MORPHOLOGY OF BACTERIA

- Micro-organisms initially classified in to two Kingdom

  1) Plant and

  2) Animal Kingdom

- Proved unsatisfactory. They were then classified in to third kingdom is Protista.

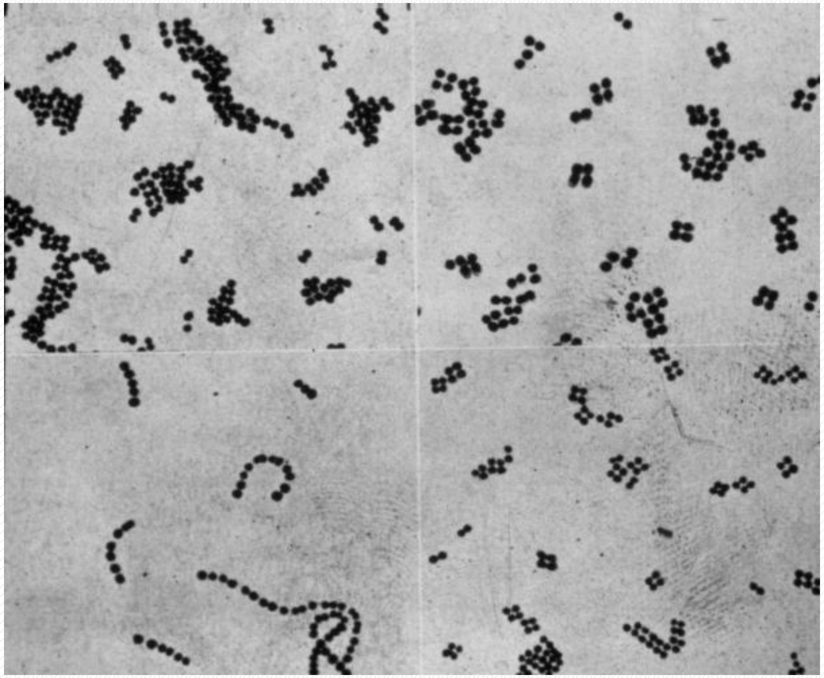
  Based on cellular organisation and bio chemistry the kingdom Prostista has been divided into two group Prokaryotes and Eukaryotes. Bacteria, Blue green algae are Prokaryotes while fungi, protozoa, slime mould and other algae are Eukaryotes.

- Bacteria are unicellular prokaryotic microorganisms without chlorophyll. They do not show true branching except in higher bacteria (Actinomycetes)

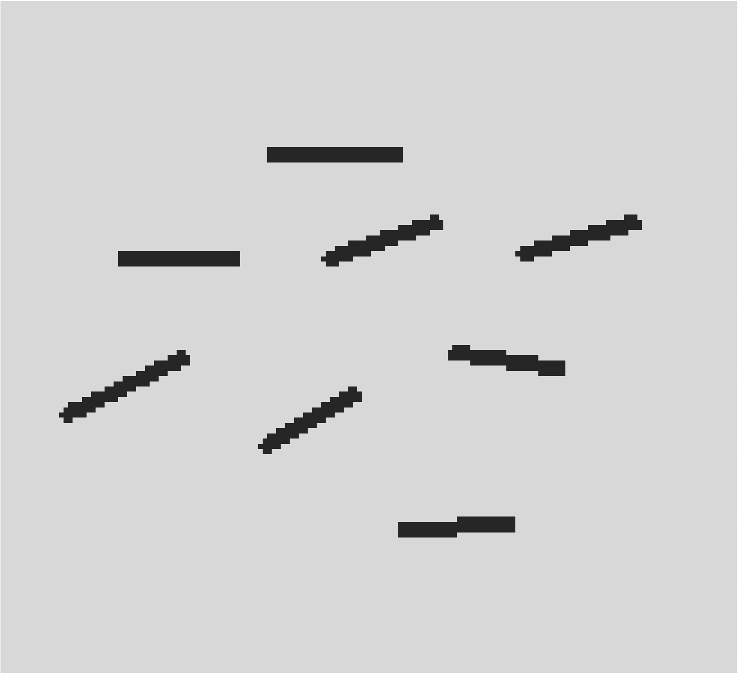
❖ Classification of bacteria

According to their shape:

- Cocci - oval or spherical in shape
- Bacilli — rod shaped

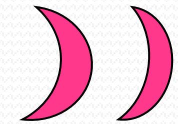


Cocci

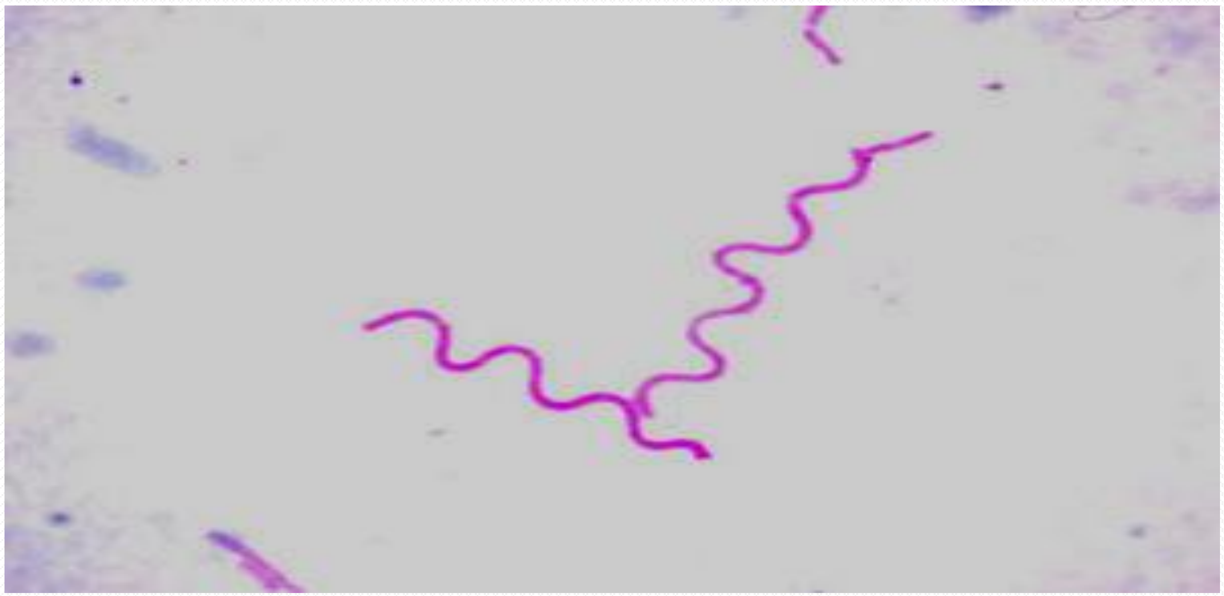


Bacilli

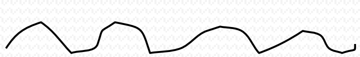
- Comma shaped, curved rods: e.g. Vibrio



