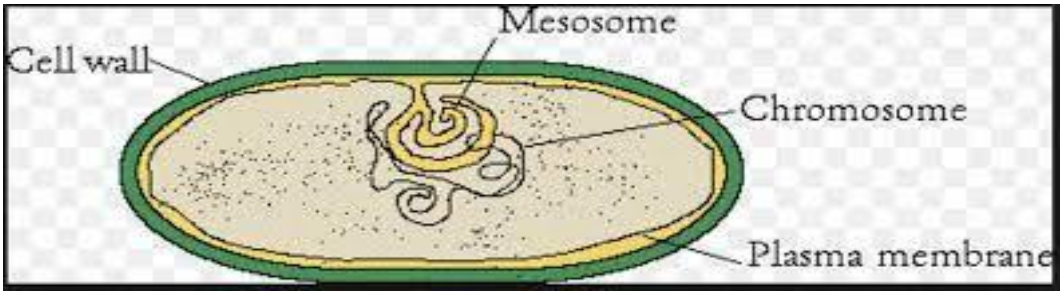
Bacteriology

Lec 3 Cytoplasmic ultrastructures

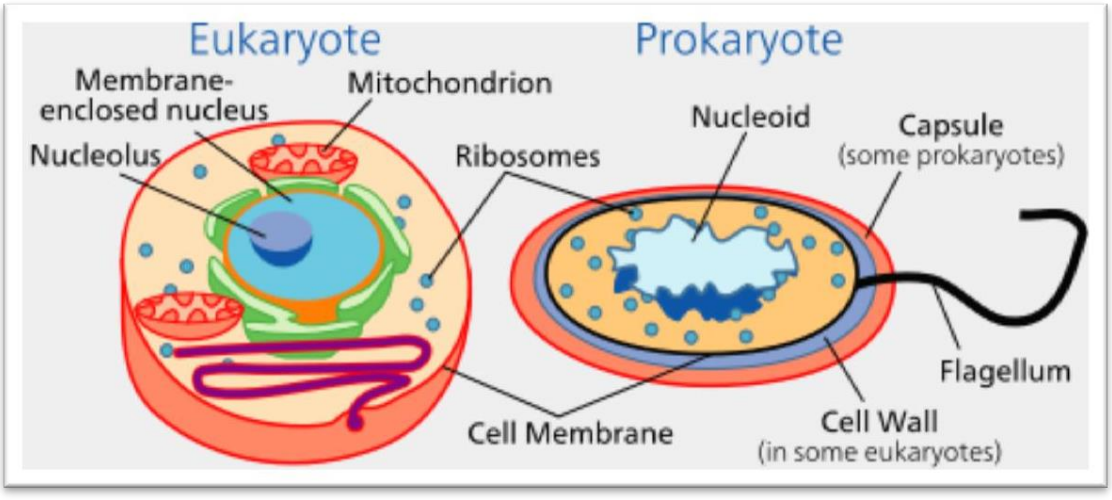
1- Mesosomes

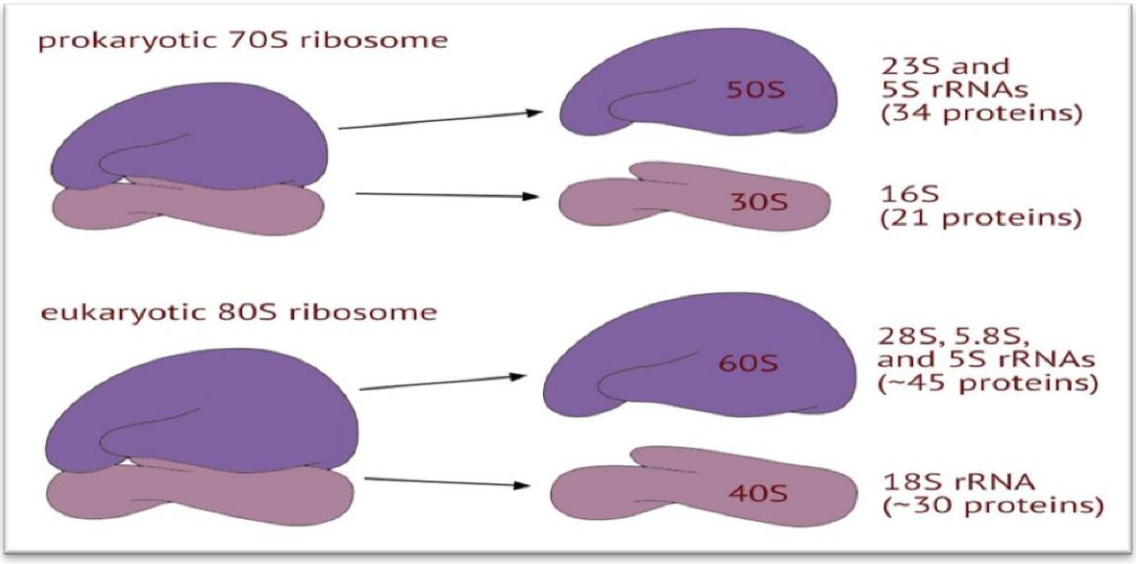
One or more large irregular invaginations of the plasma membrane often are seen in the thin section of bacteria, called mesosomes. There are two types of them, **septal mesosome** and **lateral mesosome**. Septal mesosomes function in the formation of a transverse cell membrane during cell division and always seen attached to DNA. Enzymes associated with respiration of bacteria are located on the mesosome.



