BHARATHIDASAN UNIVERSITY

Tiruchirappalli-620024

Tamil Nadu, India.

Programme: M.Sc., Biomedical Science

Course Title : Microbiology

Course Code : BM24AC4

Unit-III

Bacterial Anatomy

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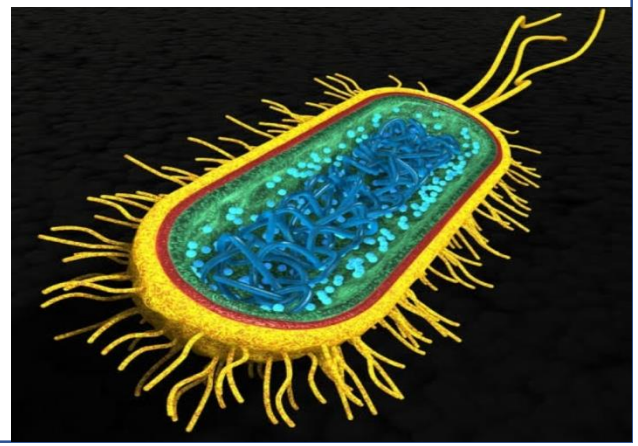
Department of Biomedical Science

BACTERIAL ANATOMY



ANATOMY OF BACTERIA

- Bacteria is unicellular, free living, microscopic microorganism capable of performing all the essential functions of life.
- They possess both deoxyribonucleic acid (DNA) and ribonucleic acid(RNA).
- Bacteria are prokaryotic microorganism that do not contain chlorophyll.
- They contain in water, soil, air, food, and all natural environment.

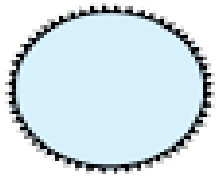
- They can survive extremes of temperature, ph, oxygen, and atmospheric pressure.
- Average bacteria 0.5-2.0 um in diam.
- Cocci is 1um &bacillus is 2-10 um

SHAPES OF BACTERIA

- COCCI-small, spherical or oval shape.
- BACILLI-rod shaped shape.Eg:E.coli,Clostridium botulinum
- VIBRIOS-comma shaped curved rods. Eg:Vibrio cholerae
- SPIRILLA-helical shape and rigid body. Eg: Helicobacter pylori
- SPIROCHETES-slender and flexuous spiral forms. Eg: Spirochaeta,Treponema

