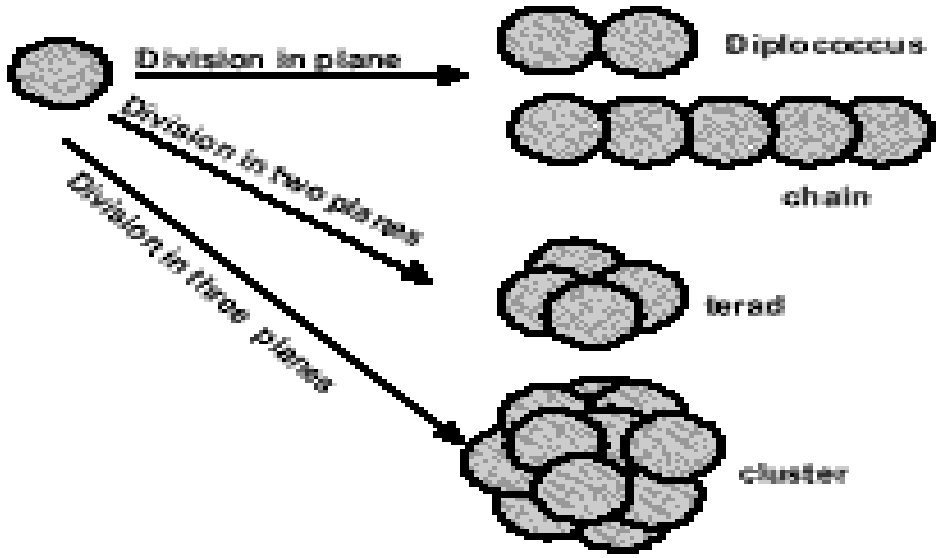
MORPHOLOGY OF BACTERIA

Dr.Avani Patel

Morphological Classification of Micro-organism

1. **Coccus**: Single, **Cocci**: More than one, Round
2. **Bacillus**: Single, **Bacilli**: More than one, Rods
3. **Vibrios**: Coma shaped organism
4. **Spirillum**: Spiral filaments with terminal flagellum
5. **Spirocheates**: Cork-Screw like spiral organism
6. **Fungus**: Single, **Fungi**: More than one, Branching filaments
7. **Chlamydia**: Basophillic intracellular micro-organism Containing RNA & DNA
8. **Viruses**: Eosinophillic intracellular micro-organism Containing either RNA OR DNA

Bacterial Morphologies	Examples
Straight rod	Escherichia
Club-shaped rod	Corynebacterium
Branching rod	Actinomyces
Spore forming rods	Bacillus
Spiral forms	Spirochaeta
Comma forms	Vibrio
Coccus	Staphylococcus

