

MORPHOLOGY OF BACTERIA

* INTRODUCTION:

- Bacteria are unicellular, free-living, microscopic microorganisms Capable of performing all the essential functions of life.
- They possess both deoxyribonucleic acid (DNA) and ribonucleic acid (RNA).
- Bacteria are prokaryotic microorganisms that do not contain chlorophyll.
- They occur in water, soil, air, food and all natural environments.
- They can survive extremes of temperature, pH, oxygen, tension and atmospheric pressures.

*SIZE OF BACTERIA:

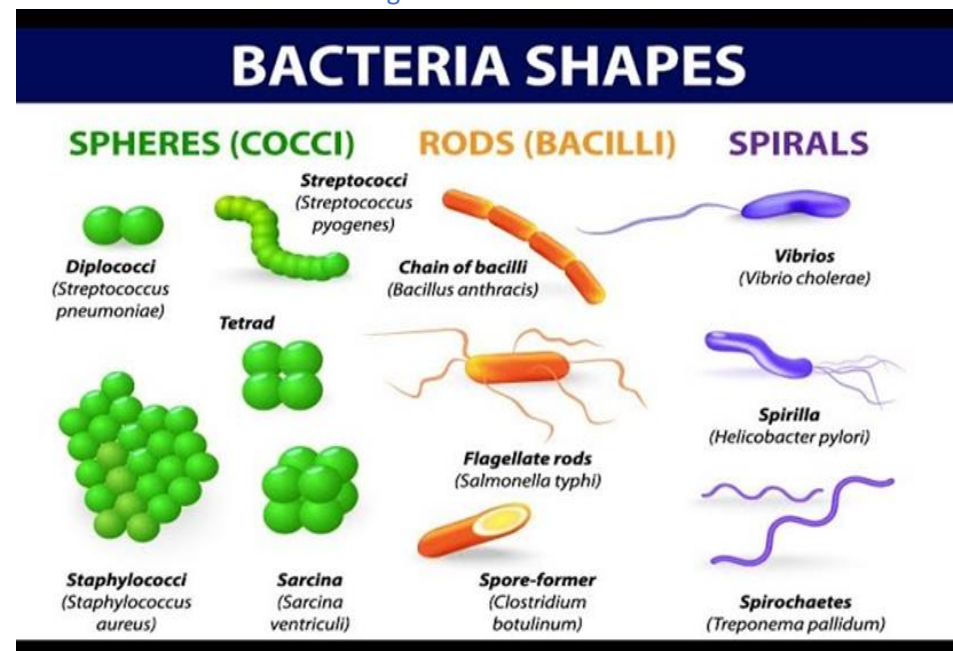
- Bacteria are very small microorganism which are visible under the light microscope.
- Cocci are about 1µm in diameter and bacilli are 1 to 8 µm in length and 0.1 to 0.5 µm in width.
- Bacteria are staining by staining reagents and then visualised under higher powers of magnification (1000x) of compound microscopic.
- An electron microscope is used for clear visualisation of internal structures of the bacteria.

*SHAPE OF BACTERIA:

Depending on their shape, bacteria are classified into several various.

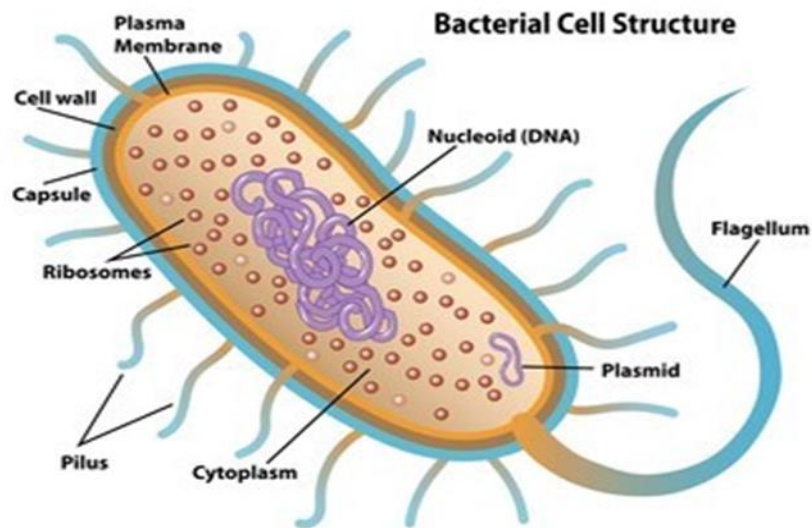
- 1. Cocci (from kokkos meaning berry) are spherical or oval cells. Eg. Micrococcus.

- 2. Bacilli (from baculus meaning rod) are rod shaped cells. Eg. bacillus anthracis.
- 3. Vibrios are comma shaped curved rods . Eg.vibrio comma.
- 4. Spirilla are rigid spiral forms. Eg. Spirillum ruprem .
- 5. Spirochetes (from speira meaning coil and chaite meaning hair) are flexuous spiral forms.
- 6. Actinomycetes are branching filamentous bacteria. (from actis meaning ray and mykes meaning fungus). Eg. Streptomyces species.
- 7. Mycoplasmas are bacteria that are cell wall deficient and hence do not possess a stable morphology. They occur as round or oval bodies and as interlacing filaments.