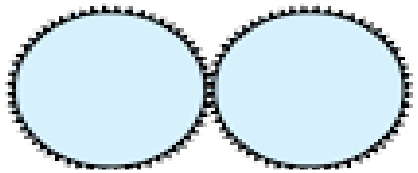
Arrangements of Cocci

coccus



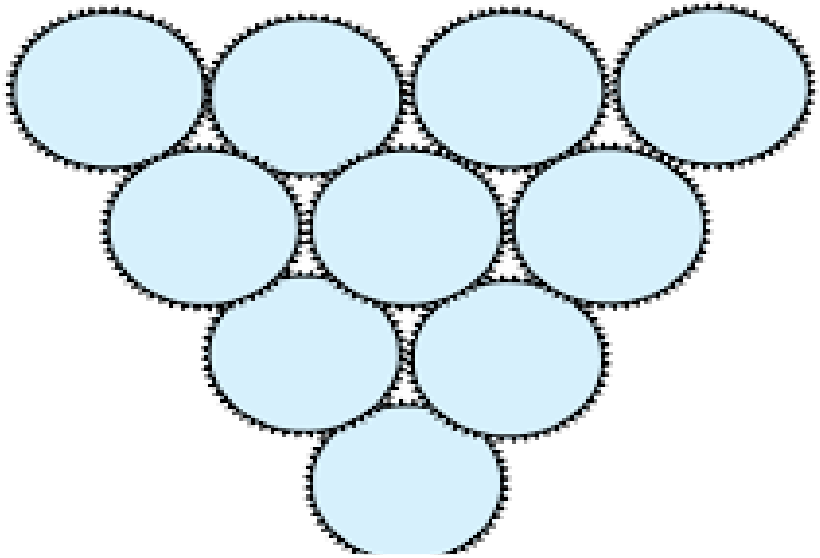
Micrococcus flavus

diplococci

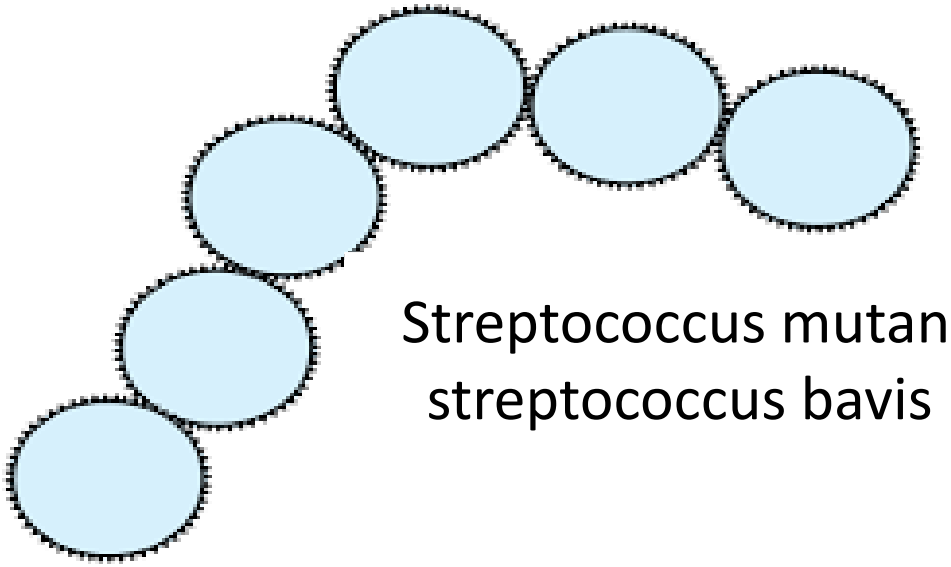


Neisseria spp
Streptococcus pneumoniae

Staphylococci

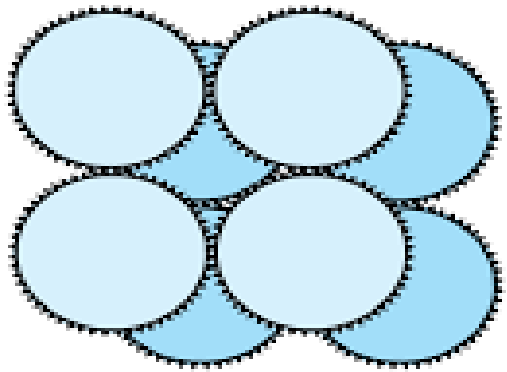


Staphylococcus aureus



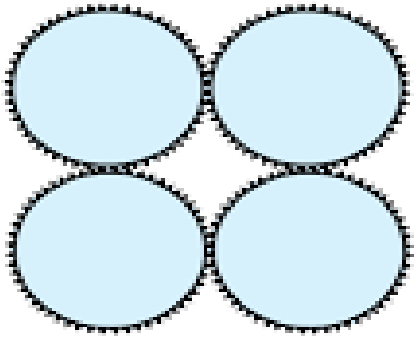
Streptococcus mutans,
streptococcus bavis

