



General Microbiology

Lecture 2

(Bacterial Structure and Classification)

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1- what's the important of shape? 2- what're the different shape of it?


Shapes and Forms of Bacteria

3- what're the classification of the cocci? and based on what?

→ in hospital, they depend on the shape of bacteria to applied the treatment.

Different shapes have been recognized:

1. Spherica/Cocci: . كروي

- Cocci has originated from a greek word; kokkos = seed.
- (0.5μ - 1.25μ in diameter) → arrangement of shape of bacteria are determined by plane of division.
- On the basis of arrangements cocci are further classified as follows:
 - a. Micrococci: appears singly. *separated, scattered*
 - b. Diplococcus: appear in a pairs of cells ⇒ *incomplete division* ⇒ 
 - c. Streptococci: appear in rows of cells or in chains. *incomplete division chain*
 - d. Staphylococci: arrange in irregular clusters like bunches of grapes e.g. *Staphylococcus aureus*. →
 - e. Tetrads: arrange in a sequence of four.
 - f. Sarcinae: arrange in cuboidal or in a different geometrical.

Shapes and Forms of Bacteria

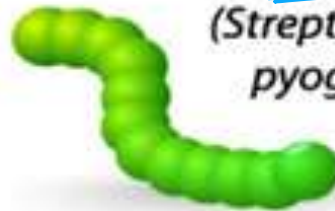
SPHERES (COCCI)



Diplococci
(*Streptococcus pneumoniae*)



Staphylococci
(*Staphylococcus aureus*)

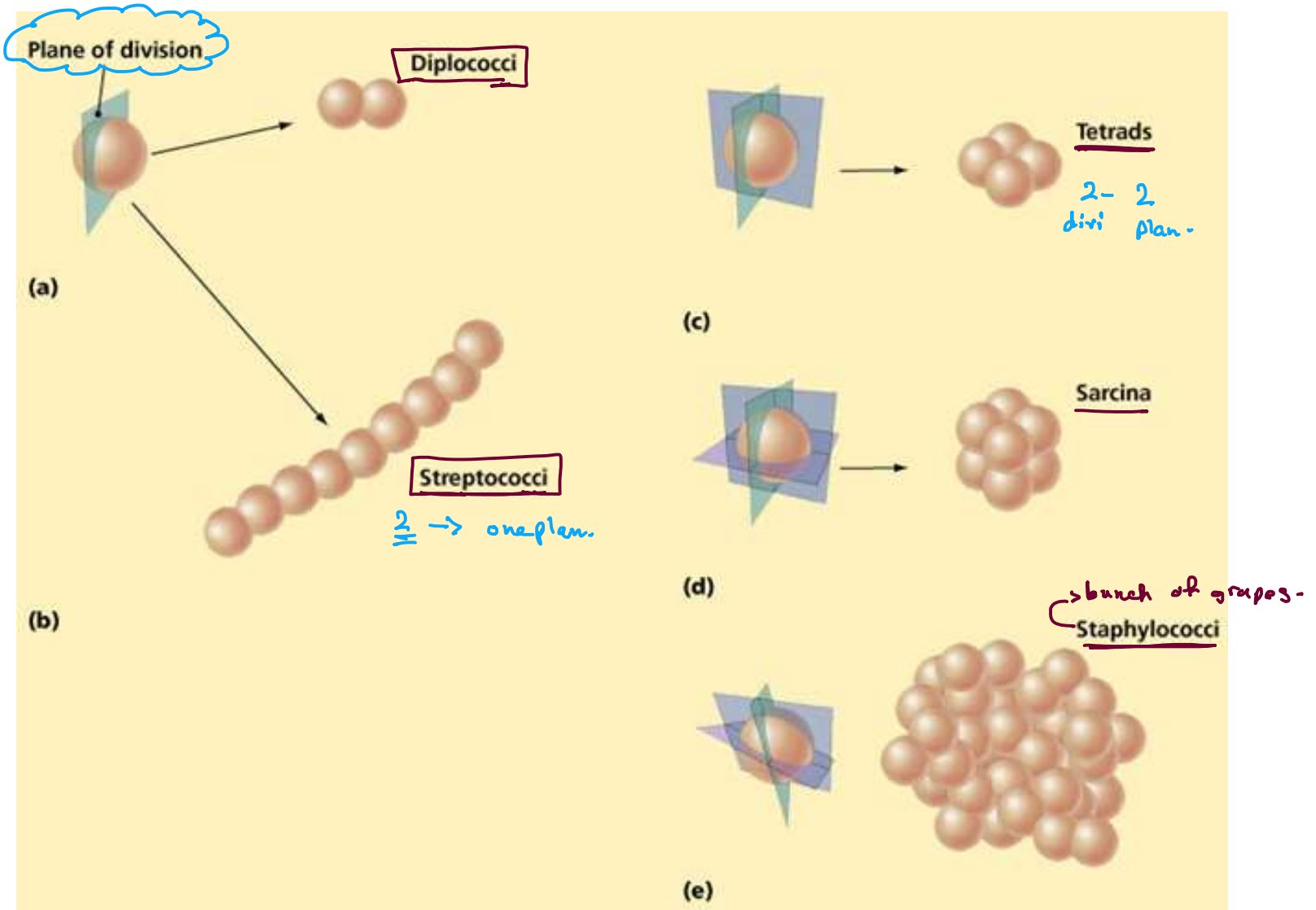


Streptococci
(*Streptococcus pyogenes*)

Tetrad



Why do bacterial cells have different arrangement?



1- Describe its shape?

2- what's the type of them?

Shapes and Forms of Bacteria

الحموية .

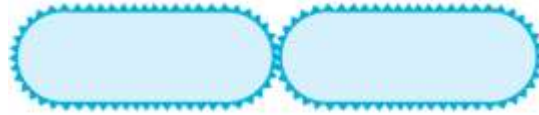
2. Rod Shaped Bacteria or Bacillus:

• From greek word, bacilli means rod or stick.



bacilli

• There ends are rounded flat or pointed.



diplobacilli

• 0.5-1.2μ in diameter and 3- 7μ in length.

• Flagellated or non-flagellated. أسواق



Streptobacilli

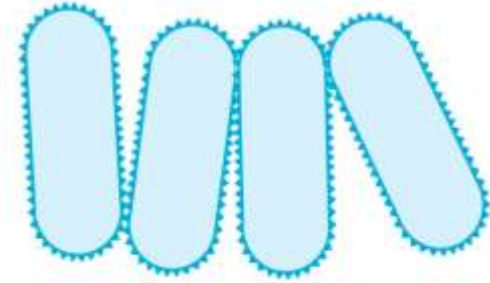
• They may be of following types:

✓ Monobacillus: arrange singly.

✓ Diplobacillus: present in a group of two.

✓ Streptobacillus : in chains.

✓ Palisade: Very rarely the bacillus



palisades.

arrange in a palisade arrangement. [like chinese number]

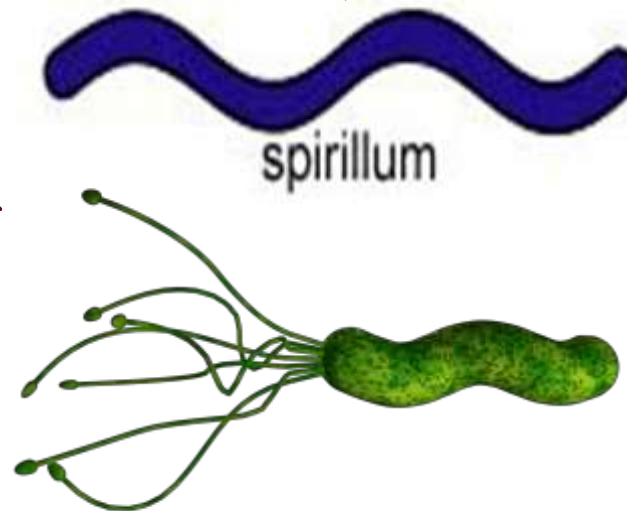
1- Describe its shape? 2- where does it live?

Shapes and Forms of Bacteria

3. Spiral or Helical ^{اللزونية} ⇒ H-bilary.

- From greek word; spira means coiled.
- A single spirillum has more than one turn of helix. // لفات
- 10-50 μ in length and 0.5 - 3 μ in diameter.
- They are flagellated ⇒ Live in mucous membrane.

↳ any bacteria live in fluid and semi fluid → flagellated structure.

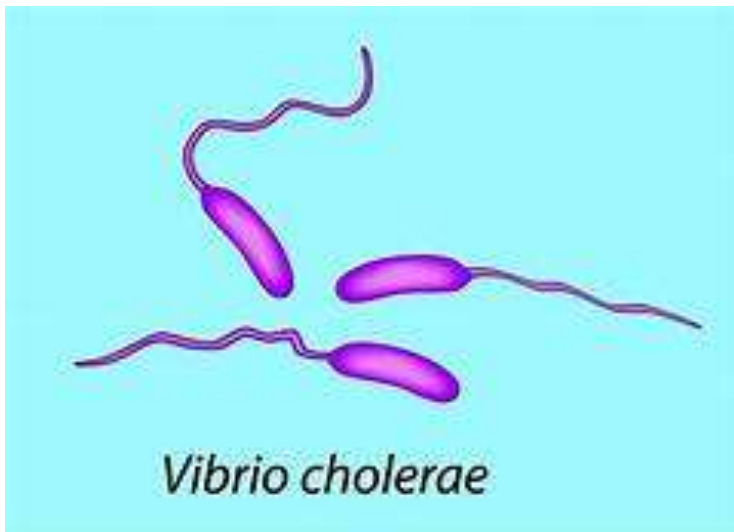


Shapes and Forms of Bacteria

1- Describe its shape? Give an example?

