Structure of Bacterial cell

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Lecture No. 3

Objectives

1- Classification of bacteria based on shape

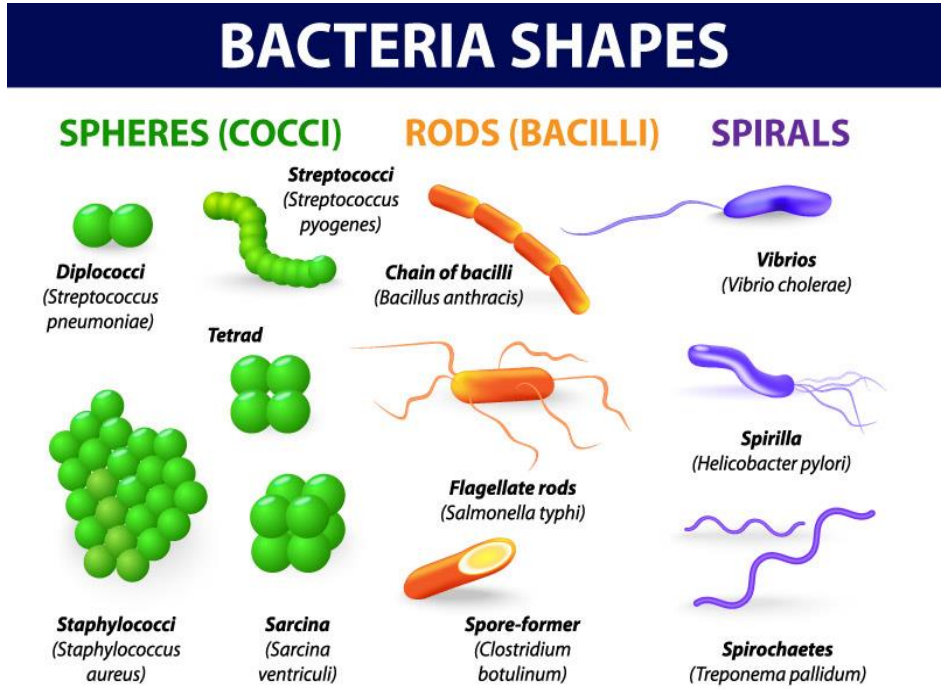
2- Study the structural components of Bacterial cell

Shape & Size of Bacteria

Bacteria are classified by shape into three basic groups:

- Cocci
- Bacilli
- spiral

Bacteria range in size from about 0.2 to 5 µm



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- The shape of a bacterium (Rigid cell wall)
- Microscopic appearance (Gram's Reaction)
- The arrangement of Bacteria
- The orientation and degree of attachment of bacteria

