchow → Omnis cellula-e-cellula

New cells arise from pre-existing cell.

\* All living organisms are made of cell and products of cells

\* All cells arise from pre-existing cell.

## Prokaryotes

Both

## Eukaryotes

→ Simple

→ Ribosome

→ More complex

→ No nucleus memb.

→ cytoplasm

→ Nucleus

(Nucleoid)

→ plasma memb.

→ memb. bound

→ No membrane bound

→ DNA

organelles

organelles

→ Linear DNA

→ Circular DNA

\* Smallest cell :- Mycoplasmas (0.3 μm)

Largest cell :- Egg of ostrich

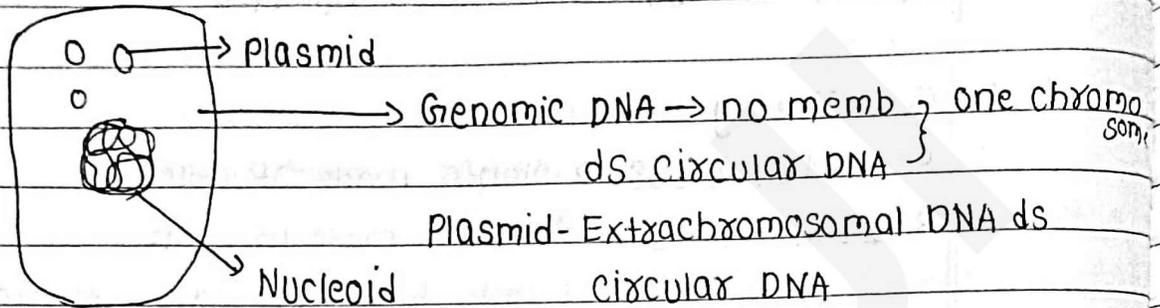
Longest cell :- Nerve cell

Bacteria - 3-5 μm

RBC - 7.0 μm micrometers

### \* Prokaryotic Cells.

- Bacteria, Mycoplasma, blue-green algae, Mycoplasma & PPLO
- Nucleoid.



- Provides resistance to antibiotics
- Gets transferred from one bacterium to another

### → Cell organelles in Prokaryotic cells

### \* Cell envelope and its modification.

- It is a Chemically complex protective covering. It is made of 3 tightly bound layers - Glycocalyx, cell wall & plasma memb.
- Glycocalyx - outermost; protection; pathogenic
  - It may be loose sheath called Slime layer
  - tough and thick layer called capsule.
- Cell wall - Next to Glycocalyx; Provides shape to the cell and gives structural support; protect the bacterium from burst
  - cell wall made up of peptidoglycan.
- Based on the types of the cell envelopes and response to Gram staining, bacteria are two types
  - Gram positive - They take up and retain the gram stain
  - Gram negative - They do not retain the gram stain.

- Plasma membrane - Innermost layer
  - Structure is similar to Eukaryote
  - Semi-permeable (Allows only selective substances to enter)

\* Mesosomes - Infoldings of Plasma membrane in the form of vesicles, tubules, lamellae.

Functions of Mesosome.

- Cell wall form<sup>n</sup>; DNA replication & distribution
- Respiration & Increase the surface area of plasma memb.

→ Chromatophores - Contain pigments for photosynthesis they are membrane infoldings e.g. cyanobacteria

→ Flagella - Thin filamentous longest extension from the cell wall

- made of flagellin protein

- Bacterial flagellum is composed of filament, hook & basal body

→ Pili - formation of conjugation bridge DNA transfer

→ Fimbriae - attach bacteria to host tissue; rocks

\* Ribosomes.

- 70 s — 50 s      S is Svedbergs unit  
                   30 s

- Function: - Translation (protein synthesis)

- Several ribosomes may attach to a single mRNA and form a chain called polyribosome or polysome

\* Inclusion bodies.

- non-membranous

Gas vacuoles - Maintain buoyancy

- Stored reserve material,

- Blue green

} photosynthetic

Phosphate granules,

- Purple & green

} Bacteria

cyanophycean granules &

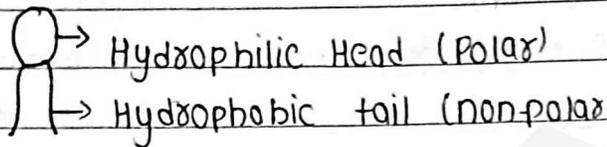
Glycogen granules

## \* Cell Eukaryotic Cell

### \* Cell Membrane

Chemical Studies on human RBCs shows that the cell membrane is composed of a lipid bilayer, protein & carbohydrate

Phospholipid - Mainly phosphoglycerides



→ Ratio of protein and lipid varies in different cells Ex. In human RBC, membrane has 52% protein & 40% lipids.

