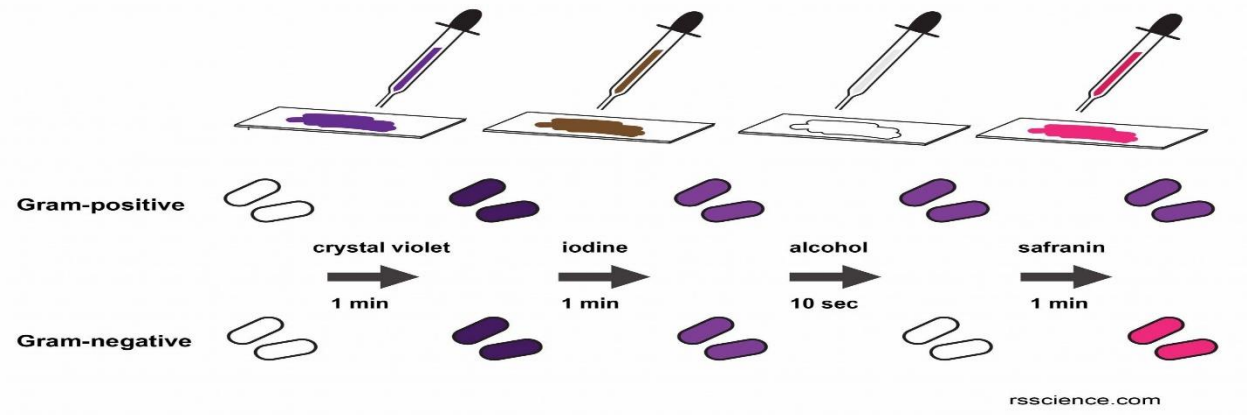
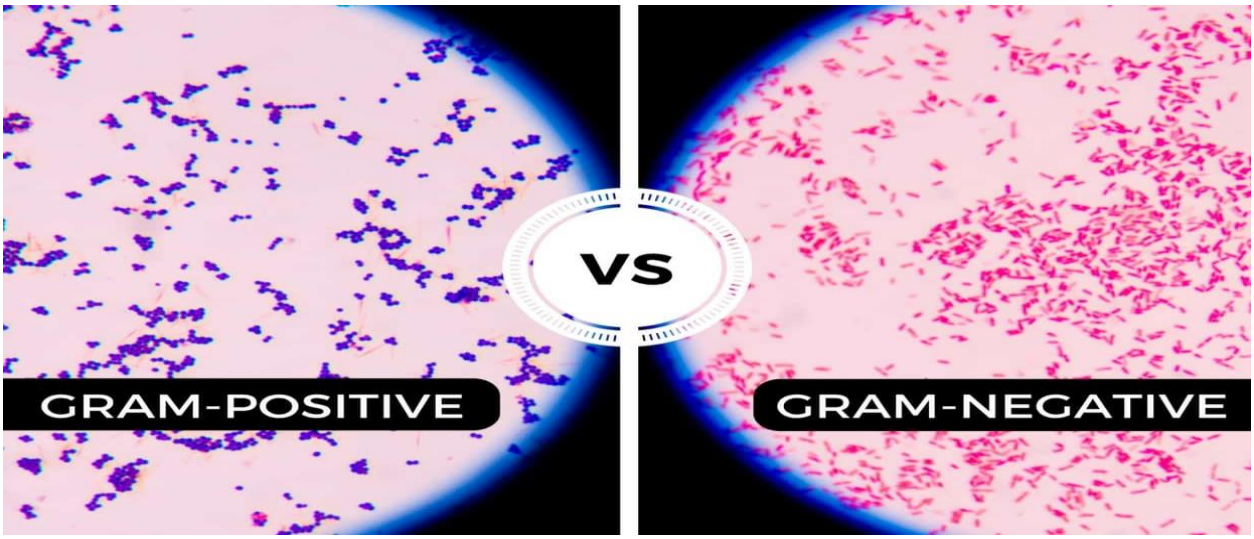
Bacterial Cell Structure

Bacteria are single-celled microorganisms that are found nearly everywhere on earth, and they are very diverse in their shapes and structures.