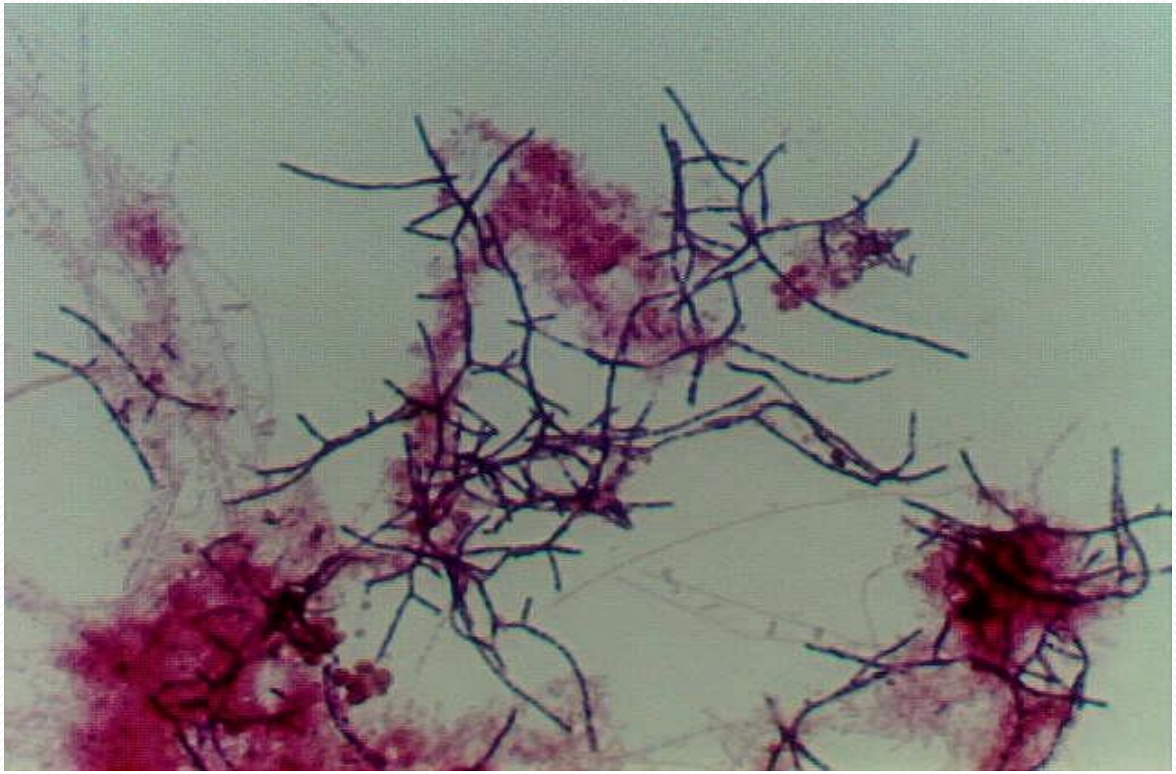
- Rigid spiral forms: e.g. Spirilla



- Flexuous spiral forms: e.g. Spirochetes



- Branching filamentous forms: e.g. Actinomycetes

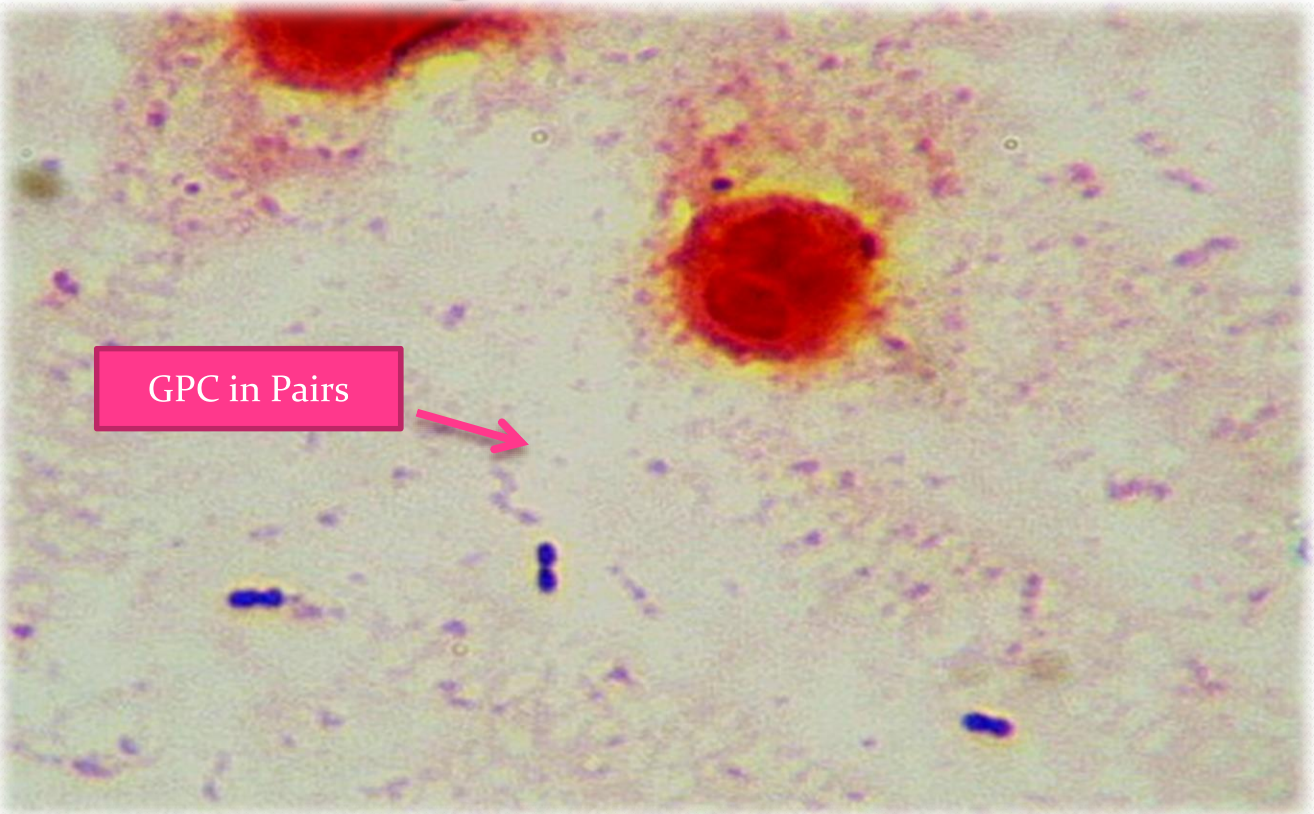