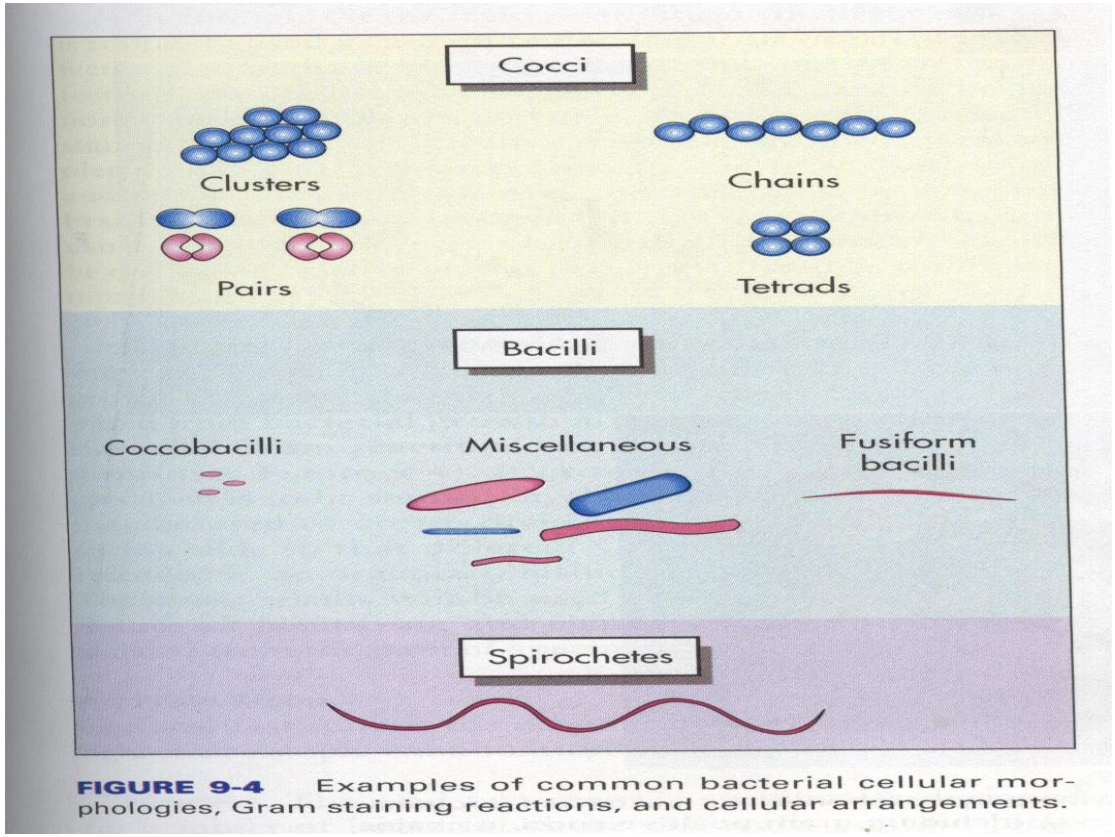
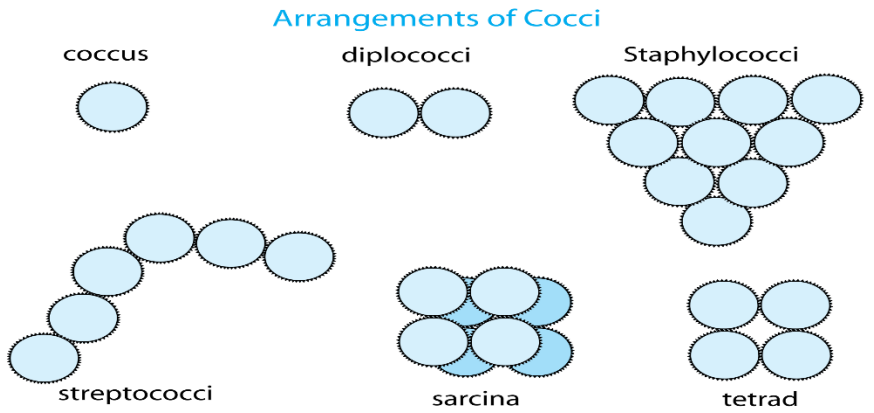


FIGURE 9-4 Examples of common bacterial cellular morphologies, Gram staining reactions, and cellular arrangements.

Arrangement of bacteria

- Pairs (diplococci)
- Chains (streptococci)
- Grapelike clusters (staphylococci).



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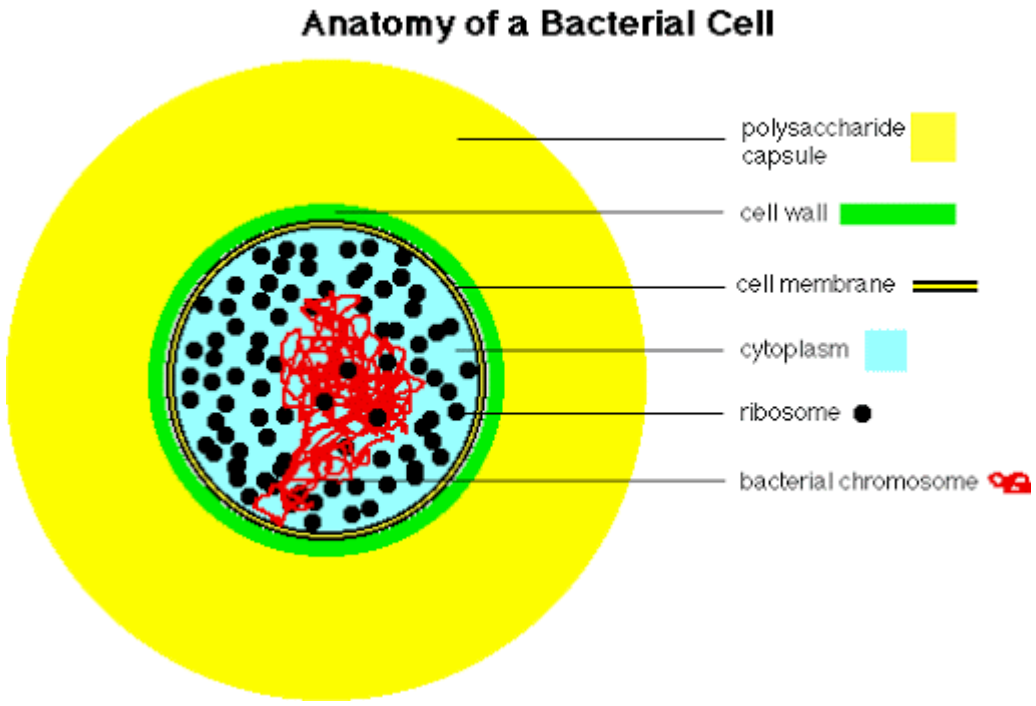
These arrangements are determined by the orientation and degree of attachment of the bacteria at the time of cell division.

