

Bacterial Morphology and Structure

The slide features a white background with a decorative graphic on the right side. This graphic consists of several overlapping, semi-transparent green shapes in various shades, ranging from light lime green to dark forest green. These shapes are primarily triangular and polygonal, creating a dynamic, layered effect. A thin, light gray line also runs diagonally across the lower right portion of the slide, intersecting the green shapes.

SIZE OF BACTERIA

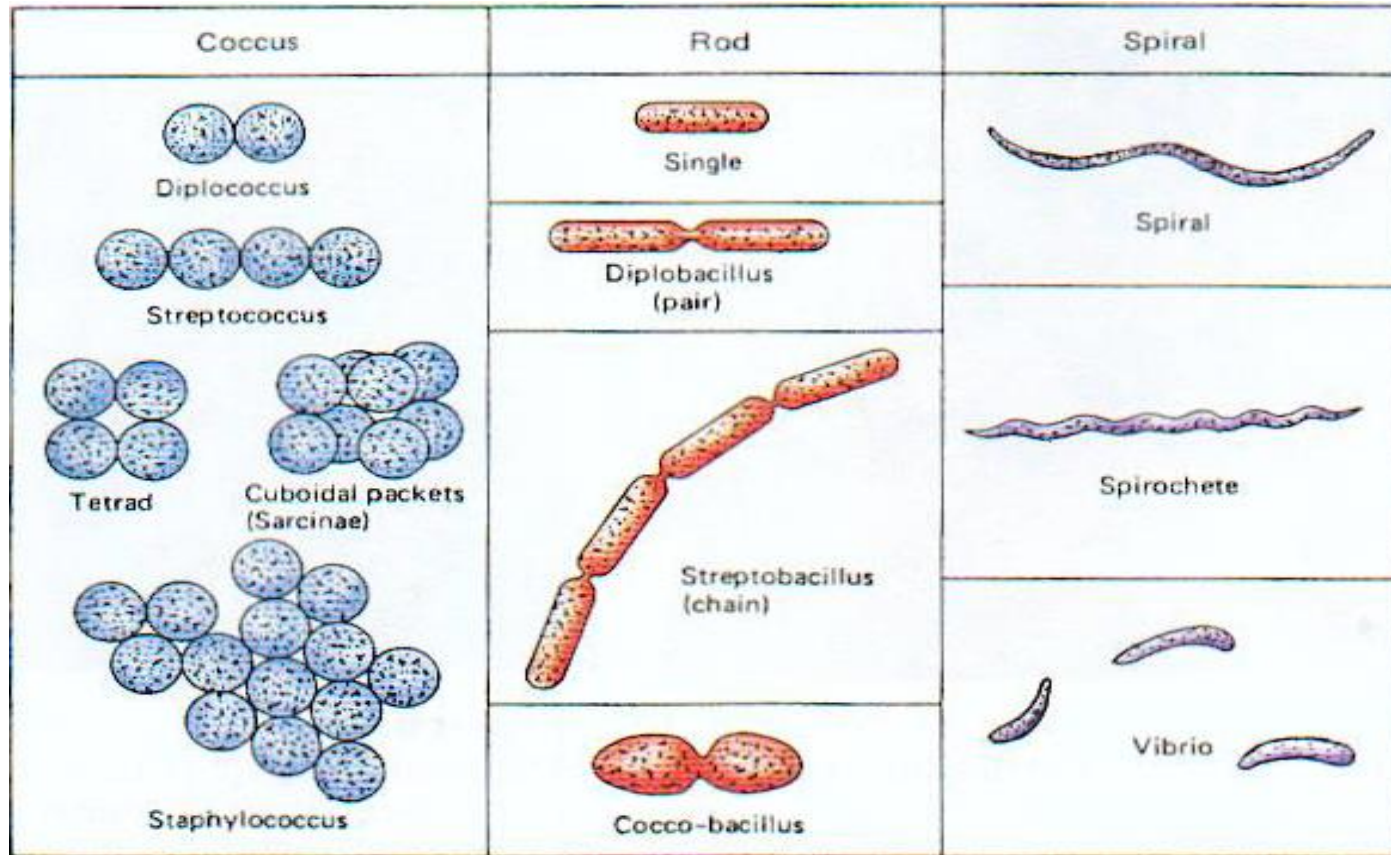
▶ Unit for measurement :

Micron or micrometer, μm : $1\mu\text{m}=10^{-3}\text{mm}$

▶ Size:

Varies with kinds of bacteria, and also related to their age and external environment.

