

Tishk International University
Faculty of Applied Science
Nutrition and Dietetics Department



Structure and Function of Microbial Cell

Food Microbiology / 2nd Lecture
2nd Grade / Spring Semester

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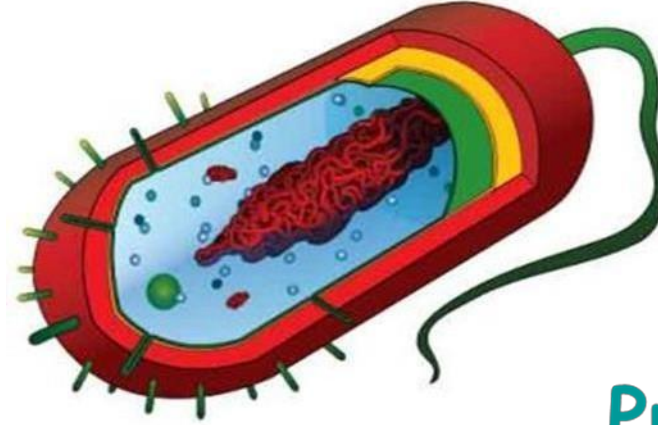
■ **Classification of Microorganisms?**

- ✓ Microorganisms are also known as microbes:
 - Are a diverse group of microscopic living organisms that include bacteria, archaea, viruses, fungi, algae, and protozoa.

- ✓ These microorganisms can be classified into different groups based on various criteria Including:
 - Their cell type, structure, metabolism, habitat, and other characteristics.

Two Types of Cells:

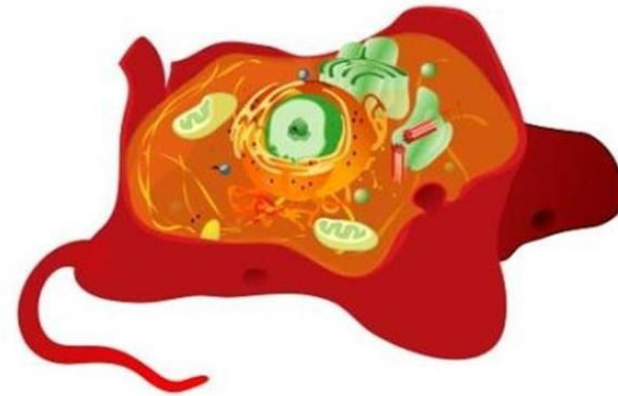
- ✓ Prokaryotic ("No true nucleus"):
 - This group includes bacteria and archaea.



Prokaryotic
Cells

- ✓ Eukaryotic ("True nucleus"):

- Protozoans
- Fungi
- Algae
- Animals
- Plants



Eukaryotic
Cells

- ✓ However, viruses, prions and viroids are acellular :- "without a cell".



■ Characteristics of Prokaryotic Cells :

1. DNA is:

- Not enclosed within a nuclear membrane.
- A single circular chromosome.
- Not associated with histone proteins.

2. Lack membrane-enclosed organelles like mitochondria, chloroplasts, Golgi, etc.

3. Cell walls usually contain peptidoglycan, a complex polysaccharide.

4. Divide by binary fission.



- Characteristics of Eukaryotic Cells:

1. DNA is:

- Enclosed within a nuclear membrane.
- Several linear chromosomes.
- Associated with histones and other proteins.

2. Have membrane-enclosed organelles like mitochondria, chloroplasts, Golgi, endoplasmic reticulum, etc.

3. Divide by mitosis.



- Bacteria:
 - Eubacteria (True Bacteria):
 - ✓ This group includes the majority of bacteria and is characterized by their typical cell structure with **peptidoglycan** in their cell walls.
 - Archaeobacteria (Archaea):
 - ✓ Archaea are a group of microorganisms that are similar to bacteria but differ in their genetics, biochemistry, and cell membrane structure.



■ **Algae:**

- ✓ Algae are photosynthetic microorganisms that can be found in aquatic environments.

- ✓ They can be classified into various groups based on pigments and cell structure, such as green algae, red algae, and brown algae.

- Eukaryotic: Unicellular or multicellular
- Size: Some microscopic
- Motile or nonmotile
- Autotrophs
- Disease causing? no



Fungi:

- Yeasts:
 - ✓ Are single-celled fungi that reproduce by budding. They are commonly used in baking and brewing industries.