streptococci



sarcina

Sarcina ventriculi



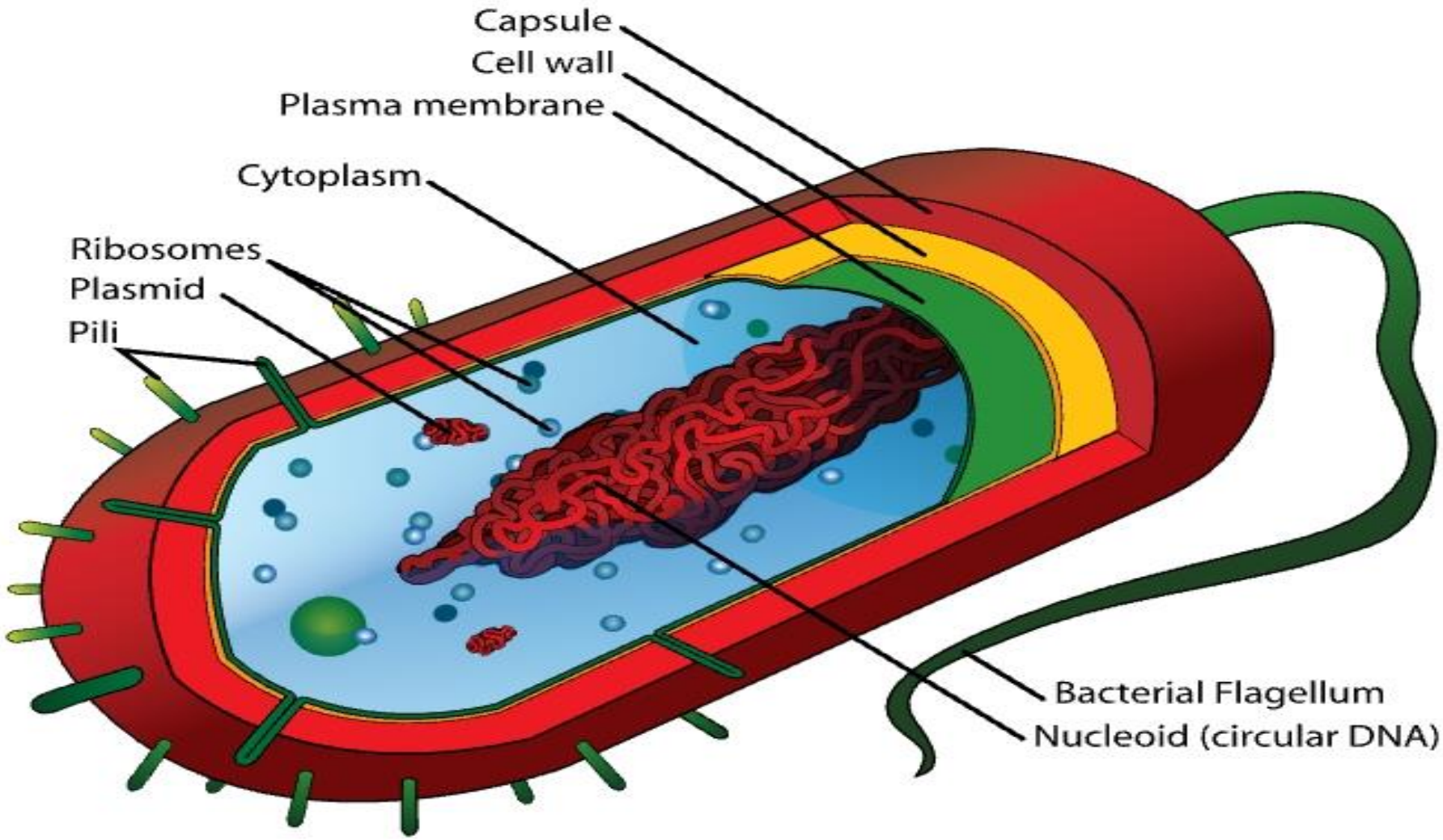
tetrad

Pediococcus spp


vibrio *

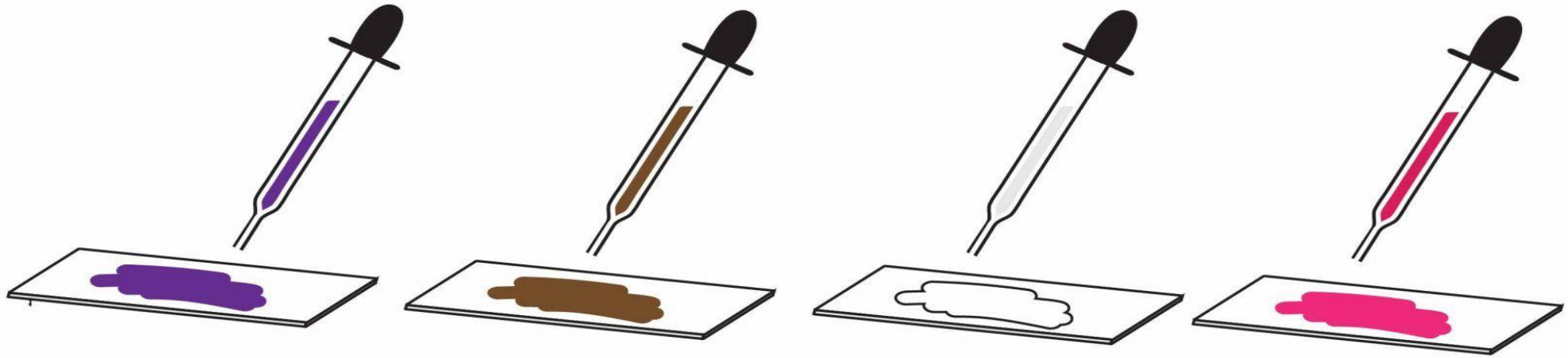
BACTERIAL STRUCTURES

- Cell wall
- Teichoic acids
- Lipopolysaccharide
- Cytoplasm
- Flagella
- Pili
- Capsule
- Inclusions
- spores


Capsule
Cell wall
Plasma membrane
Cytoplasm
Ribosomes
Plasmid
Pili
Bacterial Flagellum
Nucleoid (circular DNA)

CELL WALL

- Cell wall is an important structure of a bacteria.
- It gives shape, rigidity and support to the cell.
- Encloses the protoplast and lies immediately external to the cytoplasmic membrane.
- Rigid with some elasticity
- Thickness depends on type of bacteria.
- On the basis of cell wall composition, bacteria are classified into two major groups . Gram positive and gram negative.



Gram-positive

crystal violet

1 min

iodine

1 min

alcohol

10 sec

safranin

1 min

Gram-negative

rsscience.com

- **TYPES OF CELL WALL**

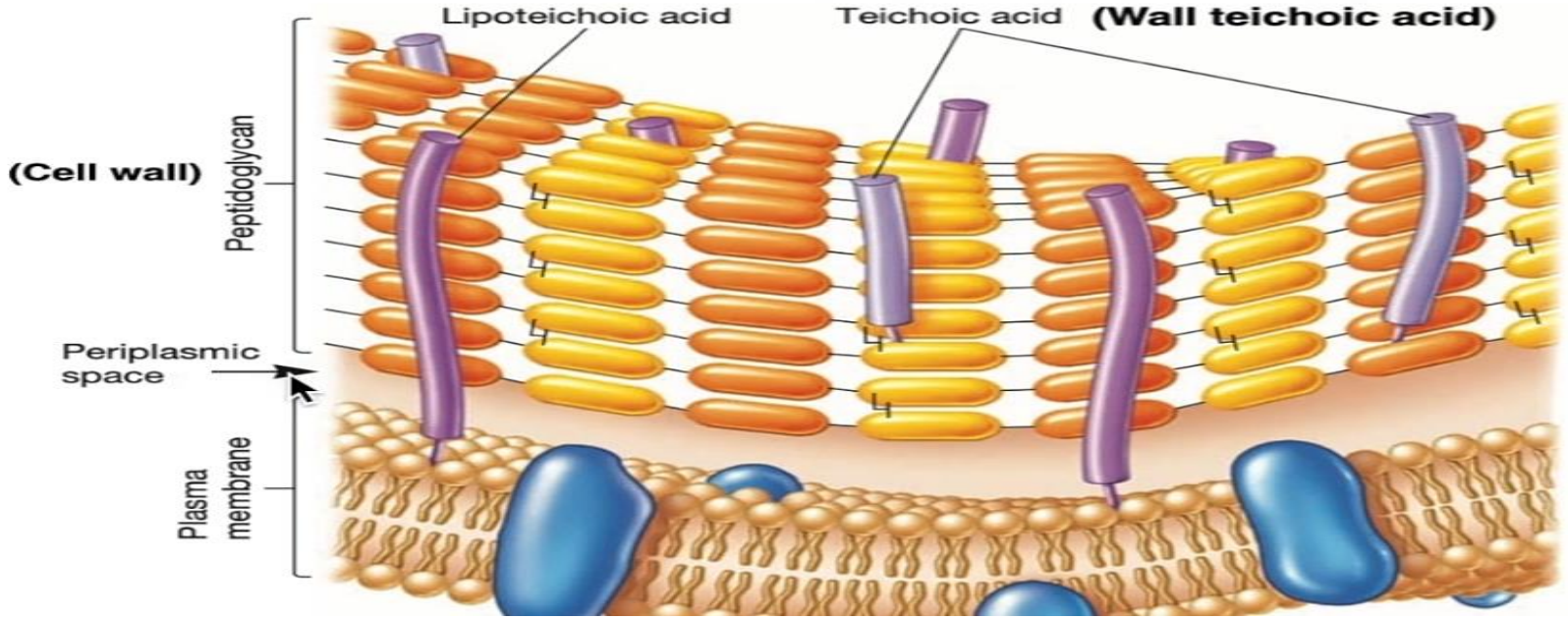
❑GRAM POSITIVE CELL WALL

Cell wall composition of gram positive bacteria.

