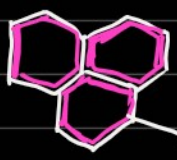
Prokaryotic cell

22 April 2021 10:26 AM

CELLTHE UNIT OF...

CELL - structural & functional unit of life

Discovered by - Robert Hooke in cork of Oak plant (Quercus suber)



= cellulae = cell → Dead cell

→ suberin

* First living cell → A. V. Leeuwenhoeck (Aquatic bacteria)

* Nucleus → Robert Brown in Orchid cell

→ Cyclosis = Cytoplasmic streaming

* Protoplasm → 'Physical basis of life'. ↳ Julian Huxley

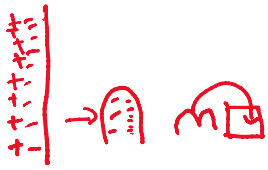
* Arena for cellular activities → Cytoplasm

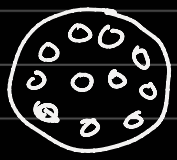
CELL THEORY - by M. Schleiden (Bot) & T. Schwann (Zoo)

1. All organisms are made up of cells or their products
2. Activities of organisms are result of activities & interaction of cells.
3. All cells arise from pre-existing cells.
   'Omnis cellula e cellula'
   ↳ Rudolf Virchow

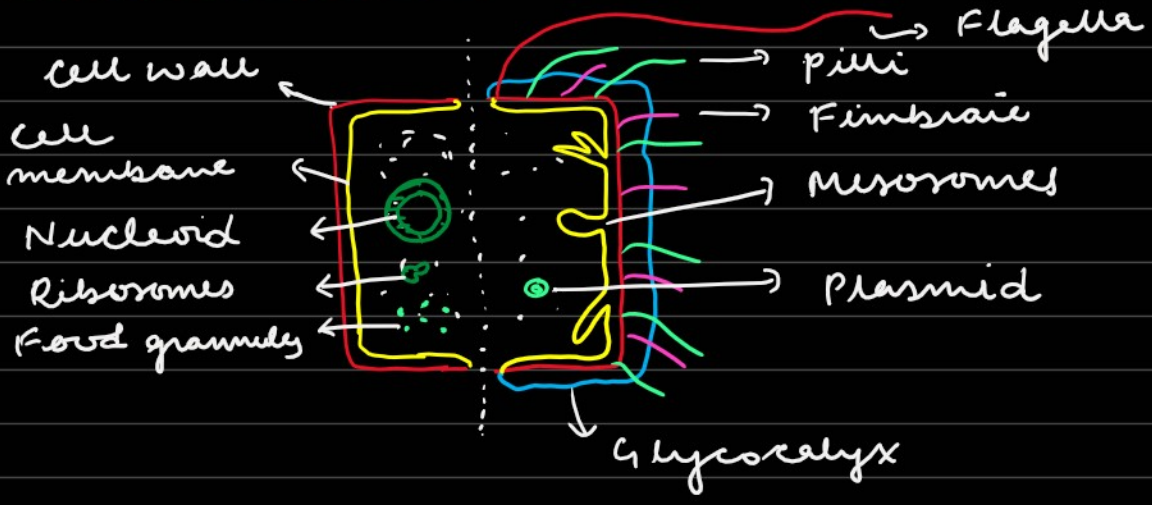
Exceptions - i) Virus → Acellular
ii) Multinucleate condition - Rhizopus
iii) Enucleate living cells -
eg Mature RBCs, Sieve tubes in phloem

PROKARYOTIC CELL (Primitive)	EUKARYOTIC CELL (Advanced)
1) Incipient nucleus - NM & nucleolus absent.	1) True nucleus – nuclear membrane & nucleolus present
2) DNA - ds, circular Nucleoid or Genophore ← Cytoplasm	2) DNA - ds, linear in the form of chromosome Nucleus ←
3) Histones absent but Polyamines (Basic) present.	3) Histones - Basic (+ve) protein, help in DNA packaging.
4) Membrane bound organelles absent	4) Present - Mitochondria, ER, G B etc.
5) Ribosome - 70S type	5) Ribosome - 80S type
6) Cyclosis absent	6) Cyclosis present
7) Cytoskeleton absent	7) Cytoskeleton present
8) Flagella - Made up of flagellin protein * Unistranded	8) Flagella - Made up of tubulin protein * 9+2 arrangement





PROKARYOTIC CELL – Bacteria = Monera



1) CELL ENVELOPE - Glycocalyx + Cell wall + Cell membrane

a) Glycocalyx (May be present)