Shape of Bacteria

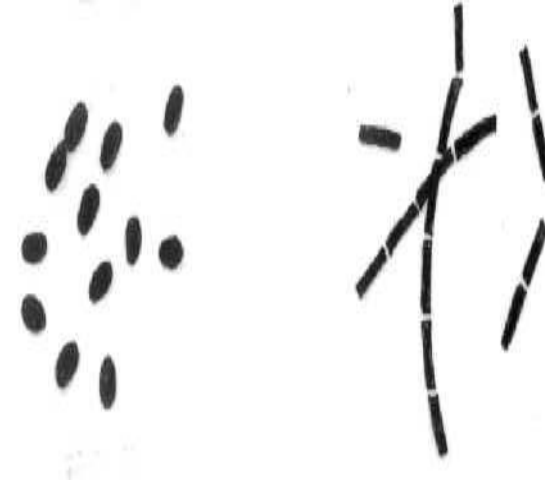


- ▶ Cocci: sphere, 1 μ m
- ▶ Bacilli: rods , 0.5-1 μ m in width -3 μ m in length
- ▶ Spiral : 1~3 μ m in length and 0.3-0.6 μ m in width

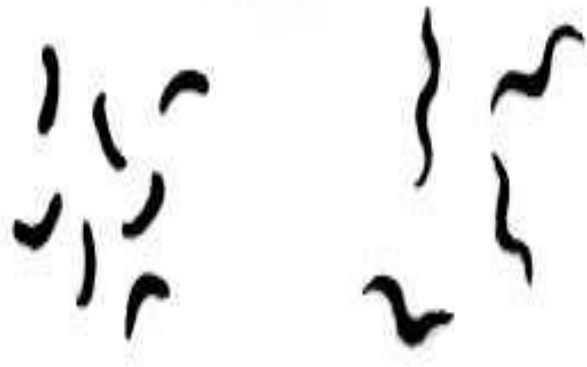