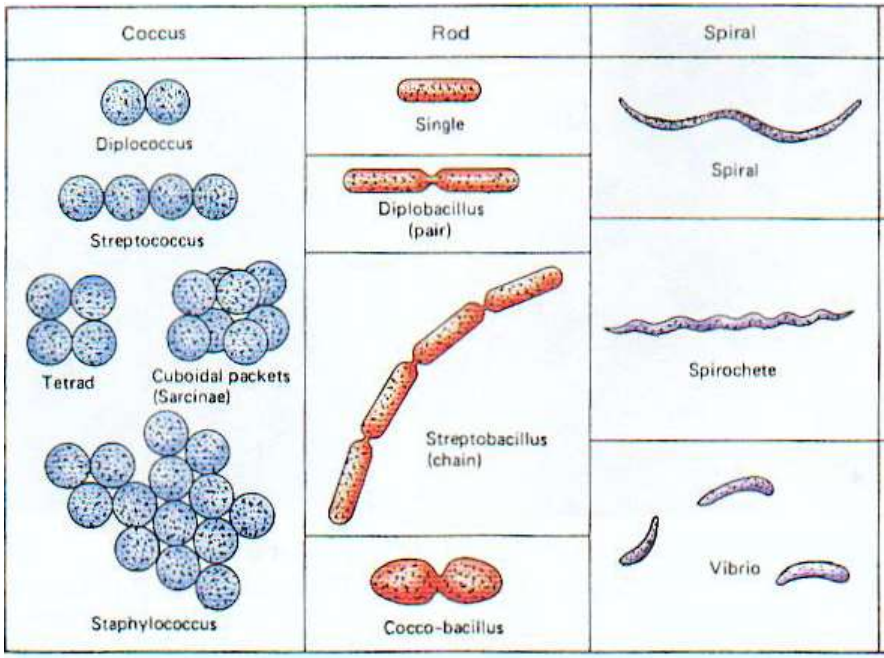


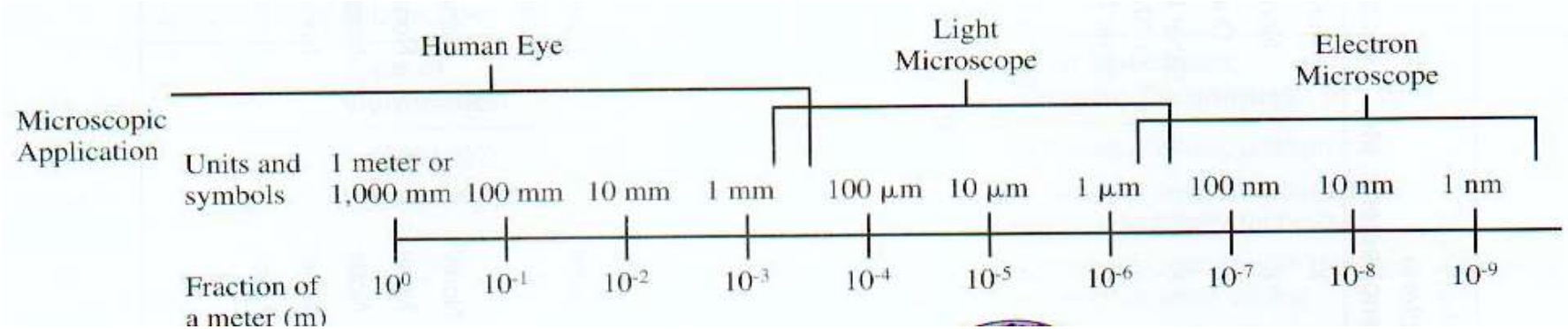
Diplococcus	Neisseria
chain	Streptococcus
tetrad	Saricina
cluster	Staphylococcus

SIZE OF BACTERIA

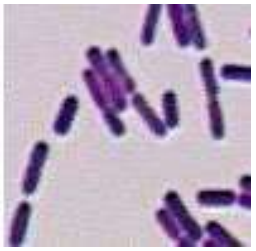
- Unit for measurement :
  Micron or micrometer,μm:
  $1\mu m = 10^{-3} mm$
- Size:

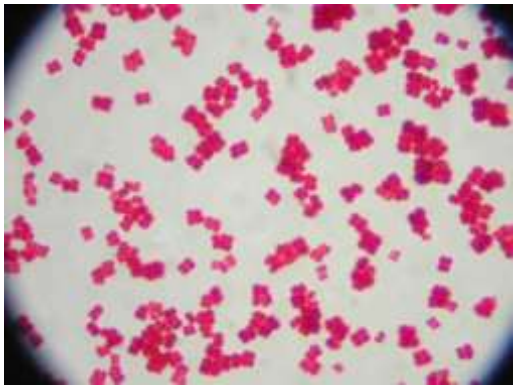
  Varies with kinds of bacteria, and also related to their age and external environment.