1. Peptidoglycan
2. Teichoic acid

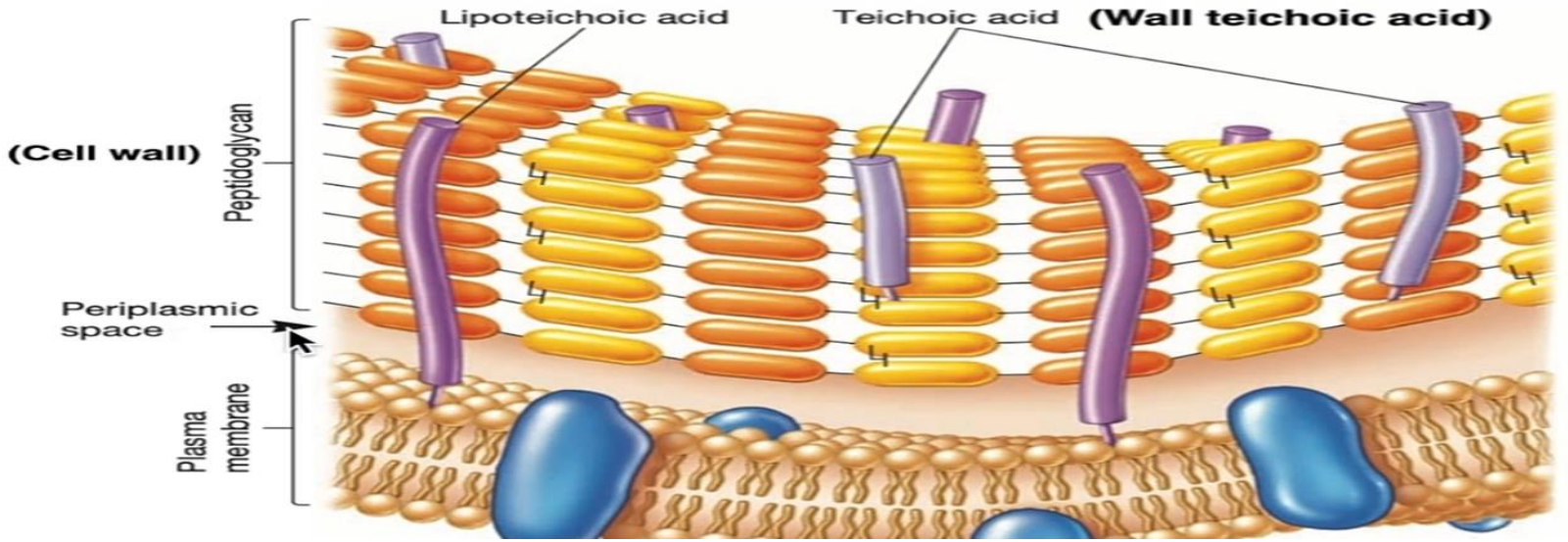
PEPTIDOGLYCAN:

- Peptidoglycan, is a mesh-like polymer composed of many identical subunits.
- Peptidoglycan comprises up to about 50% of the cell wall material.
- Peptidoglycan layer is 20-80 nm thick.
- It constitutes 50-90% of the dry weight of the cell wall and are thicker and stronger.



TEICHOIC ACID

- gram –positive bacteria do not have outer membrane but have a much thicker cell wall containing teichoic acid, lipoteichoic acid and lipoglycan .
- major antigen of gram positive bacteria.
- Teichoic acid was discovered by BADDILEY(1933).



GRAM NEGATIVE CELL WALL

Cell wall composition of gram negative bacteria.

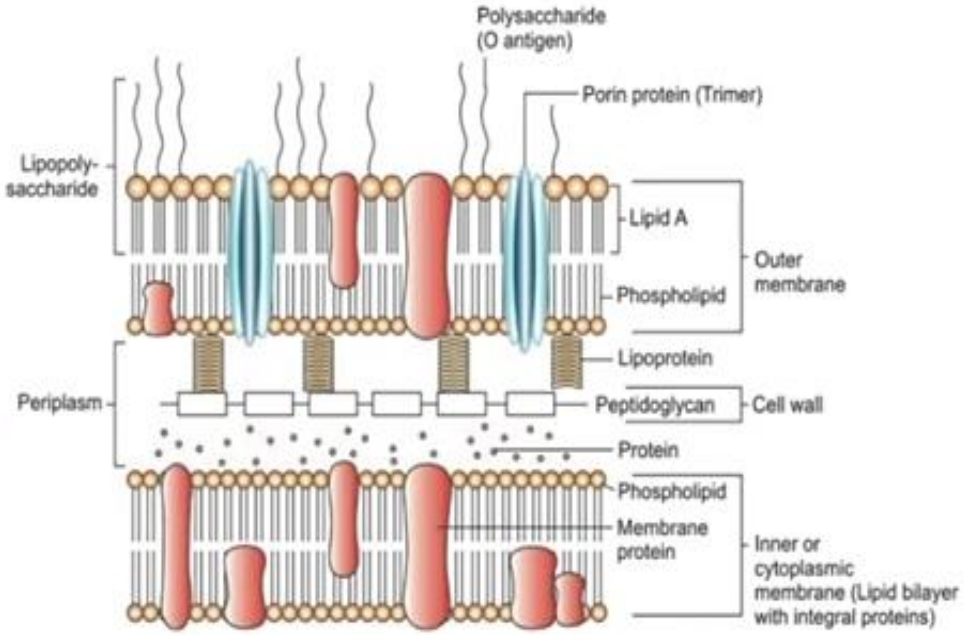
1.Peptidoglycan

2.outermembrane;