Cocci



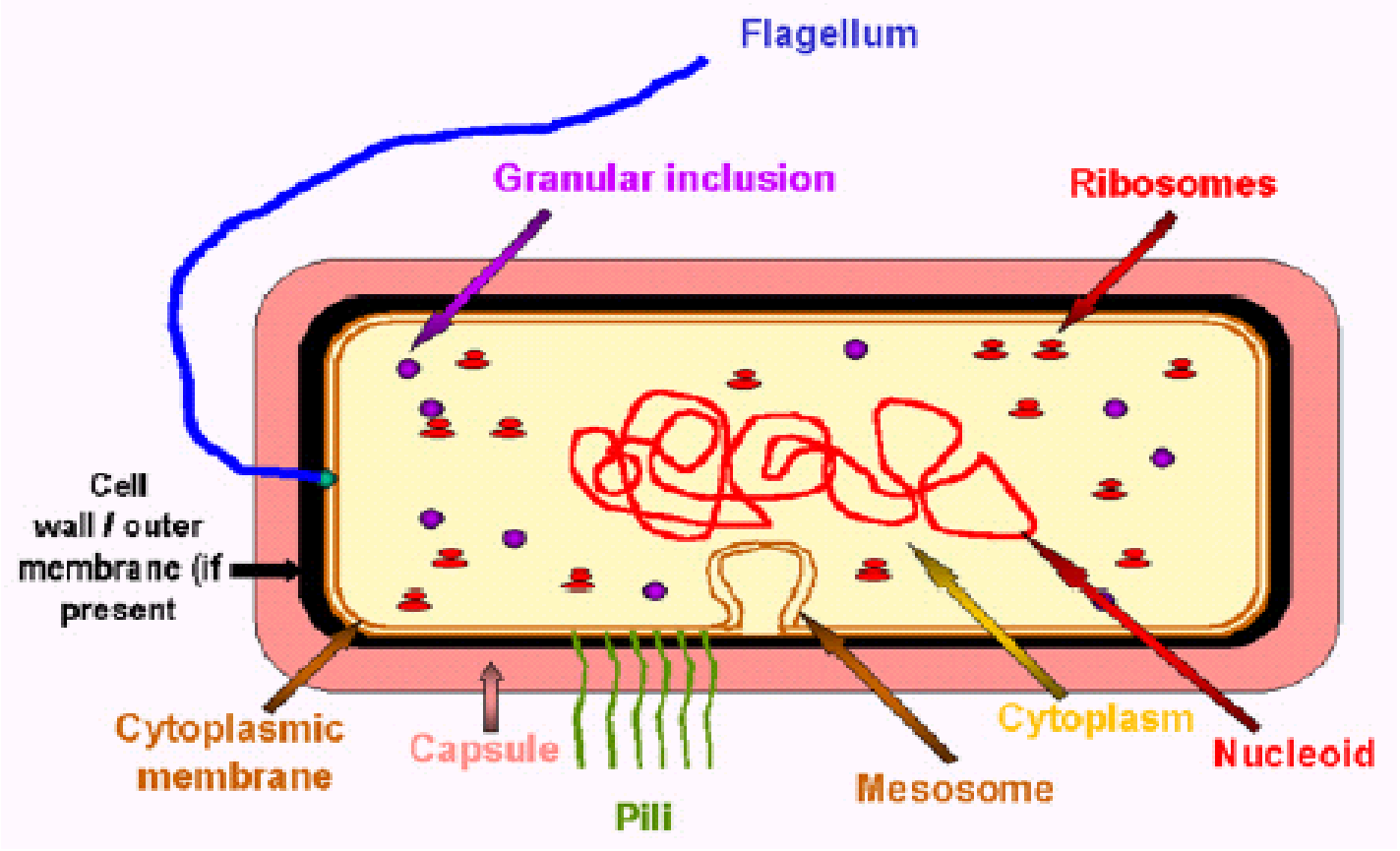
Bacilli



Spiral



Structure of Bacteria



Essential structures

cell wall

cell membrane

Cytoplasm

nuclear material

Special structures

Capsule