The cell wall is a protective layer, complex and mesh-like structure that surrounds some cells and gives them shape and rigidity. It is located outside the cell membrane and prevents osmotic lysis, (bursting due to increasing volume) It as an ideal target for some of our most powerful antibiotics also helps to anchor appendages like the pili and flagella.

The chemical composition of the cell walls varies between bacterial genera. Bacteria are divided into two major groups: Gram-positive bacteria and Gram-negative bacteria, based on their reaction to Gram staining due to cell wall structure.

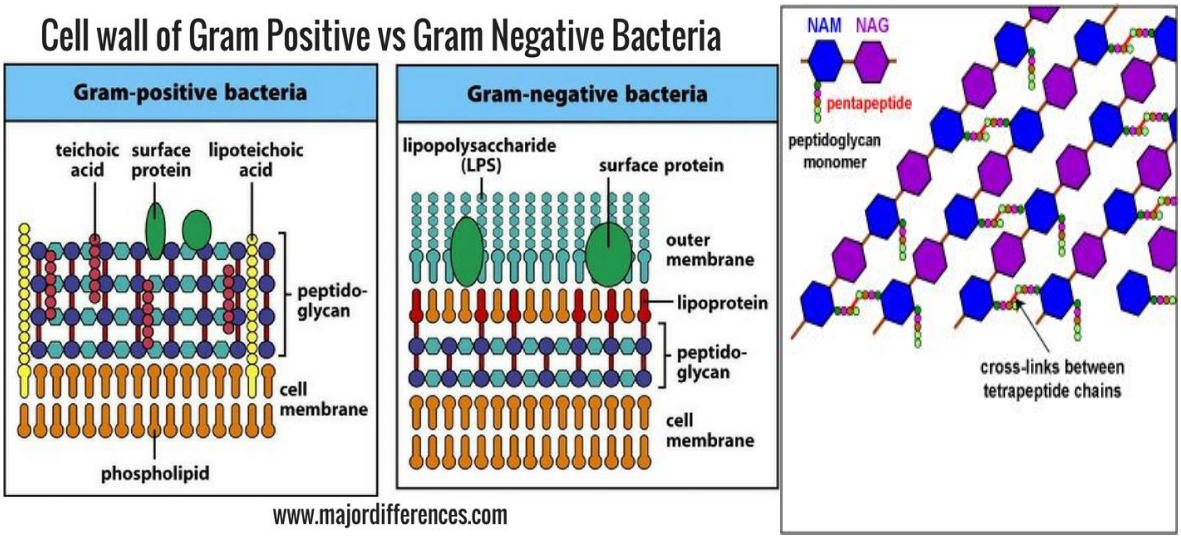




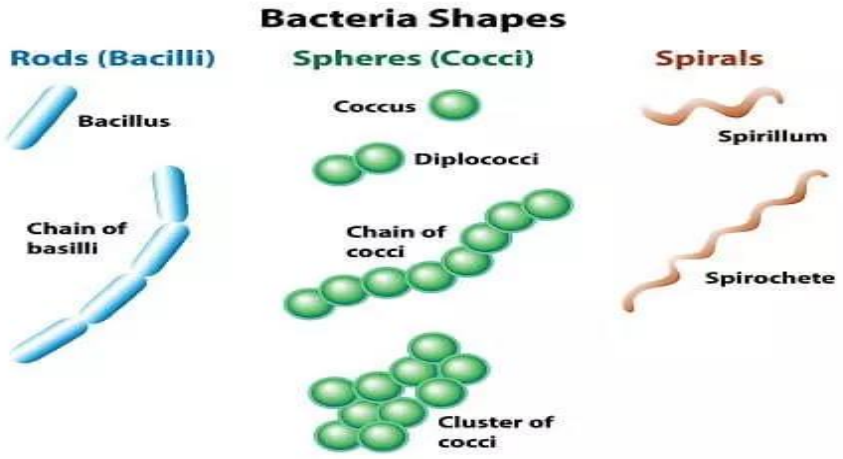
Differences between Gram- positive and Gram-negative Cell Wall