- Molds:
 - ✓ Are multicellular fungi that form a network of filaments called hyphae.
 - They are involved in food spoilage and the production of antibiotics like penicillin.



- **Mushrooms:**

- ✓ Are complex, multicellular fungi with fruiting bodies. Some are edible, while others are toxic.

- **Protozoa:**

- ✓ Are single-celled, eukaryotic microorganisms that are classified based on their locomotion methods.

- They can be flagellates, ciliates, amoebas, or sporozoans.



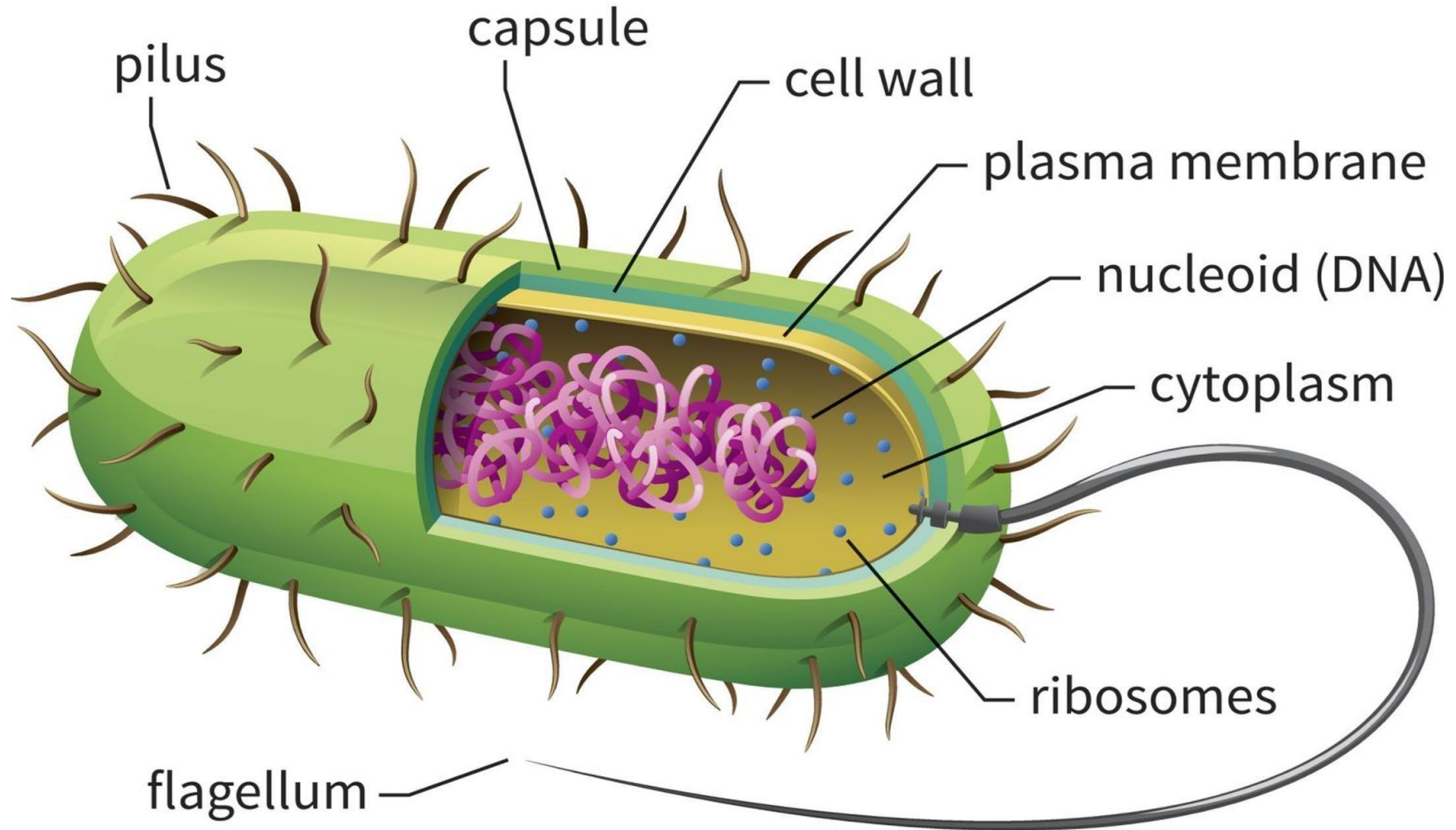
- **Helminths:**

- ✓ Helminths are parasitic worms, including flatworms and roundworms.
- They are multicellular and often infect humans and animals

- **Viruses:**

- ✓ Are not classified as living organisms because they cannot carry out metabolic processes or reproduce on their own.
- They consist of genetic material enclosed in a protein coat called a capsid.