4. Vibrio or Coma:

- They bear flagella at their end.
- 1.5-1.7 μ in diameter and upto 10 μ in length
- e.g. *Vibrio cholerae*.



Shapes and Forms of Bacteria

5. Spirochaeta: ^{سپيروكيتا} more than 3 rapes.

- These bacteria appear like a corkscrew.
- Their length is more as compared to their diameter.
- Their body is more flexible.
 - very thin
 - very s-all
- Transported by sex.



The Ultrastructure of Bacterial Cell

↳ NOT similar in same bacteria.

- 1- What're the external and internal structure of
- 2- What's the function of the cell wall ?

The Ultrastructure of bacterial cell

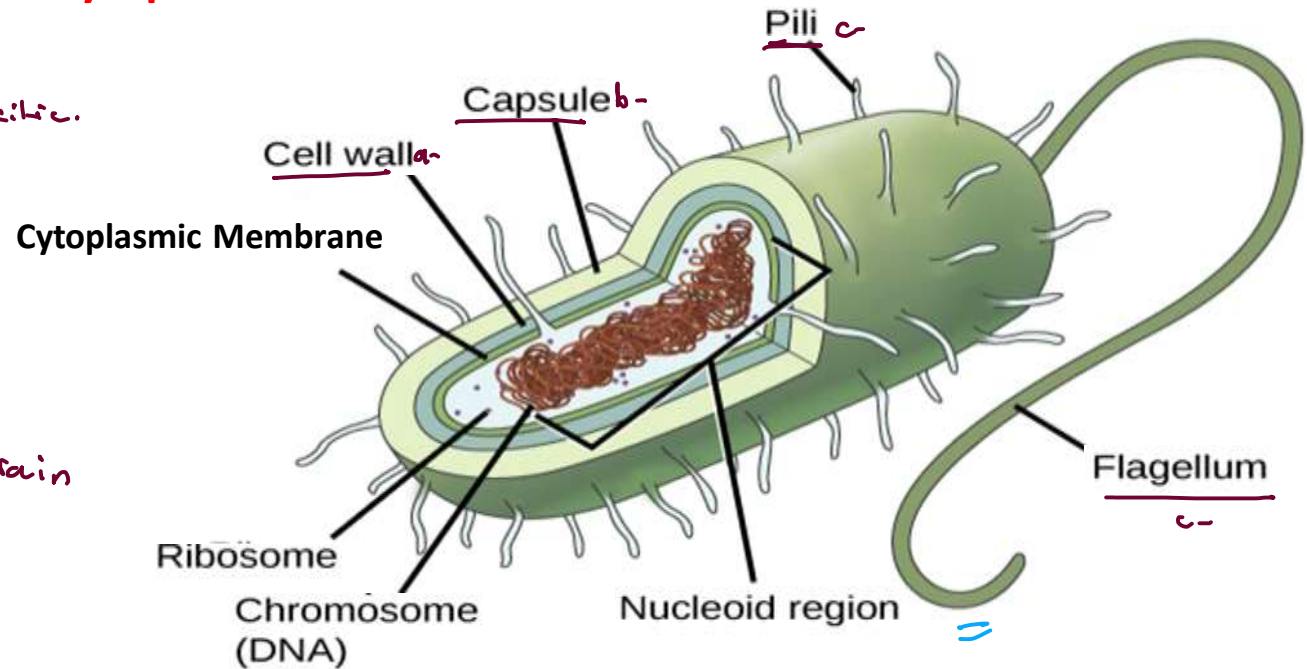
Structures external to the cytoplasmic membrane:

- **Cell wall** ①
- **Capsule** ② ⇒ anti-phagocitic.
- **Flagella** ③
- **Pili (Fimbriae)** ④

External :-

cytoplasmic membrane

internal :-



Structures internal to the cell wall:

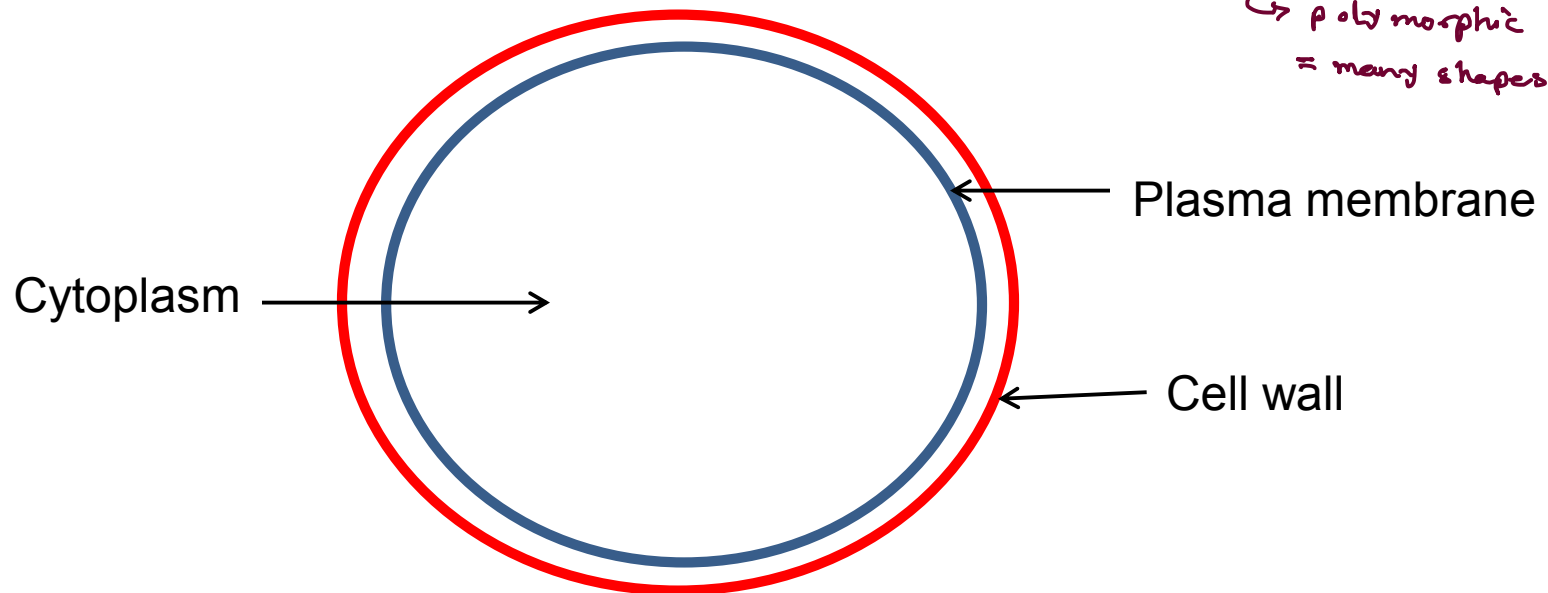
- **Cytoplasmic Membrane** ⇒ surround by cell wall ⇒ This is surrounded sometime by capsule!
- **Mesosomes**
- **Ribosomes**
- **Cytoplasm**
- **Inclusion Bodies**
- **Chromosome (DNA)**
- **Plasmid**
- **Episome**

The cell wall

↳ determine shap.
↳ without it → No shap will have.

Functions

- Very rigid structure and provide definite shape to the cell ✓
- Preventing the cell from expanding and eventually bursting because of uptake of water ✓
اللي نفجاس
- Resistant to extremely high pressure. ✓
- Essential for the growth and division of bacteria
- Cell wall protects against osmotic lysis ✓



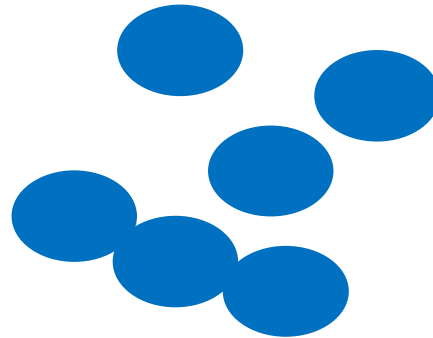
Microplasma bacteria s-

↳ polymorphic
= many shapes.

