

1.

INTRODUCTION TO COMPUTATIONAL
BIOLOGY
UNIT:- 1

CELL AND EVOLUTION

CELL:- A cell is the fundamental, structural and functional unit of all living organisms.

- A cell would constitute an entire organism i.e unicellular organism. Or it could be a part of multicellular system where a cell forms a ~~differentiated~~ function which is division of labor.

DISCOVERY

- Robert Hooke (1665) :- Discovered hollow cavities like compartments in a very thin slice of cork (cell wall) with microscope and named them as cellular or cells.
- Anton Von Leeuwenhoek :- First saw and described a new cell (living cell)
- Robert Brown :- later discovered and named nucleus in a cell.

TERMS:-

PROTOPLASM:- FLUID IN CELL (Cytoplasm + Nucleus)

PROTOPLAST :- Cytoplasm + Plasma membrane

CYTOPLASM :- FLUID IN CELL except the ~~Nucleus~~

CELL THEORY:-

- Cell theory was given by German Botanist M. J. Schleiden (1838) and a British Zoologist T. Schwann (1839). They gave the concept that "All living organisms are composed of cells" and products of cells.
- They together formulated the cell theory but this theory did not explain how new cells were formed.
- Rudolf Virchow (1855) first explained that cells divide and new cells are formed from pre-existing cells (Omnis cellula e-cellula). He modified the hypothesis of Schleiden and Schwann and given the cell theory.

Cell theory states :-

1. All living organisms are composed of cells and products of cells.
2. All arise from pre-existing cells.
3. All cells have similar fundamental structure and metabolic reactions.

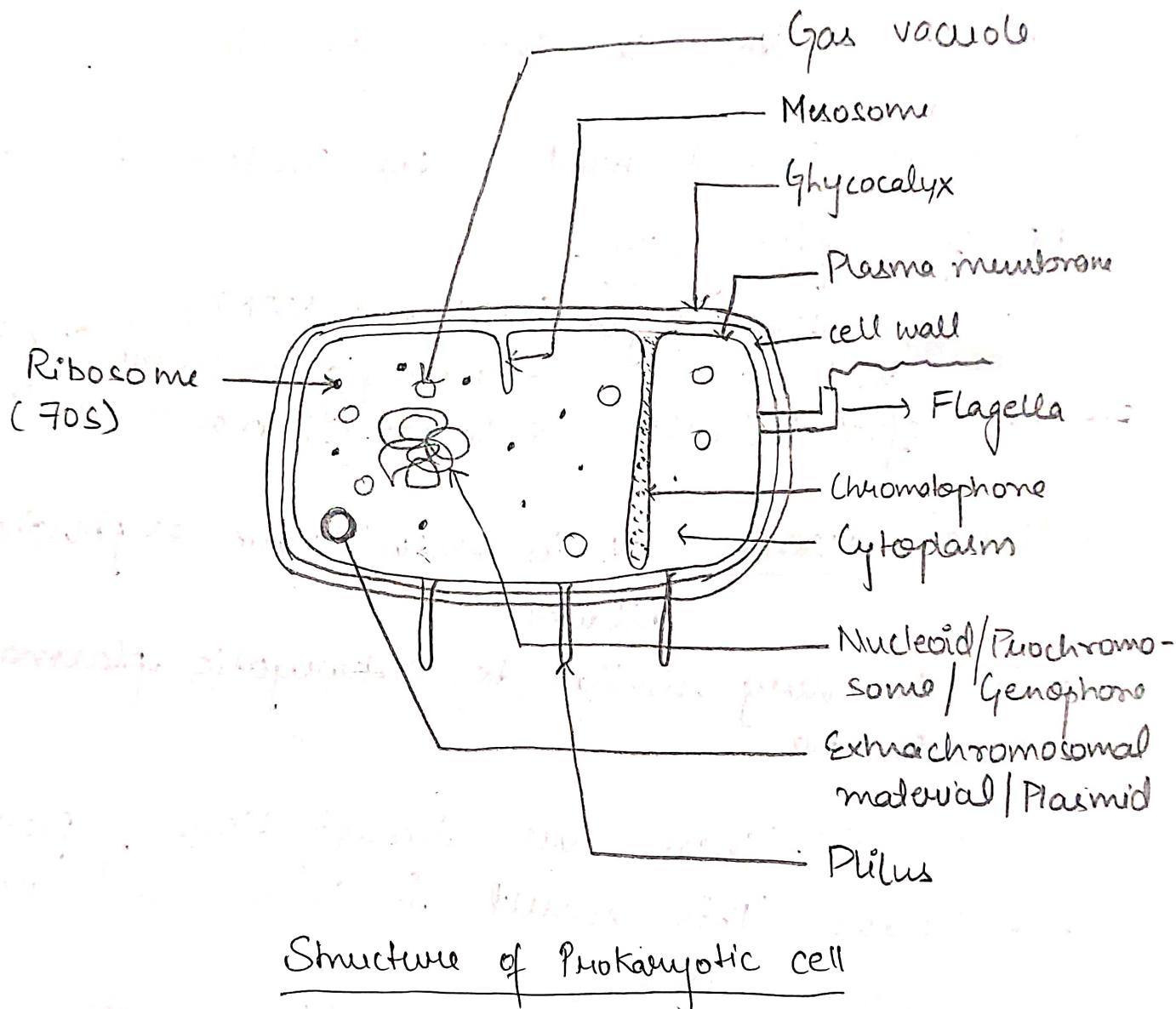
Exception to cell theory: Virus, Viroids and prions.