■ PROKARYOTIC CELL STRUCTURE:





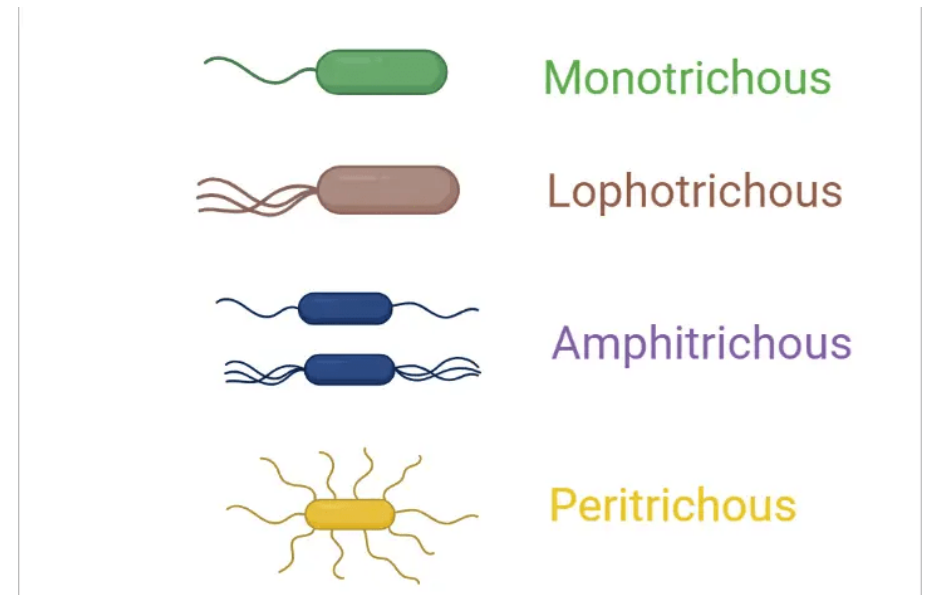
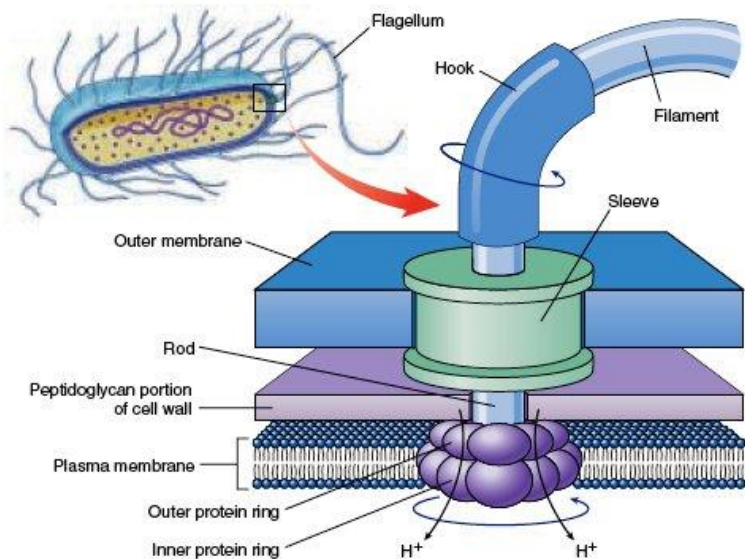
■ Pili:

- ✓ Straight hair-like appendages; they are usually short. all gram negative bacteria have pili.

- ✓ Function is to attach bacteria to other bacteria, other cells, or other surfaces (**not for locomotion**):
 - Sex pili:
 - Allow one bacterial cell to adhere to another called **conjugation**.
 - Other types of pili attach bacteria to plant or animal cells
 - If pili have been lost in disease-causing bacteria, the bacteria will not be able to establish an infection.