- Mycoplasma - cell wall deficient bacteria

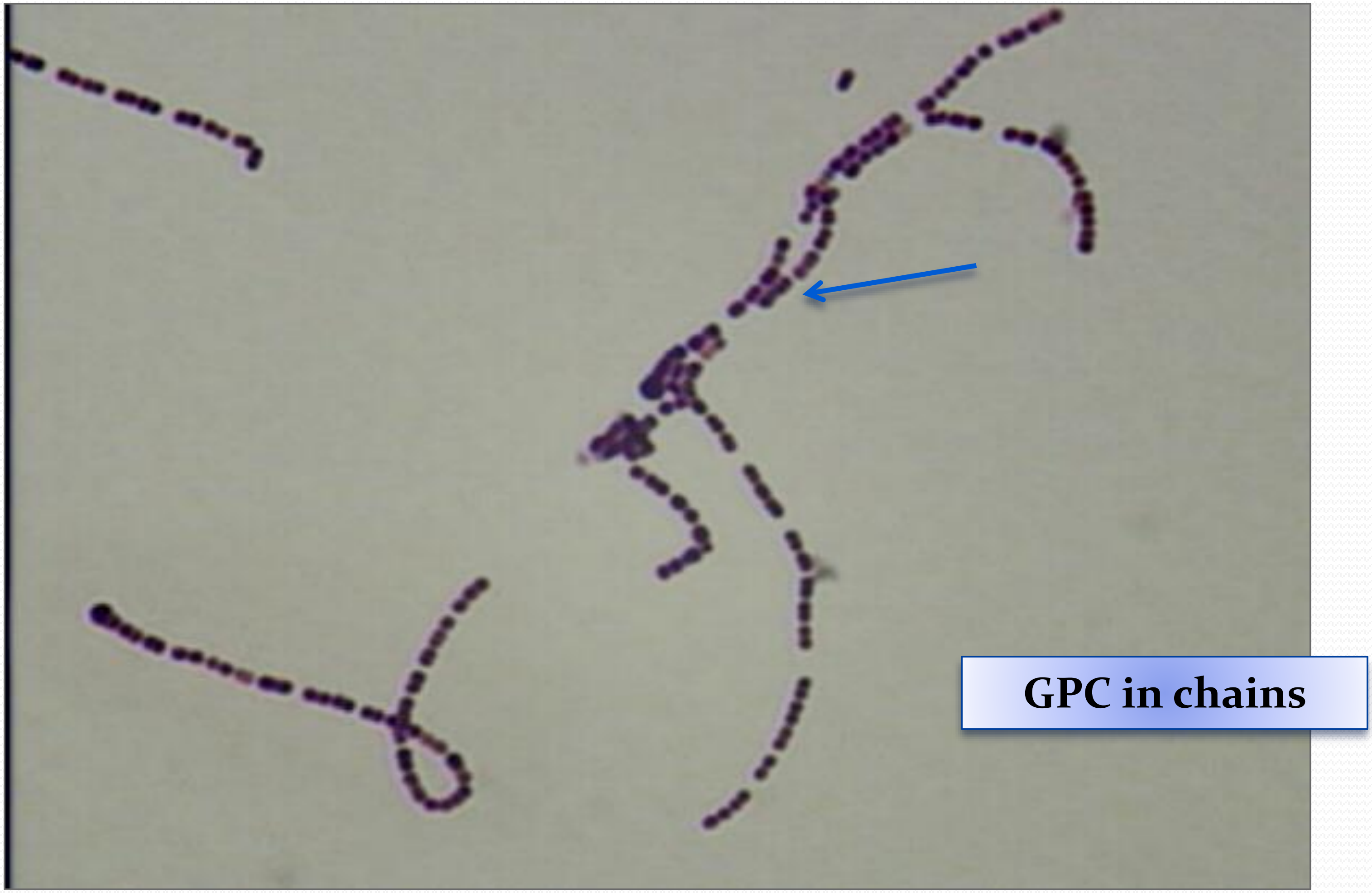
According to their arrangement:

<u>Cocci may be arrange in</u>

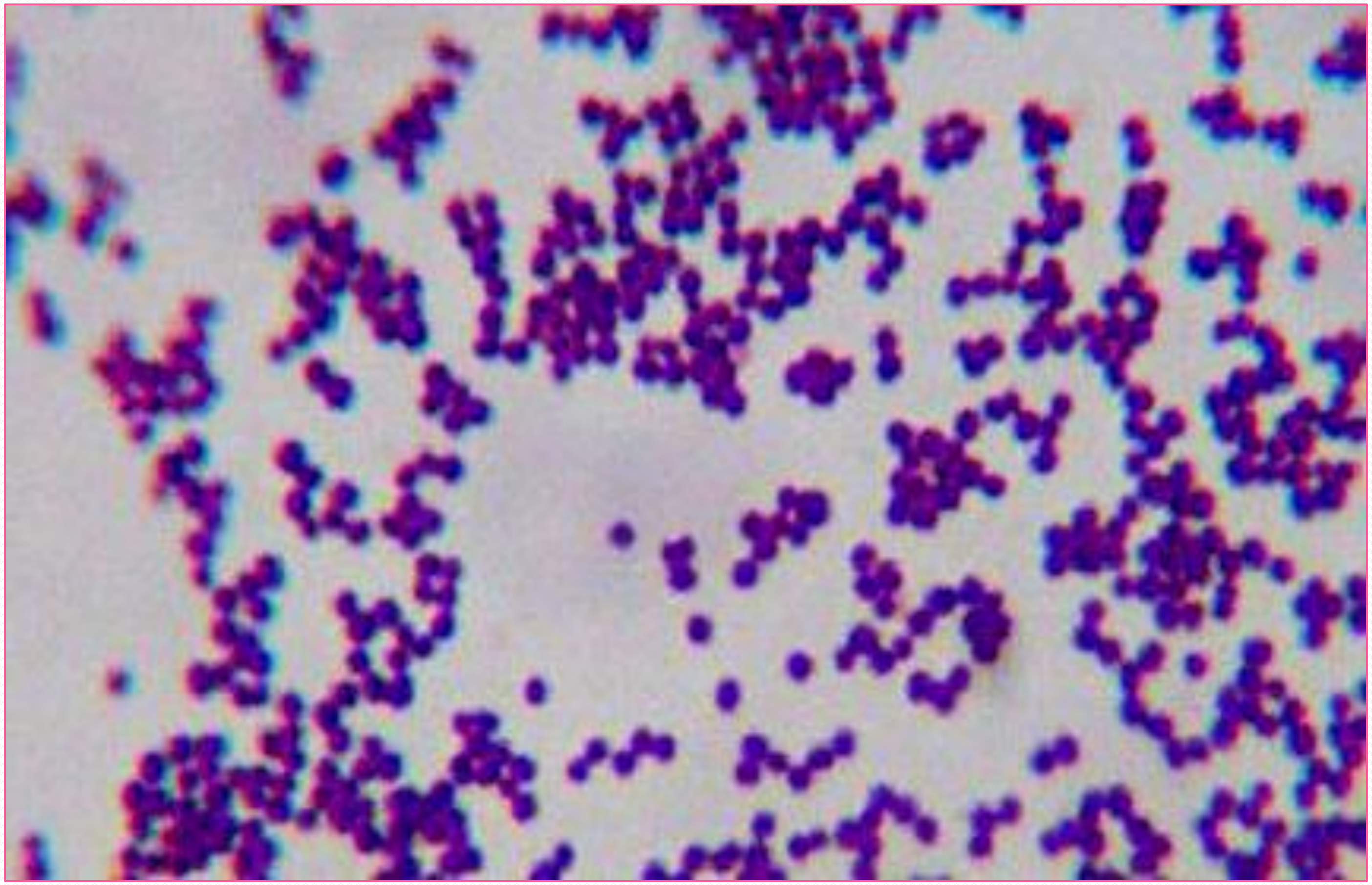
- Pairs - e.g. Diplococci (Pneumococcus, Gonococcus,Meningococcus)



