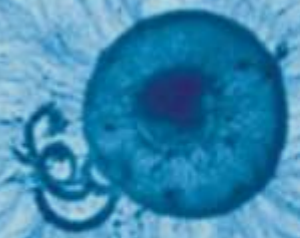
BACTERIA



“If you don't like bacteria, you're on the wrong planet.”

Bacteria – the benign, the bad and the beautiful.

Facts :

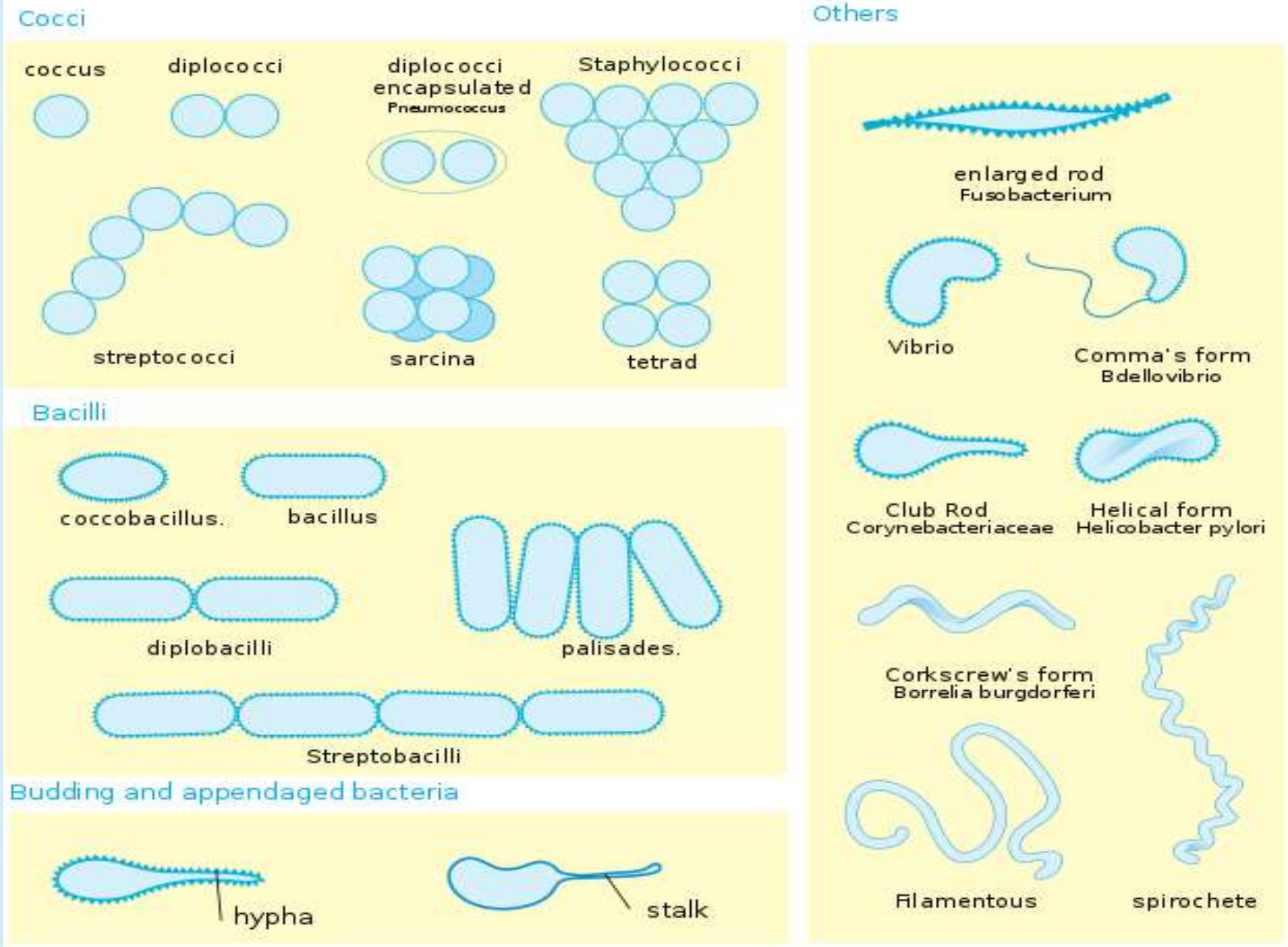
- **Bacteria are present almost everywhere from deep in the earth's crust to the polar ice caps and oceans to inside the bodies of plants and animals.**
- **There are more bacteria in your mouth than there are people in the world.**
- **Babies are born with no bacteria in their bodies.**
- **Electronics, cellphones, laptops, keyboards etc. hold a lot of bacteria. Single smartphone screens hold 18 times more bacteria than a toilet handle.**
- **Smell of rain is caused by a bacteria called actinomycetes.**
- **Sweat itself is odourless. It's the bacteria on the skin that mingles with it and produces body odour.**
- **Horseshoe crab blood is worth US $15000/ L due to its ability to detect bacteria.**
- **Gonorrhea bacteria is the strongest creatures on the earth as they can pull 100,000 times their own weight.**