▪ Flagella:

- ✓ Prokaryotic cells possess flagella, which are long, whip-like structures used for movement.
- ✓ Flagella in prokaryotes are different in structure from eukaryotic flagella.
- ✓ Bacteria can have 1, 2, or many flagella



Flagella arrangement in bacteria



▪ Cell Envelope:

✓ Layers from outside to inside:

- Glycocalyx: protective slimy layer on the cell surface that helps bacteria stick to surfaces, form biofilms, and survive in harsh conditions
 - A thick glycocalyx is often called a **capsule**
 - A thin glycocalyx is often called a **slime layer**



- Function:

- Protection from drying out
- Helps a cell adhere to a surface where conditions are favorable for growth
- Provide protection against phagocytosis



■ **Cell Wall:**

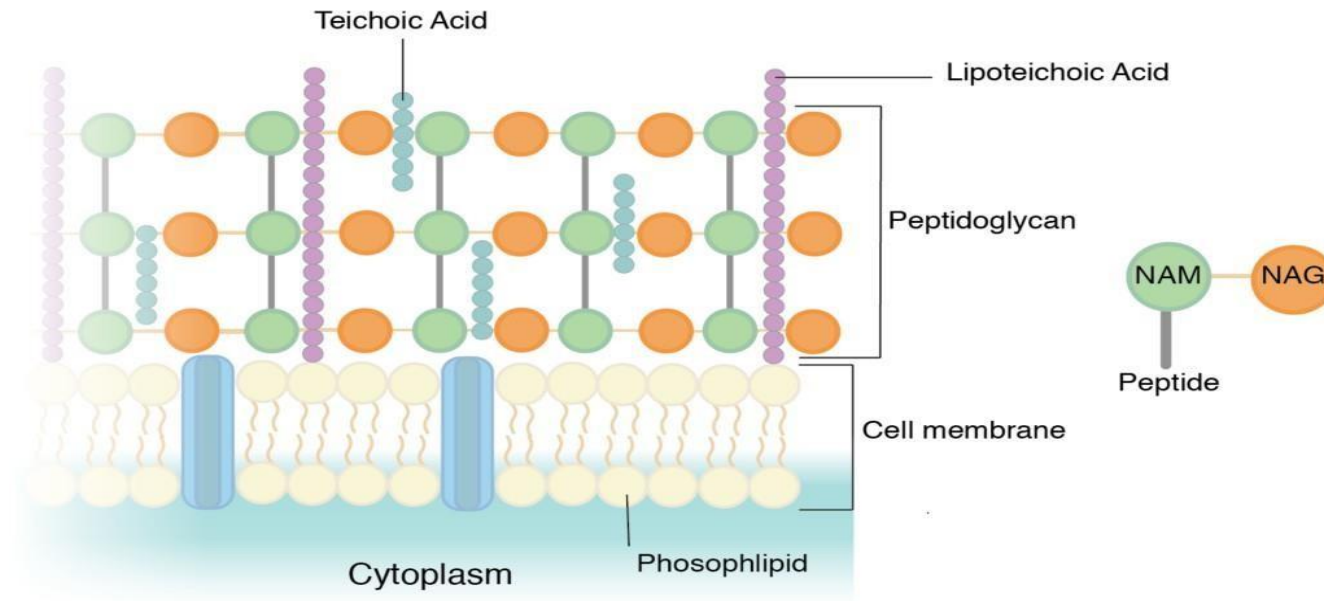
- ✓ Prokaryotic cells typically have a rigid cell wall made of peptidoglycan, a unique molecule composed of sugar and amino acid chains.
- The cell wall provides structural support and protection.
- A major difference between G(+) & G(-) bacterial cell walls:
 - a) G(-): peptidoglycan 2-3 interconnected layers
 - b) G(+): peptidoglycan wall is many layers thick approximately 10–20 layers

