

# INTRODUCTION TO PROKARYOTES & EUKARYOTES

(Study of ultra-structure and morphological classification of bacteria)



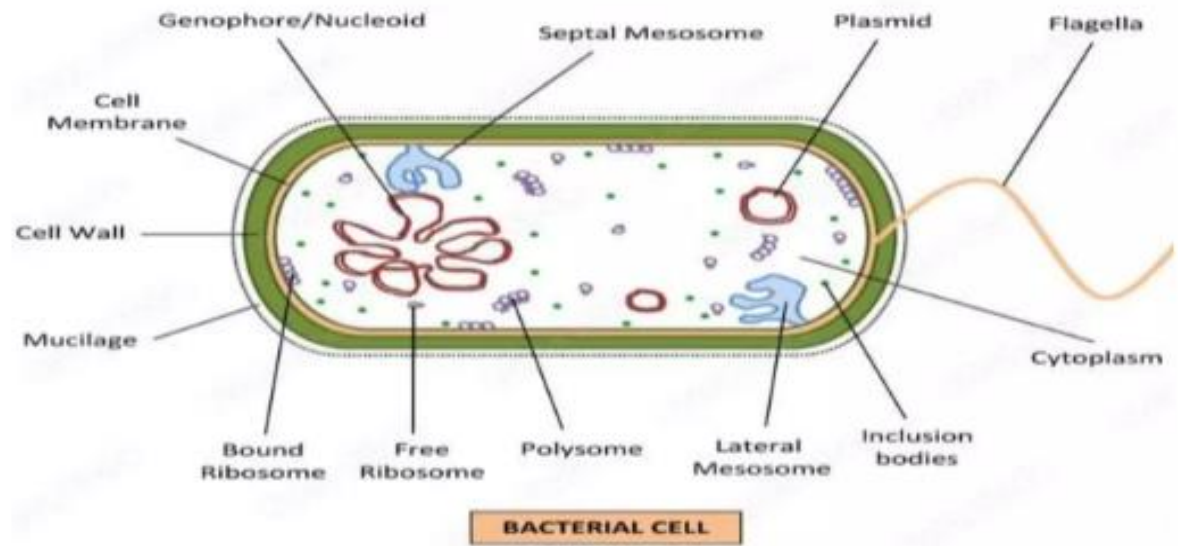
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# Prokaryotes

- The primarily single-celled organisms found in the Bacteria and Archaea domains are known as prokaryotes.
- These organisms are made of prokaryotic cells — the smallest, simplest and most ancient cells.