2- Ribosomes

Spherical densely stained objects mostly grouping in chain called **polysomes**. The ribosomes are designating according to their sedimentation coefficient as 70S (Svedberg unit = 10^{-13} cm/sec) in prokaryotes and 80S in eukaryotes. Ribosomes are responsible for the synthesis of proteins.





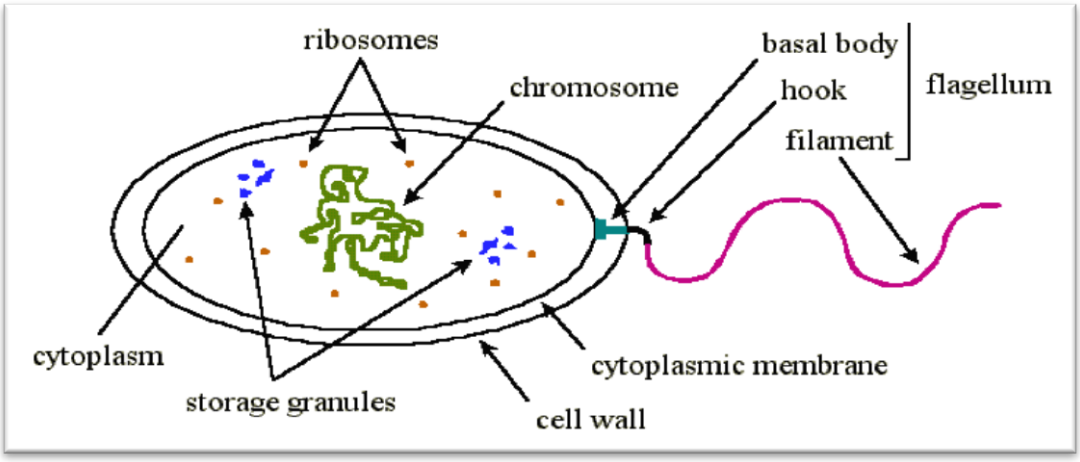
3- Granular inclusion

Many species of prokaryotes and eukaryotes store up reserve food substance in intracellular granules such as:

i- **Lipid**: in bacteria many of the inclusions formerly regarded as fat.

ii- **Volutin**: is metachromatic granules especially rich in organic phosphate.

iii- **Polysaccharide**: many species synthesize and store up excess soluble carbohydrate food substance; these are polymers of glucose.

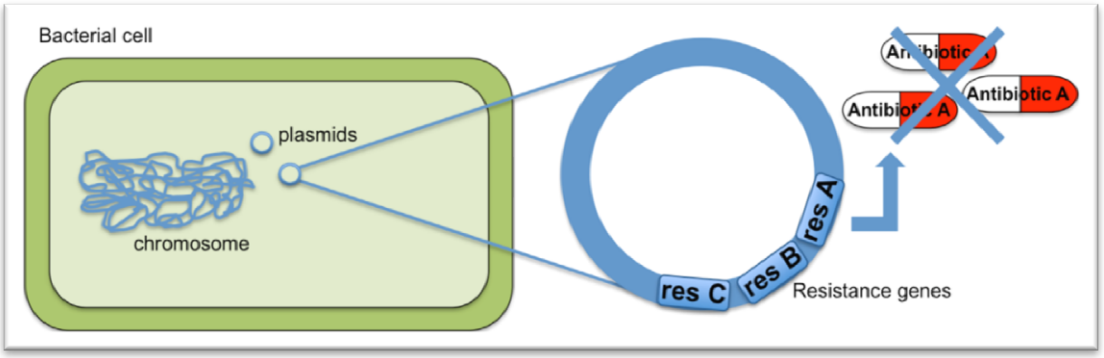


4- Nuclear body (Nucleoid)

The nucleoid in prokaryotes does not enclosed by a membrane. On contrary, in eukaryotes it is surrounded by the nuclear membrane.