Prokaryotes – Cell Wall

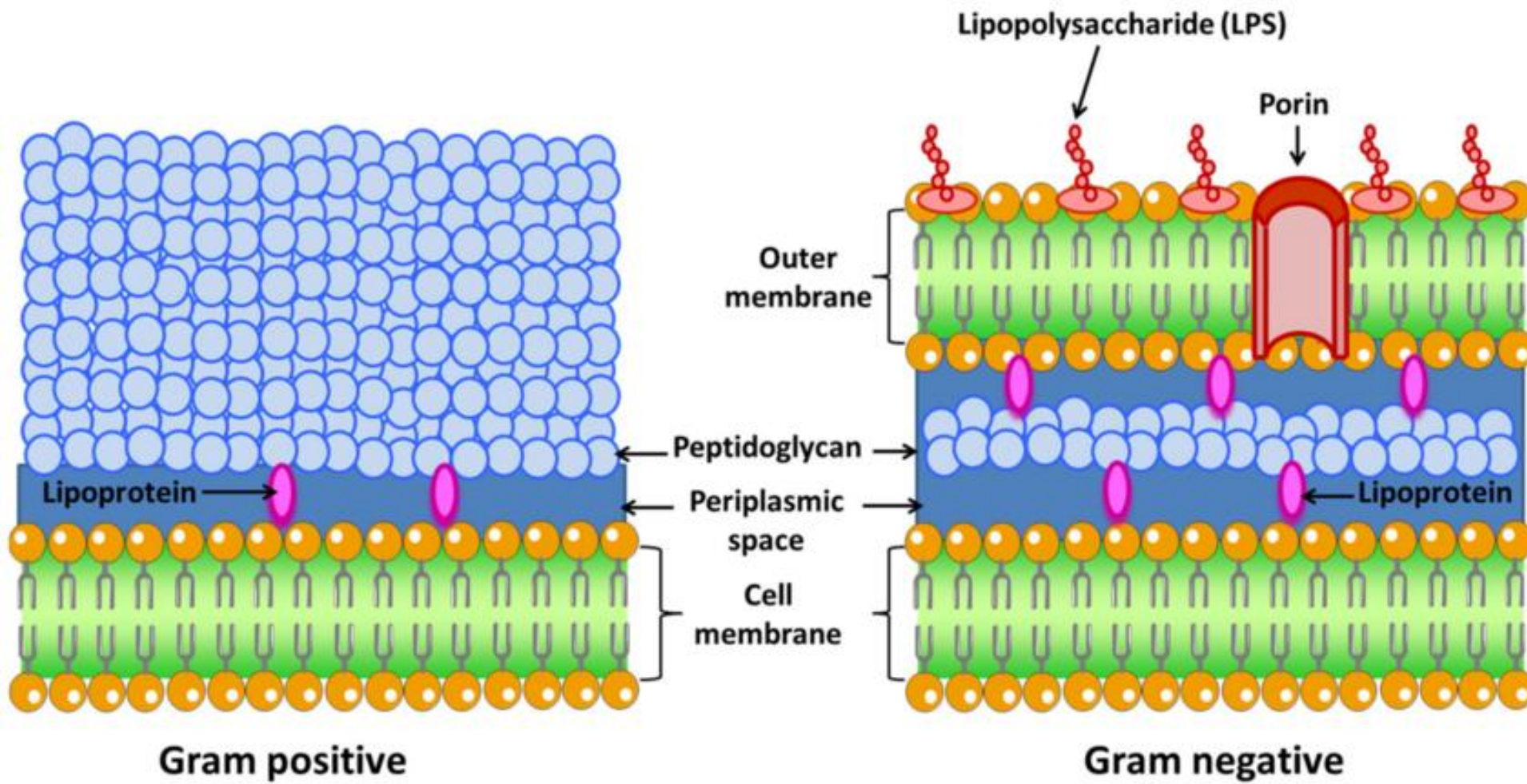


- **Peptidoglycan** is a large molecule made up of repeating units that form long chains linked together makes up the **cell wall of most bacteria.**

Peptidoglycan = sugar chains + protein chains connected together“



Gram Positive Bacteria Cell Wall



What are the differences between G +ve and Gram -ve bacteria?



- **Plasma Membrane:**

- ✓ Is a phospholipid bilayer that surrounds the cytoplasm of the cell.
- ✓ It regulates the passage of substances in and out of the cell
- ✓ Contains various proteins for transport, signaling, and other functions

Selective barrier - controls what enters/exits cell

Contains transport proteins

Energy production site (like mitochondria in eukaryotes!)