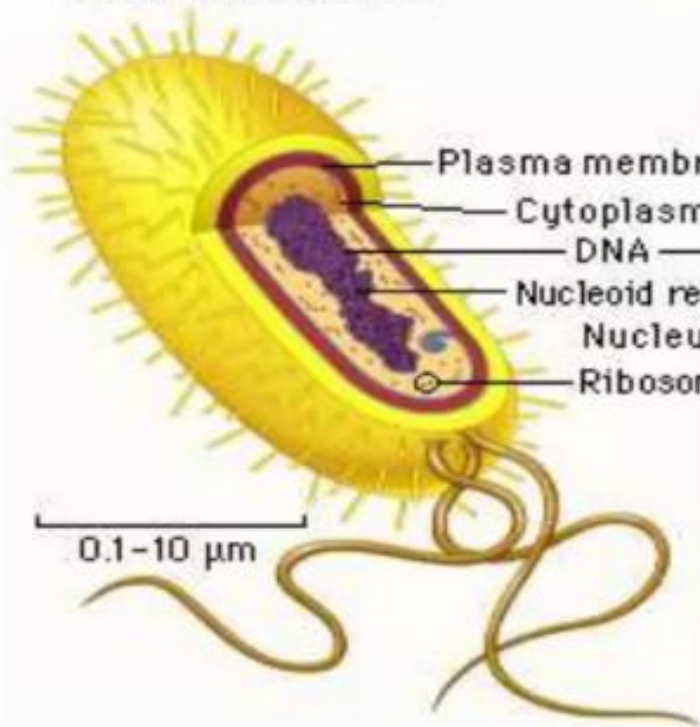


# Eukaryotes

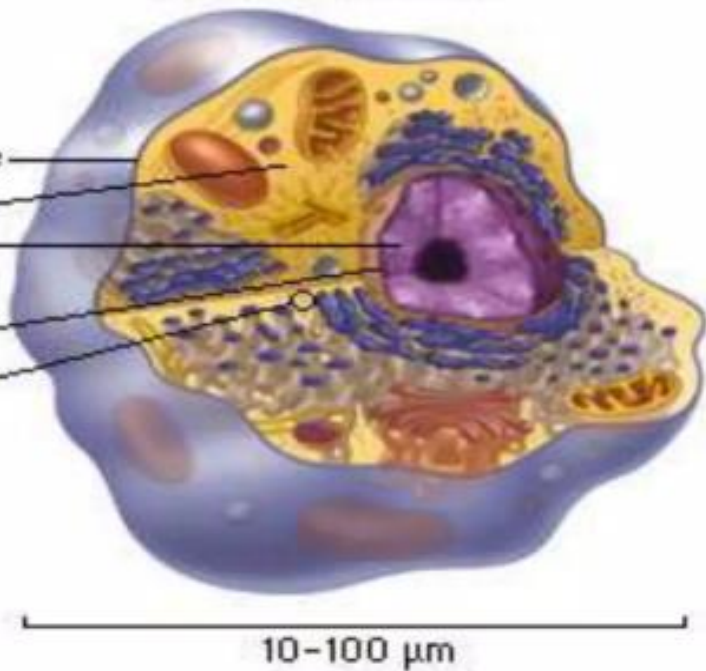
- Organisms in the Eukarya domain are made of the more complex eukaryotic cells.
- These organisms, called eukaryotes, can be unicellular or multicellular and include animals, plants, fungi and protists.
- Many people are unclear on whether yeasts or fungi are prokaryotes or eukaryotes.
- Both are eukaryotes and share similar cell structure to all other eukaryotes.

# Cells: Prokaryote vs Eukaryote

Prokaryotic cell



Eukaryotic cell



Plasma membrane

Cytoplasm

DNA

Nucleoid region

Nucleus

Ribosomes

0.1-10  $\mu\text{m}$

10-100  $\mu\text{m}$

## Differences between prokaryotic and eukaryotic cells

### -Prokaryotic Cells

- 1- They are very minute in size.
- 2 -Nuclear region (nucleoid) is not enveloped by a nuclear membrane.
- ..
- 3- Single chromosome present.
- 4- Nucleolus is absent.
- 5- Membrane bound organelles are absent.
- **6- Multiplication of cell is by fission or budding.**
- 7-Cell type is usually unicellular.
- 8- Cell size is 1-10 $\mu\text{m}$
- Example: Bacteria, archaea

### Eukaryotic Cells

- 1-They are larger in size.
- 2- Nucleus is surrounded by a double Membrane later
- 3- More than one chromosome are present.
- 4- Nucleolus is present.
- 5- membrane bound organelles are **present.**
- 6-cell division by mitosis or meiosis.**
- 7-Usually multicellular cells.
- 8- Cell size 10 - 100 $\mu\text{m}$ .
- Example: animal cells and plant cells

# PROKARYOTIC CELLS

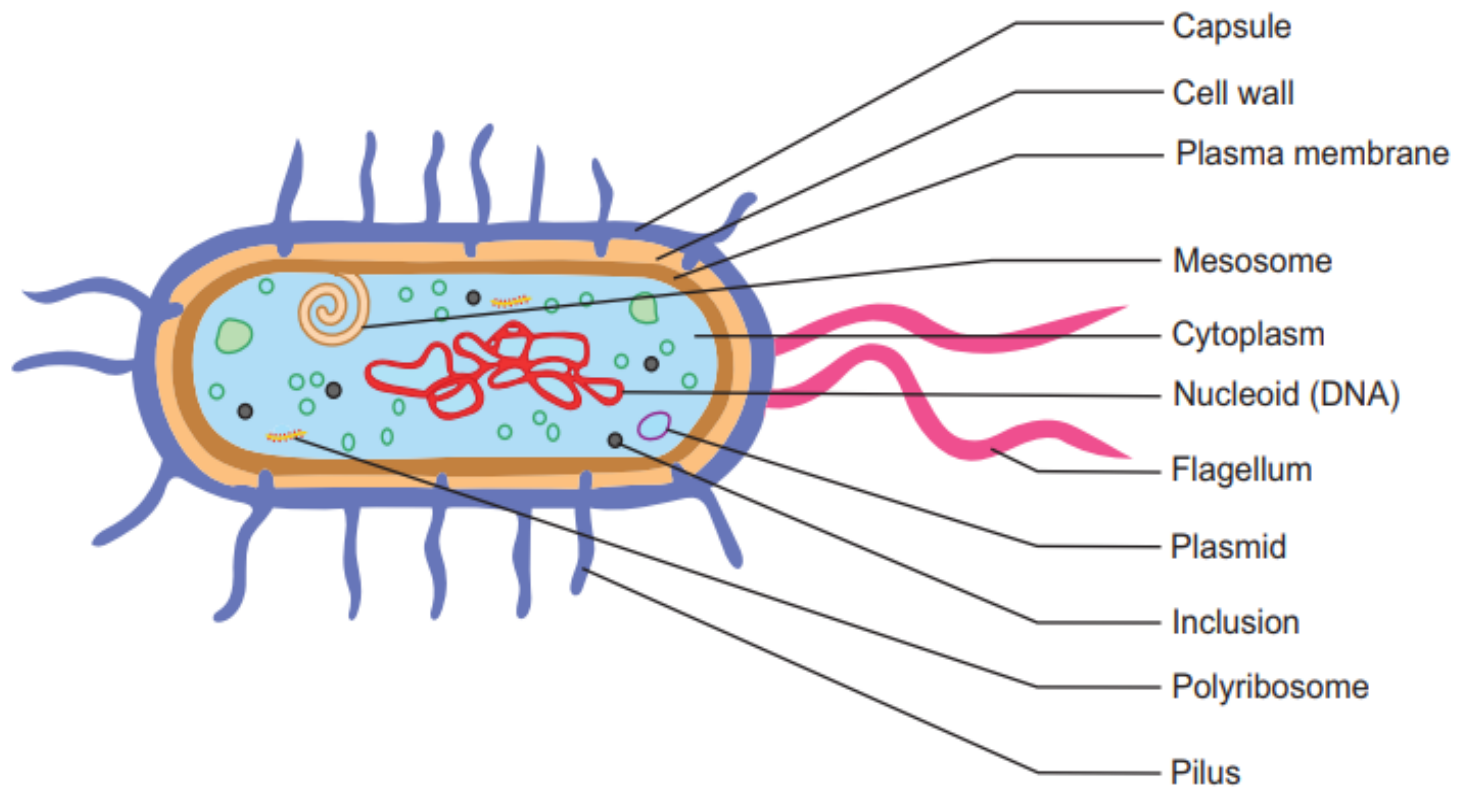
- Prokaryotes have no membrane bound **organelles** such as a nucleus, mitochondria, chloroplasts, golgi apparatus, or endoplasmic reticulum.
- Only membrane in prokaryotic cells is the plasma membrane, which is the outer boundary.
- Prokaryotes are most always single celled, except when they exist in colonies.