Cell wall and Gram Staining (History)

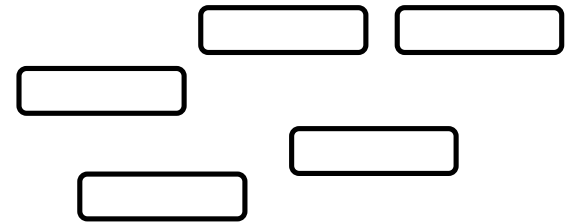


Danish scientist **Hans Christian Gram** (1853–1938)



S. pneumoniae

فانوس الريد

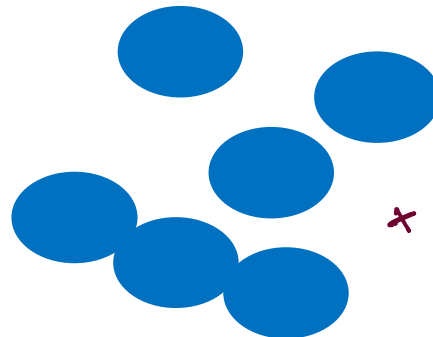


K. pneumoniae

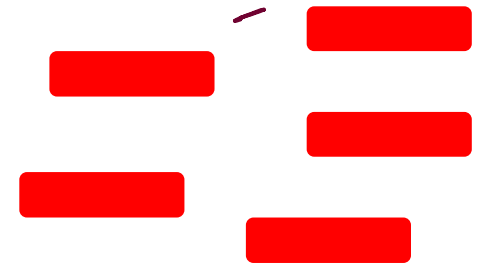
colorless



German pathologist **Carl Weigert** (1845- 1904)



S. pneumoniae



K. pneumoniae

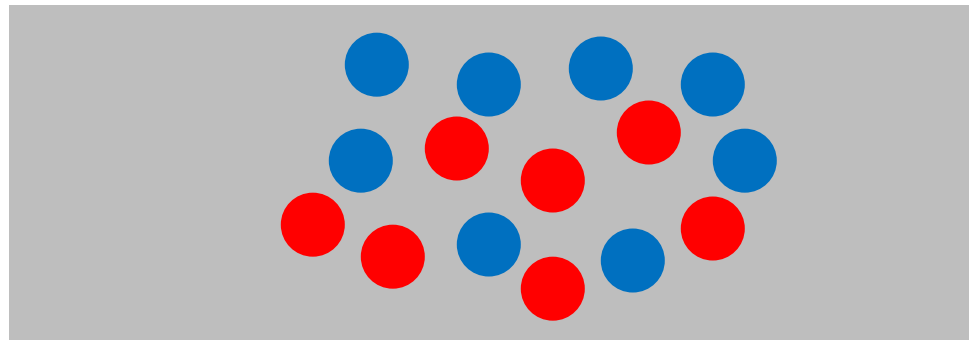
+ subfraline.

The Ultrastructure of bacterial cell

The cell wall



Staining bacteria



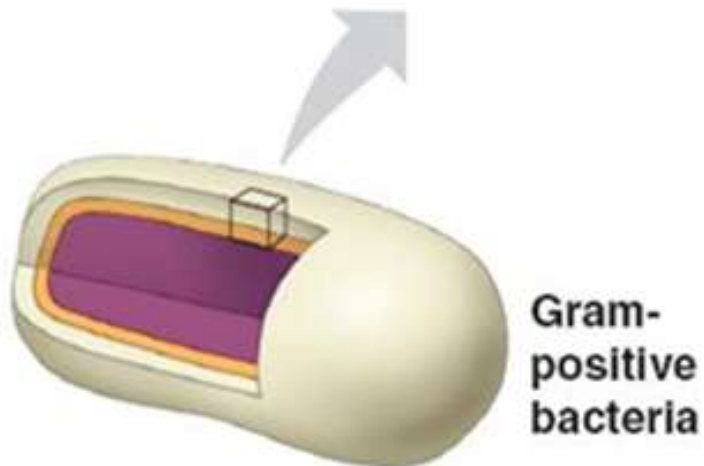
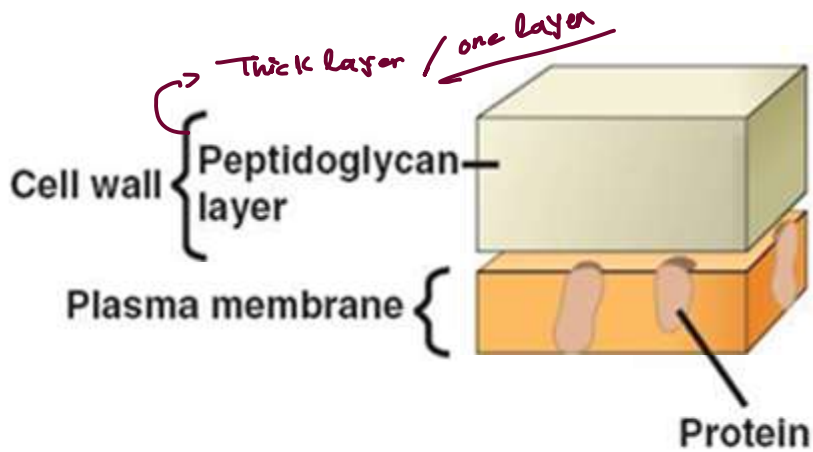
Two colors (red& blue)

Called the **blue** ones
Gram **positive**

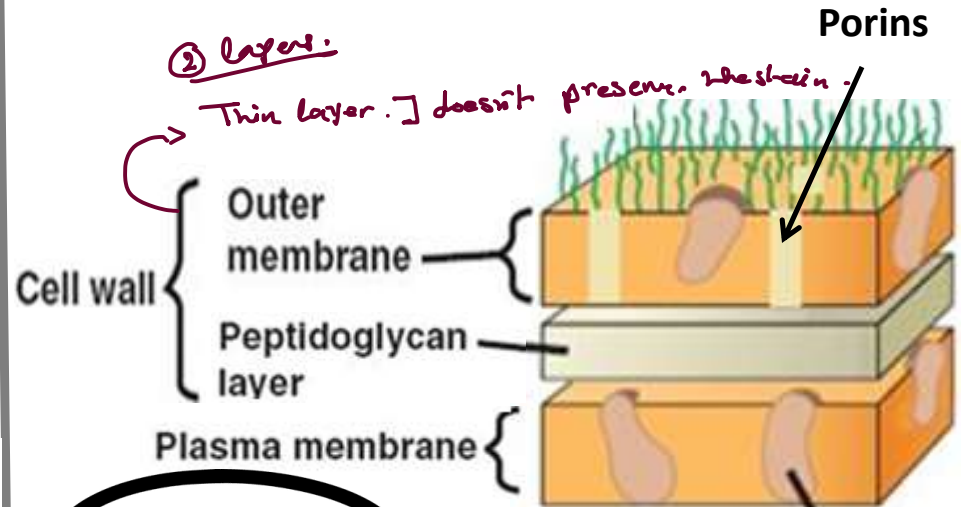
Called the **red** ones
Gram **negative**

The Ultrastructure of bacterial cell

Gram positive bacteria

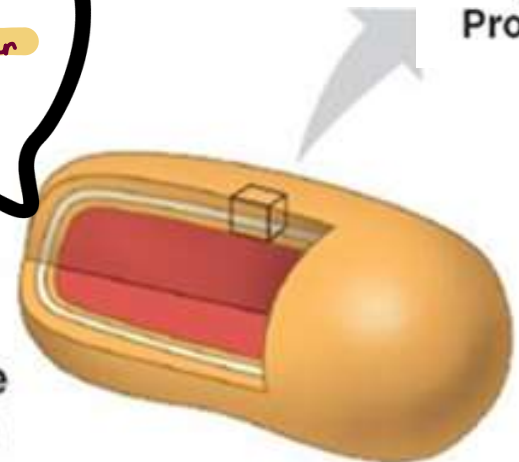


Gram negative bacteria



peptidoglycan
↳ protein + sugar

Gram-negative bacteria

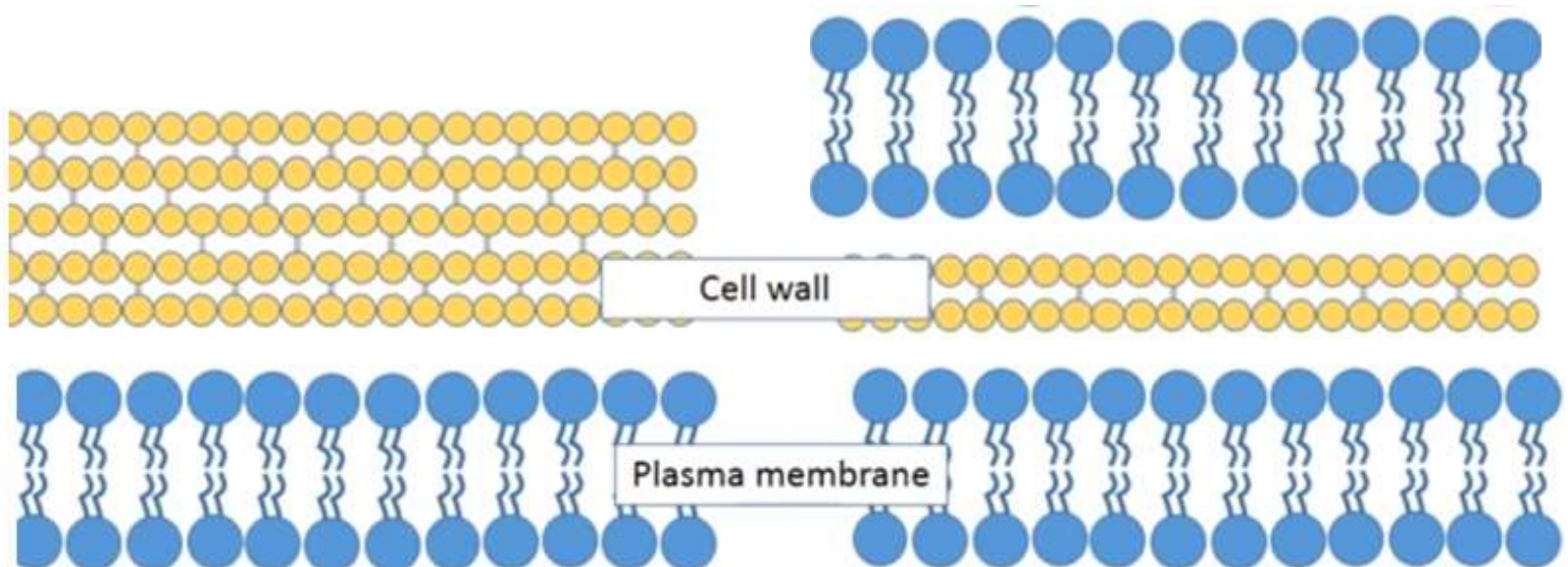


Gram positive (blue)

