

# CELL: THE UNIT OF LIFE

## Introduction

Unicellular  
(Single Cell)

(Amoeba,  
Paramecium)

Multi Cellular

↓  
Cellular

↓  
Tissue

↓  
Organ

↓  
Organ System

↓  
Organism

(Humans)

What is Cell?

→ Electron Microscope

Knoll and Ruska

→ Robert Hooke → Discovered Cork Cell

→ Term Cell → Misnomer

→ Total living material inside cell

→ Anton Von Leeuwenhoek → protoplasm  
↳ Discovered Living Cell.

→ Robert Brown → Nucleus.

## Cell Theory

→ 1838 → Matthias Schleiden (German Botanist)

all plants are composed of cells.

→ Cell is structural and functional unit of life in plants.

→ 1839 → Theodore Schwann (British Zoologist)

→ plant cell → cell wall

→ Cell Membrane / plasma membrane  
↳ Animal Cell.

→ Cell is structural and functional unit of life in all plants and animals.

→ 1855 → Rudolf Virchow → (Omnis Cellula e Cellula)

→ Cell arise from pre-existing cells.

## An Overview Of Cell

prokaryotic Cells

primitive type Nucleus

Cell Organelles  
absent.

→ Smallest cell → Mycoplasma (0.3 μm)

↳ Cell wall  
absent

Eukaryotic Cells.

True Nucleus

Cell Organelles  
membrane bound.

→ PPLO (Pleuro Pneumonia Like Bacteria)

↳ 0.1 μm

→ Bacterial Cell → 3-5 μm

→ Virus → 0.02 μm

→ Red Blood Cell → 7 μm

→ Immature RBC → Circular (Nucleate)

→ Mature RBC → Biconcave (Enucleate)

Surface ↑ → mitochondria absent

→ Erythropoiesis → Bone marrow of long bones

→ Erythropoietin → Kidney.

→ Graveyard / Reservoir of RBC → Spleen

→ Life Span → 120 days

→ Largest Cell → Ostrich Cell

→ Longest Cell → Nerve Cell

→ WBC (amoeboid in shape)

→ Phagocytosis.

→ Defense mechanism of Body.

→ Tracheid Cell (Elongated)

↳ For conduction of water in plants.

→ Mesophyll Cells → Oval

↓  
Dorsiventral Leaf → Palisade (cylindrical)  
Chloroplast → Photosynthesis. Spongy (oval)

## Prokaryotic Cells.

→ Bacteria, Blue Green Algae, Cyanobacteria, Mycoplasma and PPLO.

→ Cell envelope and its modifications.

→ Outermost Layer → Glycocalyx

↓ Thick-Capsule  
Loose Sheath → Slime layer.

→ Protection

→ Adhesion

→ Desiccation

→ Cytoplasmic Inclusion

→ mesosome

→ Glycocalyx

→ Cell Wall

→ Cell membrane

→ plasmid

→ Fimbriae

→ 70s Ribosome

→ Bacterial Cell

→ Flagella

→ pili

Cell Wall → Made up of peptidoglycan.

↳ Rigidity / Support and protection.

→ Prevents bacterial cell from collapsing or bursting.



Cell Membrane → Living / Selectively permeable membrane.  
Similar to that of eukaryotic cell.

Based on 2 type of Cell Wall

Gram +ve Bacteria      Gram -ve bacteria

Henry Christian Gram ★

Bacterial Stain

Stain with Crystal Violet

Bacteria gets Violet Colour

Washed with Water

Stained with Iodine

Violet

Washed with ethanol

Retained Stain

Gram +ve Bacteria

→ Thick Cell Wall

→ Murein (70-80%)

→ Single Layered

→ Techoic acid present.

→ Few pathogen formed.

→ Clostridium,  
Corny bacterium,  
Streptococcus.

Destained Bacteria

(Saffron) → Pink

Gram -ve Bacteria

→ Thin Cell Wall

→ Murein (10-20%)

→ 2-3 layered.

→ Techoic acid absent.

→ More pathogen formed.

→ E. coli, Salmonella,  
Xanthomonas,  
Vibrio.

Mesosomes → A special Membranous structure mesosome is formed by invagination of the plasma membrane in the cell.

Functions → ① Cell wall formation.

