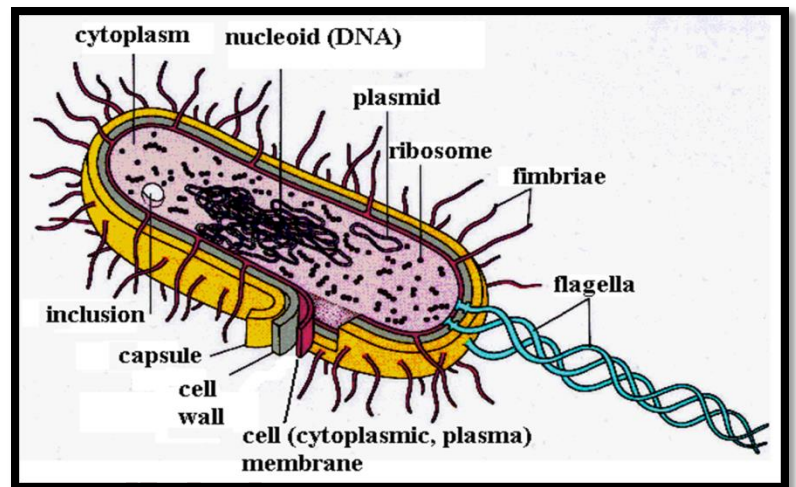


Lec.2 Bacterial Cell

✚ General property of bacterial cell:

- Typical prokaryotic cell
- Contain both DNA and RNA
- Most grow in artificial media
- Replicate by binary fission
- Almost all contain rigid cell wall
- Sensitive to antimicrobial agent



Typical bacterial cell structure

✚ Structure of bacteria :

Bacterial structure is considered at three levels.

1. **Cell envelope proper:** Cell wall and cell membrane.
2. **Cellular element enclosed with in the cell envelope:** Mesosomes, ribosomes, nuclear apparatus, polyamines and cytoplasmic granules.
3. **Cellular element external to the cell envelope:** Flagellum, Pilus and Glycocalyx.

1. Cell envelope proper

A. Cell wall : Multi layered structure and constitutes about 20% of the bacterial dry weight. Average thickness is 0.15-0.5 μm . Young and rapidly growing bacteria has thin cell wall but old and slowly dividing bacteria has thick cell wall.

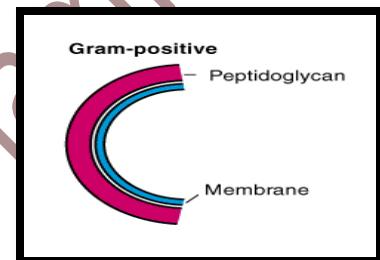
It is composed of NAM (N-acetyl Muramic acid) and NAG(N-acetyl Glucosamine) back bones cross linked with peptide chain and pentaglycine bridge.

➤ **Functions of cell wall**

1. Provides shape to the bacterium
2. Gives rigidity to the organism
3. Protects from environment
4. Provides staining characteristics to the bacterium
5. Contains receptor sites for phages/complements
6. Site of action of antibody
7. Contains toxic components to host