→ Based on the ease of extraction, membrane proteins are 2 types

i) Integral proteins - Partially or totally buried in membrane.

ii) Peripheral proteins - Lie on the surface of membrane.

Fluid Mosaic Model of cell membrane - Singer & Nicolson (1972)

- Quasi-fluid (semi-fluid like gel)

- Lateral movement of protein

Functions of Cell Membrane.

- Transport of the molecules

- Secretion

- cell growth

- Endocytosis

- Formation of intercellular junctions

- cell division

Types of Transport (downhill transport)

i) Passive transport - not require energy to transport

Diffusion - movement of molecules from high conc. to low conc.

Osmosis - movement of molecules across semi-permeable memb

ii) Active transport - uphill transport ; Need ATP

\* Cell wall.

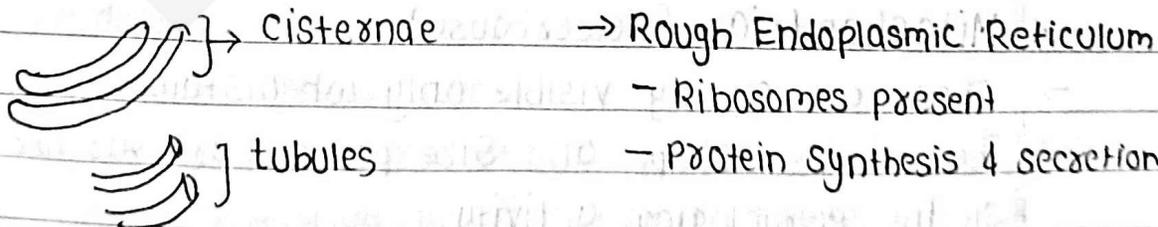
- Non-living ; Rigid
- In plants made of - cellulose, Hemicellulose, Pectin
- In algae made of - Cellulose, galactans, mannans &  $CaCO_3$
- Fungi - chitin
- Primary cell wall is thin and diminishes after sometime and replaced by Secondary cell wall which is formed towards the inner side of primary and outer to membrane
- Middle lamella is a layer made up of calcium pectate which glues neighbouring cells together
- Plasmodesmata - Bridge like connection between 2 cells
- Functions of Cell wall:

- Shape, protection, Mechanical support, helps in cell-wall interactions

\* Endomembrane System.

- It is a group of membranous organelles having coordinated functions. They include - Endoplasmic Reticulum (ER), Golgi complex, Lysosomes, Vacuoles

\* Endoplasmic Reticulum.



- o } vesicles → Smooth Endoplasmic Reticulum
- Ribosomes are absent
- Site for lipid synthesis

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### \* Golgi apparatus - Camillo Golgi (1898)

- consist of disc shaped cisternae of  $0.5 \mu\text{m}$  to  $1.0 \mu\text{m}$

- Functions

→ Modification of proteins into Glycoproteins & lipids into Glycolipid

→ Transportation ; Secretion

### \* Lysosomes:

- Membrane bound

- Formed by Golgi apparatus

- Contain hydrolytic enzymes like lipases, proteases, carbohydrases and Nucleases

- Active at the acidic PH

### \* Vacuoles:

- Bound by a single membrane called tonoplast.

- contains, water, sap, excretory product and other materials not useful for the cell

- In plant cells, the vacuoles can occupy up to 90% of the volume of the cell.

Functions - Osmoregulation - water and salt balance

- Amoeba - contractile vacuoles - excretion

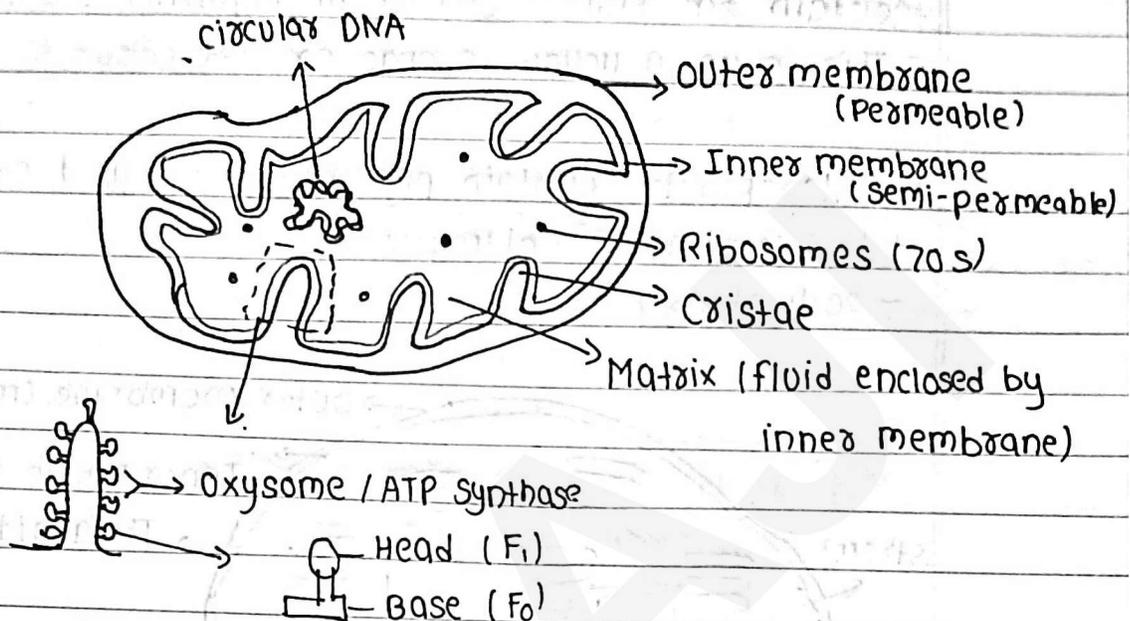
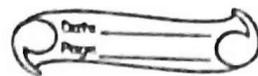
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### \* Mitochondria. (Powerhouse)