*STRUCTURE OF BACTERIAL CELL:

- The outer layer or cell envelope consists of two components such as cell wall and a cytoplasmic or plasma membrane.
- Inside the plasma membrane, there is protoplasm comprising the cytoplasm, cytoplasmic inclusions such as ribosomes, mesosomes, granules, vacuoles and nuclear body.
- The cell may be enclosed in a viscid layer, which may be a loose slime layer or organised as a capsule.
- Many bacteria have filamentous appendages called fimbriae or pili.
- Many bacteria also possess flagella which are organs of locomotion.



*FLAGELLA:

- Flagella are long hair like helical filaments extending from cytoplasmic membrane to exterior of the cell.
- Flagellin is highly antigenic and functions in cell motility.
- The location of the flagella depends on bacterial species as polar situated at one or both ends which swims in back and forth fashion and lateral at along the sides.
- The parts of flagella are the filament, hook and the basal body. Filament is external to cell wall and is connected to the hook at cell surface, the hook & basal body are embedded in the cell envelope.
- Hook & filament is composed of protein subunits called as flagellin. Flagellin is synthesized within the cell and passes through the hollow centre of flagella.
- The arrangement of flagella may be described as
 - (i) Monotrichous – single flagella on one side
 - (ii) Lophotrichous – tuft of flagella on one side
 - (iii) Amphitrichous – single or tuft on both sides
 - (iv) Peritrichous – surrounded by lateral flagella

*CAPSULE:

- Capsule is the outer most layer of the bacteria (extra cellular).
- It is a condensed well defined layer closely surrounding the cell.
- They are usually polysaccharide and if polysaccharide envelops the whole bacterium.
- it is capsule and their production depends on growth condition.
- They are secreted by the cell into the external environment and are highly impermeable.

- : When it forms a loose mesh work of fibrils extending outward from the cell they are described as glycocalyx and when masses of polymer that formed appear to be totally detached from the cell and if the cells are seen entrapped in it are described as slime layer.
- The Capsule protects against complement and is antiphagocytic.
- The Slime layer & glycocalyx helps in adherence of bacteria either to themselves forming colonial masses or to surfaces in their environment and they resist phagocytosis and desiccation of bacteria.
- Difference between capsule and slime layer

Capsule	Slime Layer
It is a glycocalyx layer consisting of tightly associated polysaccharide molecules with the cell wall.	It is a glycocalyx layer consisting of loosely associated glycoprotein molecules.
The capsule is composed of polysaccharides.	The Slime layer is composed of glycoprotein, glycolipids, and exopolysaccharide.
It is thicker than the slime layer.	It is a thin layer.
It is tightly bound to the cell wall	It is loosely bound to the cell wall
Well organized layer	Unorganized layer

***CELL WALL:**

- Cell wall is a rigid structure which gives definite shape to the cell, situated between the capsule and cytoplasmic membrane.
- It is about 10 to 20 nm in thickness and constitutes 20-30% of the dry weight of the cell.

***CHARACTERISTICS OF BACTERIA CELL STRUCTURES:-**

Structure	Functions(s)	Predominant chemical composition
Flagella	Swimming movement	Protein
Pili Sex pilus Common pili or fimbriae Capsules (includes "slime layers" and glycocalyx)	Stabilizes mating bacteria during DNA transfer by conjugation. Attachment to surfaces; protection against phagotrophic engulfment. Attachment to surfaces; protection against phagocytic engulfment, occasionally killing or digestion; protection against desiccation	Protein Protein Usually polysaccharide; occasionally polypeptide.
Cell wall Gram-positive bacteria Gram-negative bacteria Plasma membrane Ribosomes Inclusions Chromosome Plasmid	confers rigidity and shape on cells confers rigidity and shape; outer membrane is permeability barrier; associated LPS and proteins have various functions. Permeability barrier; transport of solutes; energy generation; location of numerous enzyme systems. Sites of translation (protein synthesis) Often reserves of nutrients; additional specialized functions Genetic material of cell Extrachromosomal genetic material.	Peptidoglycan (murein) complexed with teichoic acids. Peptidoglycan (murein) surrounded by phospholipid protein-lipopolysaccharide "outer membrane". Phospholipid and protein. RNA and protein. Highly variable; carbohydrate, lipid, protein or inorganic. DNA DNA

***DIFFERENCE BETWEEN GRAM-POSITIVE AND GRAM-NEGATIVE BACTERIA:-**

Gram-Positive bacteria	Gram-Negative bacteria
Cell Wall	
A single-layered, smooth cell wall.	A double-layered, wavy cell-wall.
Cell Wall thickness	
The thickness of the cell wall is 20 to 80 nanometres	The thickness of the cell wall is 8 to 10 nanometres.
Peptidoglycan Layer	
It is a thick layer/ also can be multilayered	It is a thin layer/ often single-layered.
Teichoic acids	
Presence of teichoic acids	Absence of teichoic acids.
Outer membrane	
The outer membrane is absent	The outer membrane is present (mostly).
Porins	
Absent	Occurs in Outer Membrane
Mesosome	
It is more prominent.	It is less prominent.
Morphology	
Cocci or spore-forming rods	Non-spore forming rods.
Flagella Structure	
Two rings in basal body	Four rings in basal body
Lipid content	
Very low	20 to 30%
Lipopolysaccharide	
Absent	Present

Toxin Produced	
Exotoxins	Endotoxins or Exotoxins
Resistance to Antibiotic	
More susceptible	More resistant
Examples	
Staphylococcus, Streptococcus, etc.	Escherichia, Salmonella, etc.

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