Components of cell wall of Gram positive bacteria

1. Peptidoglycan
2. Teichoic acid



Components of cell wall of Gram negative bacteria

1. Peptidoglycan
2. Lipoprotein
3. Phospholipid
4. Lipopolysaccharide

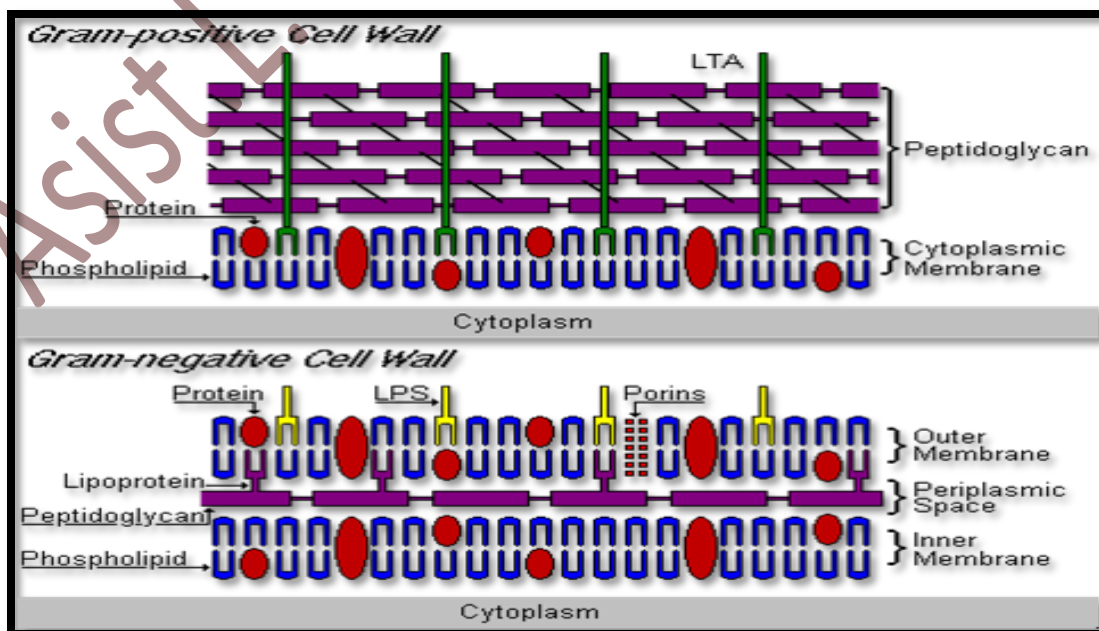
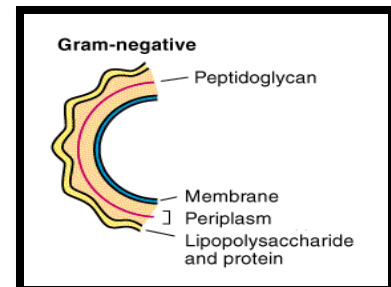


Table. Comparison of Gram +ve & Gram -ve cell walls

Characteristics	Gram +ve	Gram -ve
Number of layers	one	Two
Chemical composition	1. Peptidoglycan 2. Teichoic acid	1. Peptidoglycan 2. Lipoprotein 3. Phospholipid 4. Lipopolysaccharide
Thickness	Thicker (20-80nm)	Thinner (8-11nm)
outer membrane	No	Yes
Periplasmic space	Narrow	Extensive
Permeability to molecules	More permeable	Less permeable

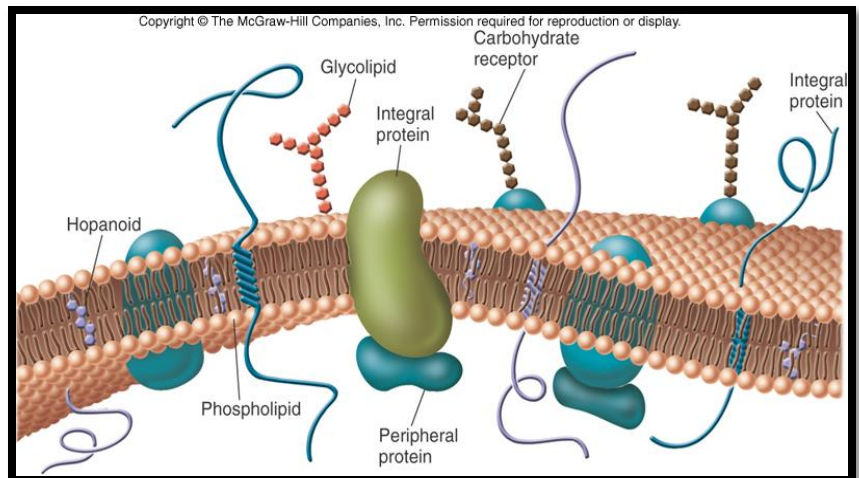
B. Cell membrane

Also named as cell membrane or cytoplasmic membrane

- It is a delicate trilaminar unit membrane .
- It accounts for 30% of the dry weight of bacterial cell.
- It is composed of 60% protein, 20-30% lipids and 10-20% carbohydrate.