Capsule	Slime layer
i) Tough & thick	i) Loose & thin
ii) Polysaccharides + Amino acids	ii) Polysaccharides only
iii) Gives gummy or sticky nature to cell	iii) Retains moisture
iv) Protects cell from host immune system	iv) Protects cell from dessication or drying

b) Cell Wall - Peptidoglycan = murein = mucopeptide

Peptidoglycan

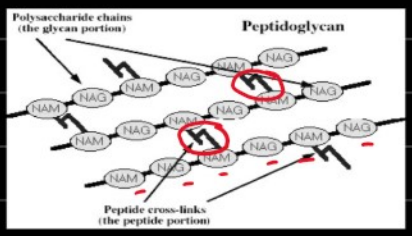
Peptidoglycan

Polysaccharides

- NAM - N-Acetyl muramic acid
- NAG - N-Acetyl Glucosamine

Peptide

- 4 amino acid as tetrapeptide
- * form cross bridges
  - ↑ ⊗ Penicillin



* Gram Staining - Developed by Christian Gram

Bacterial Smear

[redacted]

↓

Crystal violet / Gentain violet + Iodine soln (mordant)
↳ CVI complex (Blue)

↓

Blue colony

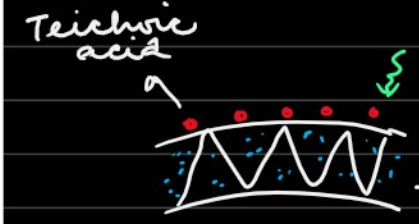
↓

Alcohol wash + Safranin (Red)

↓

Retain Blue dye (Blue)	Loose Blue dye (Red)
↓	↓
Gram +ve	Gram -ve

GRAM POSITIVE



i) Thick - 20-80 nm
- single layered (PG)

ii) Teichoic acid present (surface antigen)

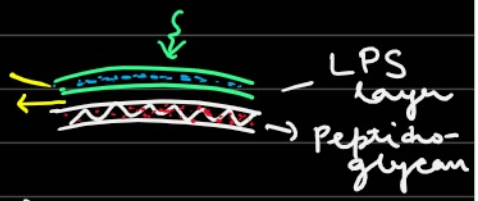
iii) Mesosomes - Mostly Present

iv) Pilli - Mostly Absent

v) Capsule - Mostly Absent

eg. Staphylococcus, Bacillus

GRAM NEGATIVE



i) Thin - 8-12 nm
- 2 layered
* outer - Lipopolysaccharide
* inner - PG

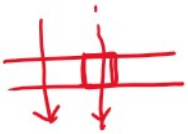
ii) Absent, LPS act as surface antigen (LPS - Porins present)

iii) Mostly absent

iv) Mostly present

v) Mostly present

eg - E. coli, Vibrio, salmonella



c) Cell Membrane - Unit membrane
- Lipid bilayer + Proteins

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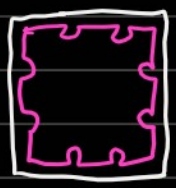
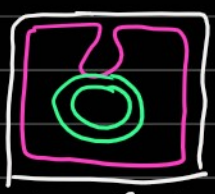
- Lipid bilayer + Proteins
* Cholesterol absent, Hopanoids present

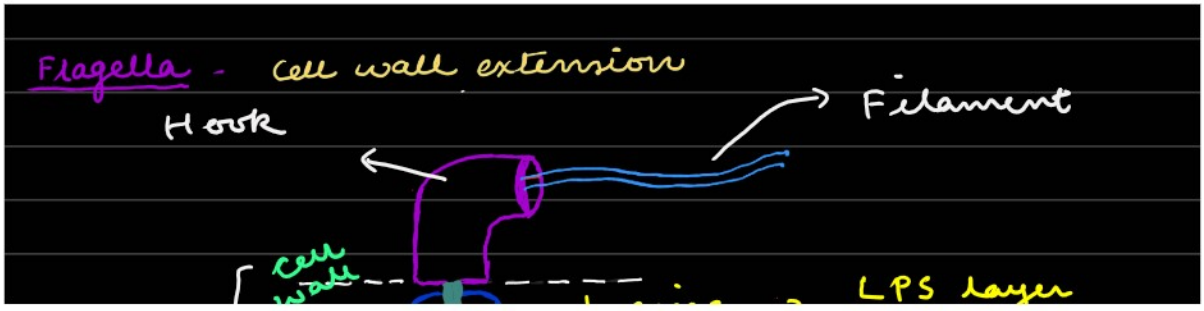
* Mesosome - Invaginations of Membrane
- can be Tubules, lamella or vesicles