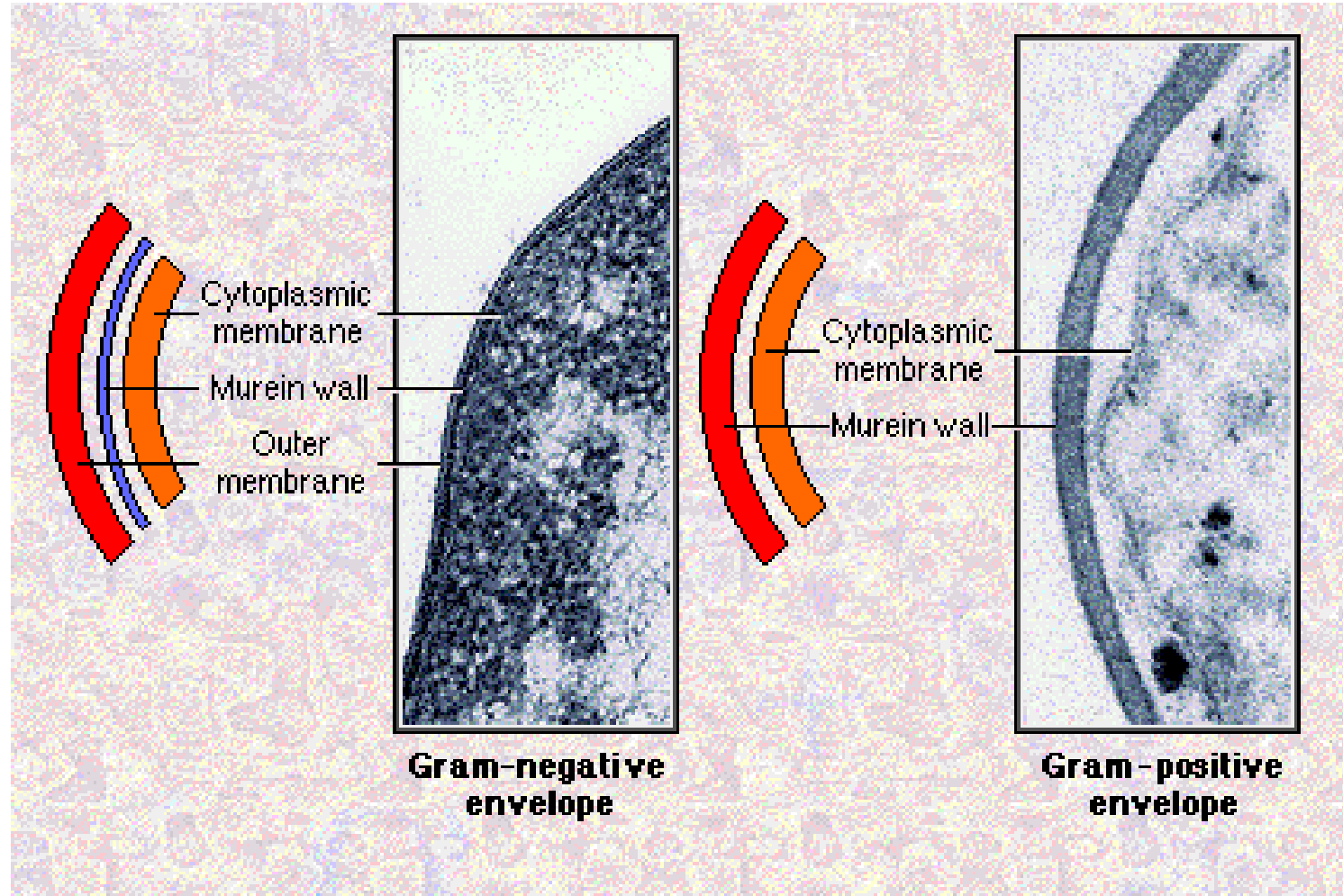
Flagella

Pili

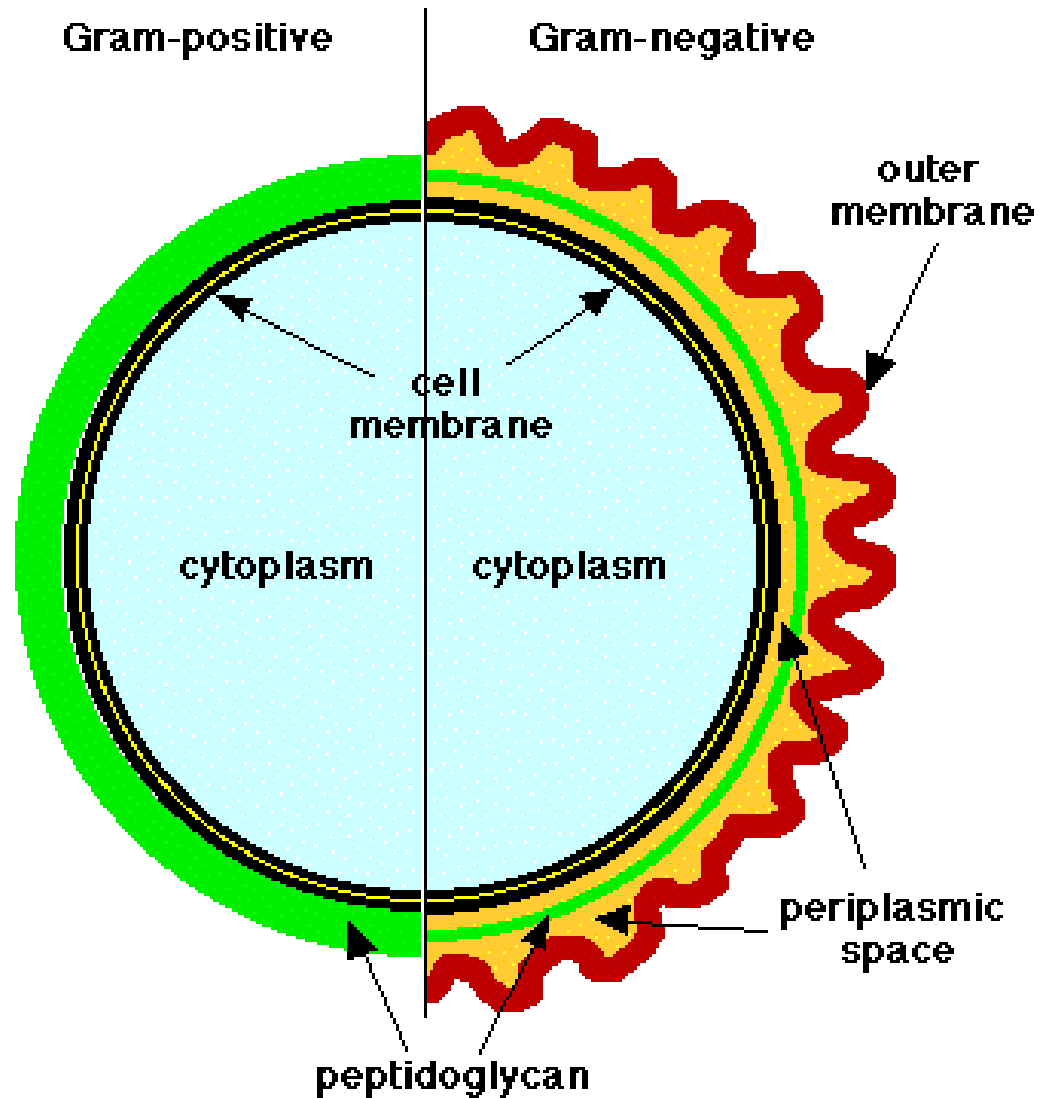
Spore

Cell wall

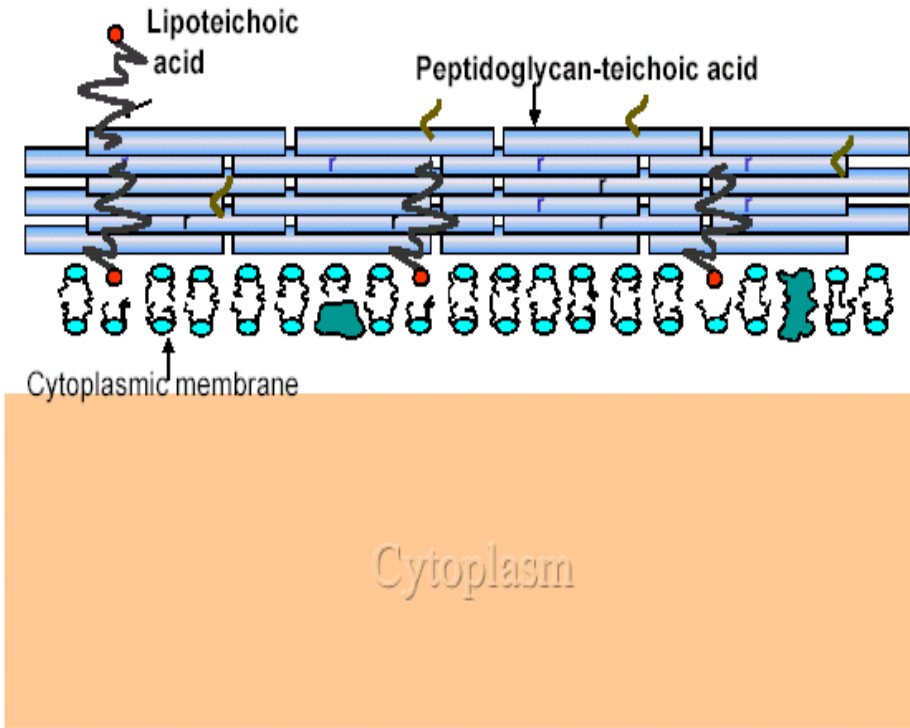
- ▶ Location: outermost portion. 15-30 nm in thickness, 10%-25% of dry weight.