Gram- positive cell wall	Gram-negative cell wall
A single layered and simple	A double layered and complex
The thickness of the cell is 20-80 nm.	The thickness of the cell is 8-10 nm.
It's a thick layer of peptidoglycan as a rigid, highly conserved, complex structure	It's a thin layer of peptidoglycan
Teichoic acids and lipoteichoic acids are present (help make the cell wall stronger).	Teichoic acids are absent
Lipopolysaccharide is absent	Lipopolysaccharide is present
The outer membrane is absent	The outer membrane is present
The lipid content is very low	The lipid content is very high

Peptidoglycan, also called murein, is a polysaccharide made of two glucose derivatives, is a polymer that made up of two alternating amino sugars, N-acetylglucosamine (NAG) and N-acetylmuramic acid (NAM). Since peptidoglycan is relatively porous, most substances can pass through the gram-positive cell wall with little difficulty

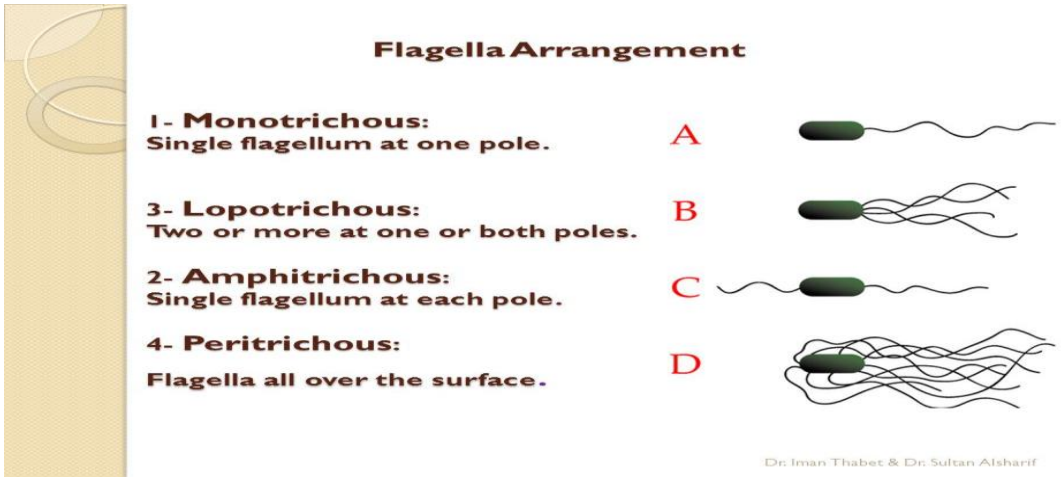


Bacteria are classified into five groups according to their basic shapes: spherical (cocci), rod (bacilli), spiral (spirilla), comma (vibrios) or corkscrew (spirochaetes). They can exist as single cells, in pairs, chains or clusters.

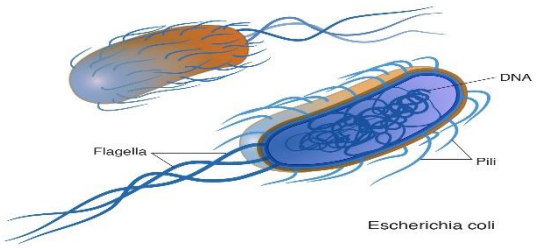


Bacterial appendages

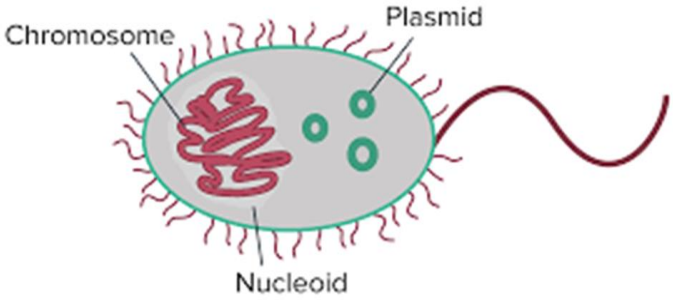
Flagella are hair like structures that help the bacterium move toward nutrients, light and away from toxic chemicals**.**



Pili (fimbriae) is small hair like projections that help bacteria adhere to surfaces such as teeth and intestine and can allow of plasmid DNA to be transferred between two prokaryotic cells in a process known as conjugation.



Plasmids are small, circular molecules of DNA that are capable of replicating independently (extra-chromosomal DNA).



