All of the organisms in the world are assembled into three domains and six kingdoms: One of the domains, the eukaryotes, is subdivided into four kingdoms: protests, fungi, plants, and animals. The remaining two domains, Archaebacteria and Eubacteria, consist of prokaryotic organisms, which are vastly different from all other living things

Domain: Bacteria, Kingdom Bacteria

Domain: Archaea, Kingdom Archaea

Domain: Eukarya: Kingdom Protista

Kingdom Fungi

Kingdom Plantae

Kingdom Animalia

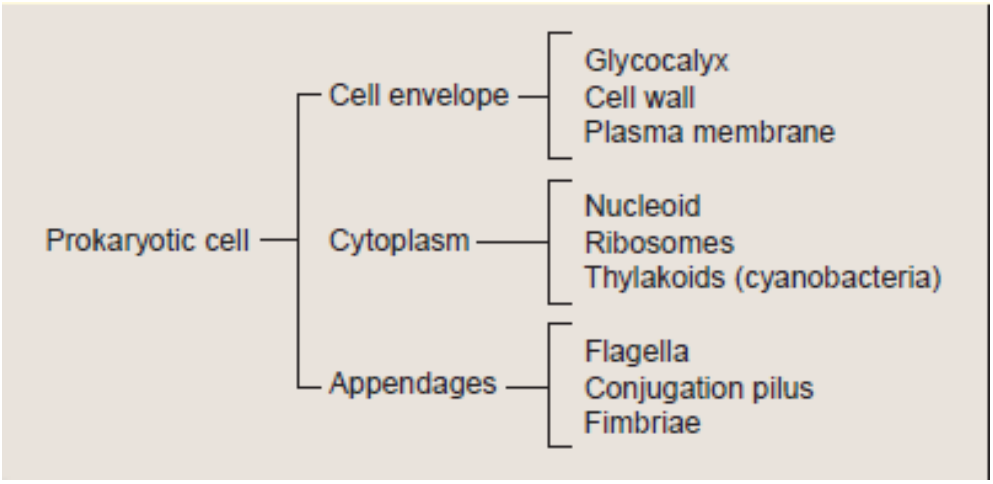
Prokaryotic

Prokaryotes generally range in size from 1 to 10 μm in length and from 0.7 to 1.5 μm in width. The term *prokaryote* means "before a nucleus," and these organisms lack a eukaryotic nucleus. A typical prokaryotic cell has a cell wall situated outside the plasma membrane. The cell wall prevents a prokaryote from bursting or collapsing due to osmotic changes

the Bacteria and Archaea are Members of prokaryotes

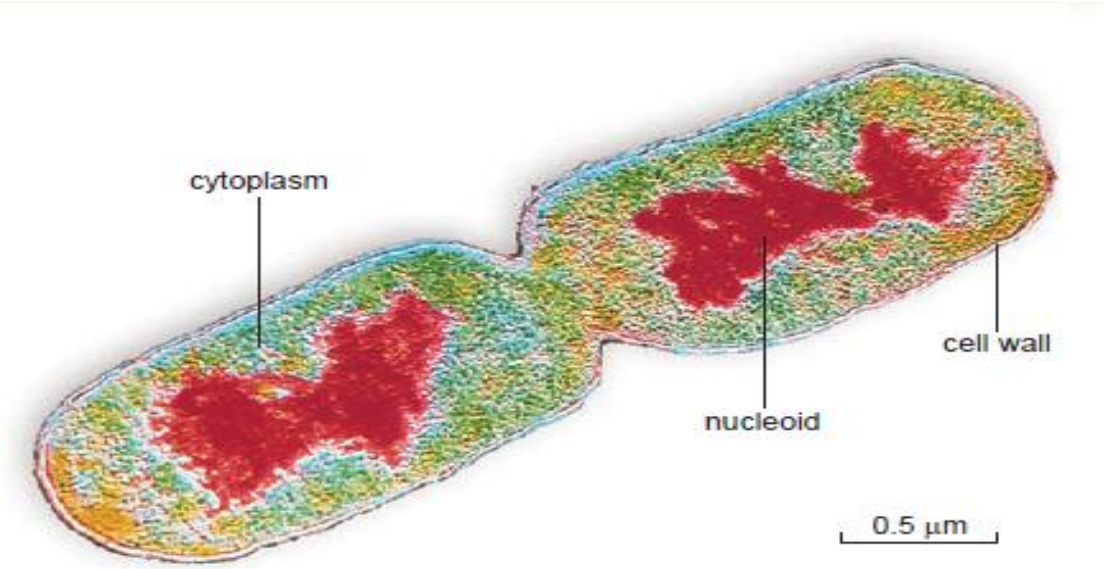
- They are unicellular, made of one cell. Prokaryote cells are small and simple.
- A prokaryotic cell lacks the membranous organelles of a eukaryotic cell,
- various metabolic pathways are located on the inside of the plasma membrane
- No nucleus. Although prokaryotes do not have a nucleus, they do have a dense area called a **nucleoid** where a single chromosome consisting largely of a circular strand of DNA is found.
- Many prokaryotes also have accessory rings of DNA called **plasmids**