→ These are clearly visible only when stained

→ Their number shape and size per cell are variable depending on the physiological activity.

→ It is sausage-shaped or cylindrical having a diameter of  $0.2 - 1.0 \mu\text{m}$  (average  $0.5 \mu\text{m}$ ) and length  $1.0 - 4.1 \mu\text{m}$



Function - Synthesis of ATP

- Site for aerobic respiration
- Mitochondria divides by fission

### \* Plastids

These are found in all plant cells and in Euglenoids. Large sized. Easily observable under the microscope. They contain some pigments.

Based on the type of pigments, plastids are 3 types

Chloroplasts } → Have pigments

Chromoplasts }

Leucoplasts } → no pigments

Leucoplast - These are colorless plastids of varied shapes and sizes with stored nutrients. They include

Amyloplasts :- Store starch. Eg- potato

Elioplasts :- Store oils and fats

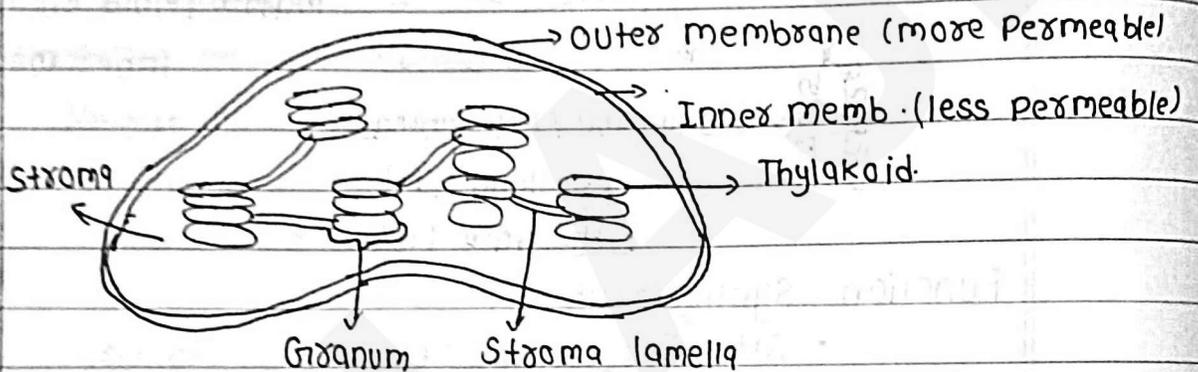
Albumoplasts :- Store proteins

\* Chromoplasts -

- contain fat soluble carotenoid pigments like carotene, xanthophyll
- This gives a yellow, orange or red colour.