Structure of Bacterial cell

- Cell Wall
- Cytoplasmic Membrane
- Cytoplasm
- Mesosome
- Granules
- Ribosome
- Nucleoid
- Structures Outside the Cell Wall
- Bacterial Spores



Cell Wall

- Outermost component common to all bacteria (except Mycoplasma species). Located external to the cytoplasmic membrane
- Some bacteria have surface features external to the cell wall, such as a capsule, flagella, and pili
- Composed of peptidoglycan. The peptidoglycan provides structural support and maintains the characteristic shape of the cell.
- Peptidoglycan is found only in bacterial cells. It is a network that covers the entire bacterium and gives the organism its shape. It is composed of a sugar backbone (glycan) and peptide side chains (peptido).

Cytoplasmic membrane

- Consists of a phospholipid bilayer (without sterols) located just inside the peptidoglycan. The membrane has four important functions:

(1) Active transport of molecules into the cell.

(2) Energy generation by oxidative phosphorylation.

(3) Synthesis of precursors of the cell wall.

(4) Secretion of enzymes and toxins.

Cytoplasm

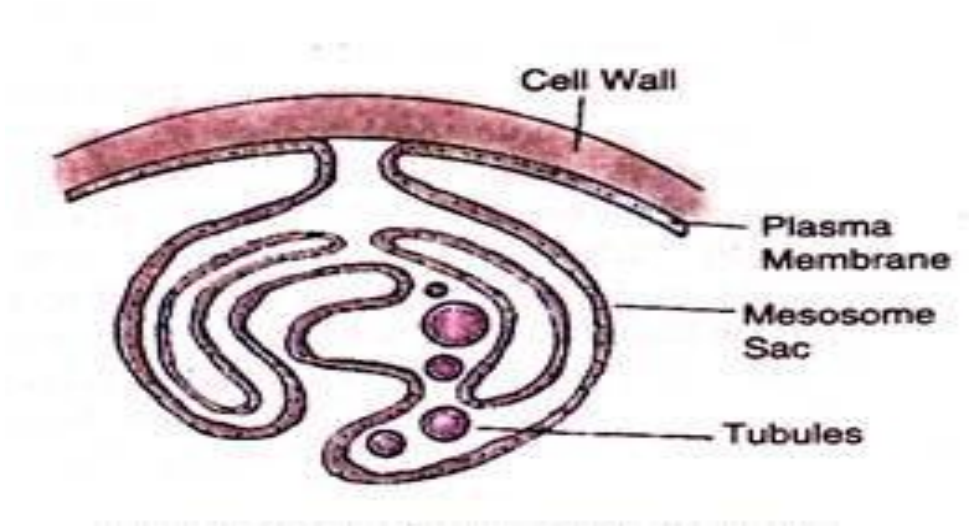
- The cytoplasm has two distinct areas when seen in the electron microscope:

(1) An amorphous matrix that contains ribosomes, nutrient granules, metabolites, and plasmids.

(2) An inner, nucleoid region composed of DNA.

Mesosome

- This invagination of the cytoplasmic membrane is important during cell division.
- A tightly folded region of the cell membrane containing all the membrane-bound proteins required for respiration and photosynthesis.



