BACTERIA

Section 20-1

WHAT ARE PROKARYOTES?

Key Idea: Prokaryotes are divided into two major groups: the domain **Archaea** and the domain **Bacteria**.

- Prokaryotes are single-celled organisms that do not have membrane bound organelles.
- They are generally found in three shapes: a rod shape (*bacillus*), a sphere shape (*coccus*), and a spiral shape (*spirillum*).

ARCHAEA

- Archaea are found in many places, including extreme environments such as salt lakes and hot springs.
- Some Archaean molecules are more similar to those found in eukaryotes.

BACTERIA

- Bacteria can be found virtually everywhere.
- One square inch of skin plays host to an average of 100,000 bacteria!

BACTERIAL STRUCTURE

Key Idea: Gram-positive bacteria have a thick layer of **peptidoglycan** and no outer membrane. **Gram-negative** bacteria have a thin layer of **peptidoglycan** and have an outer membrane.

- A **plasmid** is a small extra loops of DNA
- **Peptidoglycan** is a protein-carbohydrate compound
- **Gram-positive bacteria** have a large amount of peptidoglycan in their cell walls and have no outer membrane.
- **Gram-negative bacteria** have a small amount of peptidoglycan in their cell walls and have an outer membrane.

GRAM–POSITIVE BACTERIA

Gram-Positive Bacteria

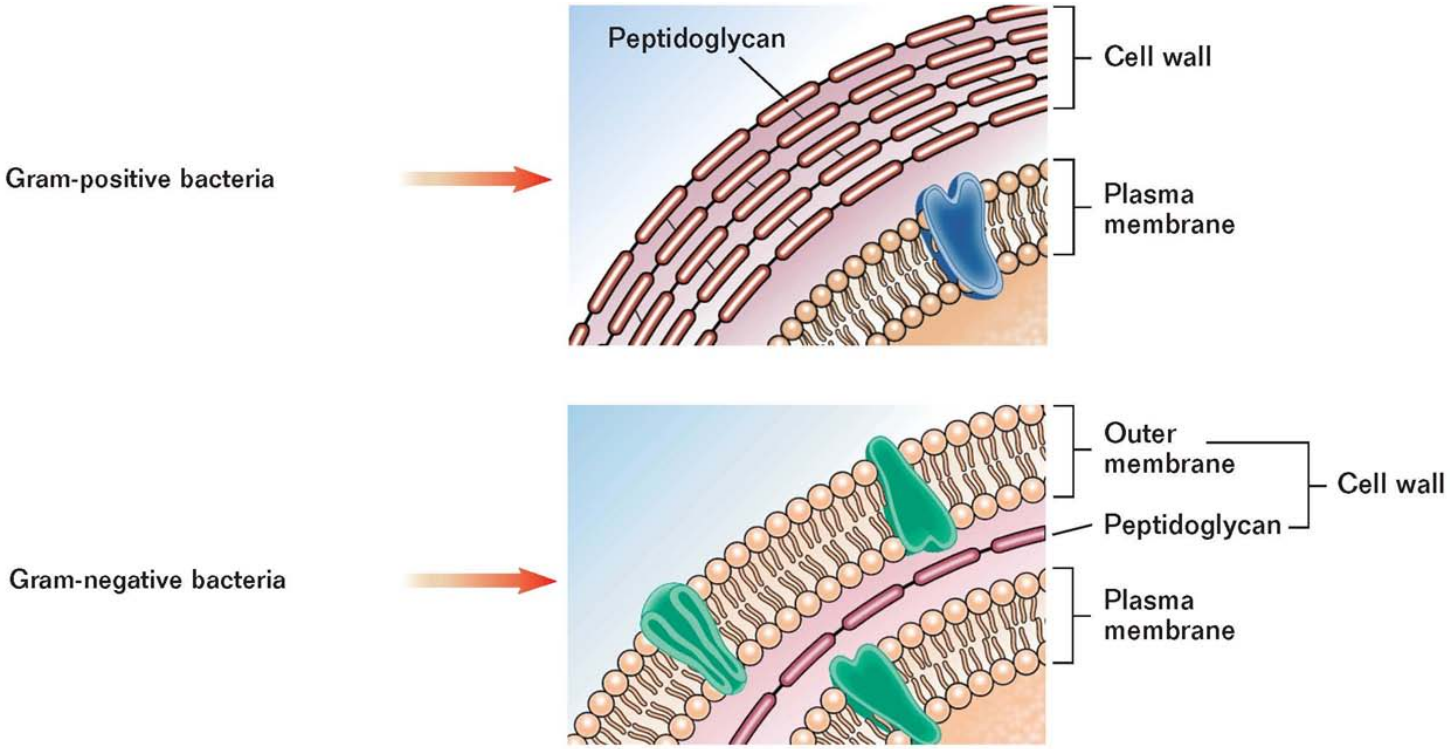
- The Gram stain involves two colors of dye.
- The first dye is dark purple. Gram-positive bacteria trap the dark purple dye because their peptidoglycan layer is very thick.
- The second, pink dye is also absorbed, but it cannot be seen because the purple dye is much darker. As a result, Gram-positive bacteria appear purple after staining.

GRAM–NEGATIVE BACTERIA

Gram-Negative Bacteria

- The thin peptidoglycan layer of Gram-negative bacteria does not trap the purple dye.
- When the pink dye is added, it is absorbed by the cell. Because the pink dye is the only dye present in Gram-negative bacteria, they appear pink after staining.
- The outer membrane of Gram-negative bacteria makes them more resistant to host defenses and to medicines.

GRAM STAINING



Obtaining Energy and Nutrients

Key Idea: Grouping prokaryotes based on their energy source separates them into **photoautotrophs**, **chemoautotrophs**, and **heterotrophs**.

PHOTOAUTOTROPHS

- Organisms that get their energy from sunlight through photosynthesis.
- These bacteria include purple sulfur and nonsulfur bacteria, green sulfur bacteria, and cyanobacteria.
- Cyanobacteria are abundant today and are a major component of the plankton that floats in the oceans.

CHEMOAUTOTROPHS

- Chemoautotrophs are the only organisms that can get their energy from inorganic sources.
- They use molecules that contain sulfur or nitrogen and simple organic molecules to obtain energy.

HETEROTROPHS

- Most prokaryotes are *heterotrophs* and get both their energy and their nutrients from other organisms.
- Most absorb nutrients from dead organisms, but some are parasites or pathogens.
- Many heterotrophic bacteria live in the presence of oxygen, but some can live without it.

Reproduction and Adaptation

Key Idea: Prokaryotes can reproduce by binary fission, **exchange genetic material through conjugation**, **transformation**, and **transduction**, and survive harsh conditions by forming **endospores**.

- **Conjugation** is when two bacteria exchange genetic material.
- **Transformation** is when bacteria take up DNA fragments from their environment.
- **Transduction** is when genetic material, such as a plasmid, is transferred by a virus. Plasmids often convey antibiotic resistance.
- **Endospore** is a thick walled structure that forms inside bacteria and resists harsh conditions.

BINARY FISSION

- Prokaryotes usually reproduce asexually by binary fission.
- In this process, a single cell divides into two identical new cells.

Genetic Recombination

- There are three ways that prokaryotes can form new genetic combinations.
  - Conjugation
  - Transformation
  - Transduction

ENDOSPORE FORMATION

- Endospores form inside the bacteria. They surround the DNA and a small bit of cytoplasm.
- Endospores can survive boiling, radiation, and acid. They show no signs of life and can be revived after hundreds of years.