- lipid
- protein
- lipopolysaccharide{LPS}

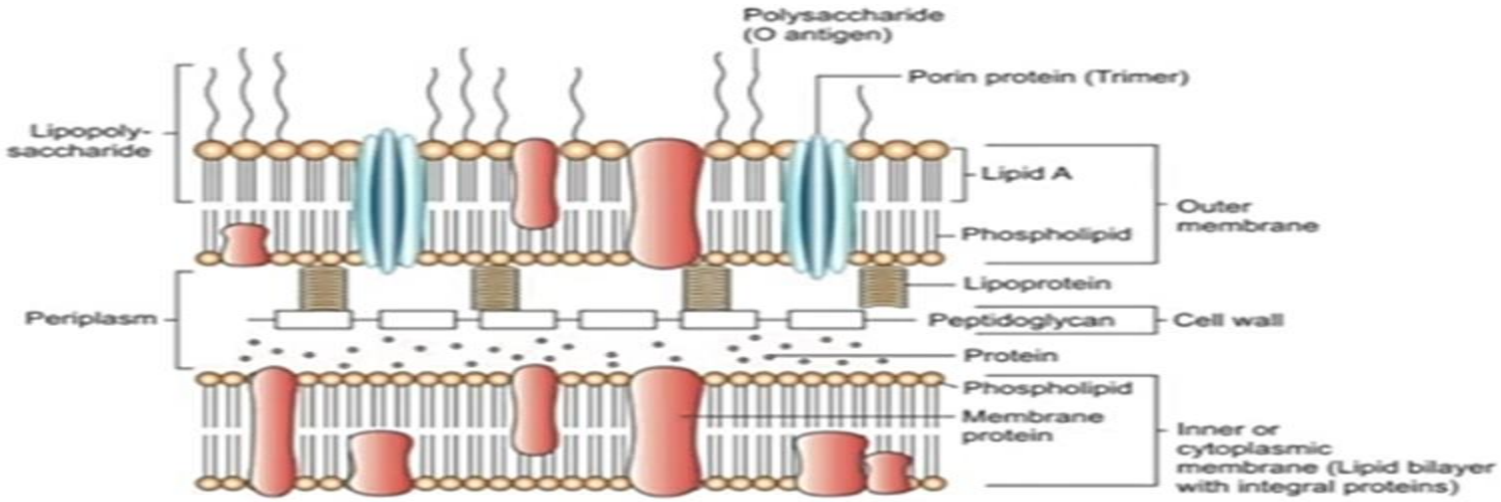
PEPTODOGLYCAN LAYER:

- The peptidoglycan layer is **single - unit thick** and it constitutes **5-10 % of the dry weight of the wall** of gram negative bacteria.
- Peptidoglycan is **bonded to lipoproteins covalently in the outer membrane and plasma membrane** and is in the **periplasmic, a gel like fluid between the outer membrane and plasma membrane**.
- In ***E. coli,*** **the peptidoglycan layer is about 2 nm thick and contains only one or two sheets of peptidoglycan.**



- **LIPOPROTEIN**
- Lipoprotein cross-link the outer membrane and peptidoglycan layers.
- Lipoprotein, or murein lipoproteins, is the most abundant protein in the outer membrane.
- Function is to stabilize the outer membrane and anchor it to the peptidoglycan layer.

- OUTER MEMBRANE
- External to the peptidoglycan, and attached to it by lipoproteins is the outer membrane.
- Its outer leaflet contains a lipopolysaccharides.
- Has special channels, consisting of protein molecules called porins.
- A PROTECTIVE BARRIER:
- It is the most important function of the outer membrane.
- It prevents or slows the entry of the toxic substances that might kill or injure the bacterium.