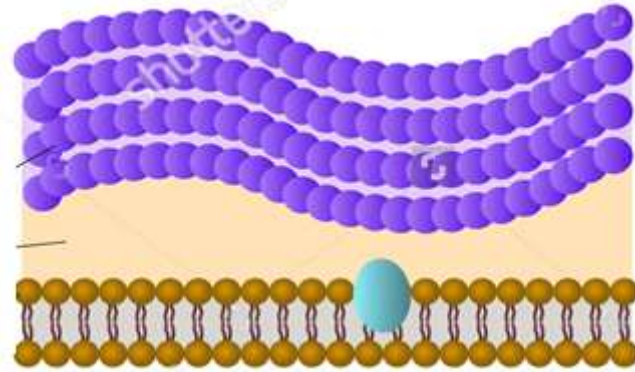
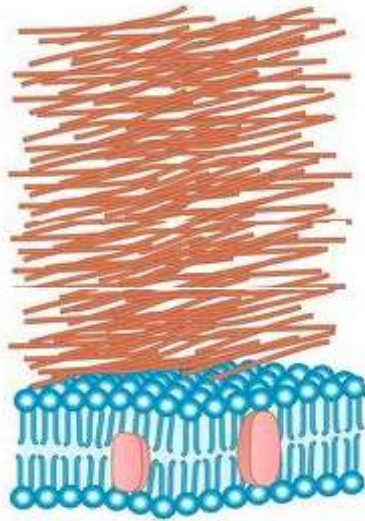
- Inner most plasma membrane
- Thick peptidoglycan cell wall
- More easily treatable with antibiotics
- Stain purple/violet after Gram Stain. ✓
- Peptidoglycan forms 40-80% of the cell dry weight.

Gram negative (red)

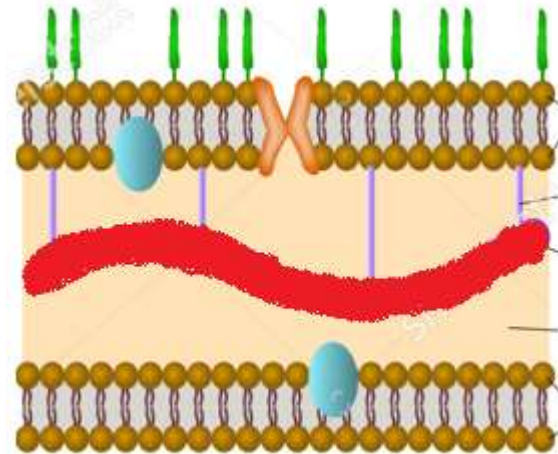
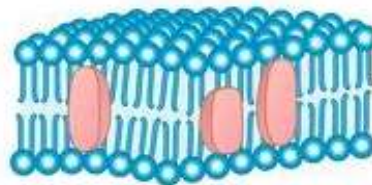
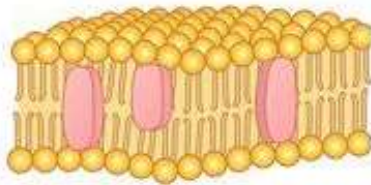
- Inner most plasma membrane
- Thin peptidoglycan cell wall
- Another outer plasma membrane ← because it's here ←
- Harder to treat with antibiotics
- Stain red/pink after Gram Stain
- Peptidoglycan forms 5-10% of the cell dry weight.



Gram positive



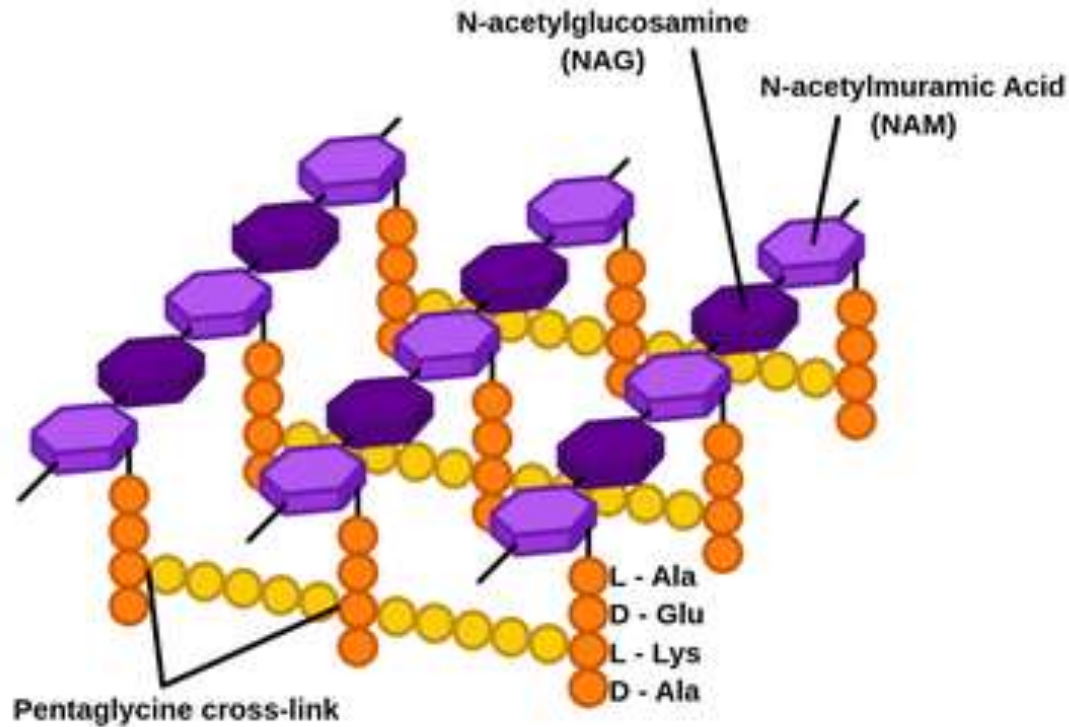
Gram negative



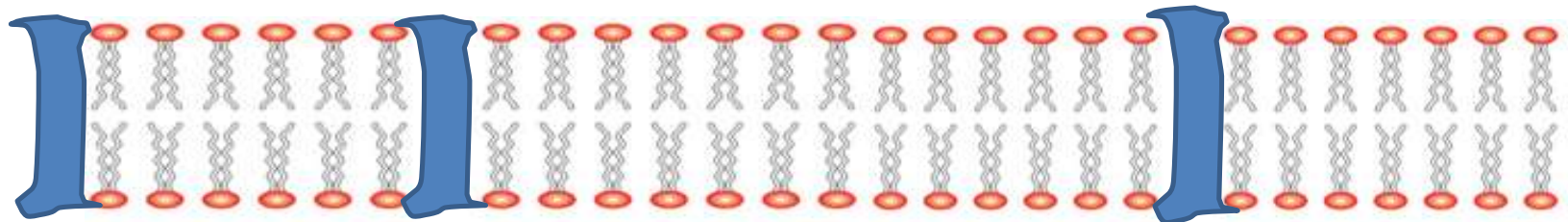
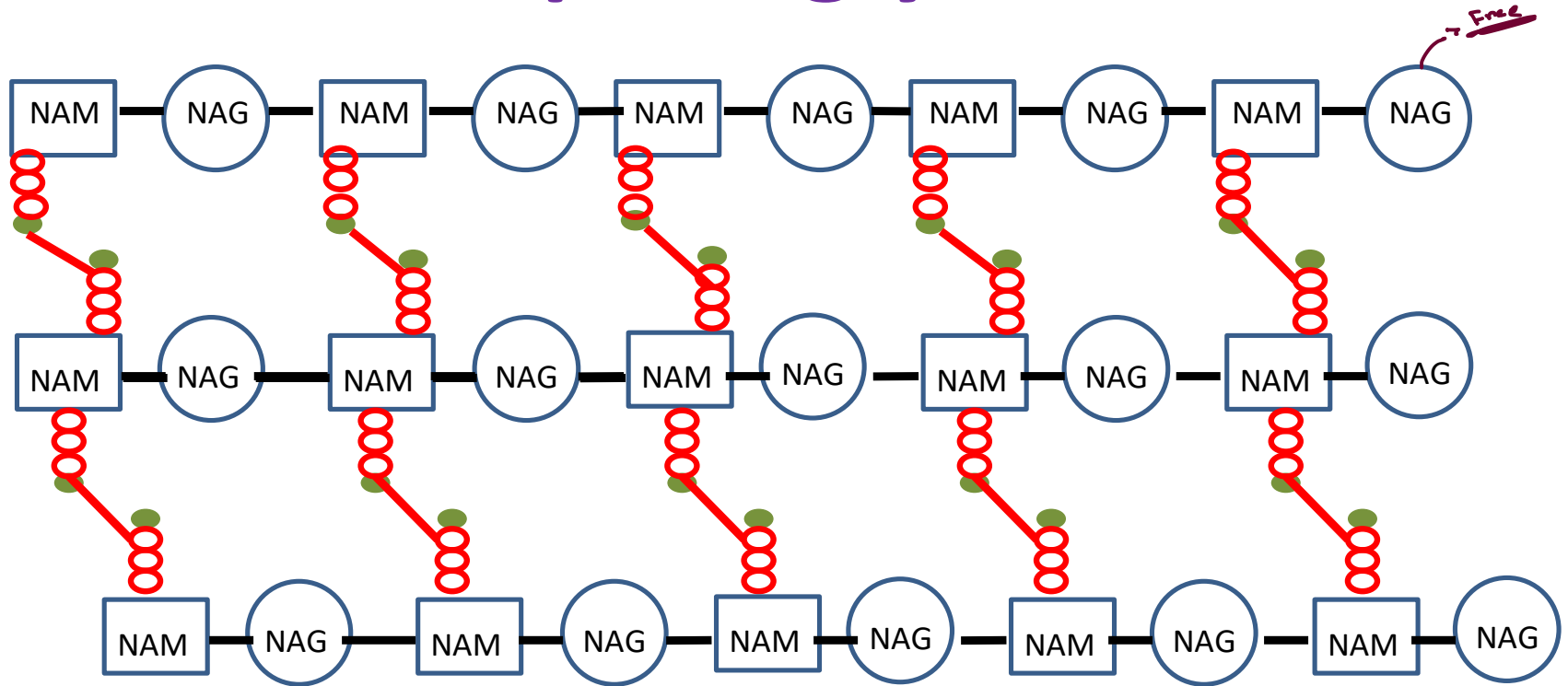
- 1-what is the peptidoglycan?
2-Describe the hole structure?