② DNA replication and its distribution to daughter cells.

③ Respiration

→ Membranous extensions of Mesosome are in form of → Vesicles, Tubules, and Lamella.

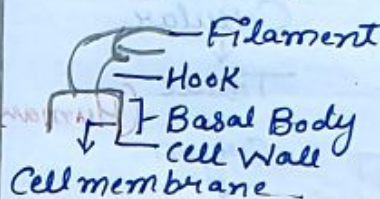
→ Only found in gram +ve bacteria

Chromatophores → Photosynthetic prokaryotes like Cyanobacteria and purple bacteria there are other membranous

extension that contains pigment for photosynthesis.

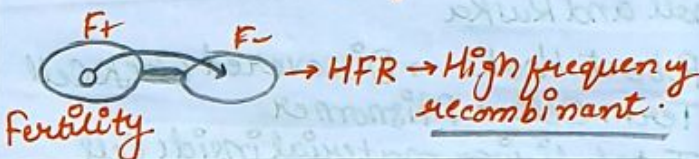
Flagella → Motile Bacteria

→ Flagellin protein (different from that of eukaryotic flagella)



Pili → Small projections

→ Bacterial Conjugation



Fimbriae → Bristle like structure projecting outward of bacterial cell that helps in attachment to surfaces.  
e.g. → Neisseria Gonorrhoea → Attached to wall of Urinary Bladder.

Ribosomes and Inclusion Bodies

→ In prokaryotes Ribosomes are attached to plasma membrane

→ 15nm by 2nm (Size)

→ 70S type — 50S (large)  
30S (small)

Svedberg Unit

→ Site of protein synthesis

→ When several ribosome, attaches to single mRNA → polyosome

→ Ribosomes of polyosome translates mRNA into protein

Inclusion Body →

→ Reserve food material is stored in cytoplasm

→ Not bound by membrane

→ Phosphate Granules

→ Cyanophycin Granules

→ Glycogen Granules

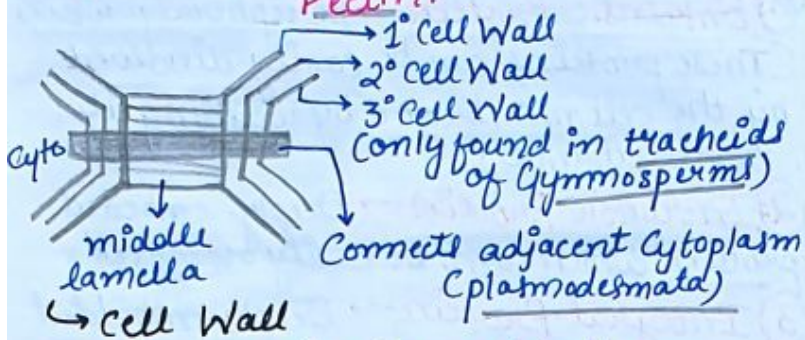
→ Gas Vacuole is found in BGA, purple and green photosynthetic Bacteria.



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→ Plant Cell → Cellulose, Hemicellulose, Pectin.



→ Animal Cell → Desmotubule.

① Primary Cell Wall → 1<sup>st</sup> formed cell wall in growing cell.

→ Thin and elastic  
→ Found in all meristematic and parenchymatous cell.

② Secondary Cell Wall →

→ Found in permanent cell  
→ Thick and provide rigidity.

→ Middle Lamella → Binding / Cementing material b/w adjacent cells.  
Made up of Calcium and magnesium Pectate.

→ Functions →  
→ Rigidity and support.  
→ Maintains shape of cell.  
→ Protect from mechanical energy.  
→ Freely permeable.

Protoplasm → Total living matter present inside the cell.

Protoplasm + Nucleoplasm → Cytoplasm

Endomembrane System

→ Endoplasmic Reticulum, Golgi Complex, Lysosome and Vacuole.

→ They are called endomembrane system because their functions are co-ordinated.

→ All of them are single membrane bound.

Single Membrane → Endoplasmic reticulum, Golgi Complex, Lysosome, Vacuole, Peroxisome, Glyoxysome, Sphaerosome, Flagella.

Double Membrane → Mitochondria, Nucleus, Plastid.