Introduction

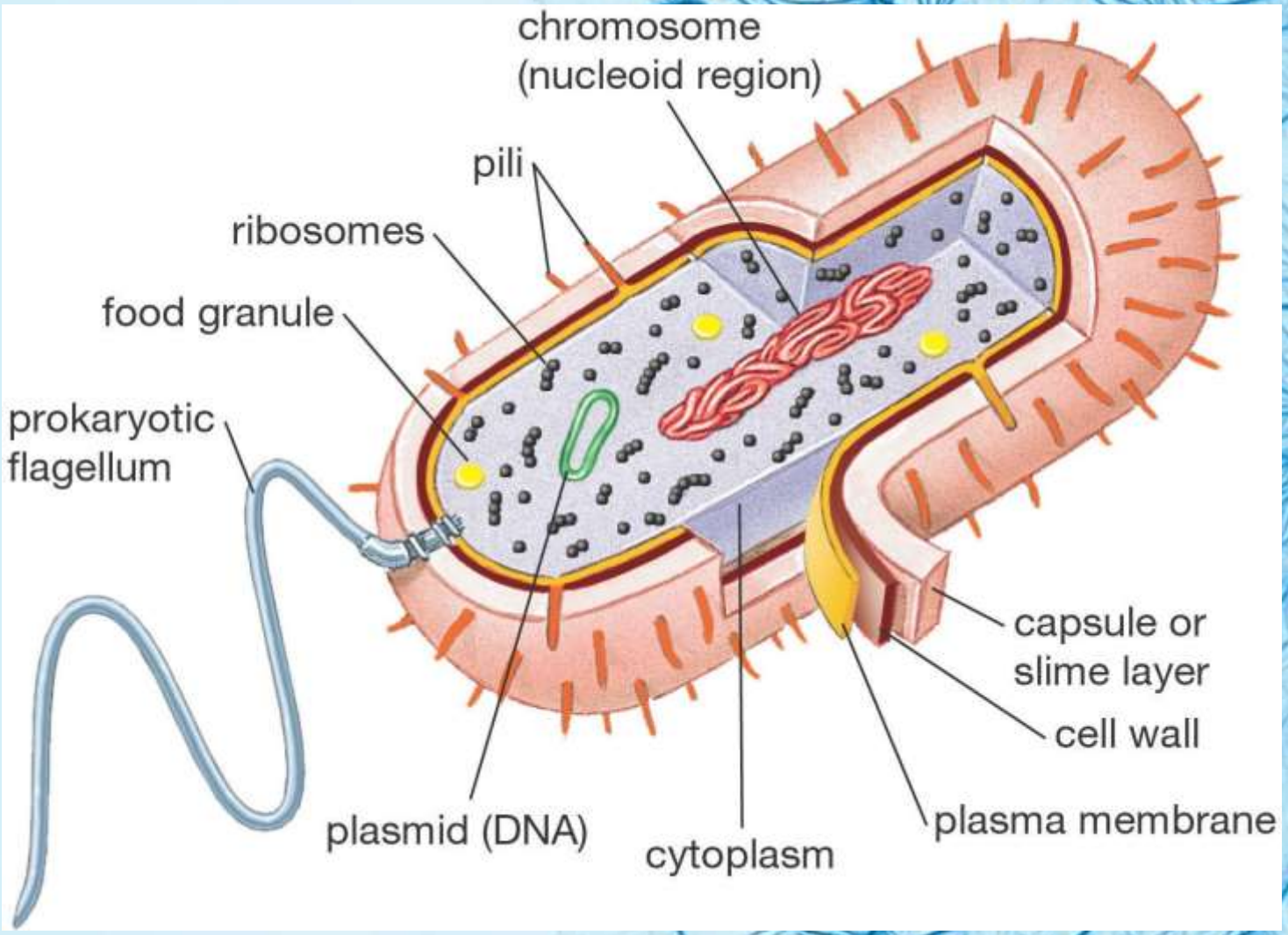
- Bacteria were discovered by Leeuwenhoek in 1676.
- They are the primitive forms of life.
- They are monerans and comprises a group of prokaryotic organisms which is characterized by:
  - Peptidoglycan wall
  - Compacted but naked DNA with attached mesosome
  - Reserve food material made up of glycogen and fats
  - Gas vacuoles may occur
  - All membranes bond cell organelles completely absent
  - 70S Ribosome occurs
- They have varied forms of nutrition.