- Cells differ greatly in size, shape and activities. for example, Mycoplasma is the smallest cell, and only 0.3 μm in length and Bacteria could be 3 to 5 μm . Among multicellular organisms, Human Red Blood Cells are about 7.0 μm in diameter and

Nerve cells are some of the longest cell.
longest cell: Ostrich Egg.

TYPES OF CELL:

i) PROKARYOTIC CELL: - Cells having primitive nucleus
Primitive Nucleus



Structure of Prokaryotic cell

PARTS OF PROKARYOTIC CELL

(ii) GLYCOCALYX: - Glycocalyx is the outermost layer of the prokaryotic cell.

- It is made up of modified sugar.

FUNCTION - It helps bacteria from desiccation and

prevents loss of water.

- It is responsible for protection from host's immunity
- It may also help in attachment.

The Glycocalyx layer can be hard or smooth. If it is hard then it is known as capsule if it is smooth, it is known as slime layer.

(iii) CELL WALL :- Cell wall of the Bacteria is made up of Peptidoglycan.

Peptide sugar [NAG and NAM]
 (made up
 of amino-acid)
 - N-acetylglucosamine (NAG)
 - N-acetyl muramic acid (NAM)

(iii) PLASMA MEMBRANE :- It is also known as phospholipid bilayer.

- It is very similar to eukaryotic plasma membrane.

(iv) MESOSOME :- These are imaginations of plasma-membrane. This result in increase in the surface area.

- functions:-
1. Helps in reproduction of cell
 2. Helps in DNA replication
 3. Helps in respiration of bacterial cell
- [Similar to mitochondria of eukaryotic cell]

— Mesosome might take different shapes :-

 — vesicle

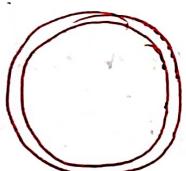
 → lamellar

 → tubular.

— Tubular mesosome sometimes might bend inside the plasma membrane and it stores some pigments then it is known as "chromatophore".

(iv) NUCLEOID/PROCHROMOSOME/INCIPENT NUCLEUS/GENOPHORE:-

— Nucleoid is circular and double-stranded DNA.



— Histone proteins (packaging proteins) are absent in prokaryotic cell.

— Hence, also known as naked DNA.

(v) CYTOPLASM:- Main arena for metabolic activities. (fluid except nucleoid)

(vi) Extra genetic material / PLASMID:-

— Plasmid is present in some bacteria. It is also known as extrachromosomal material.

→ Plasmid might have different functions. for example:

F-plasmid : responsible for fertility

R-plasmid : responsible for resistance from some antibiotic

Ti-plasmid : responsible for tumor induction.

- It may or may not be present in bacteria.
- It is circular double stranded DNA.

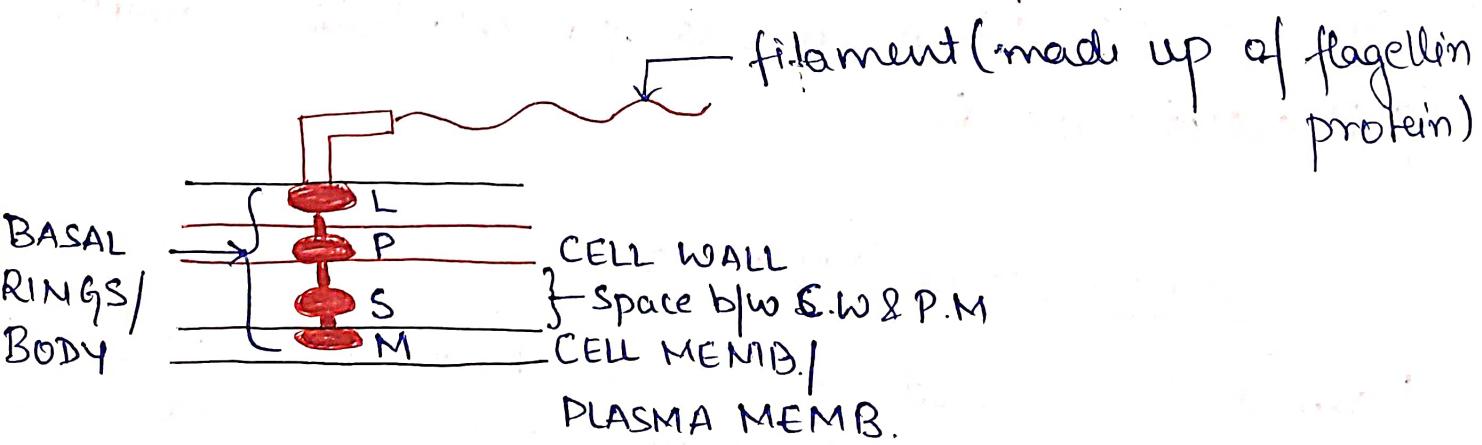
(viii) RIBOSOMES :- Prokaryotes have 70S ribosomes.