No Membrane → Ribosome, Nucleolus, Centriole

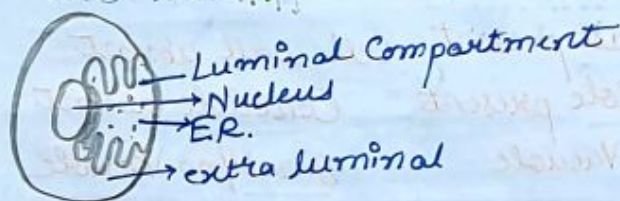
Endoplasmic Reticulum

→ Network of reticulum of tiny tubular structure scattered in cytoplasm

→ ER divides intracellular space into 2 compartments.

① Luminal Compartment →  
(Internal space enclosed within ER Membrane).

② Extra luminal Compartment →  
(space present outside ER in Cytoplasm)



① Rough Endoplasmic Reticulum

→ ER → Ribosome on surface → RER  
→ Extensive and continue with the outer membrane of nucleus.

Function →

→ Help in protein synthesis and secretion.  
→ It gives rise to SER.

→ Nissl Granules - Modifications of fragments of RER.

② Smooth Endoplasmic Reticulum

→ No ribosome → Smooth  
→ Small tubular structure scattered in cytoplasm.

→ Muscles → Sarcoplasmic Reticulum.  
(Reservoir of  $Ca^{2+}$ )

Functions →

→ Synthesis of lipid and steroidal hormone.  
→ Detoxification of drugs.  
→ Reservoir of Calcium ion and helps in muscle contraction.



## Golgi Complex → Camilleo Golgi

→ Densely stained reticular structure present in cytoplasm.

→ Present in all eukaryotic cell except Mature sieve tubes, RBC and sperm cell of Bryophytes and pteridophytes

→ Plant Golgi Body → Dictyosome \*

→ Composed of → Cisternae → Vesicles  
→ Tubules → Golgian Vacuole

### ① Cisternae.

→ Flattened sac like structure stacked on one another. (usually 4-8 cisternae in each stack).

→ Size (0.5  $\mu\text{m}$  - 1.0  $\mu\text{m}$ )

→ Cis phase (Convex phase) → Forming phase

→ Trans phase (Concave phase) → Maturing phase

Cis/Convex → Tubule  
→ Trans/Maturing phase  
→ Maturing Vesicle

forming vesicle.

### ② Tubules.

Small, flat interconnecting structures found at periphery of cisternae.

### ③ Vesicles.

Round Sac present at end of Cisternae.

Functions →

→ processing, packaging and transport of material

→ Involved in secretion to intra and extracellular targets.

→ Site of formation of glycolipid and glycoprotein.

→ Acrosome of Sperm \*

→ modified Golgi apparatus

→ Formation of plasma membrane during cytokinesis.

## Lysosomes

→ Single membrane bound spherical sac like structure

→ Acidic pH → 4.5 (Suicide bag of cell)

→ Hydrolytic enzymes.

→ Substances required to get rid of are actively transported in lysosome.

① Autophagy → Self

② Crinophagy → Other

## Vacuole

→ Single membrane bound structure found in cytoplasm.

→ Tonoplast (Selectively permeable)

→ Storage and Osmoregulation

Food Vacuole

Plant → 90% region

Contractile Vacuole

e.g. - Amoeba

Gas Vacuole → Membraneless Vacuole found in prokaryotes and helps in buoyancy

## Mitochondria

→ Cylindrical / sausage shaped double membrane organelles distributed in cytoplasm.

→ Janus Green Stain to observe Mitochondria.

→ 0.2 - 1.0  $\mu\text{m}$  (diameter), 1.0 - 4.1  $\mu\text{m}$  (length)

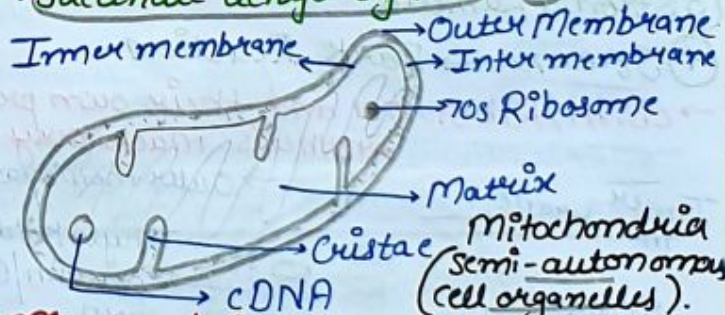
→ Chaos-Chaos (Amoeba) - 4 lakh mitochondria