Antonie van Leeuwenhoek
(1632-1723)

Bacterial cell structure § Cell morphology

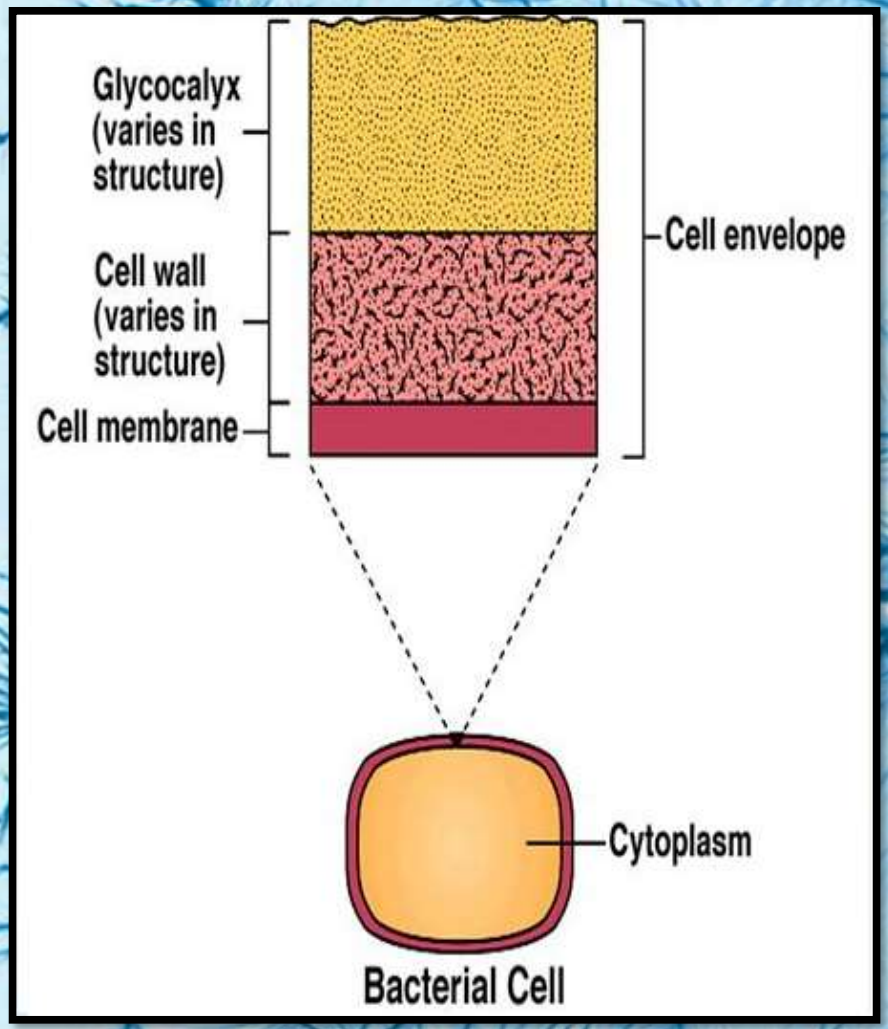


Structure of a typical bacterial cell



Cell Envelope

- ❑ Outer covering of protoplast of bacterial cell.
- ❑ The cell envelope of bacteria consist 3 components:
  - Glycocalyx
  - cell wall
  - plasma membrane



Glycocalyx

- Some bacteria have an additional layer outside of the cell wall called the Glycocalyx.
- This outermost mucilaginous layer consist of non cellulosic polysaccharides with or without proteins.
- It occurs as
  - Slime layer when glycocalyx occur in the form of loose mucilage sheath
  - Capsule when thick and tough mucilage covering.

- Glycocalyx gives sticky character to the cell.
- It is not absolutely essential for survival of bacteria. However it has several secondary functions:
  - Prevention of desiccation
  - Protection from phagocytes
  - Protection from toxic chemicals and drugs
  - Protection from viruses
  - Attachment
  - Immunogenicity
  - Virulence

Cell wall

- The bacterial cell wall differs from that of all other organisms by the presence of peptidoglycan which is located immediately outside of the cytoplasmic membrane.
- Peptidoglycan is made up of a polysaccharide backbone consisting of alternating N-Acetylmuramic acid (NAM) and N-acetylglucosamine (NAG) residues in equal amounts.
- Peptidoglycan is responsible for the rigidity of the bacterial cell wall and for the determination of cell shape.
- It is relatively porous and is not considered to be a permeability barrier for small substrates.