- **Cytoplasm:**

- ✓ Is a gel-like substance that fills the interior of the cell.
- ✓ It contains the cell's genetic material, ribosomes, and various enzymes required for metabolic processes.

- **Nucleoid:**

- ✓ In prokaryotic cells, the genetic material, which is typically a single, circular DNA molecule, is found in a region called the nucleoid.
- ✓ Unlike eukaryotic cells, prokaryotes lack a true nucleus with a membrane.

- **Ribosomes:**

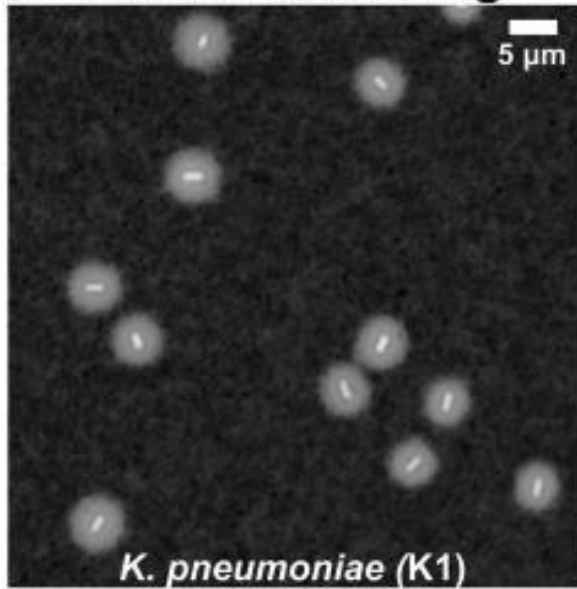
- ✓ Are small structures in the cytoplasm where **protein synthesis occurs**.
- ✓ Prokaryotic ribosomes are smaller than those in eukaryotic cells and are often referred to as 70S ribosomes.



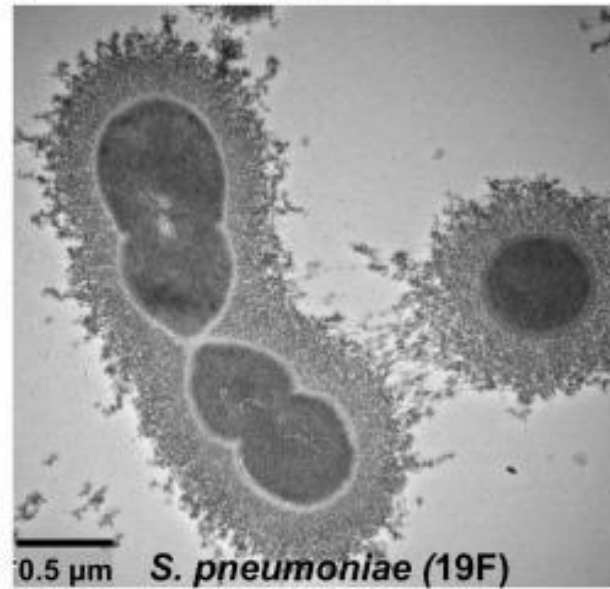
▪ **Endospores:**

- ✓ Some bacteria, notably certain species of the genus *Clostridium* and *Bacillus*, can form endospores under **adverse conditions**.
- ✓ Endospores are highly resistant, dormant structures that allow the bacteria to survive harsh environments
- ✓ This is why sterilization must reach 121°C (autoclave) - to kill endospores!