Peptidoglycan

- Peptidoglycan is a rigid mesh made up of ropelike linear polysaccharide chains made up of repeating disaccharides of **N-acetylglucosamine (NAG)** and **N-acetylmuramic acid (NAM)**.
- Tetrapeptide attached to **NAM**.

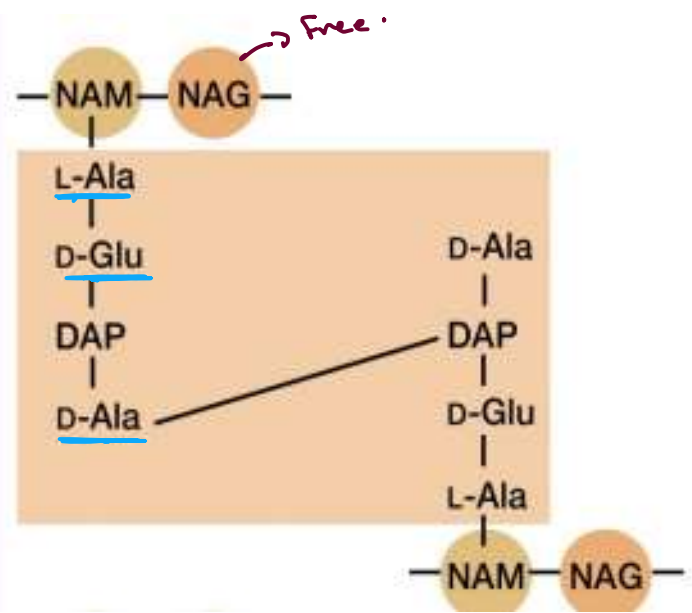


Peptidoglycan

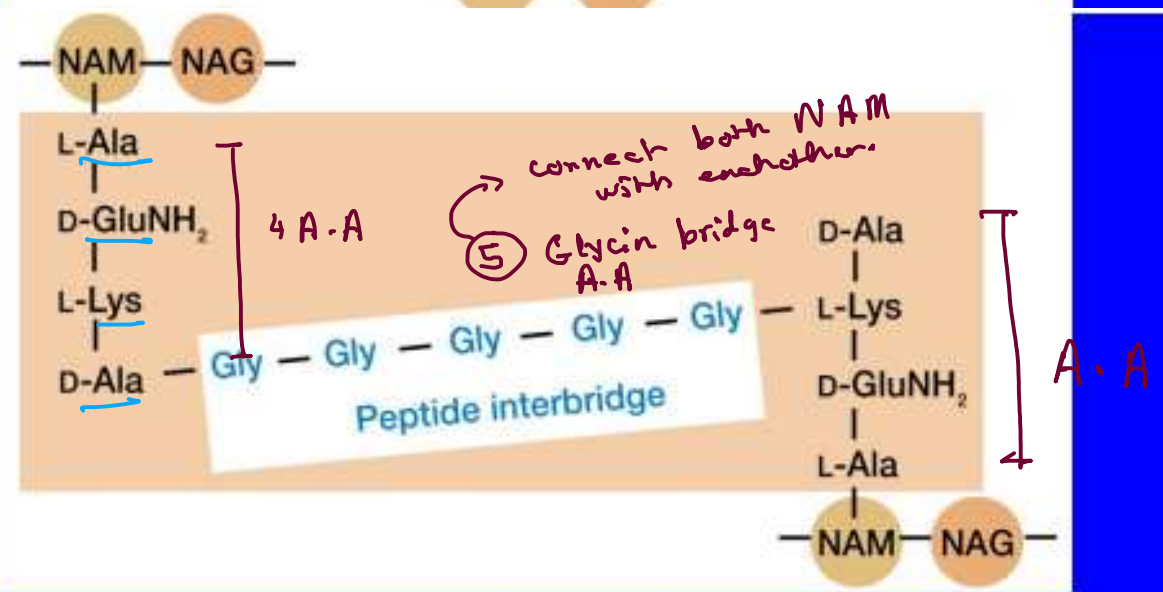


Peptidoglycan

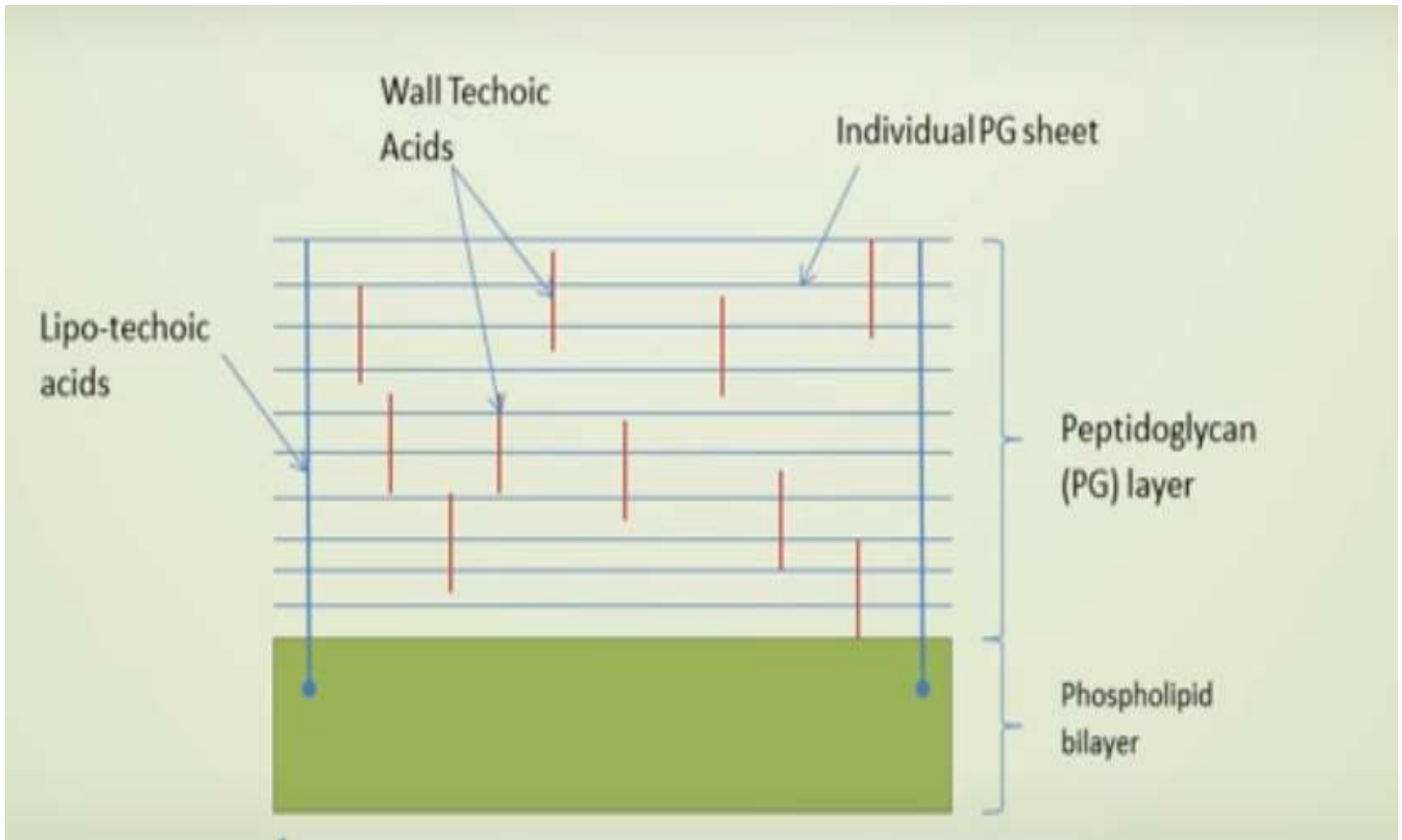
Gram -



Gram +



Anchorage of peptidoglycan layers to the plasma membrane



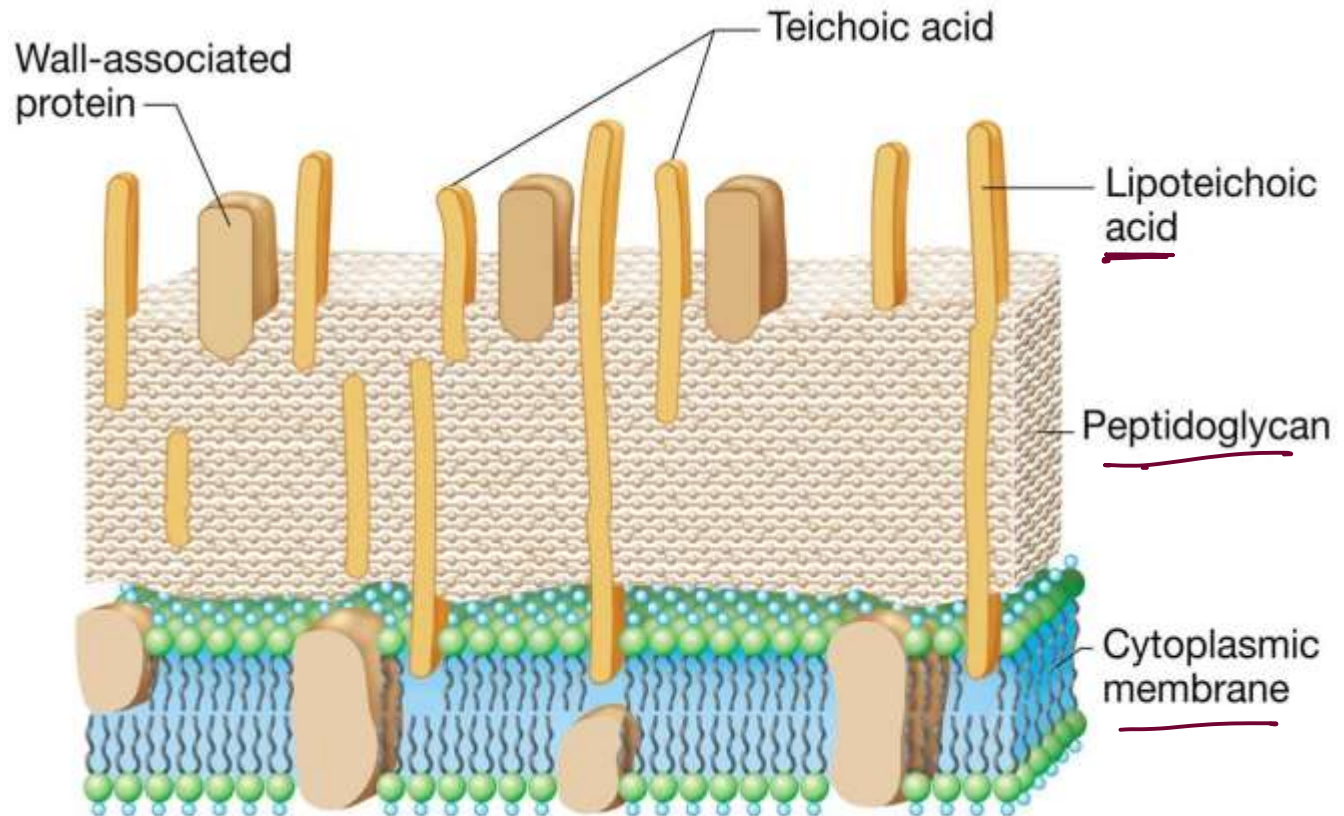
1- what's the Teichoic? and lipoteichoic?

Teichoic Lipoteichoic acids

- Teichoic acids are copolymers of glycerol phosphate or ribitol phosphate and carbohydrates linked via phosphodiester bonds.
- Lipoteichoic acids (LTA) Long chains of ribitol or glycerol phosphate.

Functions:

- Anchor peptidoglycan layers to the plasma membrane ✓
- Attachment to other bacteria and to specific receptors on mammalian cell surfaces. ✓

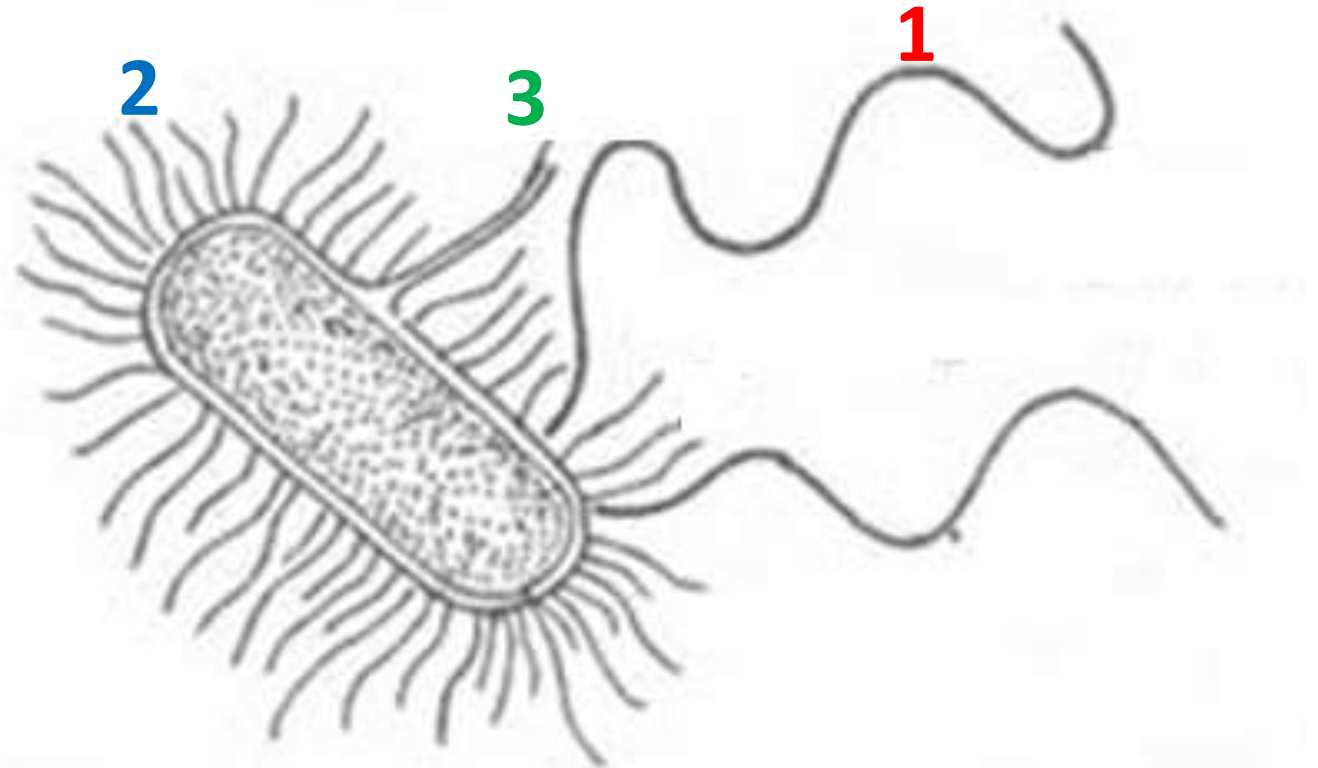


Ultrastructure of Bacterial Cell

1. Flagella

2. Pili

3. Sex Pili



1- what're the features of flagella?

2- what're the type of bacteria

3- what're the structure of

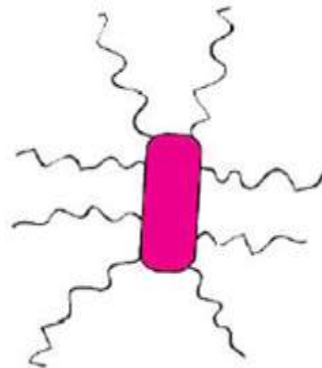
Ultrastructure of Bacterial Cell

Flagella

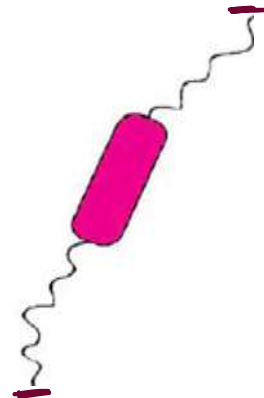
- They are flexible, whip-like appendage (singular flagellum). ①
- Measures 4-5 μ long. ②
- They are made up of protein flagellin (MWt, 40,000) ③
- The location of flagella varies in various bacteria. ④
- The bacteria which lack flagella are referred as atrichous.
- Bacteria can be divided into following types based on the location of flagella.