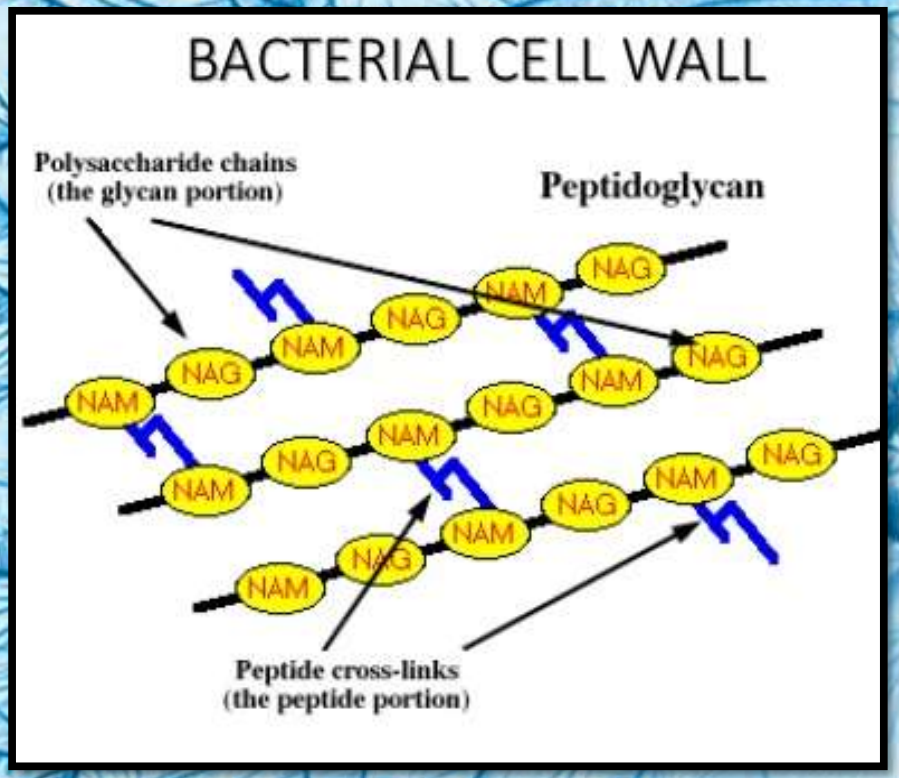


Fig: The structure of peptidoglycan.

Types of bacterial cell wall

- There are two main types of bacterial cell walls, those of gram-positive bacteria and those of gram-negative bacteria, which are differentiated by their Gram staining characteristics.
- Gram-positive cell walls are thick and Gram-negative cell walls are thin peptidoglycan layer adjacent to the cytoplasmic membrane.
- Peptidoglycan layer constitutes almost 95% of the cell wall in some gram-positive bacteria and as little as 5-10% of the cell wall in gram-negative bacteria.

