



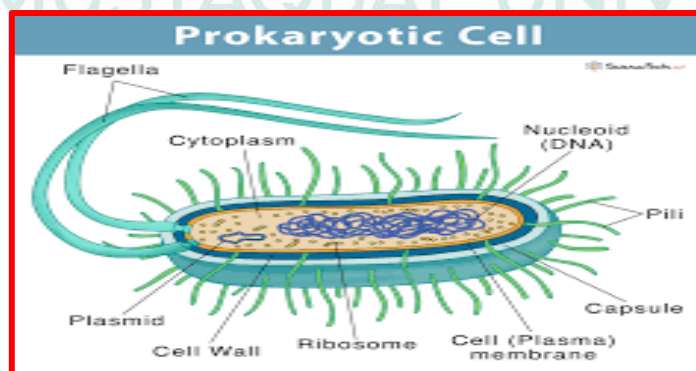
Prokaryotic Cells

Prokaryote means before nucleus in Greek. They include all cells which lack nucleus and other membrane bound organelles. Mycoplasma, virus, bacteria and cyanobacteria or blue-green algae are prokaryotes.

Most prokaryotes range between $1\ \mu\text{m}$ to $10\ \mu\text{m}$, but they can vary in size from $0.2\ \mu\text{m}$ to $750\ \mu\text{m}$ (*Thiomargarita namibiensis*). They belong to two taxonomic domains which are the bacteria and the archaea.

Most prokaryotes are unicellular, exceptions being myxobacteria which have multicellular stages in their life cycles. They are membrane bound mostly unicellular organisms lacking any internal membrane bound organelles. A typical prokaryotic cell is schematically illustrated in Figure

Though prokaryotes lack cell organelles they harbor few internal structures, such as the cytoskeletons, ribosomes, which translate mRNA to proteins. Membranous organelles are known in some groups of prokaryotes, such as vacuoles or membrane systems devoted to special metabolic properties, e.g., photosynthesis or chemolithotroph. In addition, some species also contain protein-enclosed microcompartments, which have distinct physiological roles (gas vacuoles).



Prokaryotic Cell Structure

A prokaryotic cell does not have a nuclear membrane. However, the **genetic material** is present in a region in the cytoplasm known as the nucleoid. They may be spherical, rod-shaped, or spiral. A prokaryotic cell structure is as follows:

1. **Capsule:** It is an outer protective covering found in the bacterial cells, in addition to the cell wall. It helps in moisture retention, protects the cell when engulfed, and helps in the attachment of cells to nutrients and surfaces.
2. **Cell Wall:** It is the outermost layer of the cell which gives shape to the cell.
3. **Cytoplasm:** The cytoplasm is mainly composed of enzymes, salts, cell organelles and is a gel-like component.
4. **Cell Membrane:** This layer surrounds the cytoplasm and regulates the entry and exit of substances in the cells.
5. **Pili:** These are hair-like outgrowths that attach to the surface of other bacterial cells.
6. **Flagella:** These are long structures in the form of a whip, that help in the locomotion of a cell.
7. **Ribosomes:** These are involved in protein synthesis.
8. **Plasmids:** Plasmids are non-chromosomal DNA structures. These are not involved in reproduction.
9. **Nucleoid Region:** It is the region in the cytoplasm where the genetic material is present.

A prokaryotic cell lacks certain organelles like mitochondria, endoplasmic reticulum, and Golgi bodies.

Components of Prokaryotic Cells

The prokaryotic cells have **four** main components:

Plasma Membrane: It is an outer protective covering of phospholipid molecules which separates the cell from the surrounding environment.

Cytoplasm: It is a jelly-like substance present inside the cell. All the cell organelles are suspended in it.

DNA: It is the genetic material of the cell. All the prokaryotes possess a circular DNA. It directs what proteins the cell creates. It also regulates the actions of the cell.

Ribosomes: Protein synthesis occurs here.

Some prokaryotic cells possess **cilia** and **flagella** which helps in locomotion.

Reproduction in Prokaryotes

A prokaryote reproduces in **two** ways:

- Asexually by binary fission
- Sexually by conjugation

Binary Fission

1. The DNA of an organism replicates and the new copies attach to the cell membrane.
2. The cell wall starts increasing in size and starts moving inwards.
3. A cell wall is then formed between each DNA, dividing the cell into two daughter cells.

Recombination

In this process, genes from one bacterium are transferred to the genome of other bacteria. It takes place in **three** ways: conjugation, transformation, transduction.

- **Conjugation** is the process in which genes are transferred between two bacteria through a protein tube structure called a pilus.

- **Transformation** is the mode of sexual reproduction in which the DNA from the surroundings is taken by the bacterial cell and incorporated in its DNA.
- **Transduction** is the process in which the genetic material is transferred into the bacterial cell with the help of viruses. Bacteriophages are the virus that initiates the process.

Comparison of features of prokaryotic and eukaryotic cells:

	Prokaryotes	Eukaryotes
Typical organisms	Bacteria	Fungi, Plants and animals
Typical size	~1-5 μm	~10-100 μm
Type of Nucleus	Nucleoid region; no true nucleus	True nucleus with double membrane
DNA	Circular (usually)	Linear molecules (chromosomes) with histone proteins
RNA/Protein Synthesis	Coupled in the cytoplasm	RNA synthesis in the nucleus protein synthesis in the cytoplasm
Cell Movement	Flagella made of Flagellin	Flagella and cilia containing microtubules; lamellipodia and filopodia containing actin
Mitochondria	None	One to several thousand
Chloroplast	None	In algae and plants
Organization	Usually, single cells	Single cells, colonies, higher multicellular organisms with specialized cells
Cell Division	Binary fission (simple division)	Mitosis (fission of budding) Meiosis
Chromosomes	Single chromosome	More than one chromosome
Membrane	Cell membrane	Cell membrane and membrane-bound organelles