FACULTY OF ENGINEERING &TECHNOLOGY
DEPARTMENT OF BIOTECHNOLOGY

Cytoplasm

❖Cytoplasm is thick, aqueous, semitransparent, and elastic substance present inside the plasma membrane.

❖Cytoplasm is about 80% water and contains primarily proteins (enzymes), carbohydrates, lipids, inorganic ions, and many low-molecular mass compounds.

❖Inorganic ions are present in much higher concentrations in cytoplasm than in most media.

❖The major structures in the cytoplasm of prokaryotes are a nucleoid (containing DNA), particles called ribosomes, and reserve deposits called inclusions.

Nucleoid

The nucleoid can be spherical, elongated, or dumb bell shaped devoid of any nuclear envelope and histone proteins. It contains single long, continuous, and frequently circularly arranged thread of double-stranded DNA called the

Bacterial chromosome.
This is the cell's genetic information, which carries all the information required for the cell's structures and functions.
In addition to the bacterial chromosome, bacteria often contain small usually circular, double-stranded DNA molecules called **plasmids.**

These molecules are extrachromosomal genetic elements; that is, they are not connected to the main bacterial chromosome, and they replicate independently of chromosomal DNA.

Ribosomes

❖It is responsible for protein synthesis.

❖The cytoplasm of a prokaryotic cell contains tens of thousands of ribosomes, giving the cytoplasm a granular appearance.

❖Ribosomes are composed of two subunits, each of which consists of protein and a type of RNA called *ribosomal RNA (rRNA).* prokaryotic ribosomes are called 70S ribosomes and are smaller and less denser than 80S eukaryotic ribosomes.

❖The subunits of a 70S ribosome are a small 30S subunit containing one molecule of rRNA and a larger 50S subunit containing two molecules of rRNA.

Inclusions/storage granules

Inclusion bodies are structure within the cytoplasm cells of bacterial cells which acts as reserve deposits under excess or plentiful environment and use it later under deficient environment.

There are wide varieties of inclusion found in bacterial cells.

Some inclusions are common to all bactertial cells while some are characteristically found in specific bacterial cells.

Various types of granules are as follows:

Metachromatic granules:

These are reserve of inorganic phosphate (polyphosphate) that can be used in the synthesis of ATP. It is generally formed by cells that grow in phosphate-rich environments. Metachromatic granules are found in algae, fungi, and protozoa, as well as in bacteria. These granules are characteristic of *Corynebacterium diphtheriae*, the causative agent of diphtheria.

Polysaccharide Granules:

Inclusions known as polysaccharide granules typically consist of glycogen and starch.

Lipid Inclusions: Lipid inclusions appear in various species of *Mycobacterium, Bacillus, Azotobacter*, *Spirillum* and other genera. A common lipid-storage material, one unique to bacteria, is the polymer *poly*-β-*hydroxybutyric acid*.

Sulfur Granules

Certain bacteria—for example, the “sulfur bacteria” that belong to the genus *Acidithiobacillus*—derive energy by oxidizing sulfur and sulfur-containing compounds. These bacteria may deposit **sulfur granules** in the cell, where they serve as an energy reserve.

Carboxysomes

Carboxysomes are inclusions that contain the enzyme ribulose 1,5-bisphosphate carboxylase. Photosynthetic bacteria use carbon dioxide as their sole source of carbon and require this enzyme for carbon dioxide fixation. Among the bacteria containing carboxysomes are nitrifying bacteria, cyanobacteria, and acidithiobacilli.

Gas Vacuoles

Hollow cavities found in many aquatic prokaryotes, including cyanobacteria, anoxygenic photosynthetic bacteria, and halobacteria are called **gas vacuoles**.

Each vacuole consists of rows of several individual *gas vesicles*, which are hollow cylinders covered by protein.

Gas vacuoles maintain buoyancy so that the cells can remain at the depth in the water appropriate for them to receive sufficient amounts of oxygen, light, and nutrients.

Magnetosomes

Magnetosomes are inclusions of iron oxide (Fe_3O_4) surrounded by invaginations of the plasma membrane. Magnetosomes are formed by several gram-negative bacteria such as *Magnetospirillum magnetotacticum* and act like magnets.