➤ Function of cell membrane

1. Regulates the transport of nutrients and waste products into and out of the cell.
2. Synthesis of cell wall components
3. Assists DNA replication
4. Secretes proteins
5. Carries on electron transport system
6. Captures energy in the form of ATP



Structure Cell membrane

2. Cellular element enclosed within the cell envelope

A. Mesosomes : Convoluted invagination of cytoplasmic membrane often at sites of septum formation. It is involved in DNA segregation during cell division and respiratory enzyme activity.

B. Ribosomes : Cytoplasmic particles which are the sites of protein synthesis. It is composed of RNA(70%) and proteins(30%) and constitutes 90% of the RNA and 40% of the total protein. The ribosome monomer is 70s with two subunits, 30s and 50s.

C. Polyamines : It is found in association with bacterial DNA, ribosomes and cell membrane. **Function of polyamines :** 1. Antimutagenic 2. Prevent dissociation of 70s ribosome into subunits. 3. Increase resistance of protoplast lysis.

D. Cytoplasmic granules : represent accumulated food reserves.

Nature of granules : (Glycogen ,Poly-beta hydroxy butyrate, Volutin)

E. Nuclear apparatus

Well defined nucleus and nuclear membrane , discrete chromosome and mitotic apparatus are not present in bacteria ; so nuclear region of bacteria is named as nuclear body, nuclear apparatus and nucleoid.

Bacterial genome consists of single molecule of double stranded DNA arranged in a circular form. Besides nuclear apparatus, bacteria may have extra chromosomal genetic material named as plasmids.

Plasmids do not play any role in the normal function of the bacterial cell but may confer certain additional properties (Eg. Virulence, drug resistance) which may facilitate survival and propagation of the micro- organism.

3. Cellular element external to the cell envelope

A. Glycocalyx (capsule and slime layer)

Capsule is gel firmly adherent to cell envelope , **Slime** is gel easily washed off from cell envelope. All bacteria have at least a thin slime layer. Capsule is composed of polysaccharide and protein (D-Glutamate of Bacillus anthracis)

➤ Features of capsule

1. Usually composed of polysaccharide
2. well organized and not easily removed from cell
3. visible in light microscope
4. protective advantages :
 - resistant to phagocytosis
 - protect from desiccation
 - exclude viruses and detergents

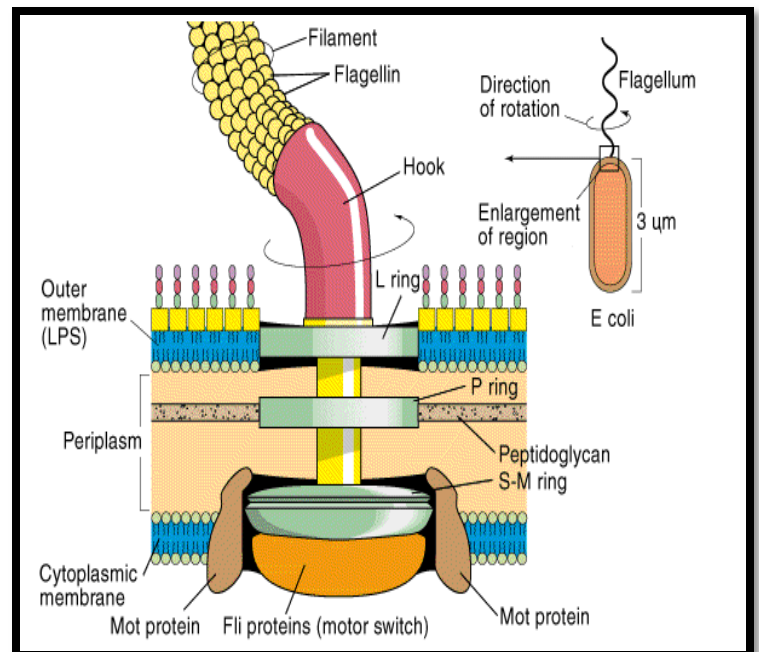
B. Flagellum

It is the organ of locomotion in bacterial cell and consists of three parts. These are : (1.The filament 2. The hook 3. The basal body)