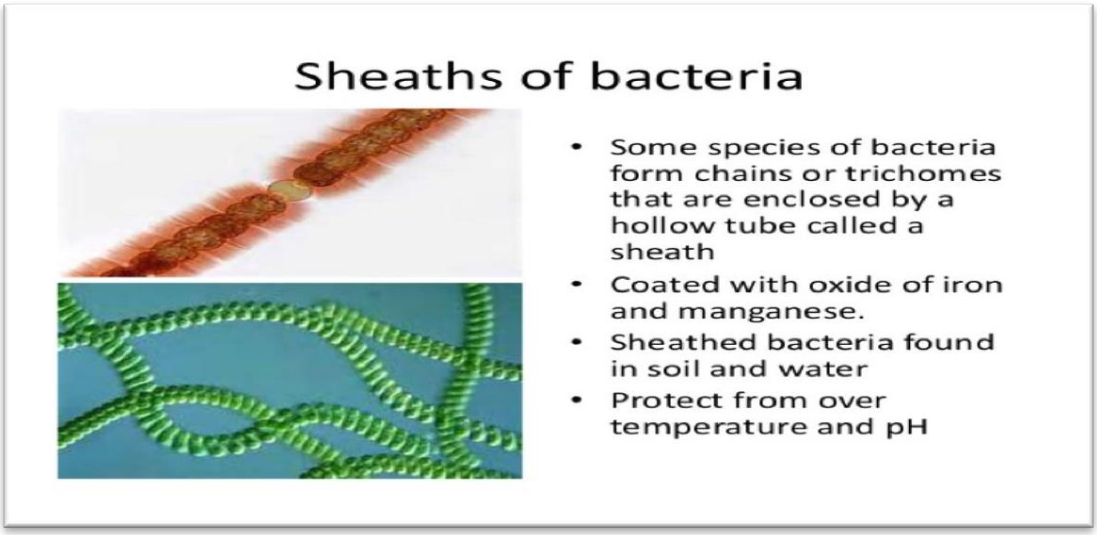
Plasmids

In addition to the bacterial chromosome, bacteria may contain one or more small, circular macromolecules of DNA known as plasmids. Plasmids contain specific genetic information such as mating capabilities, resistance to antibiotics, production of toxins, and tolerance to toxic metals.



Sheaths

It is a filamentous or tubule structure enables bacteria to attach to solid surfaces. These sheaths afford protection against predators and parasites. In some cases, they may be covered with metal oxides such as iron or manganese oxides.



Stalks

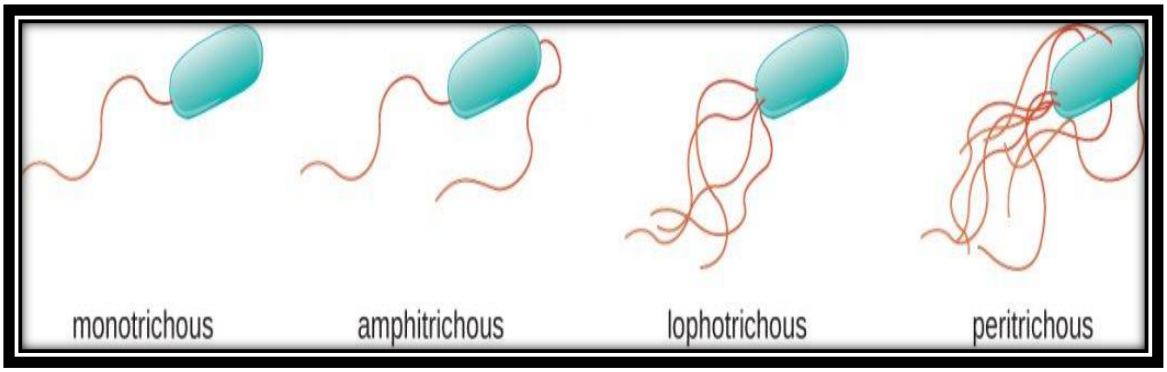
Some of bacterial species have appendages with an adhesive material at the far end of the cell by which the organisms can attach to a substrate. In some cases stalks may permit cells to adhere to each other, forming rosettes.