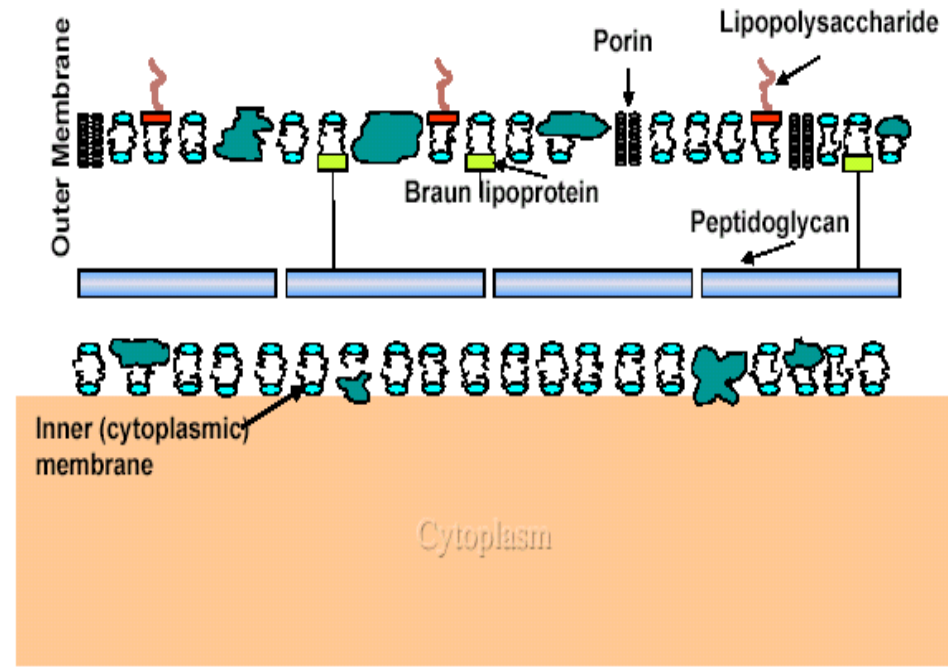
1884: Christian Gram: First publication for the Gram stain method)



Gram Positive Cell Envelope



Gram Negative Cell Envelope



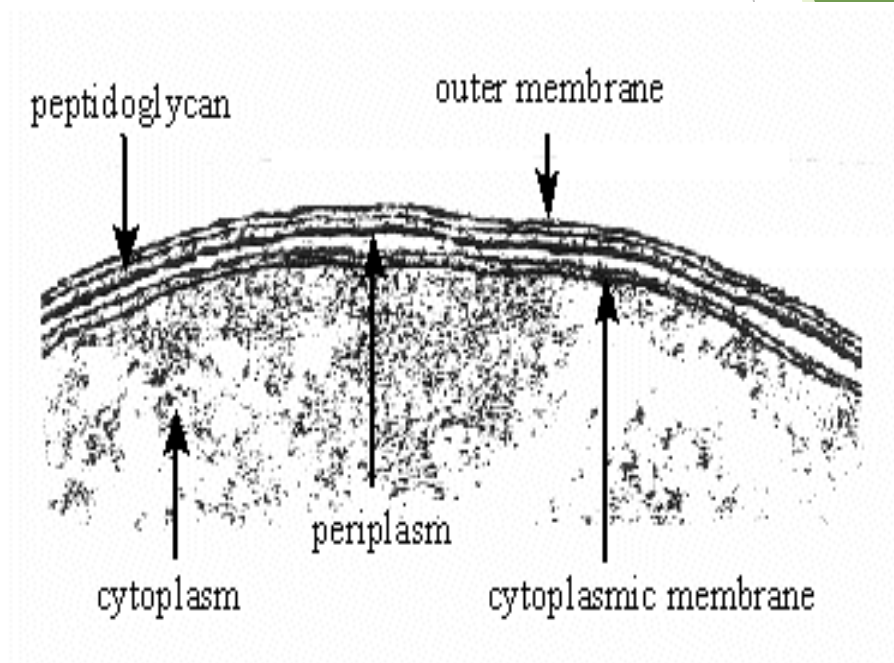
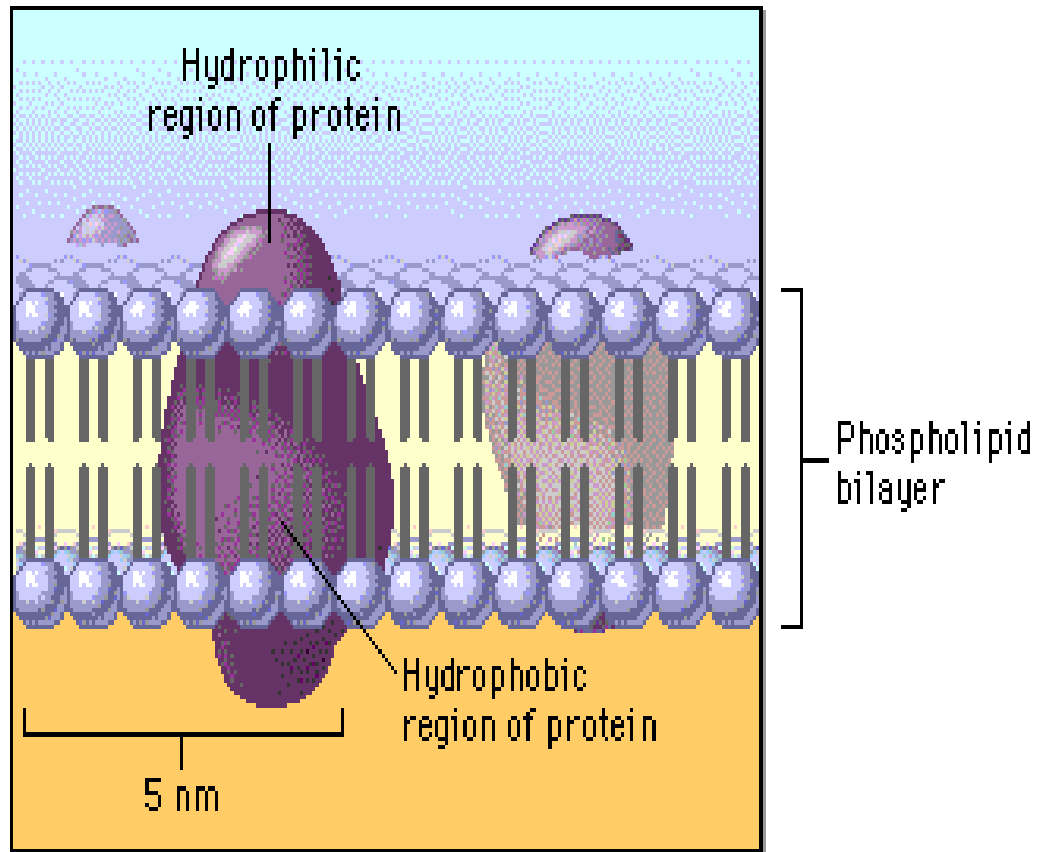
Functions of Cell Wall