Capsule is a sticky layer lying outside the cell wall in some procaryotes. The capsule is a major virulence factor in the major disease-causing bacteria, that helps adhere to surfaces, protect from drying out, resistance to immune responses and phagocytosis (engulfing) by larger microorganisms.

Ribosomes are the protein builders of the cell. They are like construction guys who connect amino acids and build long chains.

Bacterial virulence factors

Some bacteria have certain cell parts that help them to invade other organisms better. These are called virulence factors.

Types of virulence factors:

1. Adherence factors
2. Invasion factors
3. Capsules
4. Endotoxins
5. Exotoxins

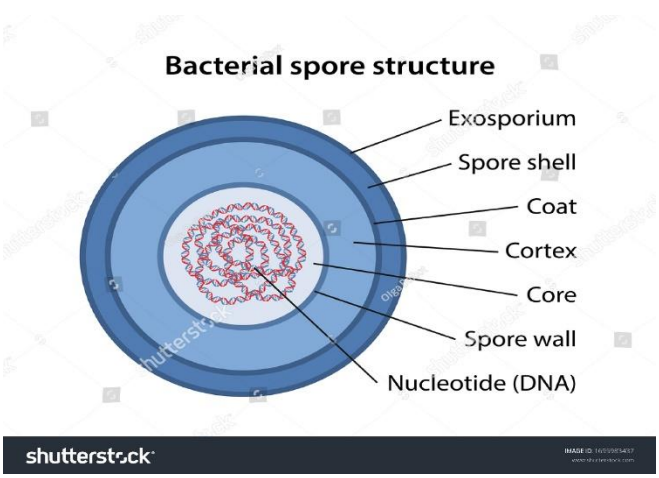
6. Siderophores (iron-chelating compounds) that are secreted by bacteria.

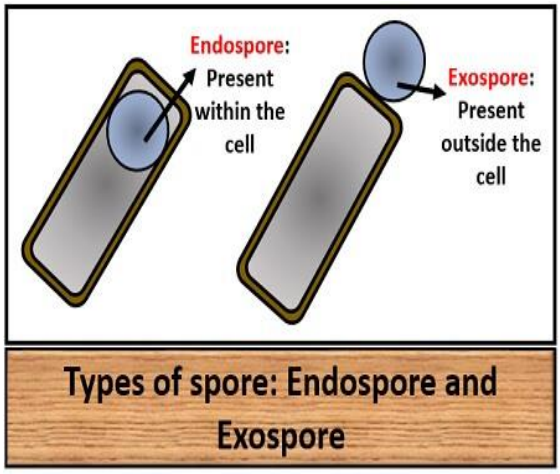
Sporulation

Sporulation refers to the formation of spores from vegetative cells during unfavorable environmental conditions such as (radiation, extreme heat, cold, pH, lack of nutrition, antibiotics etc.).

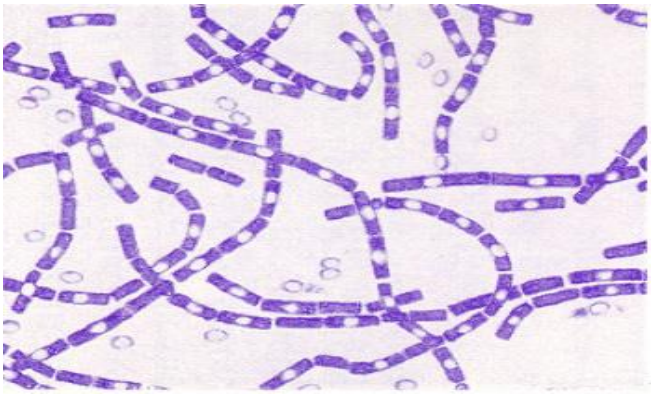
Spore is metabolically tough, dormant and non-reproductive structure and sporulation occurs during late log phase or early stationary phase. Under favorable condition spores germinate to give vegetative cell.

Sporulating bacteria are ubiquitous and can be found in soil, water, and air among other environments in nature.