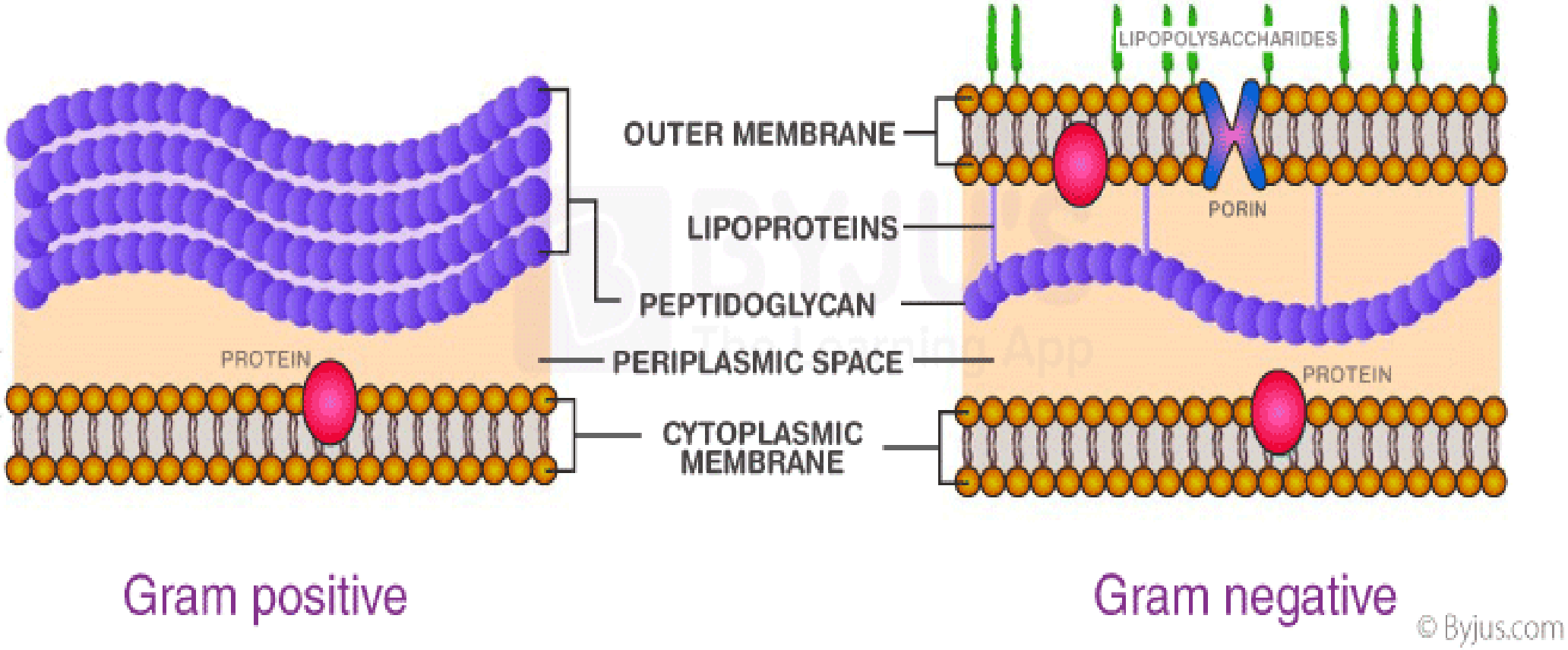


- **LIPOPOLYSACCHARIDE[LPS]**
- That is unique to the gram negative outer membrane are its lipopolysaccharides.{LPS}.

- Outermost part of cell wall of gram negative bacteria.
- Consists of three components,
- Lipid A
- Core Polysaccharide and
- O polysaccharide

- LIPID A:
- Lipid A is the lipid portion of LPS and is embedded in the top layer of the outer membranes.
- THE CORE POLYSACCHARIDE:
- The core polysaccharide is attached to lipid A and a terminal series of repeating unit contains unusual sugars.
- Its role is to provide stability.
- O POLYSACCHARIDE:
- It extends outward from the core polysaccharide and is composed of sugar molecules.

GRAM POSITIVE VS. NEGATIVE CELL WALL



Difference in Cell Wall

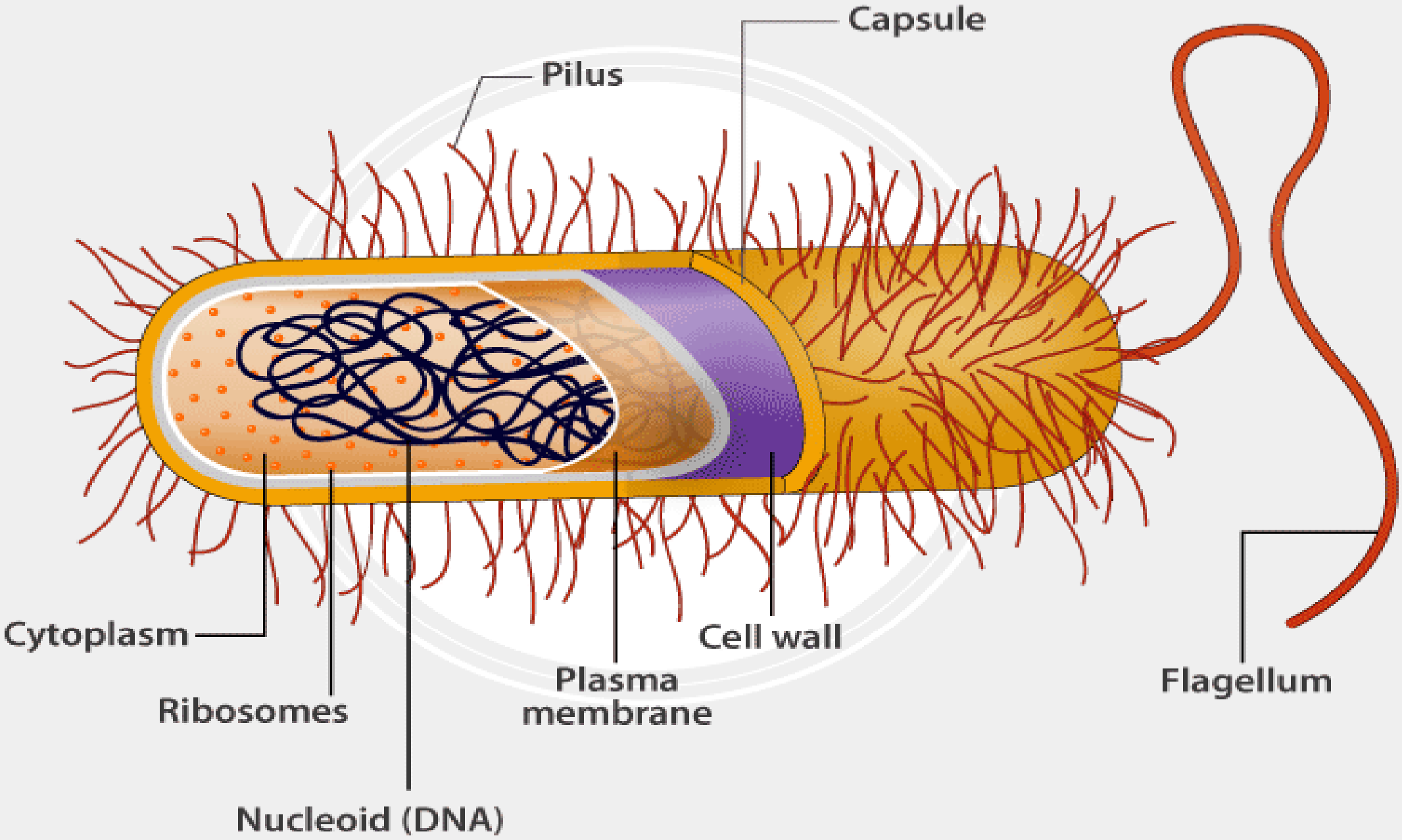
Gram positive	Gram negative
Thick peptidoglycan layer	Thin peptidoglycan layer
Mucopeptide- 80%	Mucopeptide- 40-60%
Teichoic acid present making cell wall more acidic	Teichoic acid absent so less acidic
Lipopolysaccharide membrane that is soluble in solvent like acetone and alcohol is absent	Lipopolysaccharide membrane that is soluble in solvent like acetone and alcohol is present.
Outer membrane having proteins (OMP)and pores (Porins) absent.	Outer membrane having proteins (OMP)and pores (Porins) present.