### ① Outer Compartment →

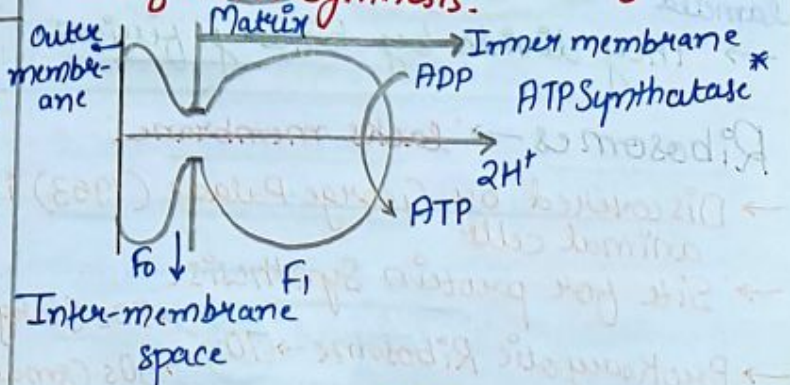
Intermembrane Space, Perimitochondrial space.

### ② Inner Compartment →

Matrix, Infoldings (Cristae)  
→ All enzymes for ETS is present in inner mito-chondrial membrane except Succinate dehydrogenase \*



→ Mitochondria - Power House of Cell.  
→ Site for ATP synthesis.



→ Mitochondria divides by Binary Fission.



## Plastids

- found in plant cells and photosynthetic protists.
- Fat Soluble → Carotenoids
- Water Soluble → Anthocyanin
- ① Leucoplast → Colourless, Storage
  - Amyloplast → Starch storage
  - Alveoplast → Protein storage
  - Elioplast → Oil storage
- ② Chromoplast → Colour, Pigment
  - Carotenoids → Red
  - Anthocyanin → Blue
  - Xanthophyll → Yellow
- ③ Chloroplast → Green, Photosynthesis and storage of starch

## Chloroplast

Size → 2-4  $\mu\text{m}$  (thickness) 5-10  $\mu\text{m}$  (length).  
→ Mitochondria < Chloroplast.

Number → Varies from 1 → Chlamydomonas  
20-40 → Mesophyll cells

→ Structure of Chloroplast →

→ Outer and Inner membrane.

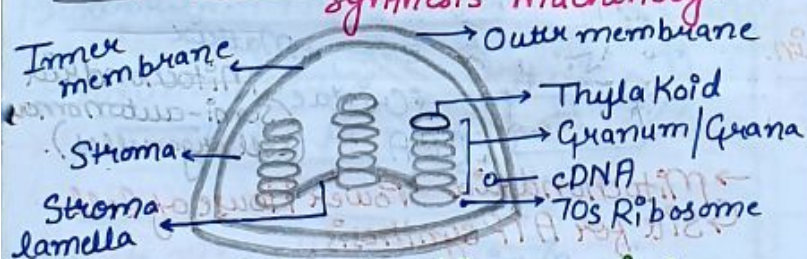
① Thylakoid → Site of light reaction.

② Granum

③ Stroma Lamella

④ Stroma → DARK Reaction

→ cDNA, Ribosomes and their own protein synthesis machinery.



→ They divide by binary fission.

Ribosomes → lacks membrane

→ Discovered by George Palade (1953) in animal cells

→ Site for protein synthesis.

→ Prokaryotic Ribosome → 70s → 50s (large) → 30s (small)

→ Eukaryotic Ribosome → 80s → 60s (large) → 40s (small)

⑤ → Sedimentation Co-efficient

→ Svedberg Unit.

1s =  $10^{-13}$  seconds.

→ When several ribosomes attached to single mRNA → Polysomes.

## Cytoskeleton

→ Minute fibrous, filamentous and tubular proteinaceous structure.

→ Supportive framework of cell.

① Microtubule →

→ Absent in prokaryotic cell

→ Hollow cylindrical structure

→ Made up of tubulin protein.