The following diagram summarizes prokaryotic cell structure



Reproduction in Prokaryotes

prokaryotes reproduce asexually by means of **binary fi ssion .** When conditions are favorable for growth, prokaryotes divide to reproduce The single circular chromosome replicates, and then two copies separate as the cell enlarges. Newly formed plasma membrane and cell wall separate the cell into two cells. This is a form of asexual reproduction because the daughter cells have exactly the same genetic material as the parent cell. . Prokaryotes have a generation time as short as 12 minutes under favorable conditions.



The Binary fission

Symbiotic Relationships

Bacteria (and archaea) form **symbiotic relationships** [Gk.*sym,* together, and *bios,* life] in which two different species live together in an nearby way.

When the relationship is:

- **mutualistic**, both species benefit.
- In commensalistic relationships,only one species benefits,
- when it is parasitic, one species benefits but the other is harmed.

Kingdom Eubacteria ("true" bacteria)

Bacteria are the most abundant organisms on earth. An estimated 5 X 1030 individuals. One bacterium can give rise to 10 million in 24 hours.

Bacteria :

Bacteria are estimated to be largest of microorganism both in quantity and type. The types of bacterium type are expected to be more than 1 billion, while their living

environment is also most believed to be of the widest as they can be found in every type of ecological environment, even in our body. Besides, many diseases of the world are caused by bacteria; nonetheless, some bacteria, such as lactic acid bacterium and Escherichia coli are much related to the maintenance of our health.

bacterial Cell Features

1-The Bacteria are a group of single-cell microorganism

2-The genetic information of bacteria is carried on a long, double stranded, circular molecule of DNA; no nuclear membrane is present and the DNA is tightly coiled into a region known as the "nucleoid"

3-The cytoplasm contain no organelles other than ribosomes for protein synthesis .

4-Many metabolic functions are carried out by the prokaryotic cell membrane .

5-In all bacteria except mycoplasmas, the cell is surrounded by a complex cell wall. External to this wall may be capsules, flagella and pilli.

The cell wall and the external structure is important in diagnosis and pathogenicity and for understanding bacterial biology.

Structures of bacterial cell:

A. Appendages:

1. Pili : only found in gram negative bacteria, tubular , hairlike structures of protein larger and more rare than fimbriae.
2. fimbriae :Adhesion to cells and surfaces, Responsible for biofilms.
3. Flagella: bacteria may have one, a few, or many flagella in different positions on the cell.

B .Cell Envelope

1-Glycocalyx - some extracellular material secreted by many bacterial cells in the form of:

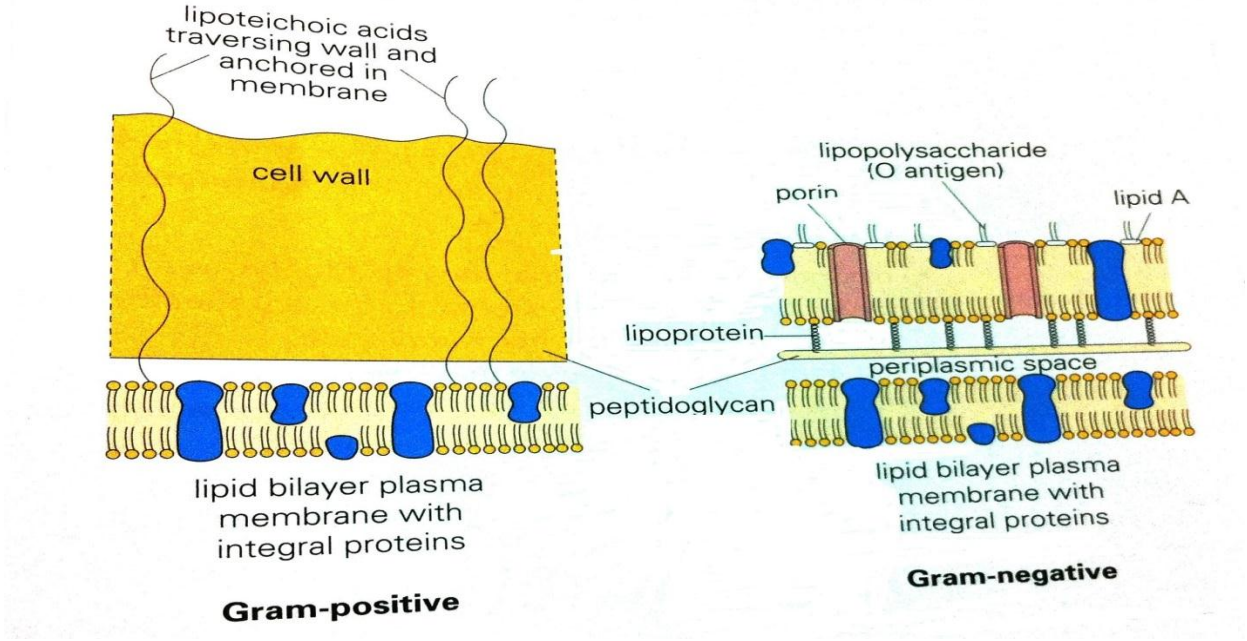
- capsule - attached tightly to the bacterium and has definite boundaries.
- slime layer - loosely associated with the bacterium and can be easily washed off.
- Composed of layer of polysaccharide and sometimes proteins .

C. Cell wall :

Most bacterial cells are protected by a cell wall that contains the unique molecule peptidoglycan. Peptidoglycan is a complex of polysaccharides linked by amino acids

Support and shape of a bacterial cell. Groups of bacteria are commonly differentiated from one another by using the Gram stain procedure.

Bactria classified according to their cell wall as Gram-positive Gram-negative. Gram staining is a basic microbiological procedure for detection and identification of bacteria



Construction of the walls of Gram-positive and Gram-negative bacteria

D. Cell (cytoplasmic) membrane

1. Structure. The cell membrane is a typical phospholipid bilayer that contains the following

constituents:

a. Cytochromes and enzymes involved in electron transport and oxidative phosphorylation.

b. Carrier lipids, enzymes, and penicillin-binding proteins (PCP) involved in cell wall biosynthesis.

c. Enzymes involved in phospholipid synthesis and DNA replication.

d. Chemoreceptors.

E. Cytoplasm

1. Bacterial cytoplasm contains ribosomes and various types of nutritional storage granules.

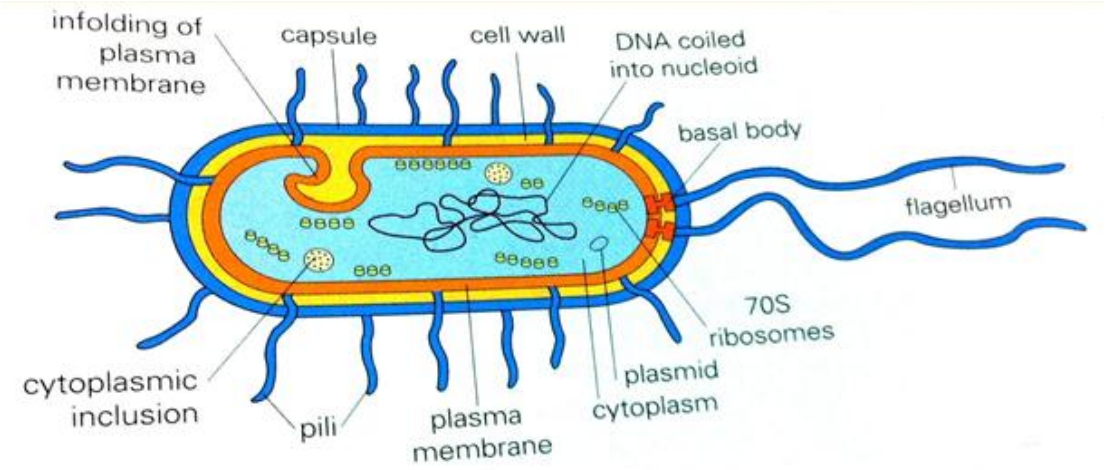
2. It contains no organelles.