# EUKARYOTIC CELLS

- More complex than prokaryotic cells
- Most eukaryotic cells also have membrane bound organelles such as mitochondria, chloroplasts and the Golgi apparatus.
- All species of large complex organisms are eukaryotes, including animals, plants and fungi.
- Cell division in eukaryotes involves separating the duplicated chromosomes, through movements directed by microtubules.



# ULTRA-STRUCTURE AND MORPHOLOGICAL CLASSIFICATION OF BACTERIA



**Figure 1.9:** Ultrastructure of a bacterial cell



- **Ultra-structure of Bacteria Cell** There are three layers in a bacterial cell.
- Capsule/glycocalyx
- Cell wall
- Cytoplasm

## CAPSULE/GLYCOCALYX

- A gelatinous substance, usually composed of *polysaccharides* or *polypeptides*, surrounds some bacteria. Glycocalyx forms a tightly bound layer on the cell wall, and this layer is called a *capsule*. This layer protects the cell from desiccation and antibiotic exposure. They stick to surfaces such as root surfaces, human teeth, and tissues because of their sticky nature. It also keeps bacterial cells nourished.

## CELL WALL

- Bacteria have granular and rigid cell walls. It provides protection and gives the cell its shape. Chemically, the cell wall consists of a complex compound called *Peptidoglycan* or mucopeptide (N-acetylglucosamine, N-acetylmuramic acid, and peptide chains containing four or five amino acids). The porin polypeptide is among the most abundant polypeptides present and is crucial for solute diffusion.

## CYTOPLASM

- The cytoplasm is semitransparent and thick. Several cell components can be found within it, including ribosomes. Included in cytoplasm are *glycogen*, *Sulphur granules*, *poly- $\beta$ -hydroxybutyrate crystals*, and *polymerized glycerol molecules*.

## PLASMA MEMBRANE

- *Lipoproteins* are found in the plasma membrane. Molecular and ion traffic is controlled by the plasma membrane. In addition to enzymes that take part in oxidation of metabolites (the respiratory chain) and photosystems involved in photosynthesis, the plasma membrane houses enzymes in charge of photosynthesis.

- **BACTERIAL CHROMOSOME** Eukaryotes have a membrane enclosing the chromosomes, whereas bacteria have a single circular DNA molecule tightly coiled. Nucleoid or Genophore is the name of this genetic material. E. coli's DNA measures approximately 1mm when uncoiled, yet contains all its genetic information.
- **PLASMIDS** Plasmids are self-replicating, circular, double-stranded elements that are extrachromosomal. Genes related to fertility, antibiotic resistance, and heavy metals can be found in them. The enzymes assist in producing bacteriocins and toxins that are not present in bacteria's chromosomes.

- **FLAGELLA** Flagella are thin hair-like processes that emerge from the cell wall of many motile bacteria. A diameter of 20 to 30  $\mu\text{m}$  and a length of 15  $\mu\text{m}$  can be measured. Eukaryotic flagella contain 9+2 microtubules, while bacteria have a single fibril for each flagellum. A flagellum acts as a locomotor. Bacteria differ according to how many flagella they have and where they are located.