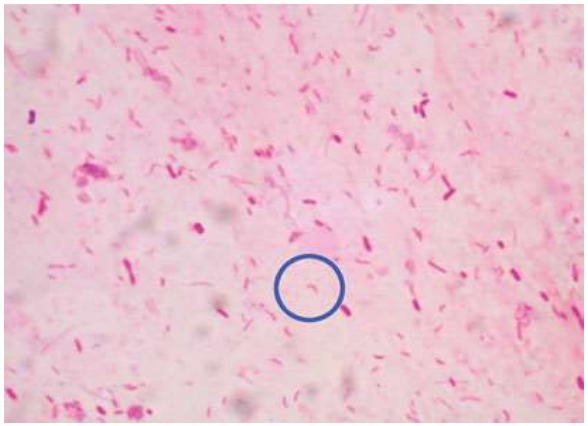


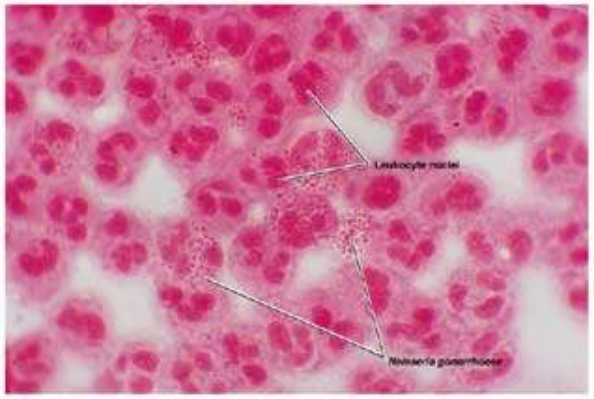


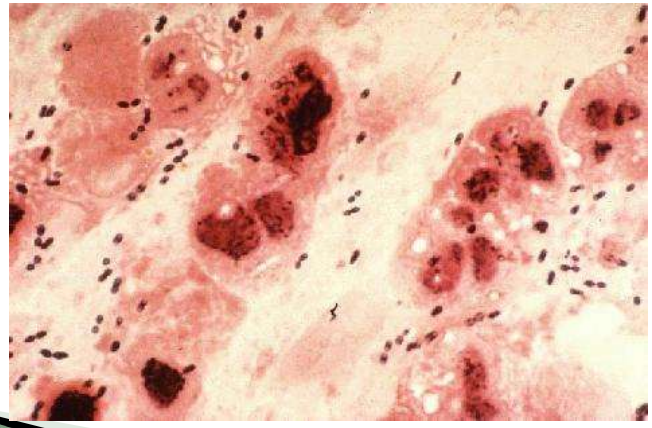
- Cocci: sphere, 1μm
- Bacilli: rods , 0.5-1 μm in width -3 μm in length
- Spiral bacteria: 1~3 μm in length and 0.3-0.6 μm in width