The basal body and hook are embedded in the cell surface while the filament is free on the surface of bacterial cell.

Size: 3-20µm in length and 0.01-0.013µm in diameter.

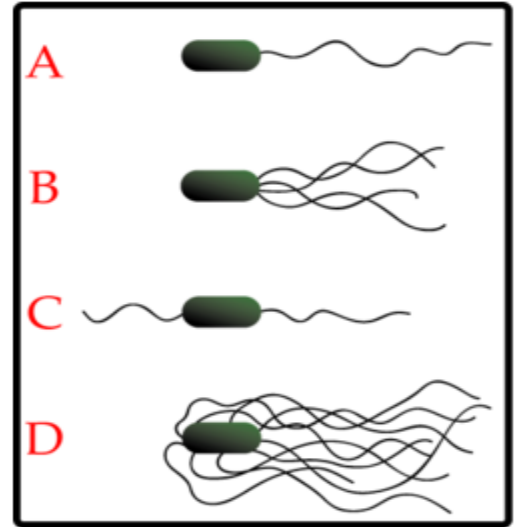
It is composed of protein named as flagellin. The flagellar antigen in motile bacterium is named as H (Hauch) antigen.



Structure of flagellum

Flagellar arrangements

1. **Atrichous:** Bacteria with no flagellum.
2. **Monotrichous:** Bacteria with single polar flagellum.
3. **Lophotrichous:** Bacteria with bunch of flagella at one pole.
4. **Amphitrichous:** Bacteria with flagella at both poles.
5. **Peritrichous:** Bacteria with flagella all over their surface.



- **Endoflagella** (axial filament) : It is the organ of motility found in periplasmic space of spirochetes.

C. Pili (fimbriae)

It is hair like structure composed of protein (pilin) ,Two types (Based on function)

- 1 . **Common pili:** The structure for adherence to cell surface.
- 2 . **Sex pili:** The structure for transfer of genetic material from the donor to the recipient during the process of conjugation.

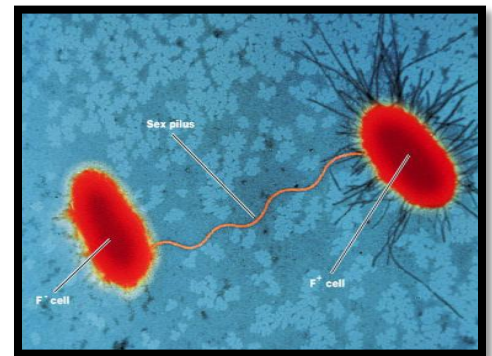


Table .comparison between flagella & pili

Character	Flagella	Pili
Size	Large	Small
Thickness	Very thick	Thin
Origin	Cell membrane	Cell wall
Organ of locomotion	Yes	No
Organ of adhesion	No	Yes
Required for conjugation	No	Yes

D. Spores

Resting cells which are capable of surviving under adverse environmental conditions like heat, drying, freezing, action of toxic chemicals and radiation.
Bacterial spore is smooth walled and oval or spherical in shape.

It does not take up ordinary stains. It looks like areas of high refractivity under light microscope. It is significant in spread of disease and indicator of sterility of materials.

➤ Arrangements of spores

1. No bulging of cell wall

- . Oval central
- . Oval sub terminal
- . Spherical central

2. Bulging of cell wall

- . Oval sub terminal
- . Oval terminal
- . Spherical terminal
- . Free spore