- **FIMBRIAE OR PILLI** Gram-negative bacteria (such as *Enterobacterium*) have hair-like appendages on the surface of their cell walls called pili or fimbriae. Pili range in size from 0.2 to 20  $\mu$ m in length and have a diameter of about 0.025  $\mu$ m. Pili are not the only type of pili found in the body. There are also sex pili that assist in conjugation.

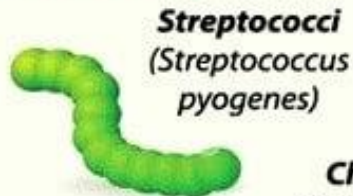


# Morphological Classification of Bacteria

- There are several types of bacteria, depending on their shape.

## Types of Bacteria on the basis of Shapes

### SPHERES (COCCI)



#### Tetrad

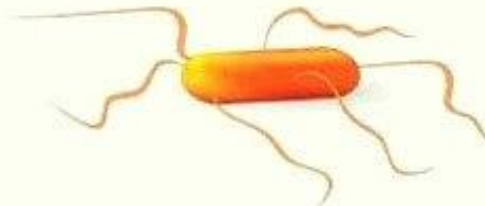


**Staphylococci**  
(*Staphylococcus aureus*)



**Sarcina**  
(*Sarcina ventriculi*)

### RODS (BACILLI)

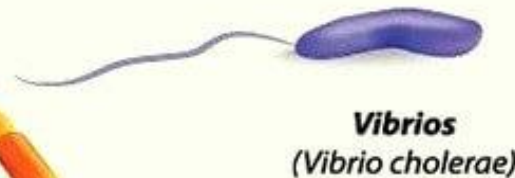


**Flagellate rods**  
(*Salmonella typhi*)



**Spore-former**  
(*Clostridium botulinum*)

### SPIRALS



**Spirochaetes**  
(*Treponema pallidum*)

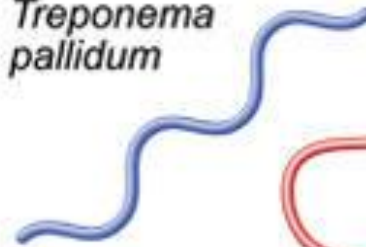


*Streptococcus pneumoniae*

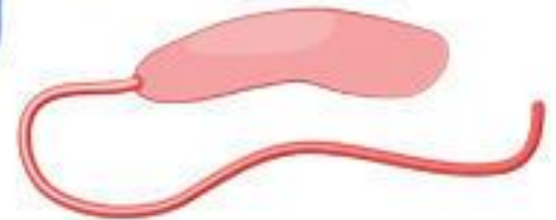


*Clostridium tetani*

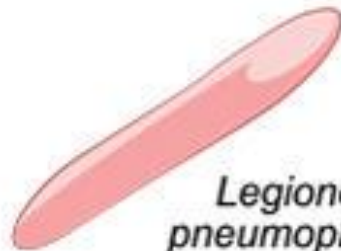
*Treponema pallidum*



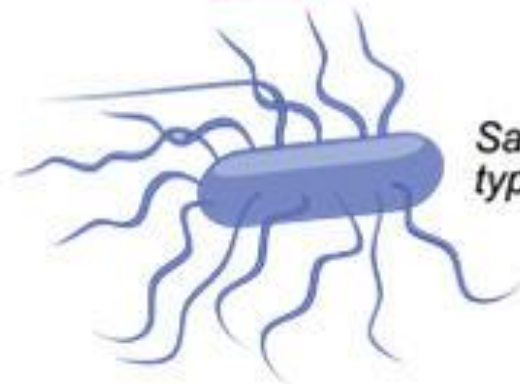
*Vibrio cholerae*



*Staphylococcus aureus*



*Legionella pneumophila*



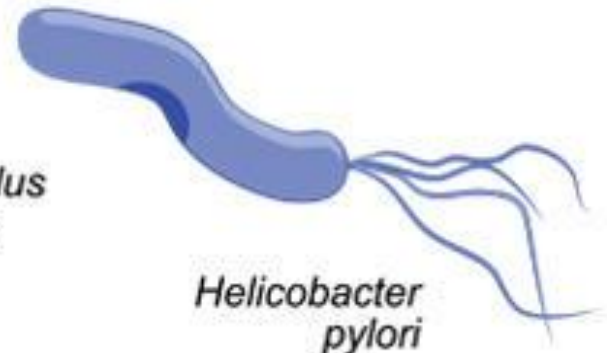
*Salmonella typhi*



*Clostridium botulinum*



*Streptobacillus moniliformis*



*Helicobacter pylori*

**THANK YOU**