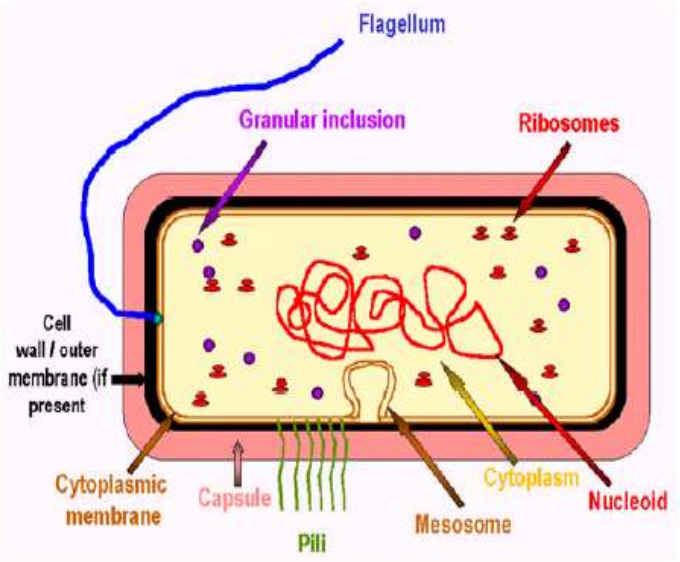

Leukocyte nuclei
Neisseria gonorrhoeae

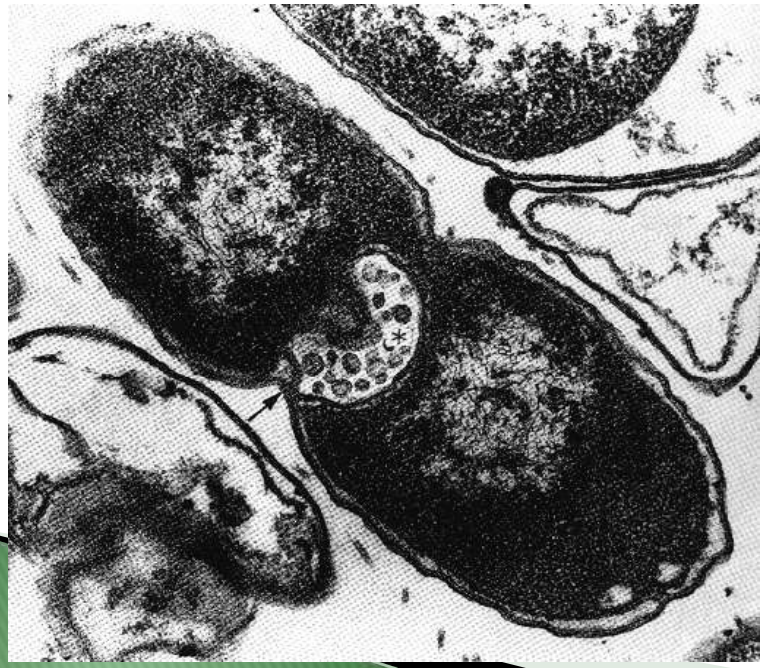


Structure of Bacteria

Essential structures

cell wall
cell membrane
Cytoplasm
nuclear material





Particular structures

capsule
flagella
pili
spore

Structure of Bacterial cell

- **Protoplast:** Body covered by very thin, elastic,& semi-permeable membrane, supports cell wall.
- **Cytoplasm:** Main part of protoplasm, contains:
  Ribosomes: small granules with RNA
  Mesosomes: visible by E/M
  Inclusion granules: volutin G. metachromatic G
  lipid & polysccharide G.
- **Bacterial Nucleus:** Nuclear body OR Chromatin made up of double stranded DNA.
- **Cytoplasmic membrane:** Covers externally protoplast is a thin lipoprotein membrane.
- **Cell wall:** Lies immediately external to cytoplasmic membrane.