Functions →

① Help in formation of spindle fibres and astral rays during cell division.

② Cytoskeleton of cilia and flagella

③ Support/Shape and rigidity of cell

② Microfilament →

→ Found in Eukaryotic cell

→ Protein → Actin/Myosin.

① Support plasmamembrane

② Cytoplasmic Streaming and amoeboid movement (formation of pseudopodia)

③ Furrow formation during cytokinesis of animal cell

③ Intermediate Filament →

→ Non contractile protein filaments

→ Packing of chromatin

→ Scaffolding protein.

## Cilia and Flagella

Small, tubulin, numerous

long, → Tubulin  
1-2 flagella.

→ Cilia and flagella covered by plasma membrane

→ Their core → Axoneme \*

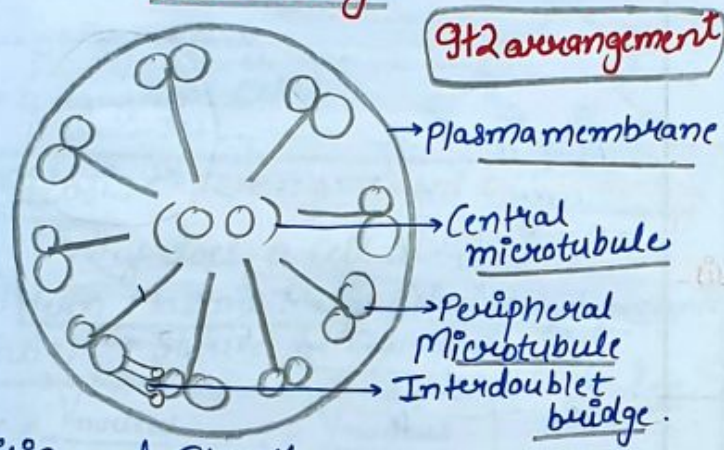
→ It possesses several microtubules running parallel to its long axis.



→ Central tubules are connected by bridges and also enclosed by a central sheath, which is connected to one of the tubule of each peripheral doublet by radial spokes.

→ 9 radial spokes.  
→ peripheral doublet are also joined by interdoubt bridge.

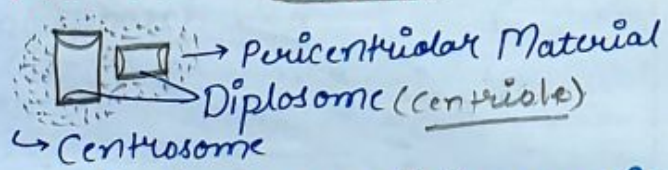
→ Both Cilia and flagella emerge from centriole like structure called basal body.



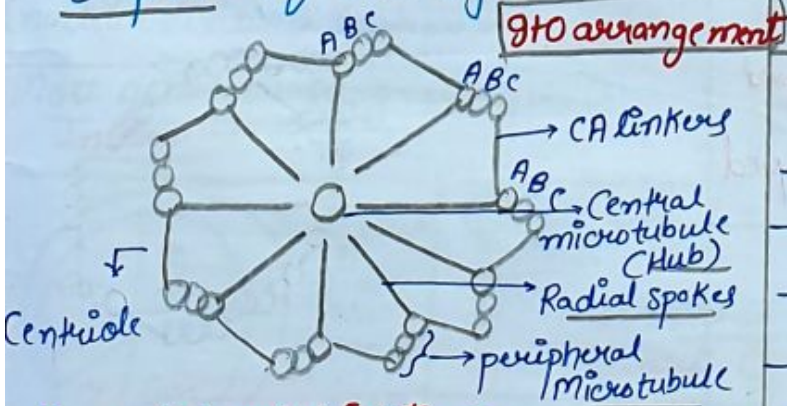
Cilia and Flagella

## Centrosome and Centriole

→ Centrosome absent in higher plants.  
→ Centrosome contains 2 centriole (diplosome) they are at right angle to each other.  
→ Surrounded by amorphous pericentriolar material.  
→ Membrane is absent.



→ Duplication of centriole occurs in S phase of cell cycle.