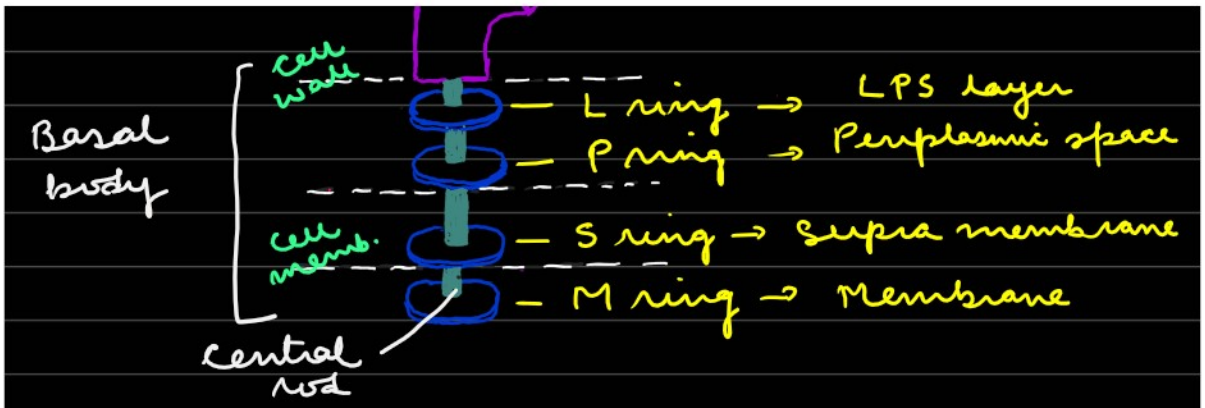
(Chromatophore)

Vesicle

Peripheral	Central
	
- Small & many - Increase surface area for respiratory ETS.	- Single & large - Attached to DNA & help in DNA replication & cell division.

Flagella - Cell wall extension





- Consist of 3 parts -

a) **Basal body** → Central rod
→ Rings -
G+ve → S & M rings
G-ve → L, P, S & M rings

b) **Hook** - Made up of different proteins
- Can rotate 360°

c) **Filament** - - Largest portion
- Unistranded (Helical)
- Made up of Flagellin protein.

* Flagella → **Locomotion**

Pilli - Hair like, made up of Pillin protein
- Help in Conjugation & recognition

Fimbriae - Bristle-like, made up of Fimbrin protein
Attachment → Aquatic bacteria → rock

Attachment — protein
- Aquatic bacteria → rock
- Parasite → Host cell

Nucleoid / Genophore – Bacterial chromosome

Nucleic Acids

- **DNA**
  - ds, circular
- **RNA**

Proteins

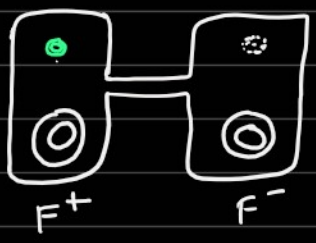
- **Basic**
  - Polyamines (Histones absent)
- **Acidic**
  - Enzymes
  - Regulators

Plasmid - Extra-chromosal, ds, circular, self-replicating DNA

- Very small wrt Nucleoid

* Provide specific feature or phenotype to host cell.

i) **F-plasmid** - Fertility plasmid
- carry genes for conjugation tube formation



ii) **R-plasmid** - Antibiotic resistant plasmid
- genes for antibiotic resistance

iii) **Col plasmid** - Colicin (toxin) producing
- Bacteria secrete colicins outside the cell, which can kill other microbes near by.

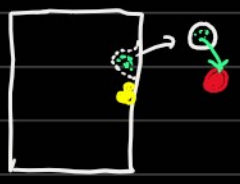
iv) **Ti-plasmid** - Tumor inducing plasmid

- Found in *Agrobacterium tumefaciens*
- cause 'Crown gall disease'

Ribosomes - rRNA + Protein * 70S type

* Free in cytoplasm - synthesis of internal proteins

* Free in cytoplasm – synthesis of internal proteins
* Attached to membrane – synthesis of secretory proteins



INCLUSION BODIES – storage bodies

A) Non-Membranous

Glycogen Granules
- store glycogen
* Also found in Fungi & Animals

Cyanophycean Granules
- BGA / Cyanobacteria
- Proteins

Volutin granules
- store phosphates

B) Membranous (sheath not unit membrane)

→ Not true membrane

Gas Vacuoles
- store gases
- Provide buoyancy to bacteria (aquatic)
- Found in BGA, Green sulphur or Purple sulphur bacteria
* Pseudovacuoles (no true membrane)

PHB Granules
- store Poly β-hydroxy butyrate
* PHB- long C-chain compounds
* Used in bioplastics