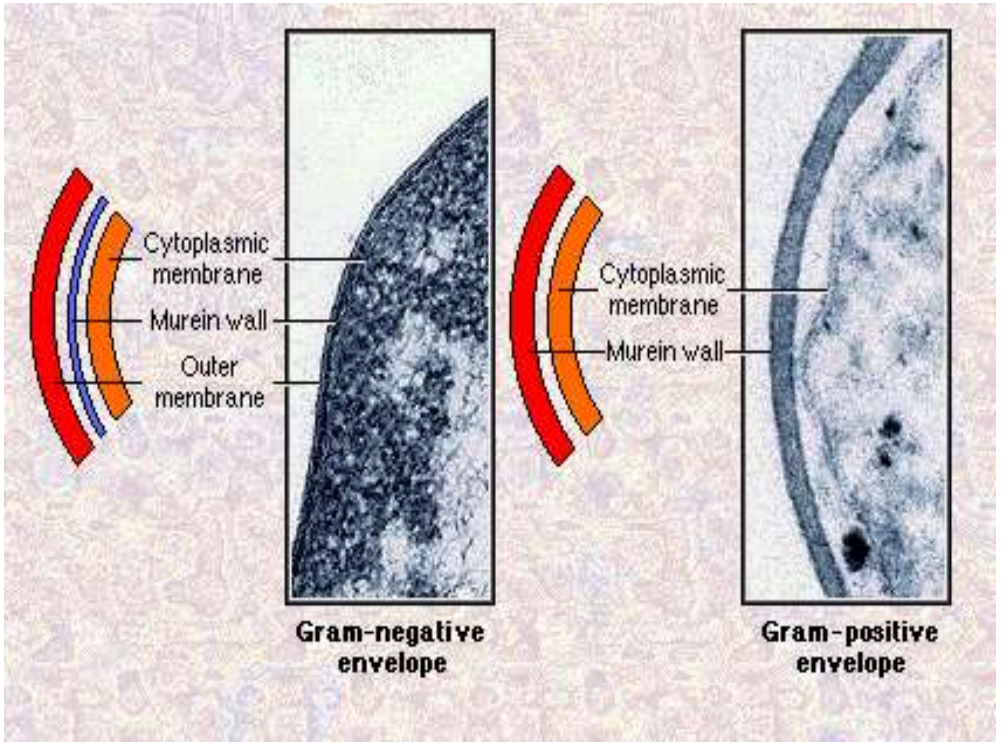
Bacterial cell

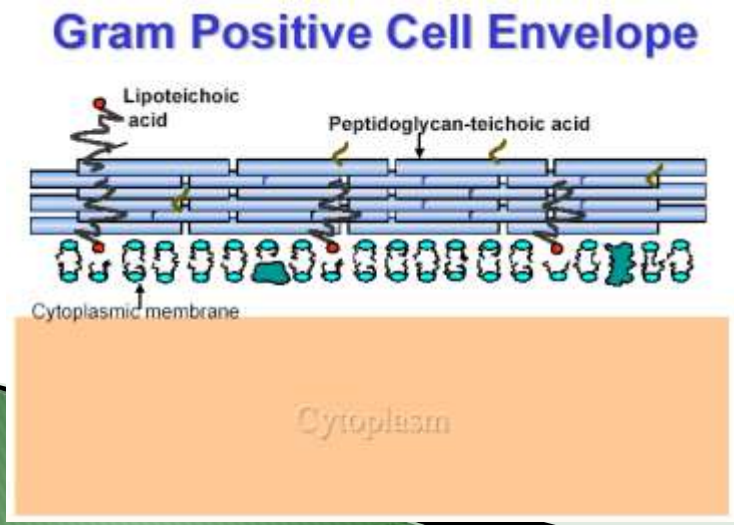
- Like other living cells bacteria posseses all the cellular orgenelles.
- Besides these orgenelles, certain bacteria posseses special appendages OR structures.

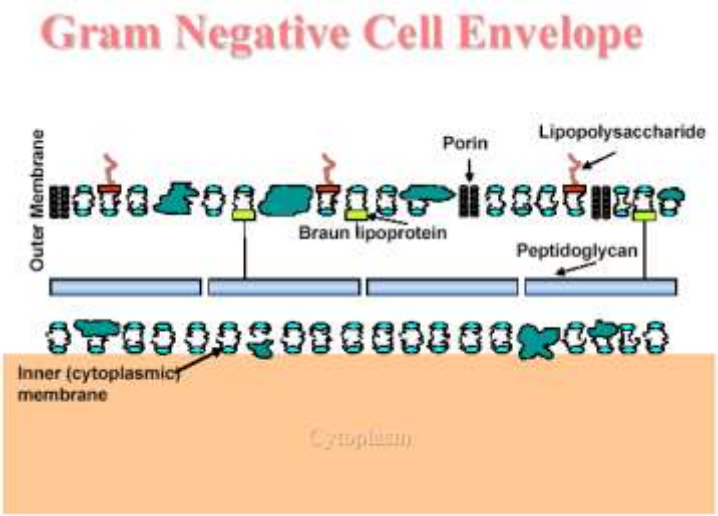
1. **Capsule**: Protective outer covering.
2. **Flagella**: Organ for locomotion.
3. **Spores**: These forms seen under unfavourable conditions.

Cell wall

- Situation: outmost portion. 15-30nm in thickness, 10%-25% of dry weight.







CELL WALL

- Differences between Cell wall of Gram positive and gram negative Bacteria:

Character	Gram positive	Gram negative
Thickness	Thicker	Thinner
Periplasmic space	Absent	Present
Lipids	Absent or less	Present
Techoic acid	Present	Absent
Peptidoglycan	16-80nm	2 nm

Function of cell wall

- Accounts for shape of the cell.
- Provide protection to the cell against osmotic damage.
- Confers rigidity upon bacteria.
- It takes part in cell division.
- It possesses target site for antibiotic,lysozyme and bacteriophage.
- Providing a rigid platform for surface appendages– **flagella**, **fimbriae**, and **pili** all emanate from the wall and extend beyond it
- Be the sites of major **antigenic determinants** of the cell surface。

CAPSULE

- Outer mucoid envelope OR slime layer .
- Organism known as CAPSULATED OR CAPSULATE.
- Present out side the cell wall.
- When too thin to resolve with ordinary light microscope known as MICROCAPSULE.
- Made up of complex substance of high molecular Wt.
- e.g. Diplococcus pneumonae: Polysccharides. Bacillus anthracis: Polypeptide.
- Capsule formation in host by: Strepto. Pyogenes, H.infuenzae, Neisseria meningitidis.
- Capsule has little affinity for basic dye: Not stained by ordinary method e.g. Gram' s method.
- Clear halo is seen around the bacterial cell.