- ▶ Maintaining the cell's characteristic shape- the rigid wall compensates for the flexibility of the **phospholipid membrane** and keeps the cell from assuming a spherical shape
- ▶ Countering the effects of osmotic pressure
- ▶ Providing attachment sites for bacteriophages
- ▶ Providing a rigid platform for surface appendages- **flagella**, **fimbriae**, and **pili** all anchored to the wall and extend beyond it
- ▶ Play an essential role in cell division
- ▶ Be the sites of major antigenic determinants of the cell surface.

Wall-less forms of Bacteria.



Cell membrane

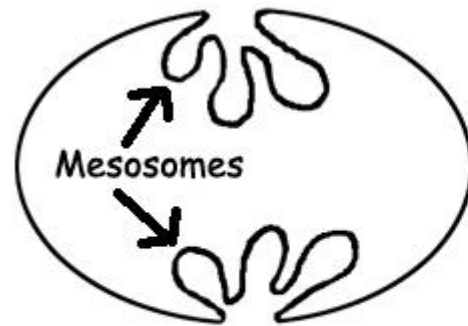


Function of Cell membrane

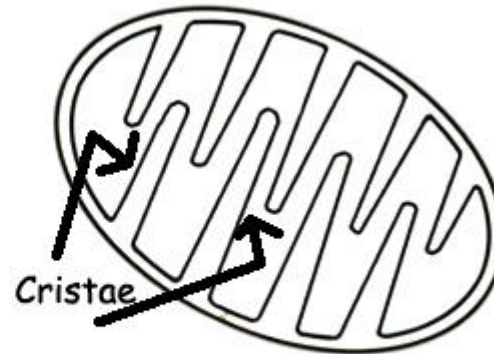
- a. Selective permeability and transport of solutes into cells***
- b. Electron transport and oxidative phosphorylation***
- c. Site of biosynthesis of DNA, cell wall polymers and membrane lipids.***

Mesosomes

- ▶ ***Mesosomes are specialized structures formed by convoluted invaginations of cytoplasmic membrane.***



Prokaryotic Cell



Mitochondrion

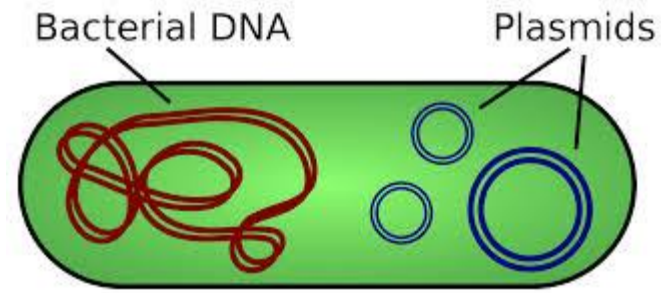
Cytoplasm

- ▶ Composed largely of water, together with proteins, nucleic acid, lipids and small amount of sugars and salts
- ▶ **Ribosomes**: numerous, 15-20nm in diameter with 70S; Ribosomes are the protein synthesizing factories of the cell.
- ▶ They translate the information in mRNA into protein sequences.
- ▶ distributed throughout the cytoplasm; sensitive to streptomycin and erythromycin site of protein synthesis

Plasmid

Plasmids are:

- Small,
- Circular,
- Extrachromosomal,
- Double-stranded DNA molecules
- They are capable of self-replication and
- Contain genes that confer some properties, such as antibiotic resistance, virulence factors
- Plasmids are not essential for cellular survival.