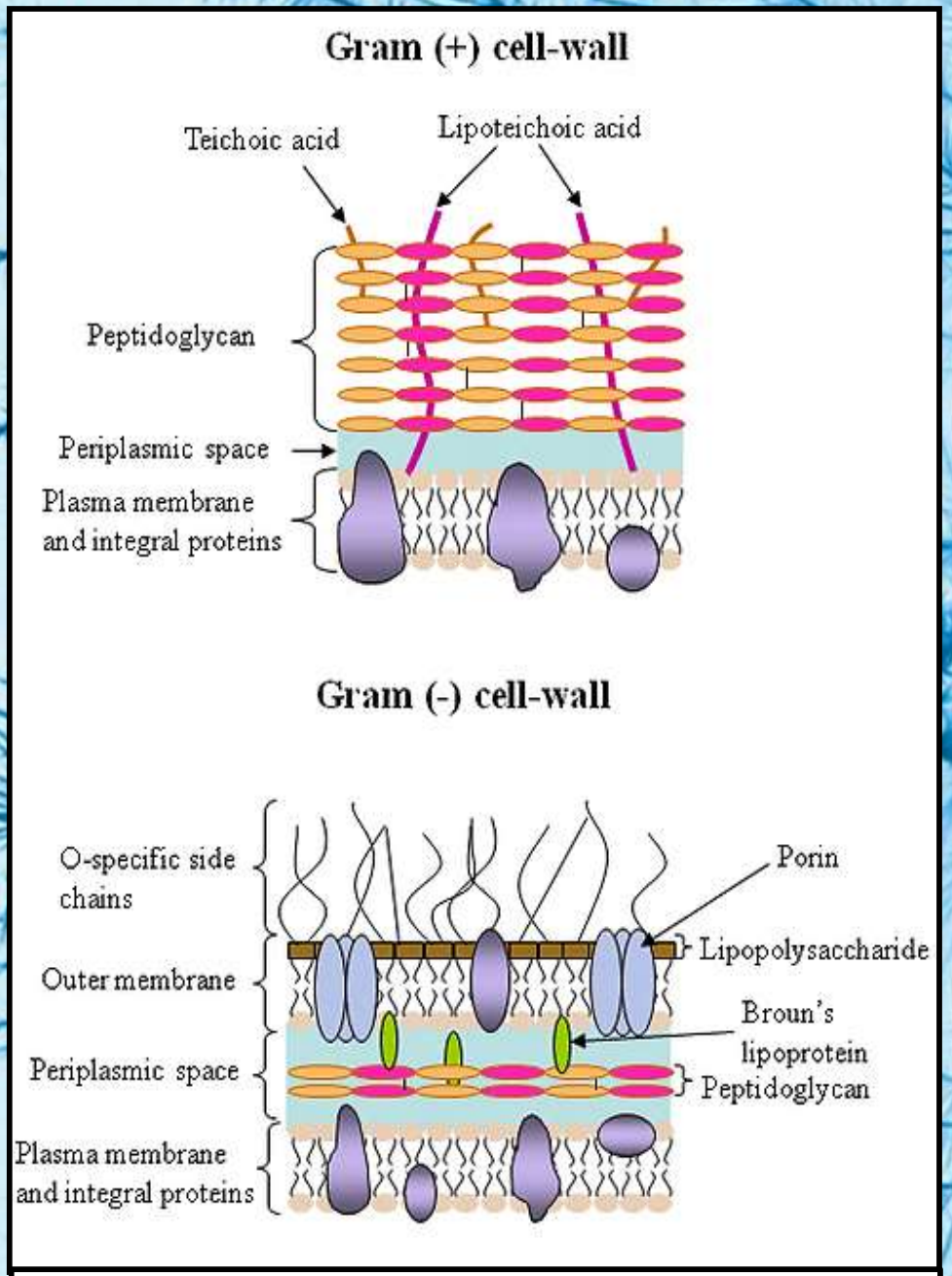


Fig: Structure of bacterial cell wall

Cell membrane

- The plasma membrane or bacterial cytoplasmic membrane is composed of a phospholipid bilayer and thus has all of the general functions of a cell membrane.
- It is selectively permeable.
- It is metabolically active as it takes part in respiration, synthesis of lipids and cell wall components.

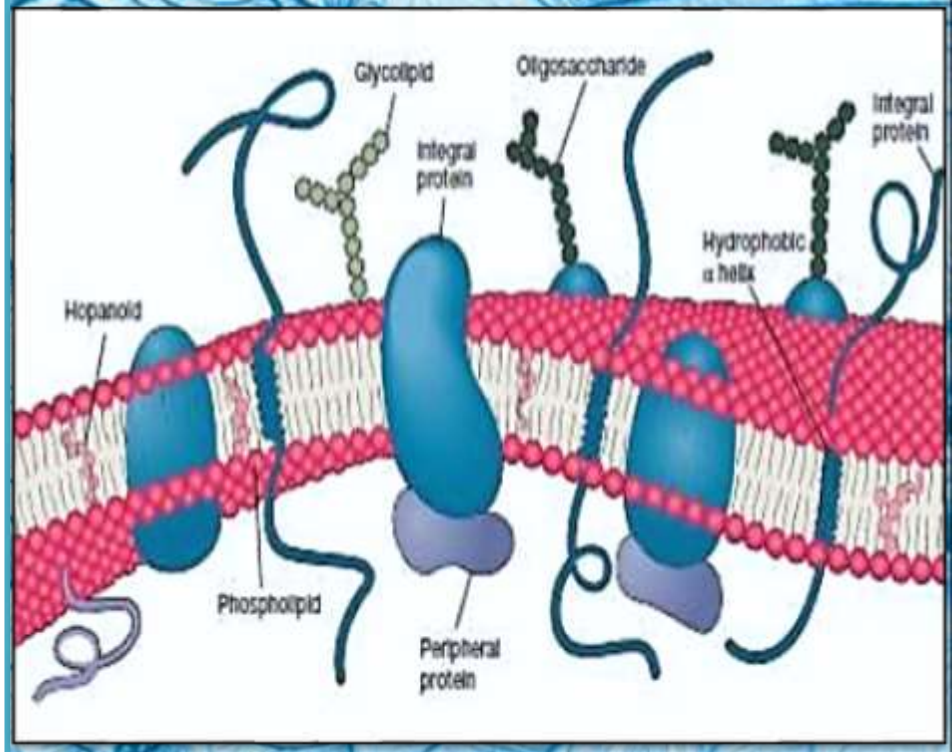


Fig: Bacterial cell membrane

Mesosome

- Multi-laminated structure formed invaginations of plasma membrane.
- Principal sites of respiratory enzymes.
- Coordinate nuclear & cytoplasmic division during binary fission.
- More prominent in Gram +ve bacteria.