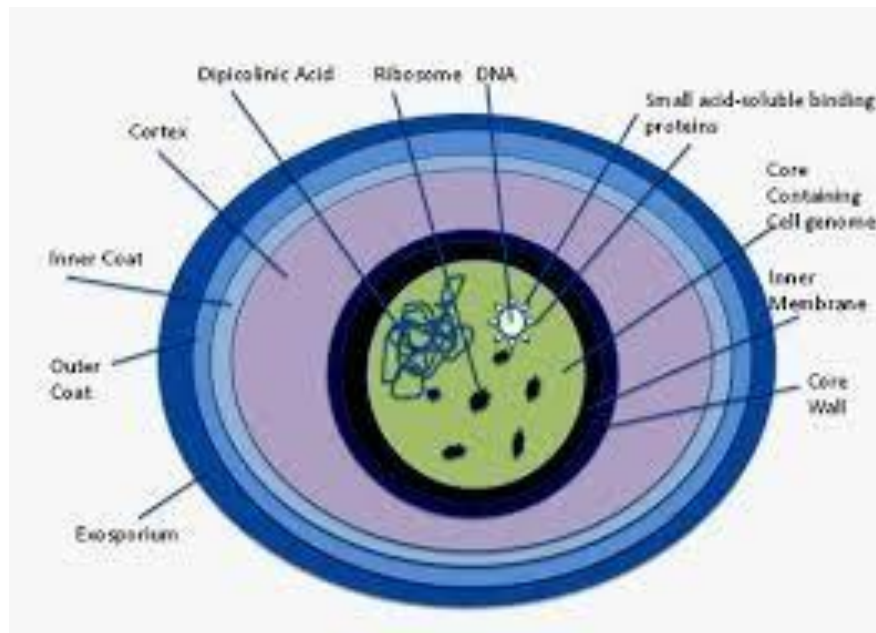
(a) India ink staining



(b) TEM



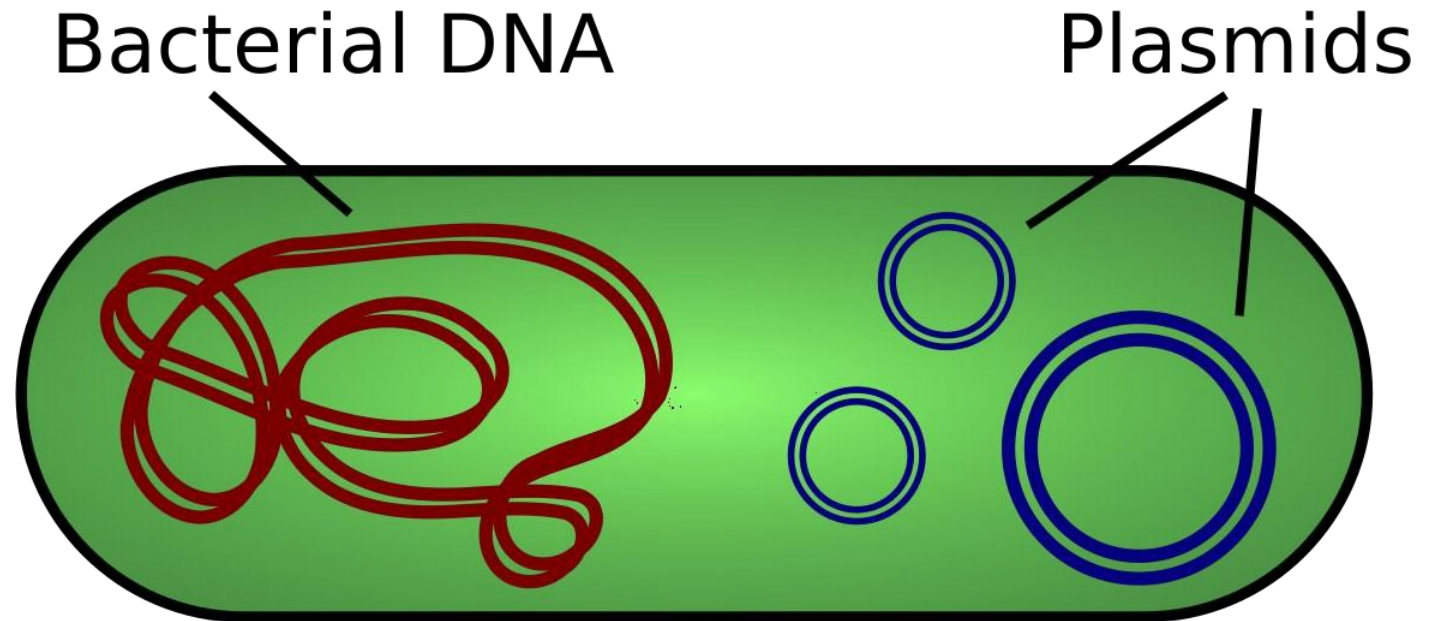
Capsule



Endospores

■ Plasmids:

- ✓ Is extrachromosomal DNA. Prokaryotic cells can contain small, circular pieces of DNA called plasmids.
- ✓ Plasmids often carry genes that provide the cell with specific advantages, such as **antibiotic resistance**.





Thanks