CAPSULE

Demonstration of Capsule

(1) Special staining method.
e.g. Hiss's method for D. pneumonae.
(2) Negative staining method.
By Wet India Ink Preparation.
Capsule is seen as clear halos around the bacterial cell against the dark back-ground.
(3) Quelung Reaction OR Quelung phenomena.
Capsular material is antigenic.

Capsulated organism
+
Specific Anti- Capsular serum

Capsule become prominent & swollen due to increase refractivity
known as Capsule Swelling OR Quelung Reaction

Functions of Capsule

- Resists phagocytosis.
- Forms partial antigen “ HAPTEN ” .
- Gives type specificity, e.g. D.pneumonae is due to its capsular substance (SSS) Specific Soluble Substance.
- Gives Precipitation reaction with Antisera.

FLAGELLA

- Only bacilli possese flagella
- Organ of locomotion.
- Bacilli are motile with flagella.
- Composed of protein Flagellin, Chemically similar to muscle protein Myosin.
- Contractile hair-like Sinous filaments OR exremely thin elongations.
- E / M Shows their origin is from the cytoplasm, they emerged outside the cell wall by piercing their cell wall.
- Real Structure of cell & form separate antigen from body known as Flagellar Antigen OR " H " Antigen.

Demonstration Of Flagella

(1) Special staining method (Basic fuschin + Tanic acid) gives 10 fold thickening.
(2) Demonstration of " H " Antigen.
(3) Immunofluorescence with Fluorescent microscope.
(4) With the help of Electron Microscope.
(5) Immobilization with Specific Antisera.
(6) Demonstration of motility by Hanging Drop method.

Functions of Flagella

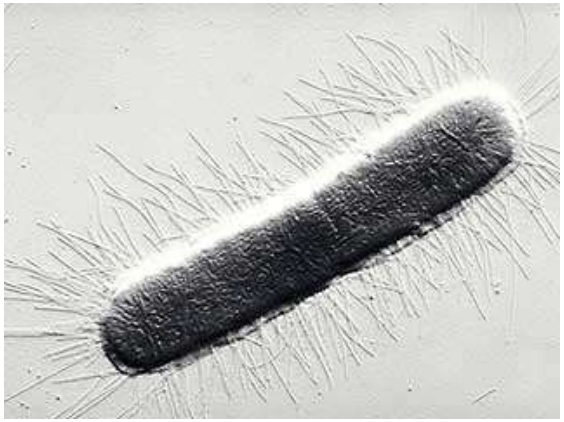
Main function is Motility OR It acts as organ of locomotion. Motility helps bacteria in Spreading, for Nutrition & Suitable Environment.
Motile aerobic bacteria > Positive Aerotaxis
Motile anaerobic bacteria > Negative Aerotaxis.