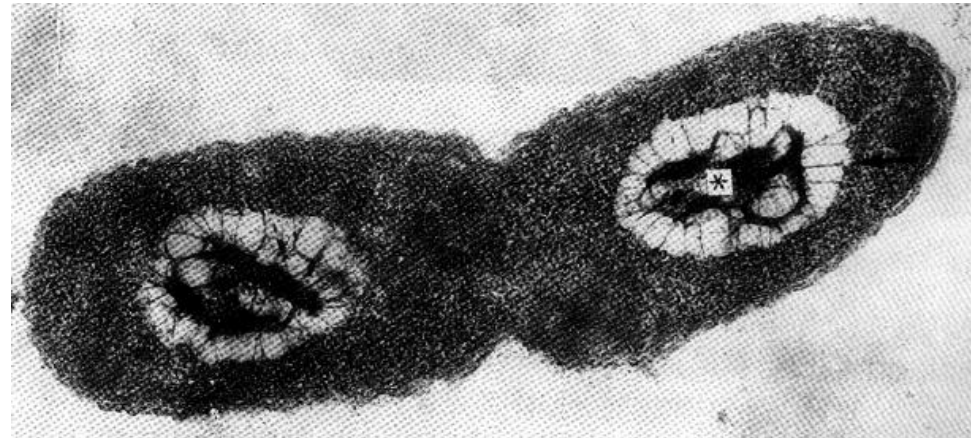


Nucleus

- ▶ Lacking nuclear membrane, absence of nucleoli, hence known as nucleic material or nucleoid, one to several per bacterium.

Bacterial chromosome

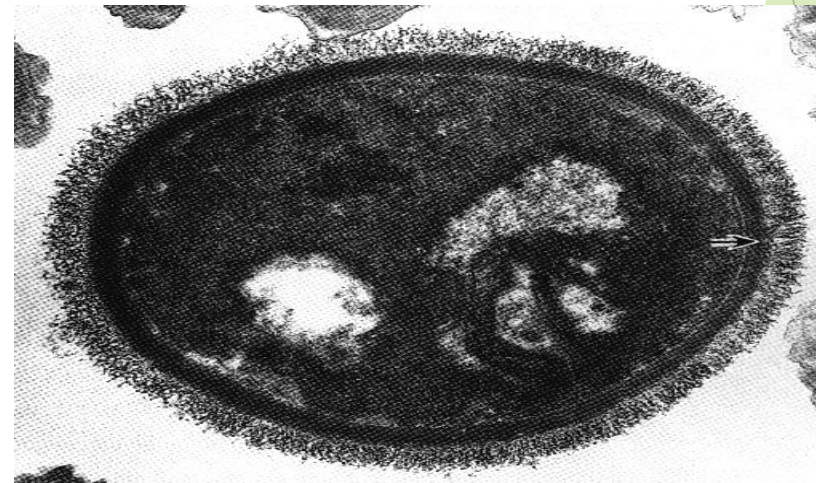
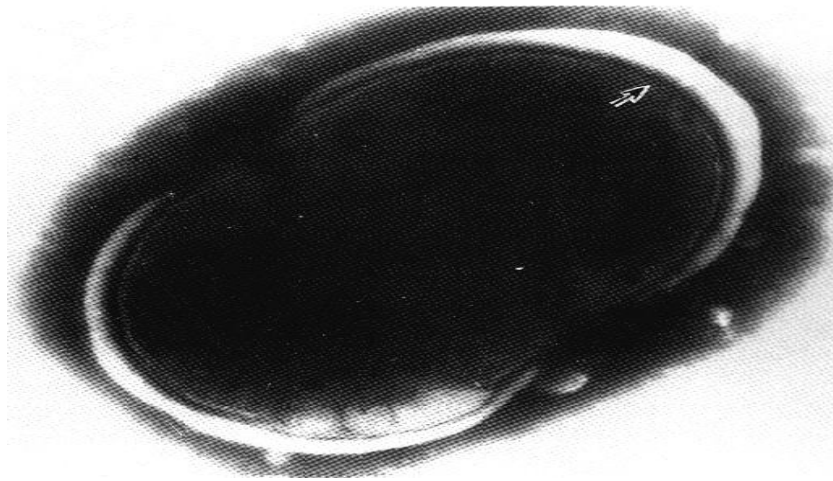
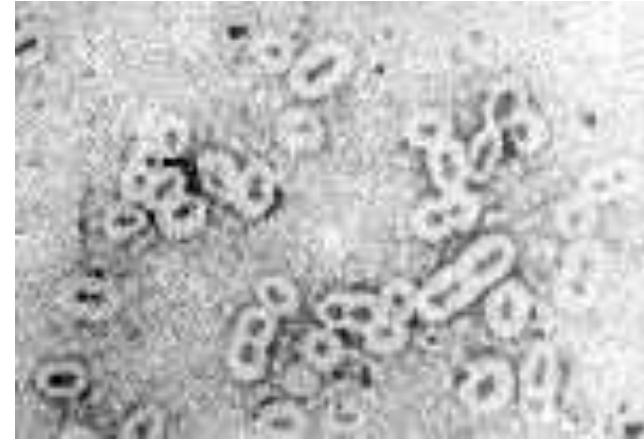
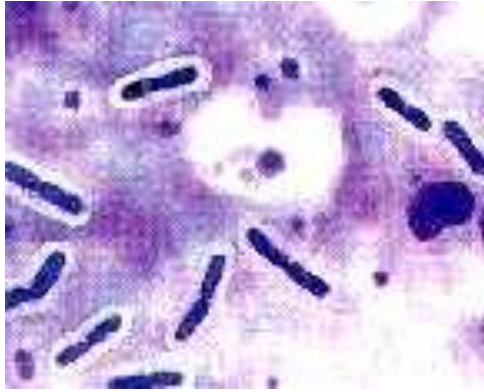
Single
Circular
Compacted