\* Chloroplast - contain pigment chlorophyll & Carotenoids

- 1 Chloroplast - Chlamydomonas (Algal)
- 20-4 chloroplast - mesophyll cells

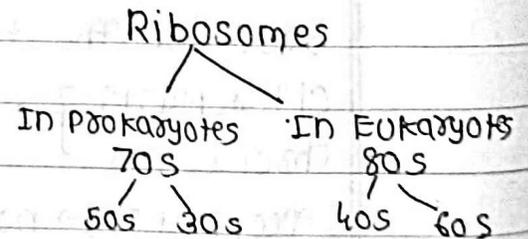


Chloroplast have

- Ribosomes 70S, DNA (circular), protein, Enzymes

\* Ribosomes

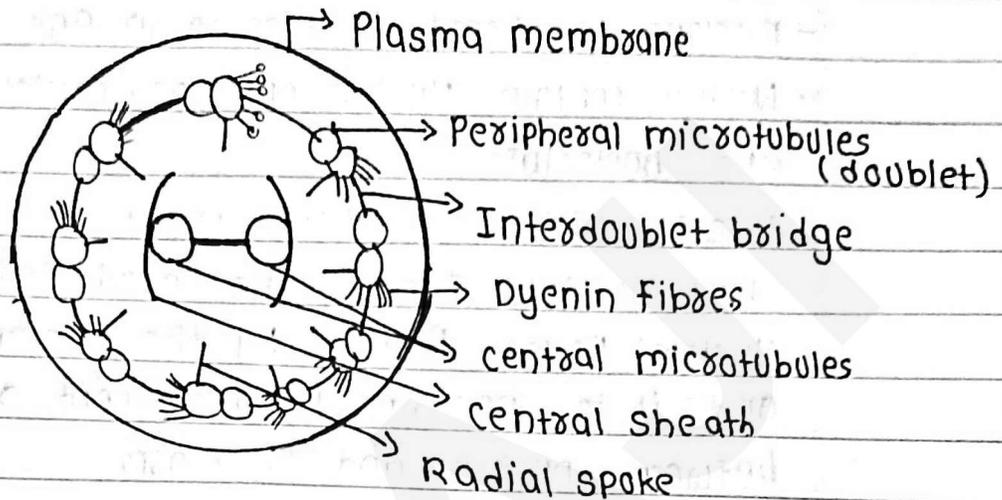
- George palade - observed ribosomes
- non-membranous ; made of ribonucleic acid & protein
- formed in nucleolus
- Function - protein synthesis.



\* Cytoskeleton.

- network of filamentous proteinaceous structures present in cytoplasm
- Support
- motility and maintain shape

- \* Cilia and Flagella:   
 ↳ many & short Long   
 For locomotion



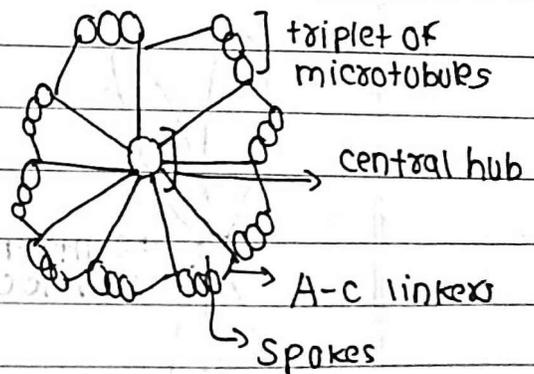
- Arrangement of microtubules - 9+2   
 → The core - Axoneme (microtubules without plasma memb.)   
 → Cilia / Flagella arise from basal body (centriole like structure)

\* Centrosome and Centrioles

Centrosome

- no membrane
- surrounded by pericentriolar material
- contains two centrioles

Centriole

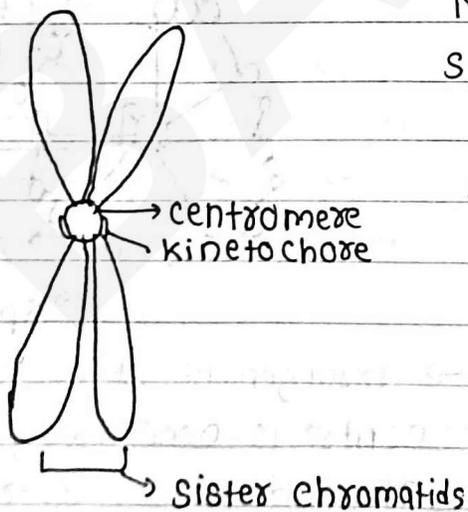


- Arrangement of microtubules 9x3   
 - centre is occupied by a proteinaceous structure called central hub

## \* Nucleus

- Discovered by Robert Brown (1831)
- nucleus is stained by basic dyes (Ac chromatin term - Fleming)
- nucleus is absent in mammalian RBC & sieve tube cells of vascular plants
- Nucleus contain - Nuclear envelope, nuclear matrix, chromatin and nucleolus
- Nuclear envelope - Outer membrane, Inner membrane  
Space between 2 membrane called Perinuclear Space
- Nuclear Pores - formed by the fusion of both membrane and it is passage for movement of RNA and proteins between nucleus and cytoplasm.
- Chromatin - Thread like network
  - contains DNA, basic protein (histones), non-histone proteins and RNA
  - During cell division, Chromatin condense

## Chromosome



Metacentric - arms almost equal

Sub metacentric - One arm long  
Another short

Acrocentric - One arm shorter  
Another longer

Telocentric - One arm very very short  
another very long

Nucleolus - No membrane

- Site for rRNA synthesis (Ribosome)

Microbodies

- Small vesicles - contain enzyme

- one membrane

- Plant and animal cell