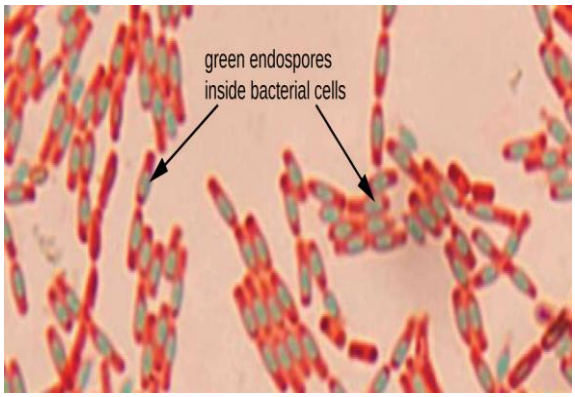




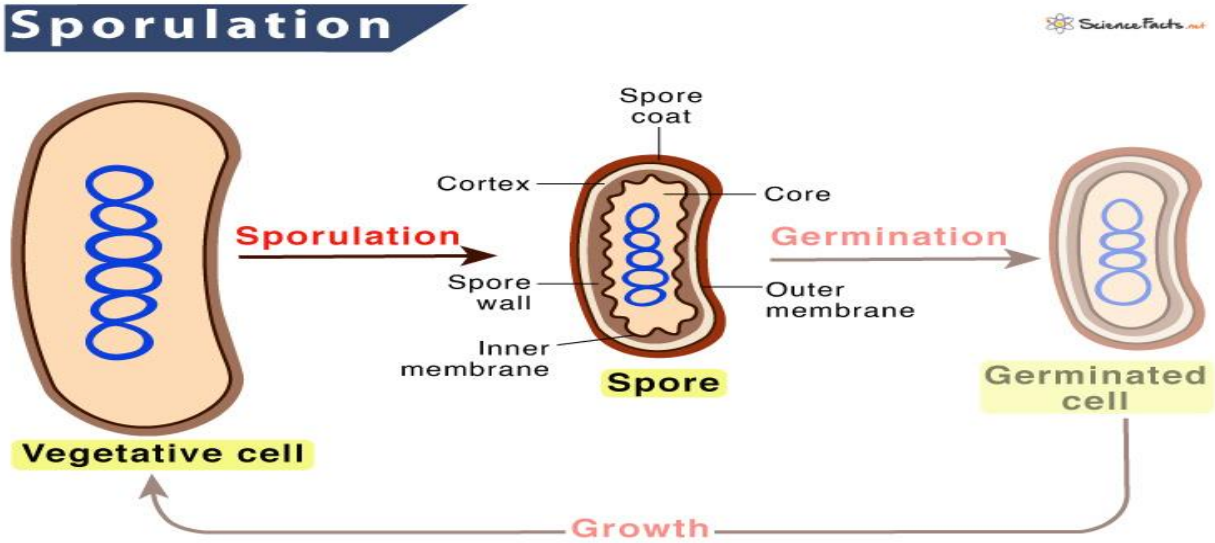
Endospores are generated by the ***Clostridium and Bacillus***. Exospores are produced by the members of the phylum **Actinobacteria** and eucaryotes.



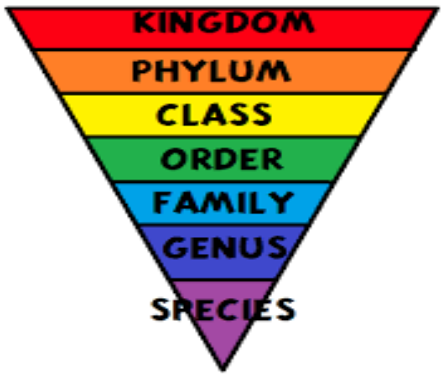
Bacterial endospore



Spore staining (malachite green)



Taxonomic hierarchies of bacteria



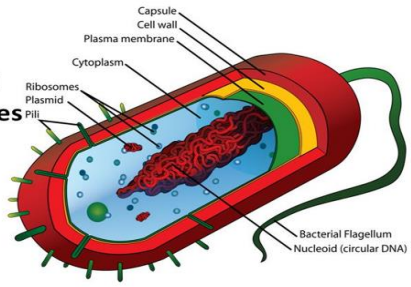
Structure of Bacteria

Essential structure

- Cell wall
- cell membrane
- Cytoplasm
- Nuclear material

Particular structures

- Capsule
- flagella
- pili
- Spore



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