Capsules and slime layers

- ▶ **These are structures surrounding the outside of the cell envelope.**
- ▶ **They usually consist of polysaccharide; They are not essential to cell viability and some strains within a species will produce a capsule, whilst others do not.**

Capsules and slime layers



Function of Capsules and slime layers(1)

- ▶ **Attachment** :These structures are thought to help cells attach to their target environment.
- ▶ *Streptococcus mutans* produces a slime layer in the presence of sucrose.
- ▶ This results in dental plaque and many bacteria can stick to tooth surfaces and cause decay once *S. mutans* forms a slime layer.
- ▶ *Vibrio cholerae*, the cause of cholera, also produces a glycocalyx which helps it attach to the intestinal villi of the host.

Function of Capsules and slime layers(2)

- ▶ Protection from phagocytic engulfment. Bacterial pathogens are always in danger of being "eaten" by phagocytes.
- ▶ *Streptococcus pneumoniae*, when encapsulated is able to kill 90% of infected animals, when non-encapsulated no animals die.

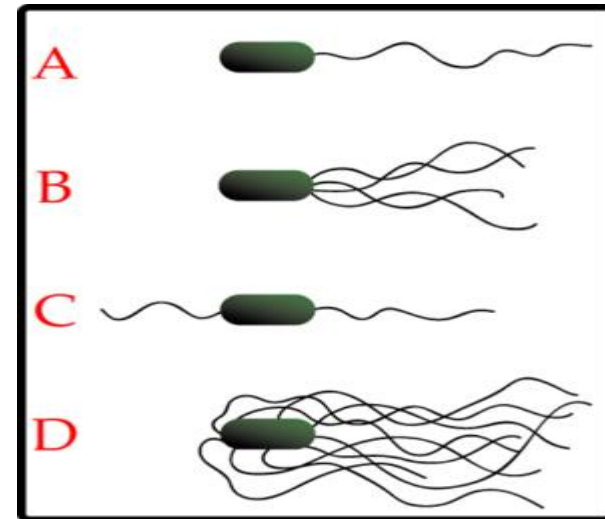
Function of Capsules and slime layers(3)

- ▶ **Resistance to drying.**



Flagella

- ▶ Flagella consist of a number of proteins including **flagellin**. The diameter of a flagellum is thin, 20 nm, and long with some having a length 10 times the diameter of cell.
- ▶ Due to their small diameter, flagella cannot be seen in the light microscope unless a special stain is applied.
- ▶ Bacteria can have one or more flagella arranged in clumps or spread all over the cell.
- ▶ Mono/trichous
- ▶ Amphi/trichous
- ▶ Lopho/trichous
- ▶ Peri/trichous



Flagella

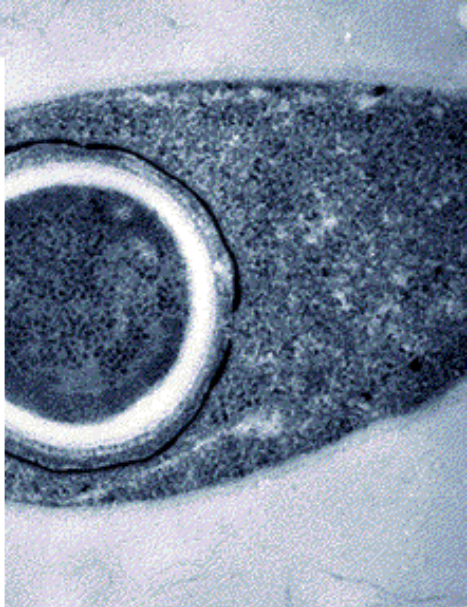
- ▶ **Used in Identification of Bacteria**
- ▶ **Contribute to Pathogenesis**
- ▶ **Motility of bacteria**

Pili

- ▶ Pili are hair-like projections of the cell , They are known to be receptors for certain bacterial viruses.
- ▶ Chemical nature is pilin

Sex pili: longer and coarser, Conjugation, as it is called, is one explanation for the rapid spread of drug resistance in many different species of bacteria.





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Spore

- ▶ Used in Identification of Bacteria
- ▶ Contribute to Pathogenesis
- ▶ Resistance to adverse environmental conditions

The endospore