FUNCTIONS OF CELLWALL

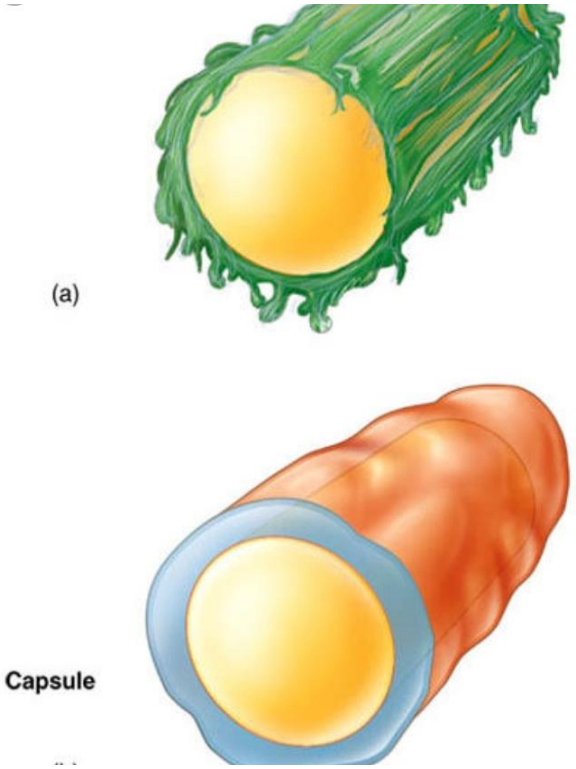
- Provides shape to the bacterium.
- Give rigidity to the organism.
- Protects from environment.
- Contains components toxic to host.
- Protection of internal structure.
- Helps in cell division.
- Bacterial cellwall is to provide overall strength to the cell.

CAPSULE

- Bacterial capsule a gelatinous envelope surrounding a bacterial cell, usually polysaccharide but sometimes polypeptide in nature; it is associated with the virulence of pathogenic bacteria.
- Capsulated cells of pathogenic bacteria are usually more virulent than cells without capsules.
- When the material is tightly associated with cellwall it is called capsule.

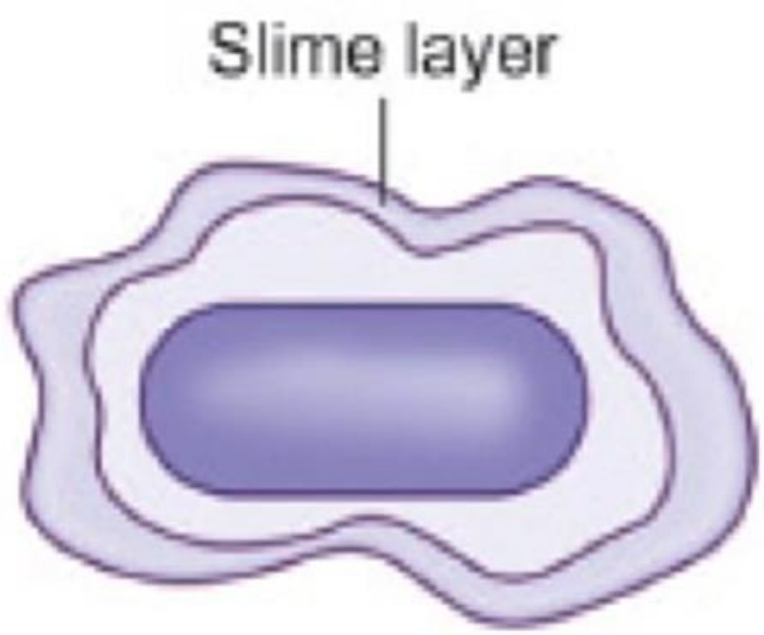

Capsule
Pilus
Cytoplasm
Ribosomes
Nucleoid (DNA)
Plasma membrane
Cell wall
Flagellum

- Capsules too thin seen under the light microscope is called microcapsule.
- DO ALL BACTERIA HAVE CAPSULE?
- Not all bacterial species produce capsules; however, the capsules of encapsulated pathogens are often important determinant of virulence. Encapsulated species are found among both gram-positive and gram-negative bacteria.
- CAPSULE VS SLIME LAYER:
- Slime layer-loosely organized and attached.
- Capsule-highly organised, tightly attached.