F.Ribosomes.

Bacterial ribosomes contain proteins and RNAs that differ from those of their eukaryotic counterparts. Where the Bacterial ribosomes have a sedimentation coefficient of 70S and are composed of 30S and 50S subunits .

G. Nucleoid

In bacteria, the nucleoid or nuclear body is not surrounded by a nuclear membrane apparatus.



Diagrammatic structure of a generalized bacterium

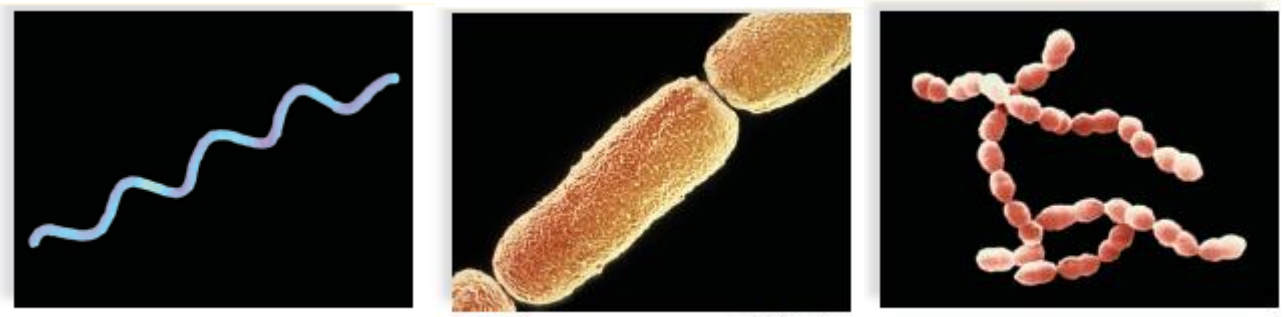
Bacterial shape:

Bacteria (and archaea) can also be described in terms of their three basic cell shapes:

a. Spiral

b. Rod-like (bacillus)

c. Round (coccus)



Bacterial Metabolism

bacteria are not much different from other organisms. One difference, however, concerns the need for oxygen.

- Some bacteria are obligate anaerobes and are unable to grow in the presence of free oxygen.
- Other bacteria, called facultative anaerobes, are able to grow in either the presence or the absence of gaseous oxygen.
- Most bacteria, however, are aerobic and, like animals, require a constant supply of oxygen to carry out cellular respiration.

Domain Archaea (Archaebacteria)

Proposed as separate group from (eu)bacteria by Carl Woese The term archaebacteria (Greek, archaio, ancient) refers to the ancient origin of this group of bacteria, which seem to have diverged very early from the eubacteria ,Archaea are less widespread than Bacteria. Differ from Eubacteria in:

- details of cell wall structure. Different chemicals are used to make the cell walls in the two groups. Cell wall protects the organism.
- Differs in structure and metabolic pathways and Biochemically diverse

- plasma membranes possess unusual lipids that differ from those found in the plasma membranes of bacteria. The plasma membrane acts as a complex barrier that filters out substances letting needed substances in and excluding undesirable substances. unique branched lipids in membrane
- also differ substantially in DNA structure.
- inhabit extreme environments
- Share traits with both eukaryotes and eubacteria, e.g., RNA polymerase, introns
- Economically important

Types

Many Archaebacteria are adapted to extreme environments.

• Methanogens

Methanogens obtain their energy by using hydrogen gas (H2) to reduce carbon dioxide (CO2) to methane gas (CH4). They are strict anaerobes, poisoned by even traces of oxygen. They live in swamps, marshes, and the intestines of mammals. Methanogens release about 2 billion tons of methane gas into the atmosphere each year.

• Halophiles

Halophiles ("salt lovers") live in very salty places like the Great Salt Lake in Utah, Mono Lake in California, and the Dead Sea in Israel. Whereas the salinity of sea wateris around 3%, these bacteria thrive in, and indeed require, water with a salinity of 15 to 20%.

• Thermophiles

Thermophiles ("heat lovers") live in very hot places, typically from 60؛ to 80؛C. Many thermophiles are autotrophs and have metabolisms based on sulfur. Some thermophilic archaebacteria form the basis of food webs around deep-sea thermal vents where they must with stand extreme temperatures and pressures.