- Chains - e.g. Streptococcus



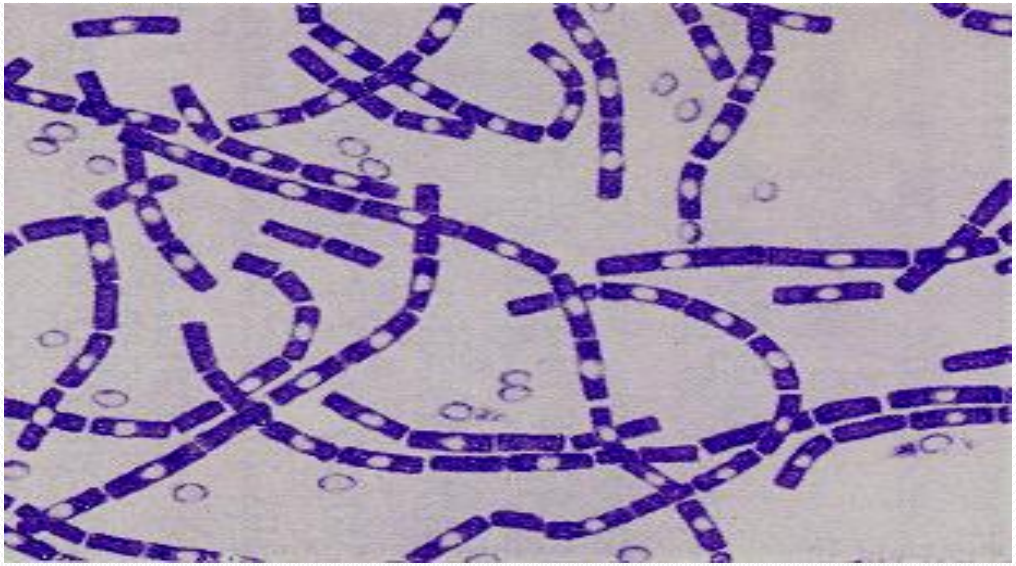
- Grape like clusters - e.g. Staphylococcus



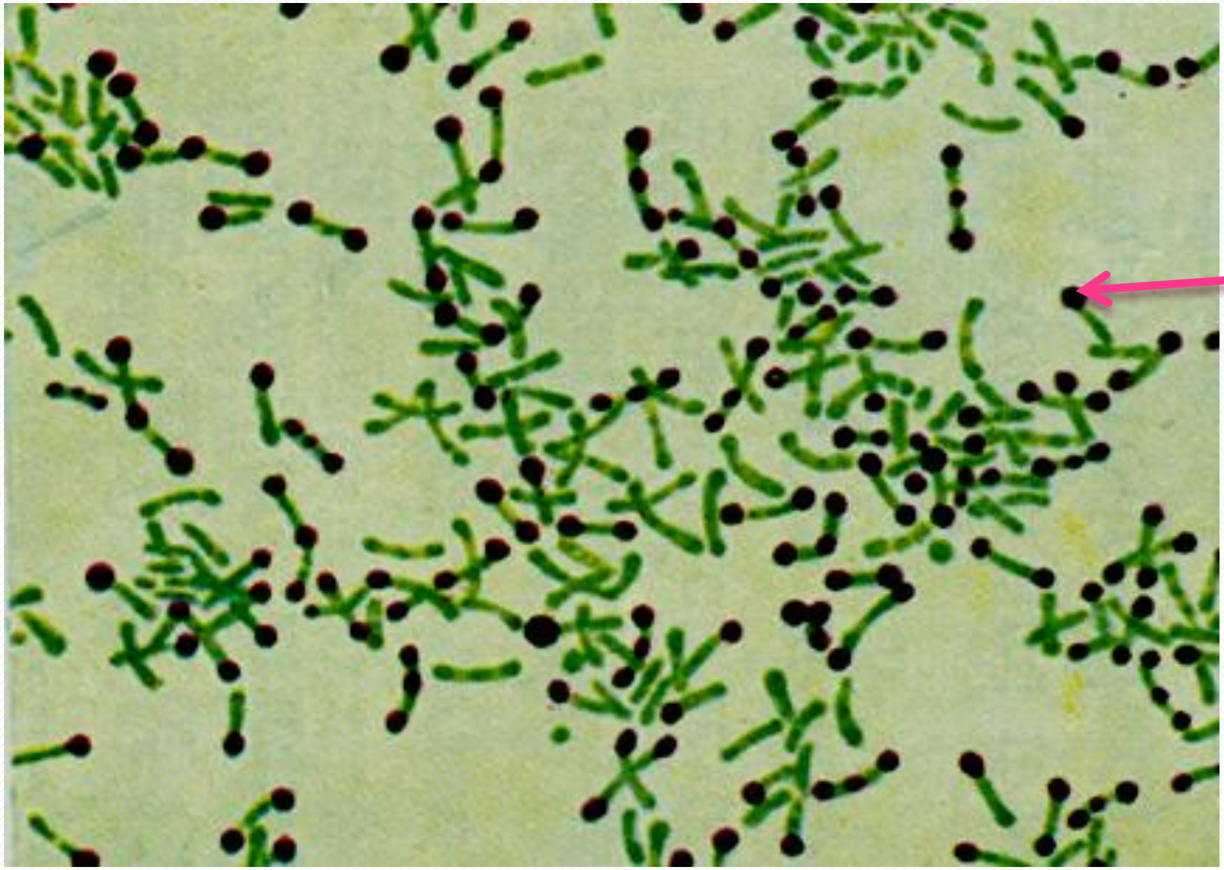
- Groups of four -e.g. Tetrads
- Groups of eight - e.g. Sarcina

<u>Bacilli may be arrange in</u>

- Chains - e.g.Streptobacilli, Bacillus anthracis



- Cuneiform or Chinese letter pattern — e.g. Corynebacterium diphtheriae



Metachromatic granules

A typical bacterial cell shows following structures:

1. Cell Wall:

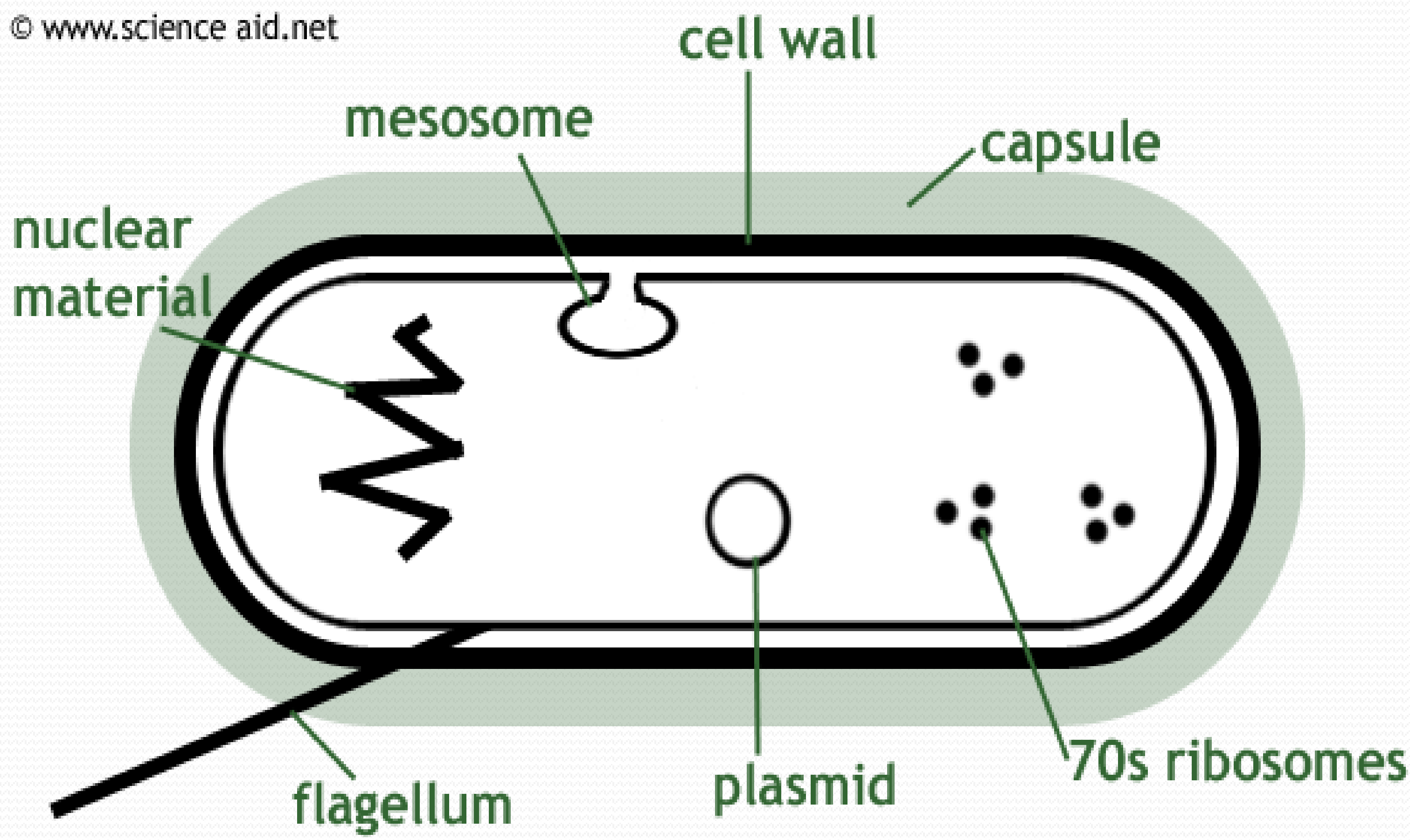
- Tough and rigid structure surrounding the bacterium like a shell, 10-25 nm in thickness & accounts for 20-30% of dry weight

❖ **Function:**

- Gives bacteria shape and protection from lysis.

❖ **Demonstration of cell wall:**

- By plasmolysis
- By microdissection
- By reaction with specific antibody
- By electron microscope


© www.science aid.net
cell wall
mesosome
capsule
nuclear
material
flagellum
plasmid
70s ribosomes

2. Cytoplasmic membrane:

- Thin, elastic, 5-10 nm, semi-permeable layer lining the inner surface of the cell wall and separating it from the cytoplasm.

- **<u>Function</u>:**

- Selectively permeable barrier
- Mechanical boundary of cell, nutrient and waste transport
- Location of many metabolic processes (respiration, photosynthesis)
- Play a role in chemotaxis

3. Cytoplasm:

It is a colloidal system containing a variety of organic and inorganic solutes in a viscous watery solution. It contains

Mesosomes:

Vesicular structure formed due to invagination of plasma membrane into the cytoplasm.

- **Function:**

  - Center for respiratory activity
  - Take part in cell division

Ribosomes:

Globular structures composed of RNA & proteins. Sedimentation coefficient is 70s

- **Function:** Site for protein synthesis

Inclusion granules:

Nonliving bodies deposited in cytoplasm when large amount of nutrients are present and disappear under the condition of starvation.

Example: Lipid granules, Volutin granules, Sulphur granules

- **Function:** Storage of carbon, phosphate and other substances

4. Nucleus:

- Not well developed and without nuclear membrane & nucleolus. Contains a single, circular molecule of DNA .
- Extracellular genetic material consisting of DNA known as plasmids or episomes

Function:

- Controls, growth and metabolism of cell
- Multiplication of cell
- Hereditary transmission of characters

5. Capsule and slime layer:

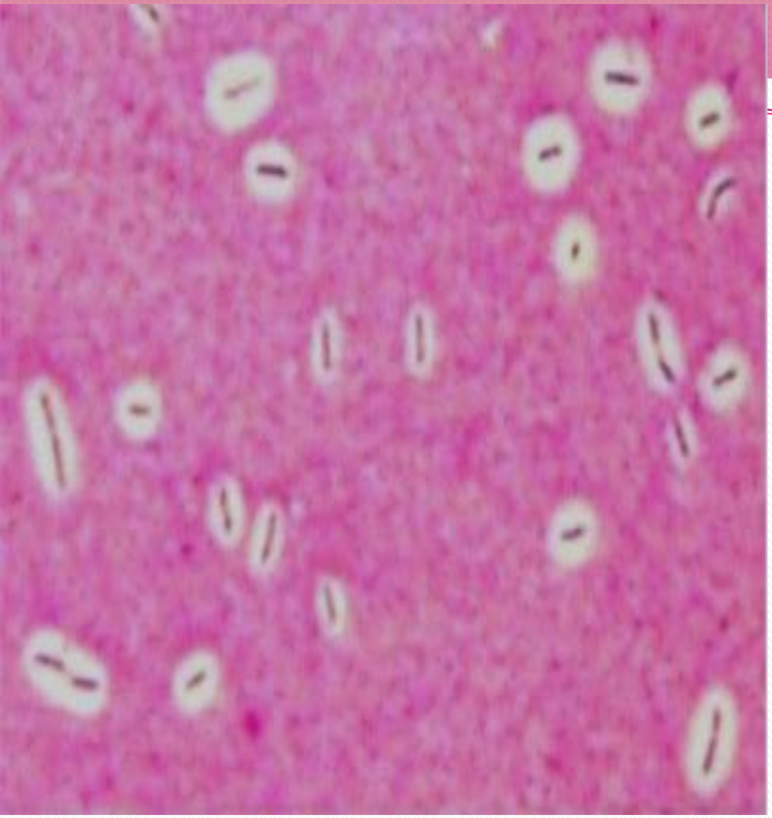
- Many bacteria secret a viscid organic material around the cell wall.
- When it organised into a sharply defined structure as in *pneumoccus* called ***Capsule***
- When it is loose undemarcated structure as in *Leuconostoc* called ***slime layer***
- Some bacteria have both capsule and slime layer e.g. *Streptococcus salivarius.*