- Responsible for protein synthesis and also known as protein factories.

(ix) INCLUSION BODIES :- Responsible for storage of food material (Starch, fats, Glycogen etc)

(x) FLAGELLA :- Responsible for locomotion of prokaryotic cell.

- It is made up of flagellin protein (FILAMENT)



(xi) PILUS :- Extensions towards the outside of the cell known as pilus.

- made up of Pilin protein

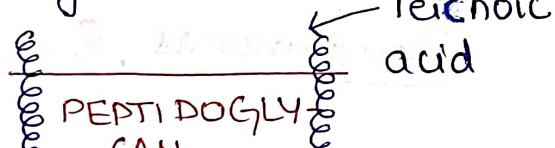
- Responsible for attachment with other bacteria, host, substratum etc.

(xii) GAS VACUOLE :- It is non-membrane bound and helps in Buoyancy (floating).

• GRAM STAINING (By Christian Gram) STAIN - CRYSTAL VIOLET

GRAM POSITIVE BACTERIA

- Stains violet, blue (retain gram stain)



CELL MEMB.

- Outer membrane is absent

- 70-80% murein/petidoglycan

- Lipid content less

- Teichoic acid present

GRAM NEGATIVE BACTERIA

- Stains pink, red
(do not retain gram stain)

OUTER MEMB.

PEPTIDOGLYCAN

CELL MEMB.

- Outer membrane present

- 10-20% murein/
peptidoglycan

- Lipid content more

- Teichoic acid absent.

GRAM POSITIVE BACTERIA

- Peptidoglycan has pentapeptide consists of amino-acids L-alanine, D-glutamic acid, L-lysine and D-alanine.
- flagellum contains 2 rings.
- less pathogenic bacteria
- Susceptible to antibiotic

Example:- Streptococcus,
Staphylococcus,
Bacillus

GRAM NEGATIVE BACTERIA

- Peptidoglycan has pentapeptide consists of amino-acids L-alanine, D-glutamic acid, mesodiaminopimelic acid and D-alanine.
- flagellum contains 4 rings.
- More pathogenic bacteria
- Resistant to antibiotics.

Example:- Salmonella,
Pseudomonas, Escherichia coli,
Rhizobium

FIVE KINGDOM CLASSIFICATION (WHITAKER'S)

Given by R.H Whitaker in 1969

Five kingdoms are:-

- Monera } PROKARYOTIC
 - Protista }
 - Fungi }
 - Plantae }
 - Animalia }
- EUKARYOTIC

1. KINGDOM MONERA :-

- These are single celled organisms with rigid cell wall. They are prokaryotic and reproduce by fission.
- Genomic recombination can take place by conjugation, transformation and transduction.
- These include Archeabacteria, Eubacteria and Cyanobacteria.

2. KINGDOM PROTISTA :-

- It contains eukaryotic organisms.
- They can be unicellular / multicellular.
- They can be photoautotrophic / Heterotrophic.
- These includes clioflagellates, diatoms, protozoa & slime moulds.

3. KINGDOM FUNGI:-

- Fungi are achlorophyllous and are mostly decomposers that invade their food from the source by secreting digestive enzymes and absorbs small organic molecules.
- Includes all fungi (Sac fungi, Club fungi, Imperfect fungi etc.)

4. KINGDOM PLANTAE:-

- These are non-motile, multicellular organisms with cell wall made up of cellulose.
- It can be divided into two types
 - Vascular (Pteridophytes, Gymnosperms & Angiosperms)
 - Non vascular (Algae, mosses, hornworts etc)
k/a Bryophytes
- They are photosynthetic and autotrophs.

5. KINGDOM ANIMALIA:-

- Includes multicellular, heterotrophic, eukaryotic organism.
- They show response to stimuli
- Main body is diploid and only the gametes are haploid.
- Includes all animals.