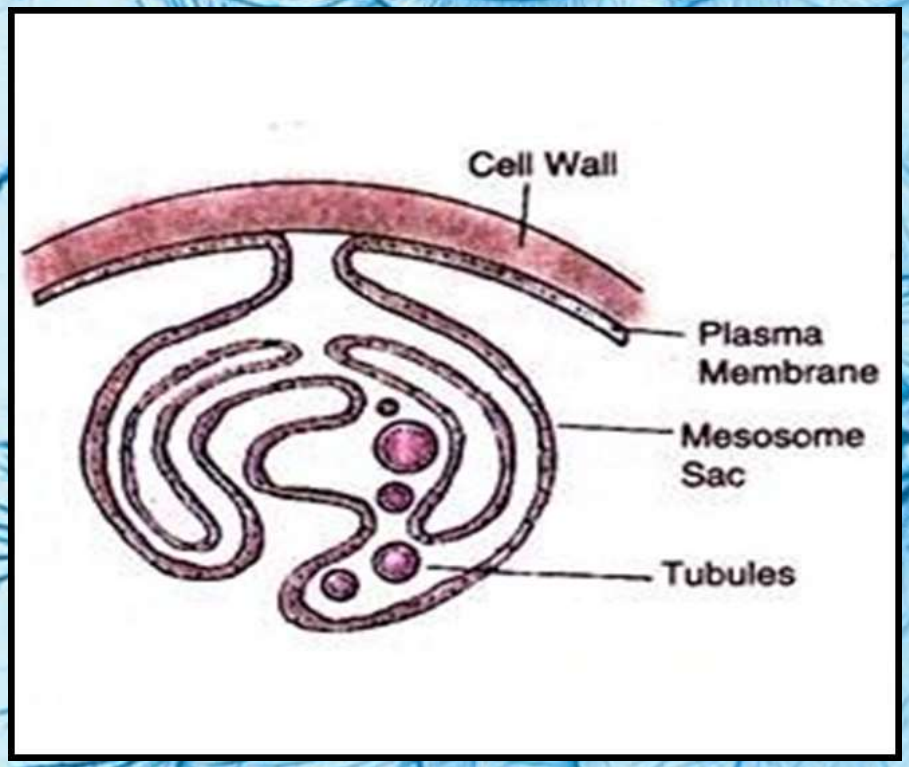


Fig : structure of mesosome

Ribosome

- **Bacteria** and archaebacteria have smaller **ribosomes**, termed **70S ribosomes**, which are composed of a small 30S subunit and large 50S subunit.
- The "S" stands for svedbergs, a unit used to measure how fast molecules move in a centrifuge

Fig : structure of 70S ribosome

Nucleoid
(Bacterial Chromosome)

- Since the bacterial cell is prokaryotic, a true nucleus is absent.
- The nuclear material is represented by DNA which is not associated with histones.
- The bacterial DNA is circular and is attached at a point to the plasma membrane.