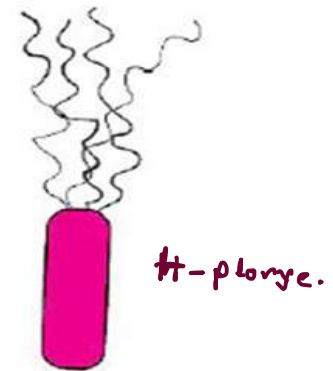
Monotrichous



Peritrichous



Amphitrichous

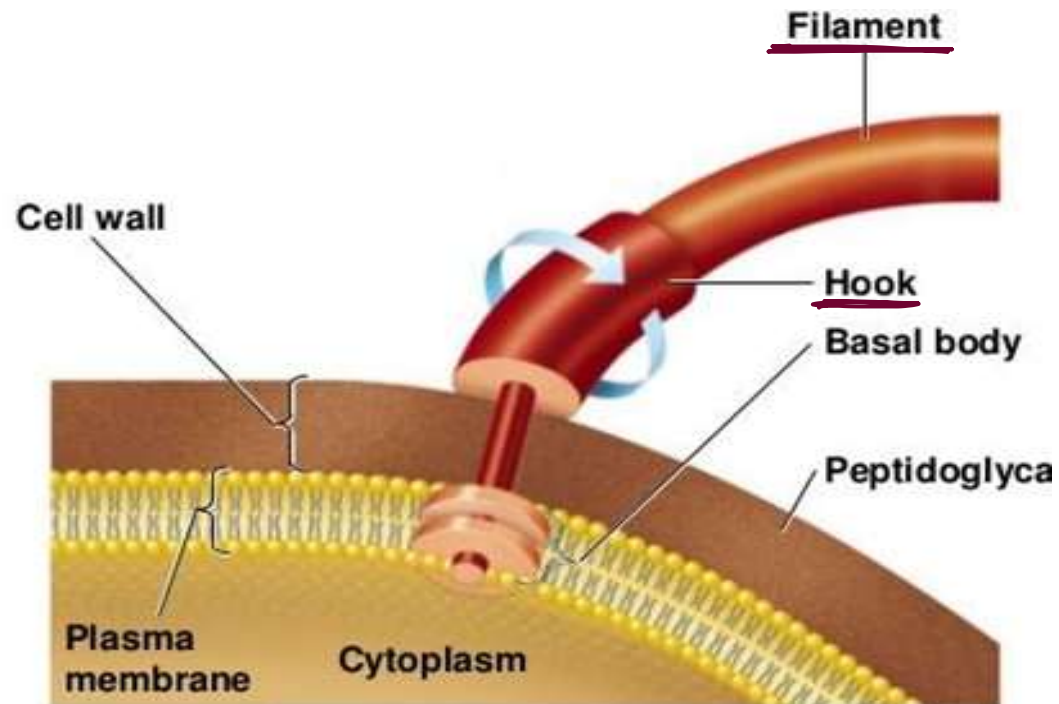


Lophotrichous

Ultrastructure of Bacterial Cell

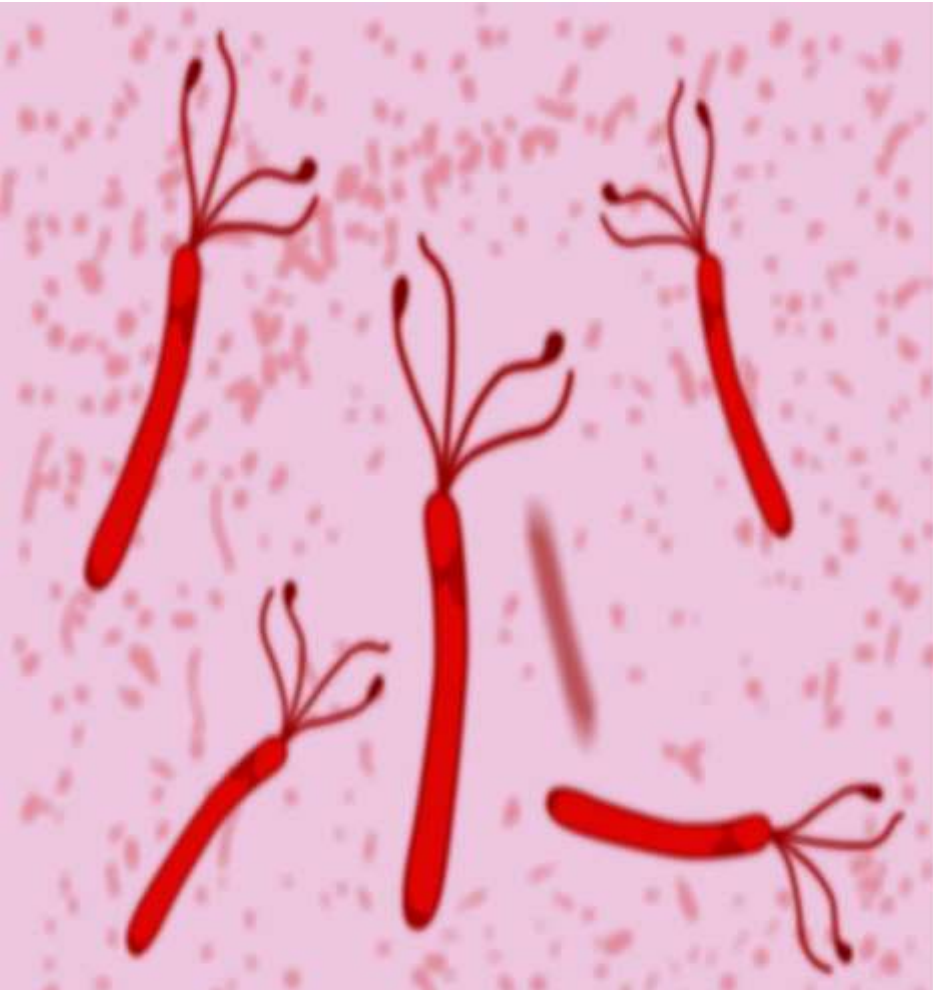
Ultrastructure of flagellum

- Each bacterial flagellum is structurally differentiated into three parts
 - ① basal body. ✓
 - ② Hook. ✓
 - ③ Main filament or shaft. ✓

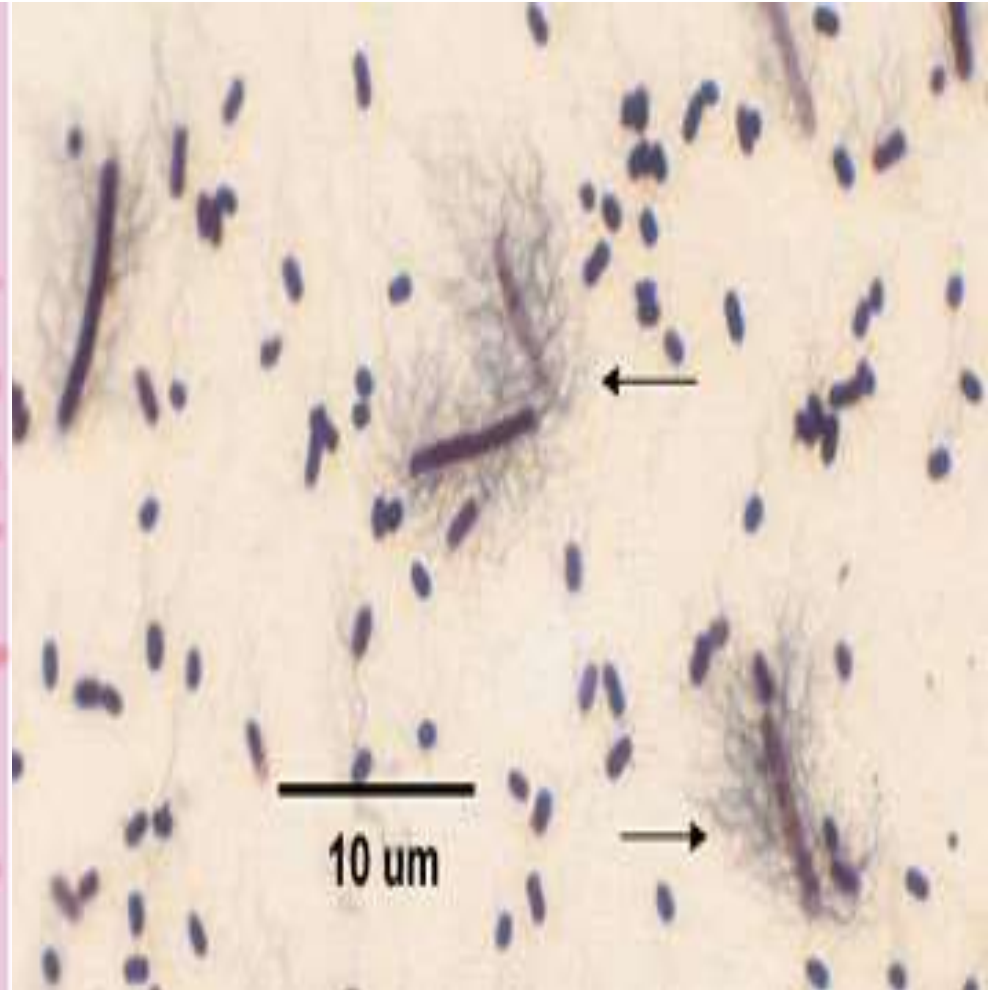


Flagella stain

Rosanalin dye



Silver nitrate + ferric tannate



1- what's the function of pili?

2- what's the type of them?