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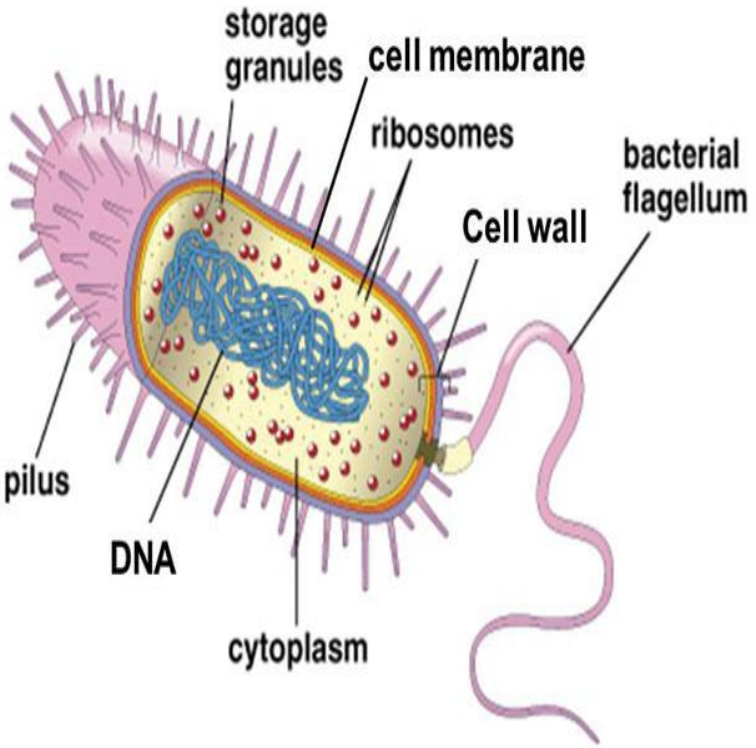
Granules

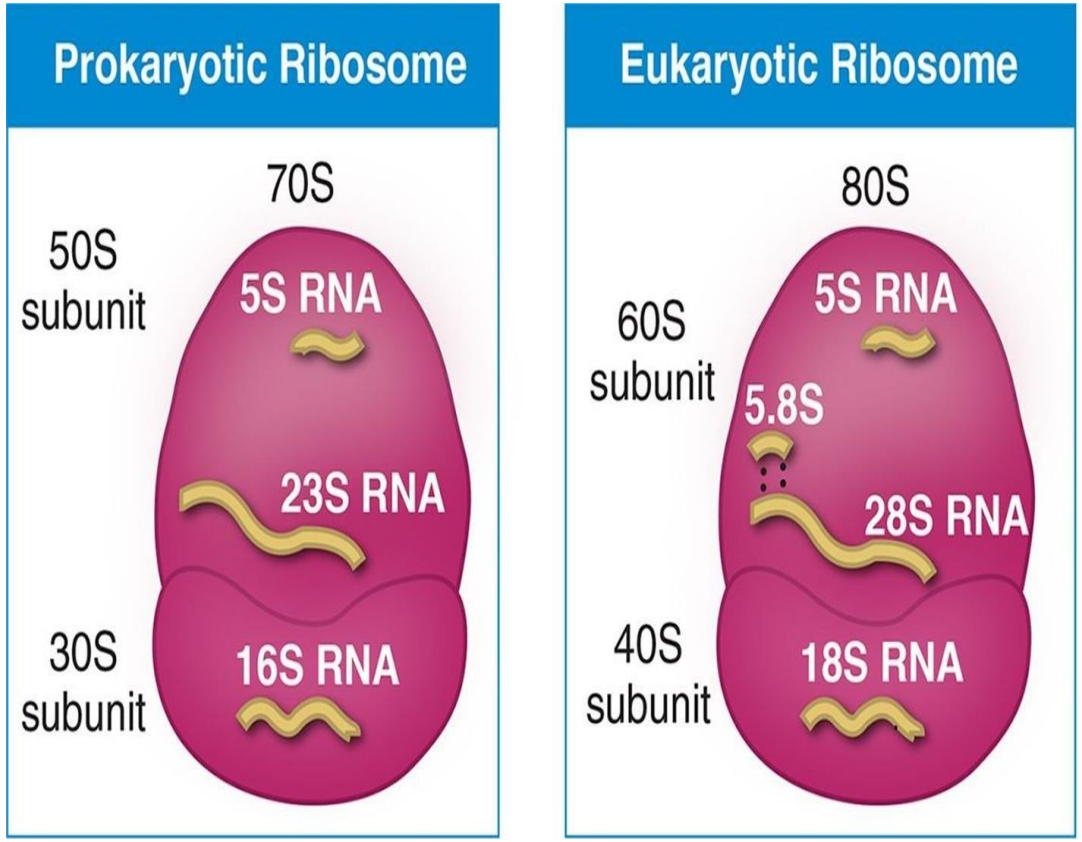
- The cytoplasm contains several different types of **granules** that serve as storage areas for nutrients and stain characteristically with certain dyes.
- For example, metachromatic granules are a characteristic feature of *Corynebacterium diphtheriae,* the cause of diphtheria.