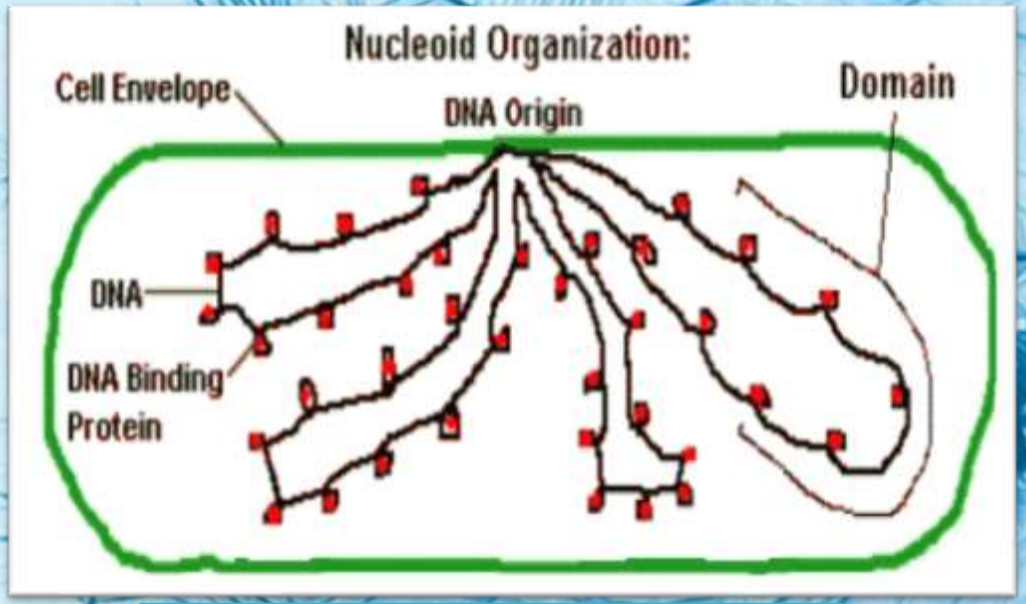
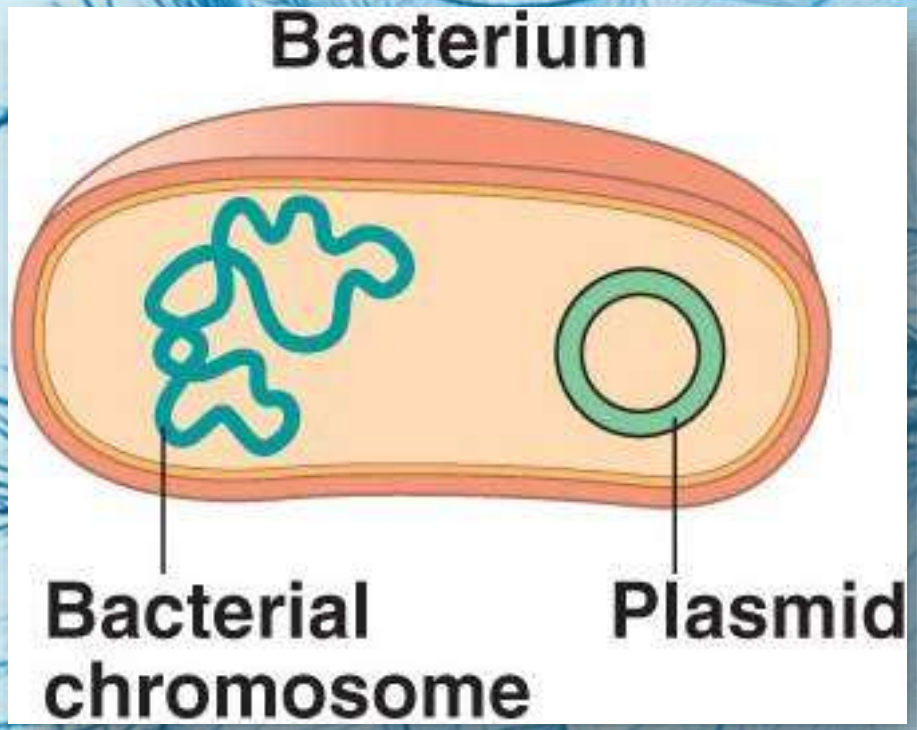


Fig : nucleoid organisation in bacteria

Plasmid

- Extra nuclear genetic elements consisting of DNA.
- Transmitted to daughter cells during binary fission.
- May be transferred from one bacterium to another.
- Not essential for life of the cell.
- Confer certain properties e.g. drug resistance, toxicity.



Flagella

- Long (3to12µ),filamentous surface appendages.
- Organs of locomotion.
- Chemically, composed of proteins called flagellins.
- The number and distribution of flagella on th bacterial surface are characteristic for a given species-hence are useful in identifying and classifying bacteria.
- Flagella may serve as antigenic determinants(e.g.the H antigens of Gram-negative enteric bacteria).
- Presence shown by motility e.g.hanging drop preparation.

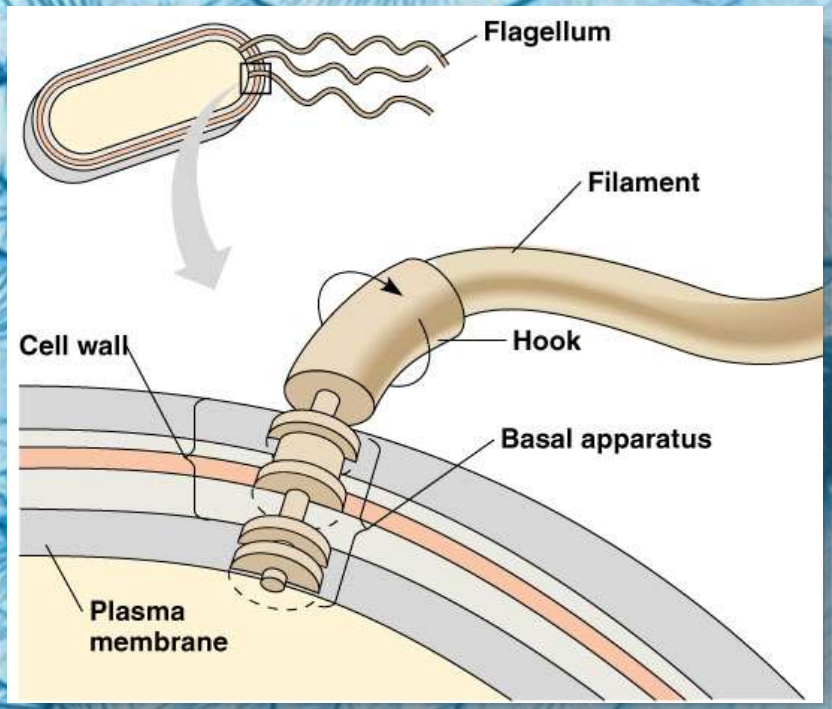
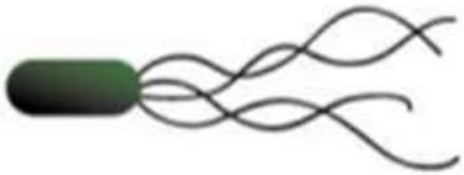