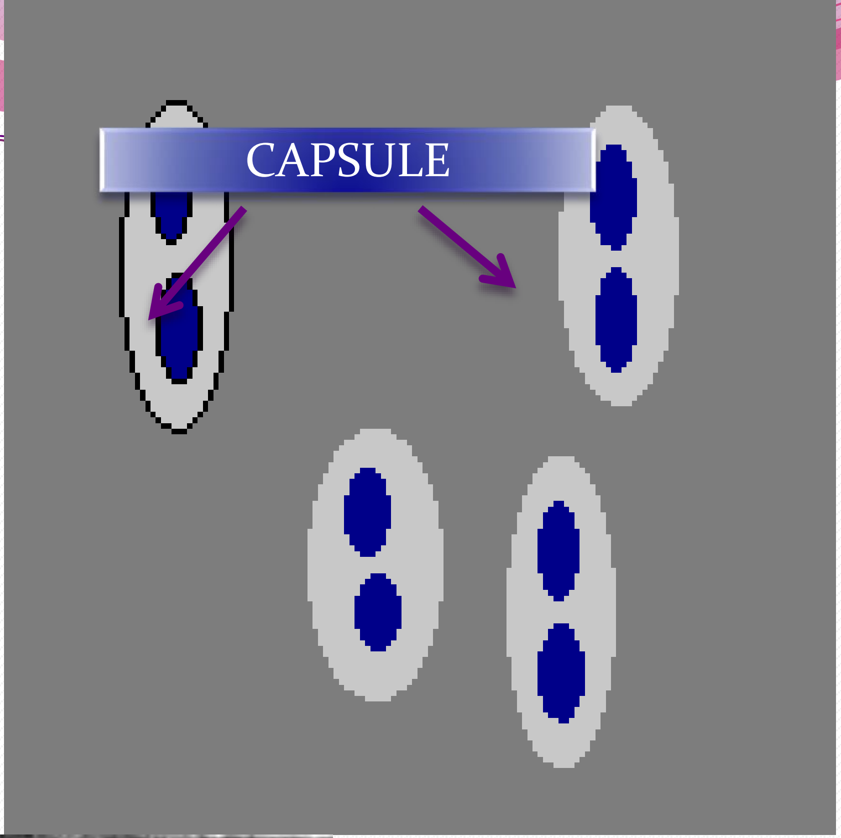
Function:

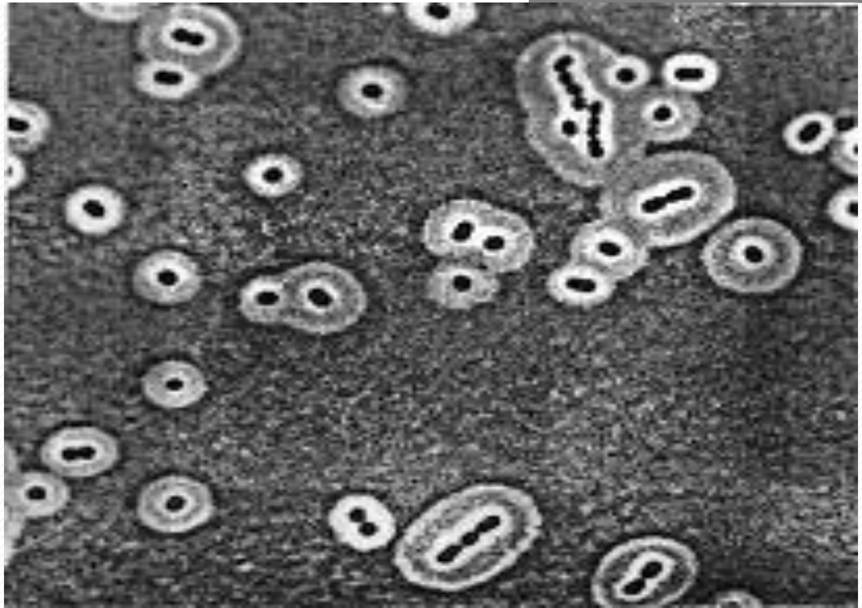
- Resistance to phagocytosis.
- Protect bacteria from deleterious agent such as lytic enzymes.
- Loss of capsule by mutation render the bacteria avirulent.
- Adherence to surfaces

Demonstration:

- Negative staining with India ink or nigrosin
- Quellung reaction
- Hiss's method




CAPSULE



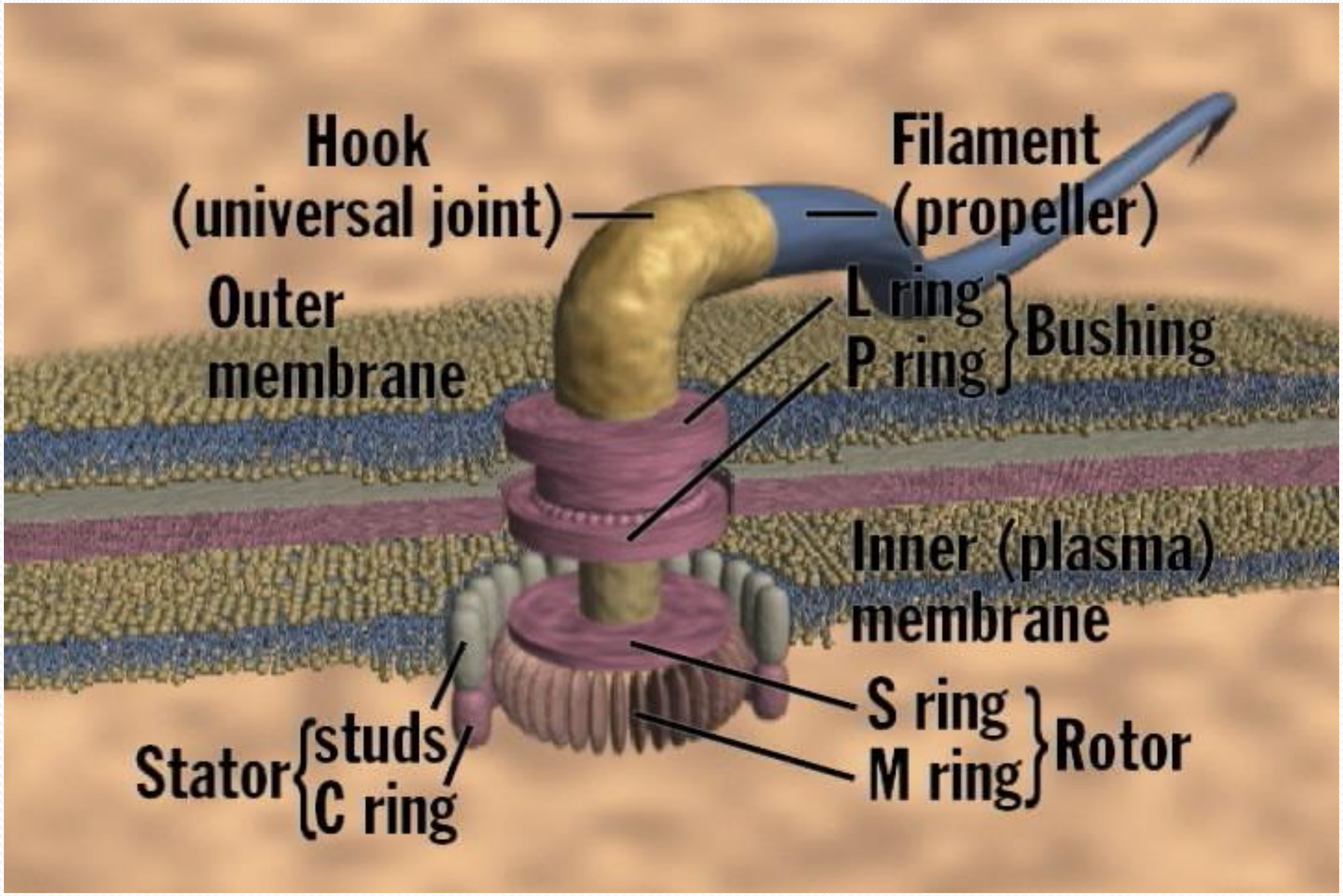
6. Flagella:

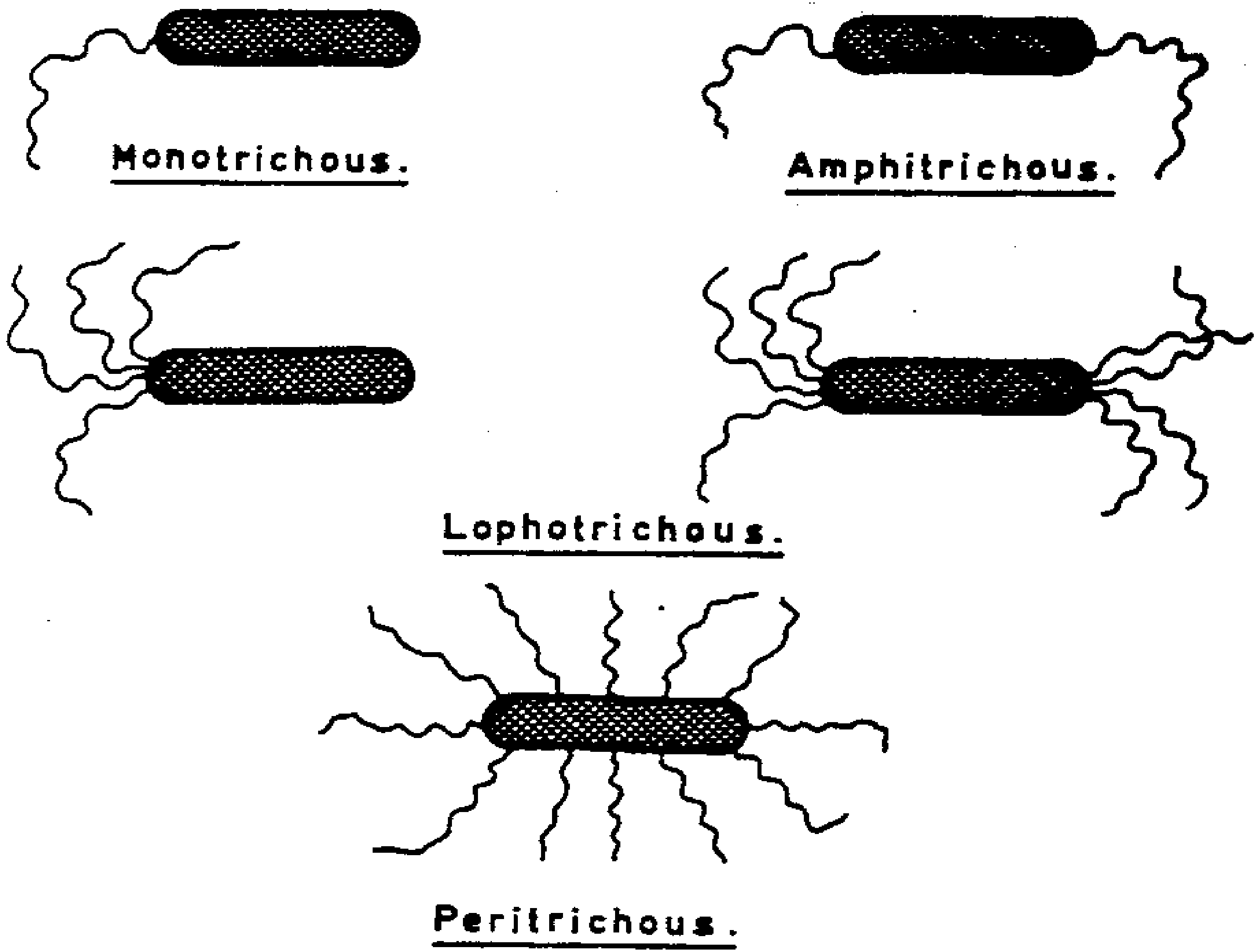
- Slender, rigid structure arising from the cytoplasm and extending out through cell wall
- It consists of three distinct parts: basal body, hook and filament.

Function: - Organ of locomotion

Demonstration:

- Electron microscope
- Impregnation method
- By demonstration of motility
- Dark ground microscopy.


Hook
(universal joint)
Filament
(propeller)
Outer
membrane
L ring
P ring
Bushing
Inner (plasma)
membrane
S ring
M ring
Rotor
Stator
studs
C ring


Monotrichous.
Amphitrichous.
Lophotrichous.
Peritrichous.