Flagella

The bacterial flagellum is a thread-like appendage (a long filamentous appendage) extending outward from the cytoplasmic membrane that propels bacteria; hence their main function is motility. It's usually several times longer than the cell, is generally only 12-25 nm in diameter. Thus flagella are too thin to be seen by ordinary microscope unless heavily coated by a special stain. Bacterial flagellum composed of many subunits of the protein flagellin, which confers a specific antigenicity.

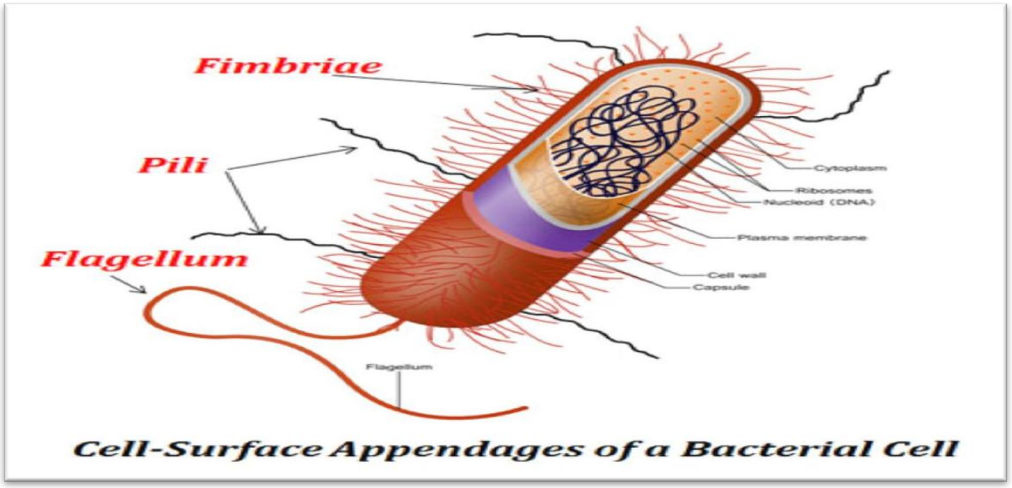
Flagella may be arranged in, various ways on bacterial cells.

1. The flagellation is said to be **monotrichous** if only one flagellum protrudes from one end, or pole, of the cell;
2. **Lophotrichous** if Several or numerous flagella protrude from one pole;
3. **Amphitrichous** if least one flagellum is at each end;
4. **Peritrichous** if the flagella protrude from all portions of the bacterial surface.



Pilus

Pilus is a hair-like appendage found on the surface of many bacteria and archaea. The terms pilus and fimbria (Latin for 'fringe'; plural: fimbriae) can be used interchangeably, although some researchers reserve the term pilus for the appendage required for bacterial conjugation. All pili in the latter sense are primarily composed of pilin proteins. Sometimes a distinction is made between types of attachment processes, with the term pilus referring only to attachment between mating bacterial cells and the term **fimbriae** referring to all other attachment.



Spores

Under conditions of limitation in supply of carbon, nitrogen, or phosphorus, (in a process known as sporulation) certain Gram positive aerobic *Bacillus* and anaerobic *Clostridium* form highly resistant dehydration, heating, and chemical agent called endospores. All bacterial spores contain large amount of dipicolinic acid and calcium, whereas these substances are undetectable in vegetative cell, the spore germinate to produce a single vegetative cell. Spore integument consists of the following layers:

i- Inner membrane surrounds the core.

ii- Spore wall (germ cell wall) is the innermost layer surrounding the inner spore membrane.

iii- Cortex is the thickest layer of the spore envelope.

iv- Outer membrane layer is densely stained called coat.

v- Between the inner and outer layers there is a thick shell or cortex.

vi- Outermost layer found in some species called exosporium.

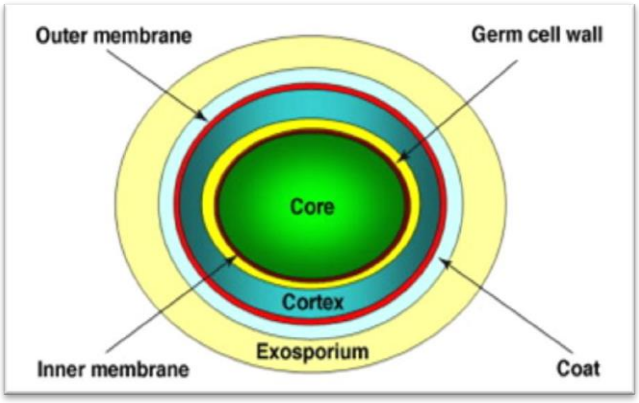


Figure 8: Endospore structure