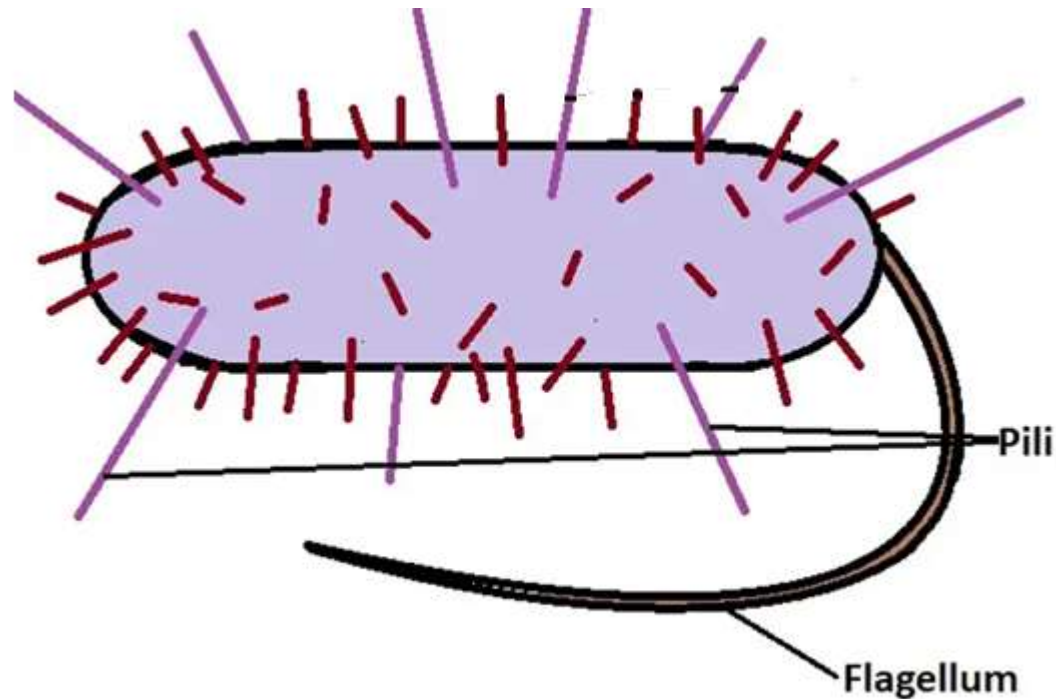
Pili shorter than flagellum movement.
↳ attachment

- These are hair like appendages present on the surface of most of the gram negative bacteria. / sometimes in gram+ ①
- They are smaller than flagella, have no role in the motility of bacteria. ②
- A single bacterial cells bears about 100-500 pili which are arranged peritrichously. ⇒ along body of bacteria.
- Their origin is from cytoplasm and penetrate through the peptidoglycan layers of the cell wall.
- Two types: Somatic pili and sex pili or conjugate pili
↳ attachment ↳ transfer of DNA.

Pili

Somatic pili:

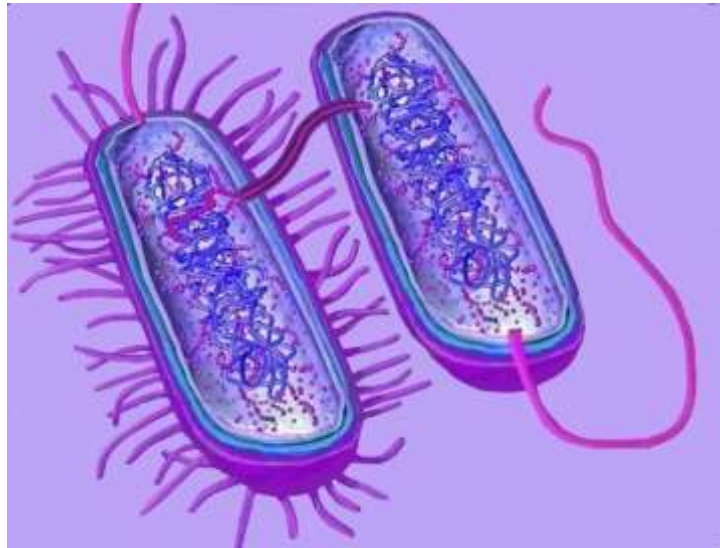
- Each bacterial cell bears about 100 somatic pili.
- Function: is to help the bacterium for attachment to a substratum.



Pili

Sex Pili or Conjugate Pili :

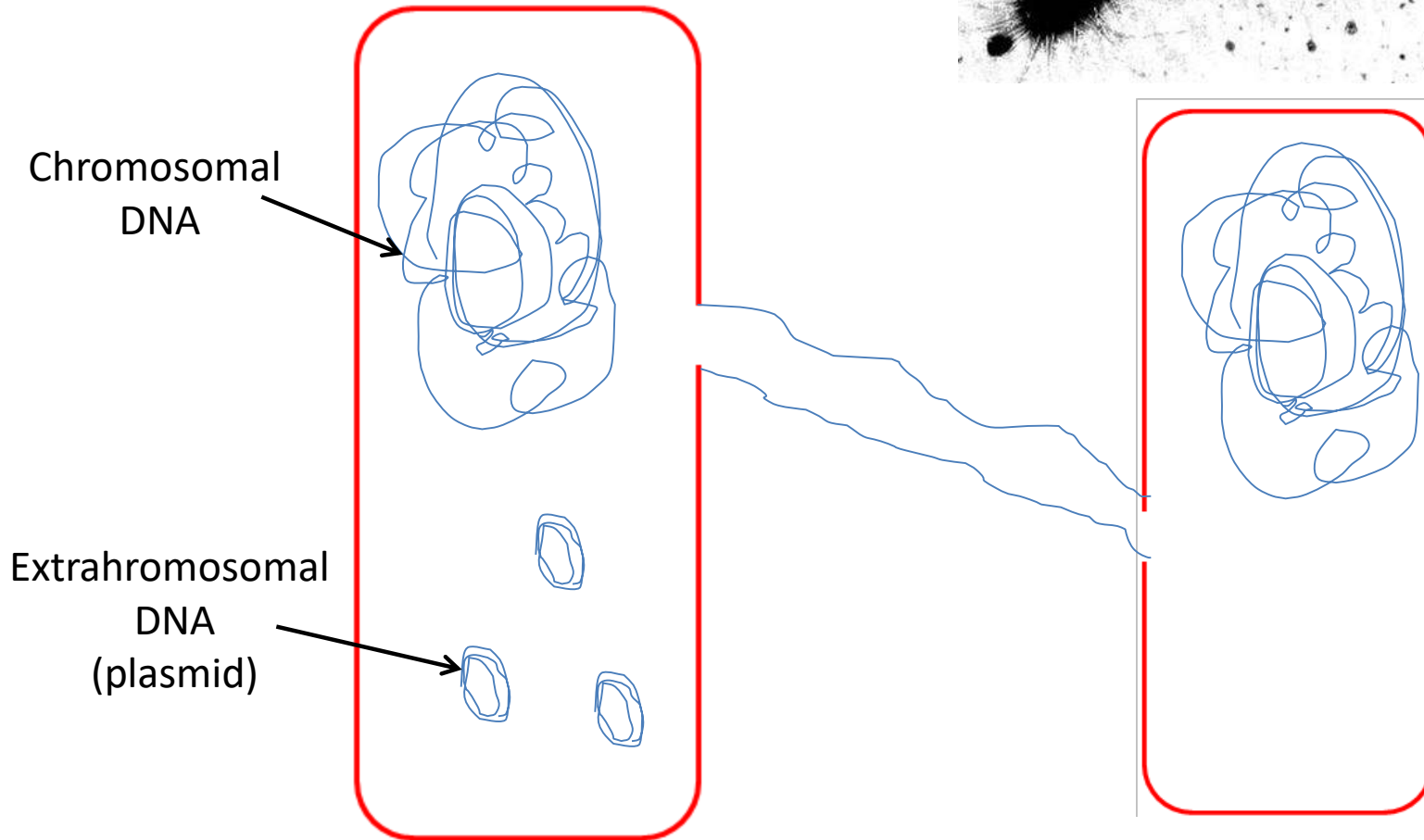
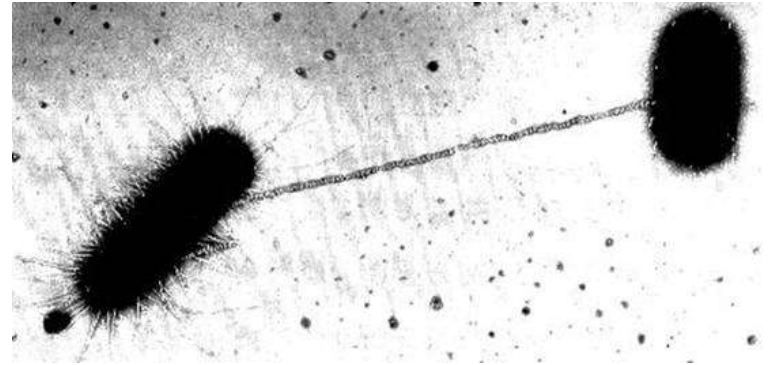
- known as F pili.
- Allow the transfer of DNA between bacteria, in the process of bacterial conjugation. This can result in dissemination of genetic traits, such as antibiotic resistance, among a bacterial population.



The Ultrastructure of bacterial cell

Pili

- Conjugative (sex) pili



Fimbriae

⇒ Same pili, but shorter.

- A fimbria is a short pilus that is used to attach the bacterium to a surface. They are sometimes called "attachment pili".
- Fimbriae are either located at the poles of a cell, or are evenly spread over its entire surface.