- **Motility**
- Types of motility

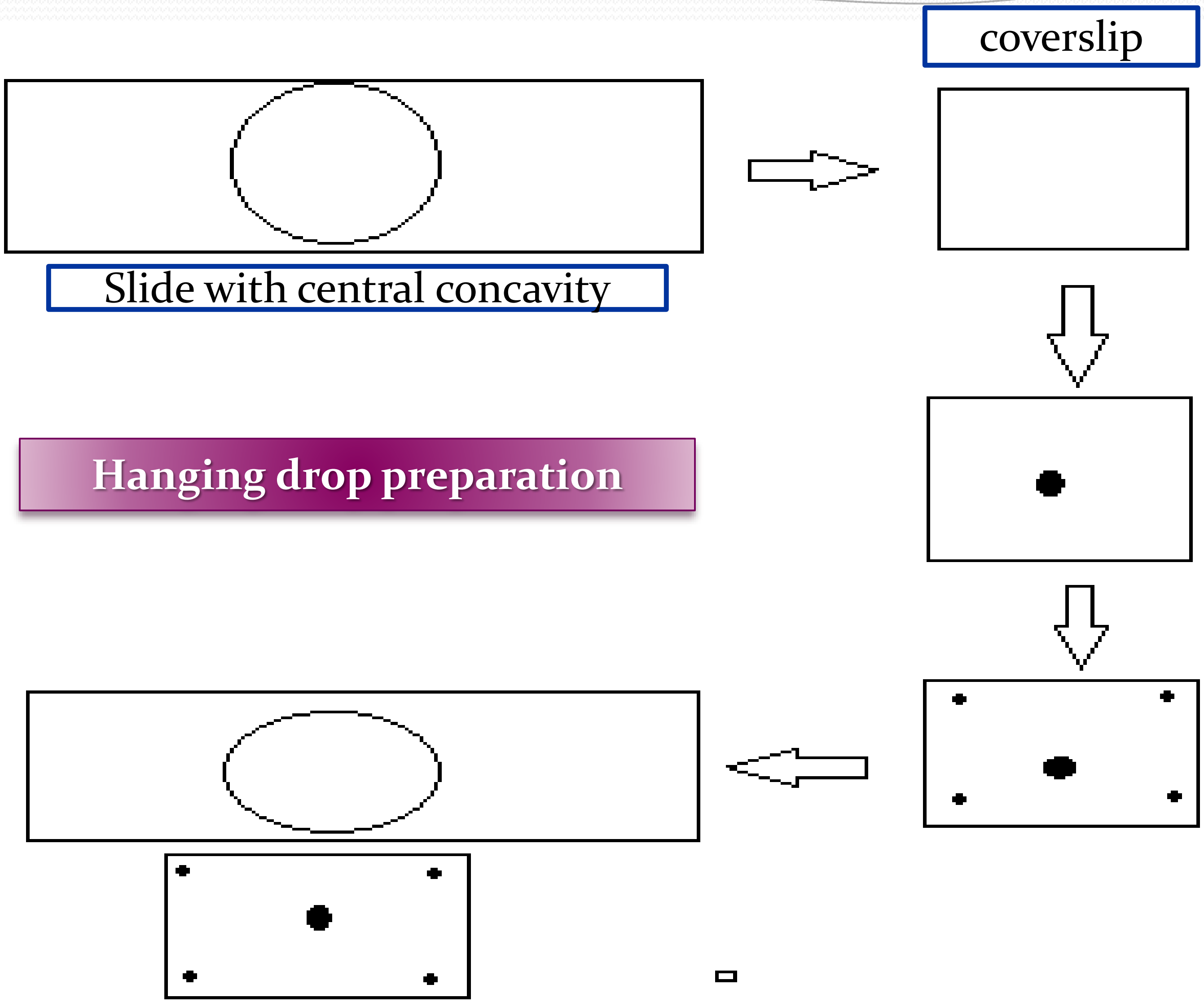
1. Tumbling motility: e.g. Listeria monocytogens
2. Darting motility: e.g. Vibrio cholerae
3. Cork screw motility: e.g. Spirillia
4. Active motile: e.g. Pseudomonas
5. Falling leaf motility: e.g. Giardia lamblia
6. Sluggish motile: e.g. Escherichia coli.
7. Brownian movement: e.g. movement of bacteria due to bombardment of microscopic particles.
8. Drifting: e.g. passive drifting of the organism in the same direction in a conventional current in the fluid.

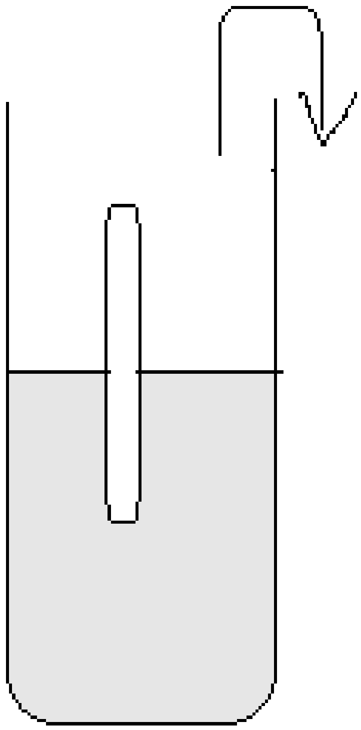
Note: Motile organisms are usually easily seen as they move among each other in separate directions. One must, of course, discount Brownian motion, the movement due to bombardment of submicrosopic particles in the liquid, where the cells (alive or dead) appear to remain in one position but shake somewhat.

- **Methods to demonstrate Motility**

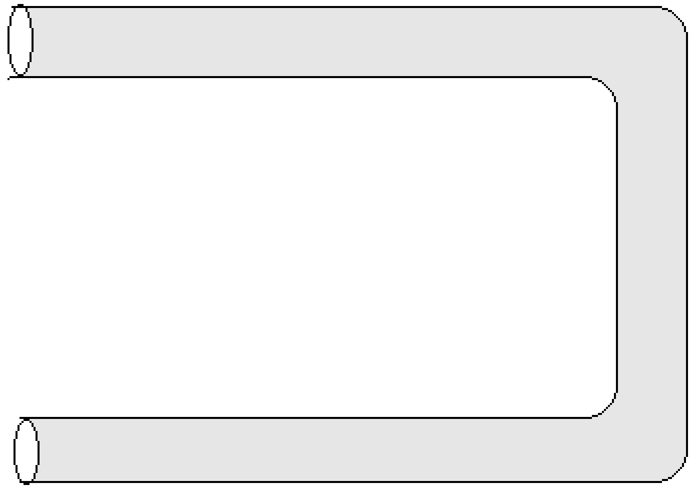
1. Hanging drop preparation
2. Wet mount
3. By detecting spreading type of growth on semi solid agar medium.
4. Craige's tube
5. 'U' tube
6. Swarming on solid media

Hanging drop preparation





Craig's tube



U tube

7. Pili or Fimbriae:

Fine, hair-like appendages arising from the cytoplasm.

e.g. Gonococcus, Escherichia, Klebsiella

Function: -Organ of adhesion. Act as a virulent factor by promoting attachment to the host cells and inhibiting phagocytosis.

Sex pili — transfer of genetic material from male to female by forming conjugation tube.

-Help to form pellicle in liquid media

Demonstration -Electron microscope

-Haemagglutination test

7. Spore:

- Highly resistant resting phase of bacteria formed during unfavourable environmental conditions. e.g. Bacillus and Clostridium
- Resistant to heat, cold, chemicals and desiccation. But destroy at 120°c temperature for 15 mins.
- Each bacterium forms one spore which on germination forms a single vegetative cell.

Spore contain core, spore wall, cortex, coat and exosporium.

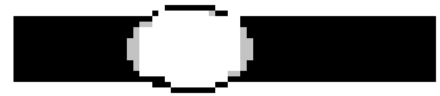
- **Shape and positions:**

1. Oval or spherical
2. Central, sub terminal or terminal
3. Bulging or non bulging

- **Demonstration:**

1. Gram stain
2. Modified acid fast stain
3. Schaeffer - Fulton staining

Central non bulging



Central bulging

Sub terminal non buldging

Sub terminal bulging

Terminal non bulging

Terminal bulging


spore

- <u>L form and Pleomorphism</u>
- Some species of the bacteria exhibit great variation in the size and shape of individual cells this is known as a ***pleomorphism***.
- Certain species (e.g. Plague bacilli and Gonococcus) show swollen and abberant form in ageing culture especially in high salt concentration this is known as a ***Involution form***.
- Pleomorphism and Involution form are due to defective cell wall synthesis.
- **L form:**
- Develop in present of Penicillin or other agent that interfere with cell wall synthesis.
- It may be **Unstable** in which morphologically abnormality is present only in present of penicilllin or other inducible agents. Or it may be **stable** where morphological changes retain in serial sub culture


Thank you!