9 - Peripheral triplet  
0 - Central microtubule  
9 - Radial spokes  
} Cart wheel like arrangement

## Microbodies

→ Single membrane bound.  
→ Sphaerosome → Plant lysosome \*

① Peroxisome → Found in both plants and animals. Help in hydrogen peroxide metabolism during photorespiration in  $C_3$  plants.

Chloroplast - Peroxisome - Mitochondria  
Enzyme used is catalase.  
→ Catalase degrades  $H_2O_2$  → Water and Oxygen

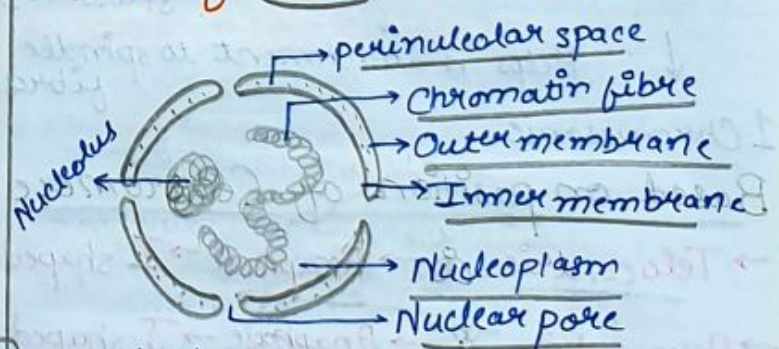
② Glyoxysomes → Found in plant cells specially in fatty acid seeds.  
→ Help in glyoxylate cycle.  
→ Converts fat to carbohydrates.  
(Highly specialized peroxisome).

## Nucleus → Robert Brown (1831)

→ Basic dye (Acetocarmine) for observing Chromatin fibres

1<sup>st</sup> observed by → Flemming

→ Nucleus absent in →  
① Mature sieve tube cells.  
② Mature RBC of mammals.  
→ RBC of camels have nucleus.



→ Nucleus

## Nuclear Membrane

→ Outer membrane  
→ Inner membrane } Space b/w two (perinuclear space)  
→ Nuclear pore is present  
→ Outer membrane is associated with endoplasmic reticulum and bears ribosomes also.



## Nucleoplasm →

→ Chromatin (Flemming)

DNA + Histone protein → Nucleoplasm  
+ packaging material → Chromatin.

→ Densely Stained Chromatin

↓  
Heterochromatin

→ Loosely stained Chromatin

↓  
Euchromatin

↓  
Transcriptionally active.

Nucleolus → F. Fontana

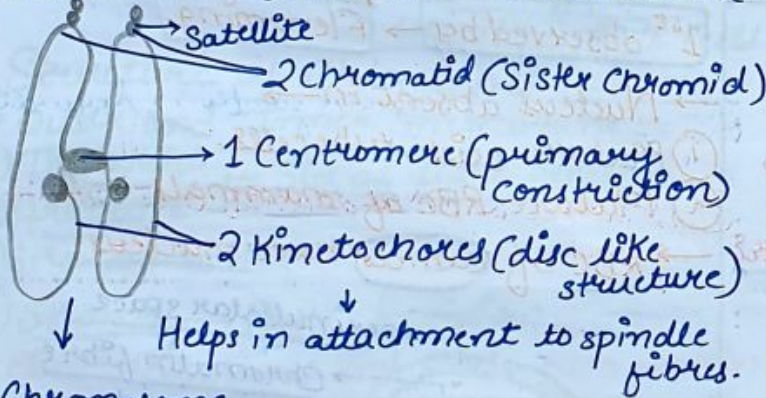
→ Membrane less

→ Site of active ribosomal RNA synthesis.

→ Ribosome factory of Cell

## Chromosome

Chromatin → Condense → Chromosome



1 Chromosome

Based on position of Centromere

→ Telocentric → Anaphase → I shaped

→ Acrocentric → Anaphase → J shaped

→ Sub Metacentric → Anaphase → L shaped

→ Metacentric → Anaphase → V shaped

## Secondary Constriction

→ Found in chromosome no.  
(13, 14, 15, 21, 22).

→ Nucleolar Organising Region  
(CNOR)

Satellite → Part of chromosome  
after NOR.

Telomere → End of chromosome  
↳ Prevents entangling of  
chromosome.

→ Galanine Rich (TTAGGG)<sub>5' 3'</sub>

# NEET SLAYER