SLIME LAYER:

- A **slime layer** is less tightly bound to the cell wall and is usually thinner than a capsule.
- When present, **it protects the cell against drying, helps trap nutrients near the cell, and sometimes binds cells together**.
- Slime layers allow bacteria to adhere to objects in their environments, such as rock surfaces or the root hairs of plants, so that they can remain near sources of nutrients or oxygen. This “biofilm” protects bacteria on the bottom of the layers from environmental or man-made chemicals.



FUNCTION OF CAPSULE;

1.Prevent the cell from desiccation and drying.

2.protection: it protects from mechanical injury, temperature, drying ,etc.

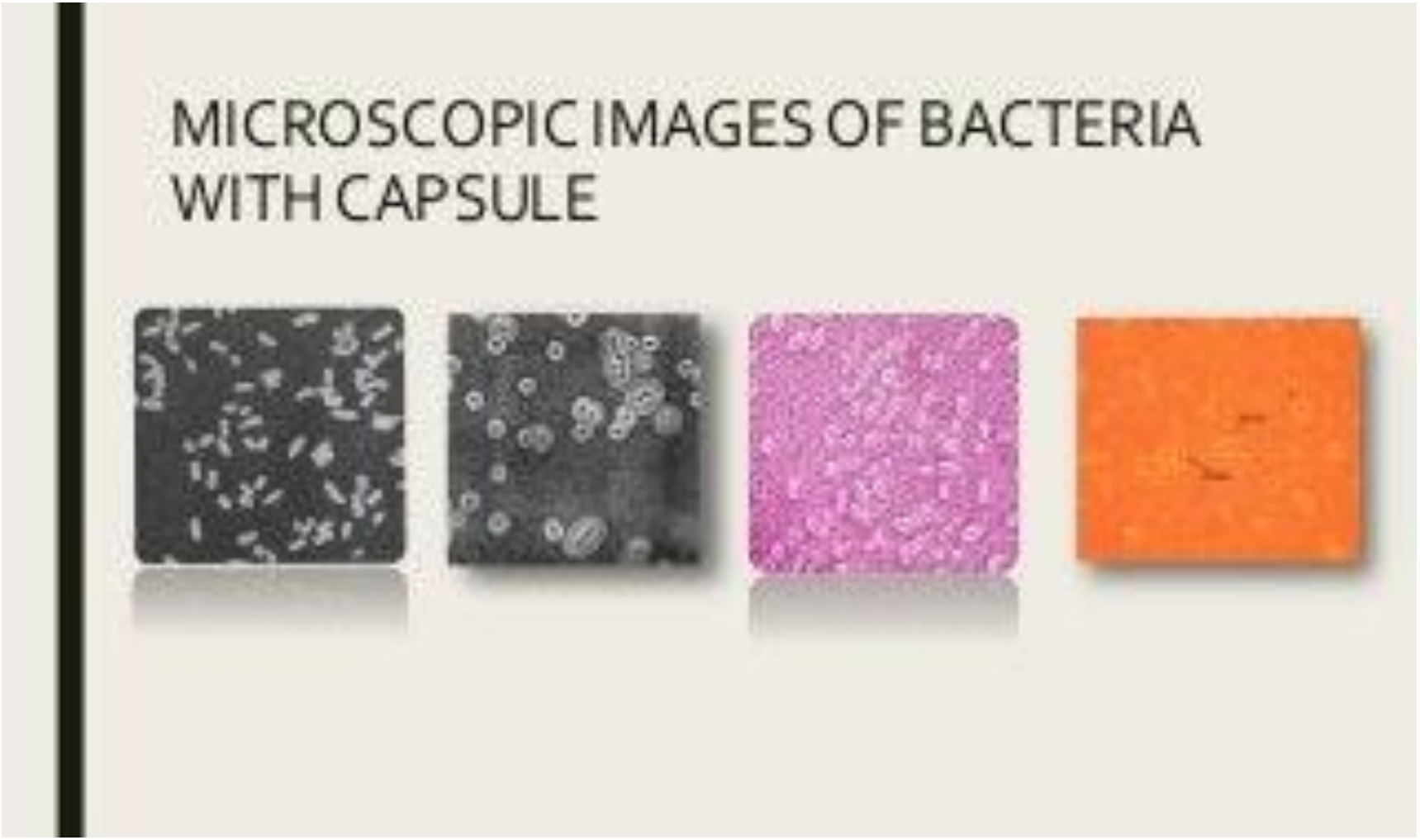
3.Attachment: capsule helps in attachment on the surface

EG: Streptococcus mutants that cause dental caries attach on teeth surface by its capsule.

4.Source of nutrition: capsule is source of nutrition when supply is low in cell.

- Protection against o stress.
- Protection from chemical present in environment, EG;detergents.
- Protection against harsh environment condition.
- In human, detection of pathogenic bacteria(disease causing bacteria)use a capsule staining widely for this purpose because of most of bacteria which contain capsule they are pathogenic in nature mostly.

MICROSCOPIC IMAGES OF BACTERIA WITH CAPSULE



REFERENCES:

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- MICROBIOLOGY-Mc Graw Hill.


Thank You