Fig : structure of flagella

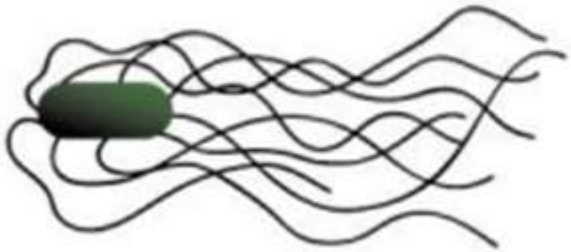
Types of flagellar arrangement

Polar/ Monotrichous – single flagellum at one pole



Lophotrichous – tuft of flagella at one pole

Amphitrichous – flagella at both poles

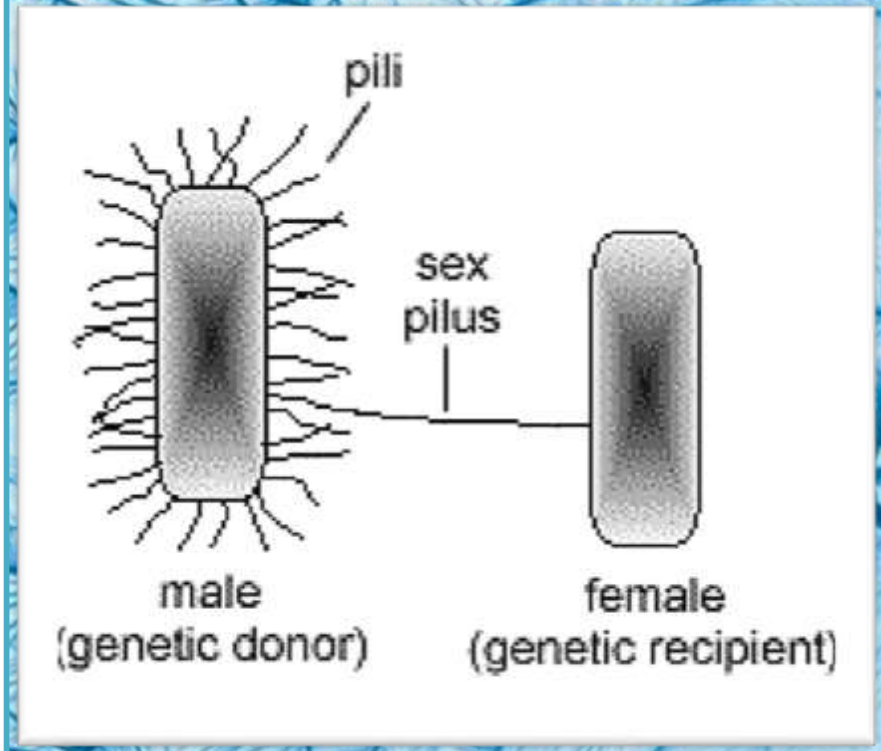


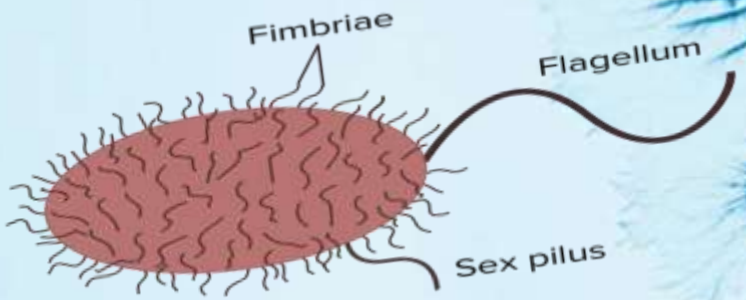
Peritrichous – flagella all over

Amphilophotrichous – tuft of flagella at both ends

Pilli and fimbriae

- Proteins filaments.
- Shorter and thinner: fimbriae
- Longer and fewer: pili
- Sex Pili : The filaments that are best known for their function in conjugation.





Inclusion bodies

- Are reserve deposits of bacterial.
- Cells accumulate nutrient when they are plenty and use when deficient.
- Major Inclusion bodies are:
  - Gas vacuoles-allows for buoyancy .
  - Sulfur granules.
  - Polyphosphate granules.
  - Glycogen granules.
  - Lipid inclusion.
  - Magnetosomes.


Thank you