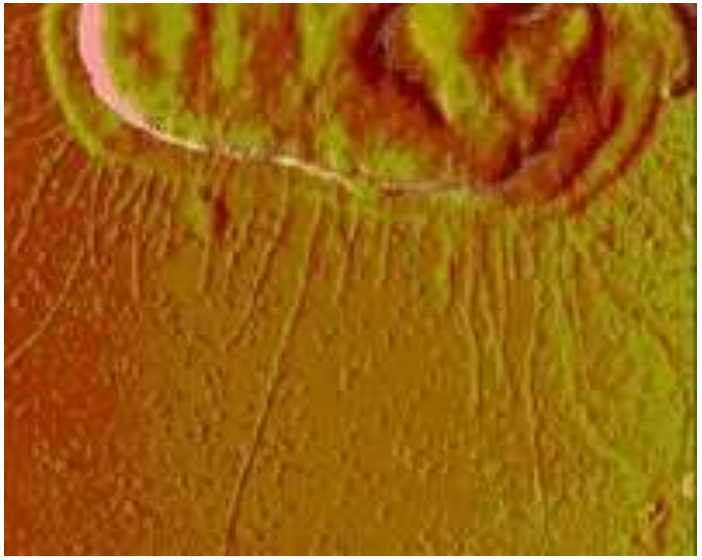
Arrangements of Flagella

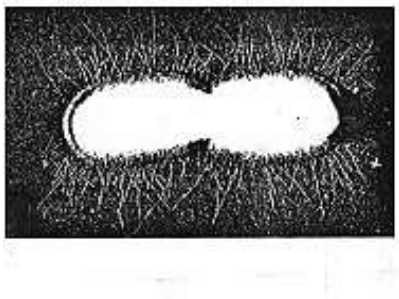
(1) Atrichate : Without any Flagellum.
(2) Monotrichate : Single terminal Flagellum at one pole. e.g. Vibrio cholerae.
(3) Amphitrichate : Single Flagellum at both the poles. e.g.Alcaligenes faecalis
(4) Lophotrichate : Tuft of Flagella at one pole OR both the poles. e.g.Spirilla
(5) Peritrichate : Flagella present all around the bacterial cell. e.g.Salmonella typhi

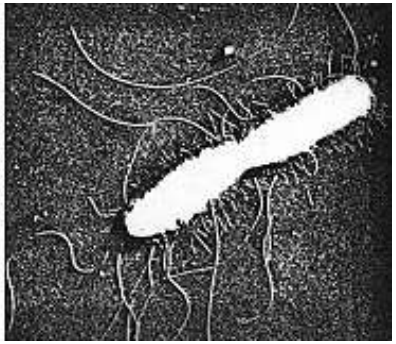
Fimbriae

- Hair like appendages projecting from the cell surface as straight filaments.
- Also called pilli.
- Shorter and thinner than flagella.
- Composed of protein pilin.
- Types: 1) common pili
  2) Sex or F pili
  3) Col I(colicin) pili









Functions of fimbriae

- Adhesion- enhances the virulence of bacteria.
- Transfer of genetic material-by sex pili.

DETECTION OF FIMBRIAE:

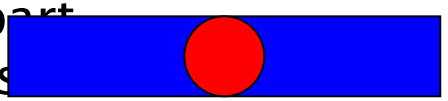
- Electone microscopy.
- Haemagglutination-e.g. E.coli,Klebsiella

SPORE

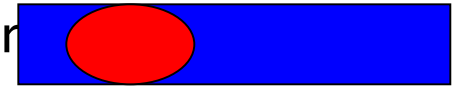
- Highly resistant , resting phage.
- Known as Endo-Spores, When present inside parent vegitative cells with thick wall formation.
- Bacteria can live in adverse environments OR under starvation.
- One spore gives rise to one vegitative cell after its germination.
- Not a method of reproduction, Physiologically resting phase.

VARIETIES OF SPORES

(1) Equitorial & Round : Present at the central part of the bacterial body. e.g. Bacillus anthracis

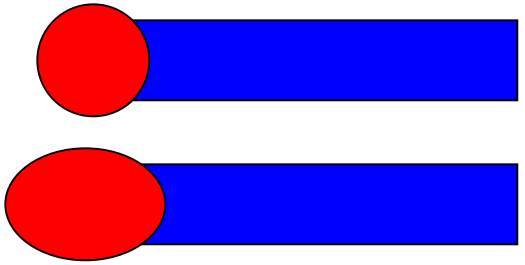


(2) Subterminal & Oval (club shaped): Present between the centre & one pole of the bacter body. e.g. Cl. septicum., Cl. Sporogenes.



(3) Terminal Spore: Present at one pole of the bacterial body.

Round Shape known as Drum Stick type
e.g. Cl. tetani,
Oval Shape known as Tennis Racket type
e.g. Cl. tertium,



Demonstration of Spore

Gram's method : Remain unstained
Special staining methods are employed.
(1) Acid fast stain:(0.25-0.5% sulphuric acid)
Spore: Red, Body Blue.
(2) Malachite green: Spore: Green,
Body Red.
(3) Moller's method: Spore: Red,
Body Blue.
(4) Gram's method: Spore : Unstained refractile,
Body violet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Uses of Spores

- Spores of certain species of bacteria are employed as indicator for proper sterilisation. e.g.Bacillus stearothermophilus which is destroyed at a temperature of 121°c for 10-20 min.

Thank you