



Lecture 2. Morphology of bacteria

Learning objectives

Upon completion of this lecture, student should be able to:

1. Differentiate between prokaryotic and eukaryotic.
2. State the functions and biologic significance of the cellular structures.
3. Compare the organization of the cell envelope for a gram-positive and a gram negative bacterium.

Introduction

All living beings can be classified into three kingdoms: **Plant**, **Animal**, and **Protista**.

The kingdom Protista has been divided into three groups: **prokaryotes**, **eukaryotes**, and **archaebacteria**.

Bacteria are **unicellular** free living organisms having both DNA and RNA. They are capable of performing all essential processes of life, e.g., **growth**, **reproduction**, and **metabolism**.



Structure	Prokaryotes	Eukaryotes
Nucleus		
Nuclear membrane	Absent	Present
Nucleolus	Absent	Present
Location	Free in the cytoplasm	Contained in membrane bound structure
Replication	Binary fission	Mitotic division
Extrachromosomal DNA	plasmid	Inside the mitochondria
Cytoplasm		
Cytoplasmic organelles	Absent	Present
Lysosomes	Absent present	
Chemical composition		
Cell wall	Present	Absent
Sterols	Absent	Present
Muramic acid	Present	Absent

Size of bacteria

The size of bacteria is measured in units of length called **microns**.

A **micron** (micrometer, μm) is the unit of measurement used in bacteriology.

- 1 **micron** (μm) = 1/1000 **millimeter** (mm).
- 1 **nanometer** (nm) = 1/1000 **micron** (μm).

Bacteria of medical importance measure 2–5 μm (length) * 0.2–1.5 μm (width).

Shape of bacteria

	Shape	Arrangement	Example
Cocci	Oval or spherical	Pairs	<i>pneumococci</i>
		tetrads	<i>micrococci</i>
		chains	<i>streptococci</i>
		clusters	<i>staphylococci</i>
Bacilli	Rod	Coccobacilli: Length of the bacteria is approximately the same as its width	<i>Brucella</i>
		Streptobacilli: These are arranged in chains	<i>Streptobacillus</i>
		Comma shaped: They exhibit curved appearance	<i>Vibrio</i>
		Spirilla: They exhibit rigid spiral forms	<i>Spirillum</i>
Spirochetes	Slender	flexuous spiral forms	<i>Treponema</i>
Actinomycetes	branching filamentous bacteria		<i>Actinomycetes</i>

The cell envelope

The cell envelope primarily consists of two components: a **cell wall** and cytoplasmic or **plasma membrane**.

The outer layer or cell envelope provides a **structural** and **physiological barrier** between the protoplasm of the cell and the external environment. It also **protects** bacteria against **osmotic lysis** and gives bacteria **rigidity and shape**.

Cell wall

A **rigid** and **chemically complex** structure present between the cell membrane and capsule/slime layer.

Cell wall **provides shape** to the cell and **protects bacteria** from changes in **osmotic pressure**.

Peptidoglycan is the main component of the cell wall and is responsible for the shape and strength of the cell.

Bacterial cells can be classified into **Gram-positive** or **Gram-negative** based on the structural differences.

Gram-positive bacteria	Gram-negative bacteria
The cell wall is thick (15–80 nm) and more homogenous.	The cell wall is much more complex
The cell wall contains large amount of peptidoglycan present in several layers.	Peptidoglycan content is significantly less than the Gram-positive cell wall.
The cell wall consists primarily of teichoic and teichuronic acids.	<p>Only 1–2 layers of peptidoglycan (2–8 nm) are present just outside the cell membrane.</p> <p>The cell wall outside the peptidoglycan layer contains three main components:</p> <ul style="list-style-type: none"> • lipoprotein layer • outer membrane • lipopolysaccharides