https://www.google.com/search?q=+granules+in+bacteria&tbm

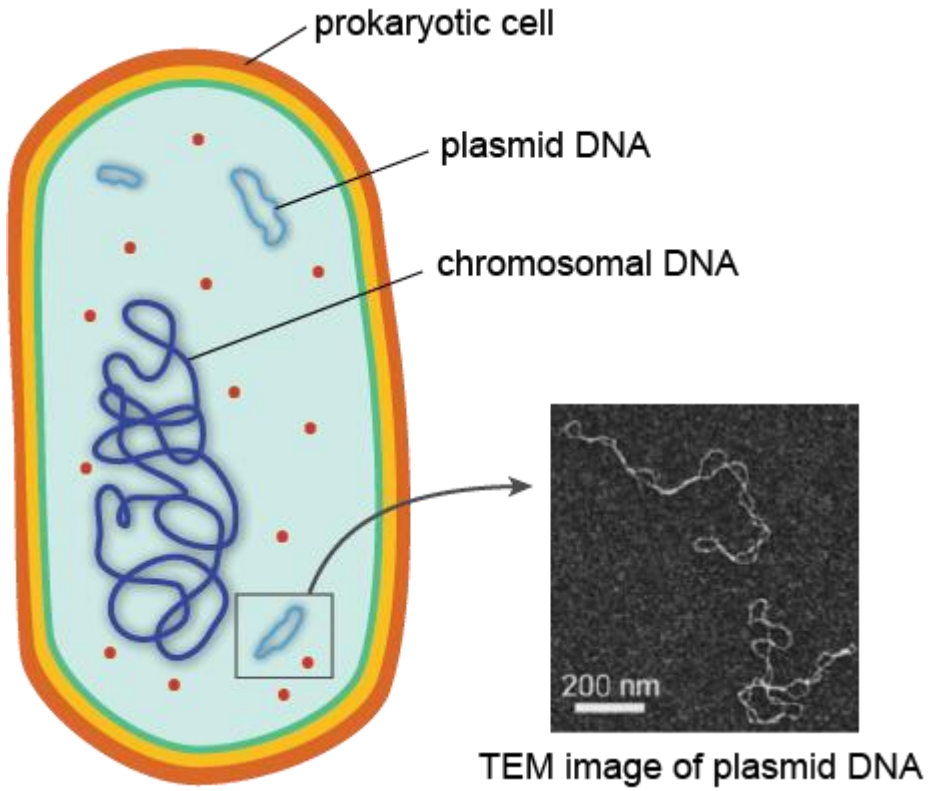
Ribosomes

- Site of protein synthesis as in eukaryotic cells, but they differ from eukaryotic ribosomes in size and chemical composition.
- Bacterial ribosomes are 70S in size, with 50S and 30S subunits.
- The differences in both the ribosomal RNAs and proteins constitute the basis of the selective action of several antibiotics that inhibit bacterial protein synthesis.



Nucleoid

- The area of the cytoplasm in which DNA is located.
- It is a single, circular molecule. Because the nucleoid contains no nuclear membrane, no nucleolus, no mitotic spindle, and no histones, there is little resemblance to the eukaryotic nucleus.
- One major difference between bacterial DNA and eukaryotic DNA is that bacterial DNA has no introns (a segment of a DNA or RNA molecule which does not code for proteins and interrupts the sequence of genes), whereas eukaryotic DNA does.



TEM image of plasmid DNA

Plasmids

- They are extrachromosomal, double-stranded, circular DNA molecules that are capable of replicating independently of the bacterial chromosome.
- They can be integrated into the bacterial chromosome.
- Plasmids occur in both gram-positive and gram-negative bacteria.
- Encode both exotoxins and many enzymes that cause antibiotic resistance

Transposons

- Small pieces of DNA that move frequently between chromosomal DNA and plasmid DNA. They carry antibiotic-resistant genes.
- Because of their unusual ability to move, they are nicknamed “jumping genes.”

References

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- Stefan Riedel, Thomas G. Mitchell, Jeffery A. Hobden, Judy A. Sakanari. Steve Miller, Peter Hotez, Stephen A. Morse, Rojelio Mejia, Timothy A. Mietzner. **2019. Jawetz, Melnick, & Adelberg's Medical Microbiology.** 28th edition. McGraw-Hill Education