## محاضرة البايولوجي النظري -10

## Difference between Gram-Positive and Gram-Negative Bacteria

Following are the important differences between gram-positive and gram-negative bacteria:



|  |  |
| --- | --- |
| **Gram-Positive bacteria** | **Gram-Negative bacteria** |
| **Cell Wall** |
| A single-layered, smooth cell wall |  A double-layered, wavy cell-wall |
| **Cell Wall thickness** |
| The thickness of the cell wall is 20 to 80 nanometres | The thickness of the cell wall is 8 to 10 nanometres |
| **Peptidoglycan Layer** |
| It is a thick layer/ also can be multilayered | It is a thin layer/ often single-layered. |
| **Teichoic acids** |
| Presence of teichoic acids | Absence of teichoic acids |
| **Outer membrane** |
| The outer membrane is absent | The outer membrane is present (mostly) |
| **Mesosome** |
| It is more prominent. | It is less prominent. |
| **Lipid content** |
| Very low | 20 to 30% |
| **Lipopolysaccharide** |
| Absent | Present |
| **Toxin Produced** |
| Exotoxins | Endotoxins or Exotoxins |
| **Resistance to Antibiotic** |
| More susceptible | More resistant |
| **Examples** |
| Staphylococcus, Streptococcus, etc. | Escherichia, Salmonella, etc. |
| **Gram Staining** |
| These bacteria retain the crystal violet colour even after they are washed with acetone or alcohol and appear as purple-coloured when examined under the microscope after gram staining. | These bacteria do not retain the stain colour even after they are washed with acetone or alcohol and appear as pink-coloured when examined under the microscope after gram staining. |

**Anatomy of BACTERIAL CELL**

1. **Capsule**: slimy layer, consisting of polysaccharide and water surrounding many cells. Also called slime coat, extracellular layer, etc .
2. **Cell Wall**: rigid layer surrounding the bacterial cell. Made of peptidoglyan in bacteria, other materials in archaea. Porous to movement of small molecules.
3. **Cell Membrane**: flexible, semi-permeable barrier with lipid center that controls diffusion in and out of cell.
4. **Cytoplasm**: the fluid-filled space inside the cell. Contains hundreds of different enzymes, along with ribosomes, DNA, RNA, and a "pool" of millions of small molecules and ions.
5. **Ribosomes**: particles made of protein and RNA, sites of protein assembly. Ribosomes may occupy 25% of the volume of a typical bacterial cell.

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**Gram stain:** staining technique for the preliminary identification of bacteria, in which a violet dye is applied, followed by a decolorizing agent and then a red dye. The cell walls of certain bacteria (denoted *Gram-positive* ) retain the first dye and appear violet, while those that lose it (denoted *Gram-negative* ) appear red.

**The procedure/steps of Gram Stain**

1. Prepare and fix the specimen to the microscope slide before staining.
2. Cover the smear with crystal violet, the primary stain, for 20 seconds.
3. Gently rinse off the stain with water.
4. Cover the smear with Gram’s iodine, the mordant, for 1 minute.
5. Pour off the excess Gram’s iodine.
6. Run the acid-alcohol decolorizer over the smear until the solution appears clear.
7. Gently rinse with water.
8. Cover the smear with safranin, the secondary or counterstain, for 20 seconds.
9. Gently rinse the stain with water.
10. Blot dry with bibulous paper.

# **Bacterial cellular morphologies**

## 1-Coccus[[edit](https://en.wikipedia.org/w/index.php?title=Bacterial_cellular_morphologies&action=edit&section=1" \o "Edit section: Coccus)]



Arrangement of cocci bacteria

:*Staphylococcus* bacteria

A [**coccus**](https://en.wikipedia.org/wiki/Coccus) (plural *cocci*, from the Latin *coccinus* (scarlet) and derived from the Greek *kokkos* (berry)) is any [microorganism](https://en.wikipedia.org/wiki/Microorganism) (usually [bacteria](https://en.wikipedia.org/wiki/Bacteria))[[1]](https://en.wikipedia.org/wiki/Bacterial_cellular_morphologies#cite_note-1) whose overall shape is [spherical](https://en.wikipedia.org/wiki/Sphere) or nearly spherical.[[2]](https://en.wikipedia.org/wiki/Bacterial_cellular_morphologies#cite_note-Brock-2) Describing a bacterium as a coccus, or sphere, distinguishes it from [bacillus](https://en.wikipedia.org/wiki/Bacillus_%28shape%29), or rod. This is the first of many taxonomic traits for identifying and classifying a bacterium according to binomial nomenclature.

Important human diseases caused by coccoid bacteria include [staphylococcal](https://en.wikipedia.org/wiki/Staphylococci) infections, some types of [food poisoning](https://en.wikipedia.org/wiki/Food_poisoning), some [urinary tract infections](https://en.wikipedia.org/wiki/Urinary_tract_infection), [toxic shock syndrome](https://en.wikipedia.org/wiki/Toxic_shock_syndrome), [gonorrhea](https://en.wikipedia.org/wiki/Gonorrhea), as well as some forms of [meningitis](https://en.wikipedia.org/wiki/Meningitis), throat infections, [pneumonias](https://en.wikipedia.org/wiki/Pneumonia), and [sinusitis](https://en.wikipedia.org/wiki/Sinusitis).[[3]](https://en.wikipedia.org/wiki/Bacterial_cellular_morphologies#cite_note-Sherris-3)

### Arrangements

Coccoid bacteria often occur in characteristic arrangements and these forms have specific names as well;[[4]](https://en.wikipedia.org/wiki/Bacterial_cellular_morphologies%22%20%5Cl%20%22cite_note-Baron-4) listed here are the basic forms as well as representative bacterial [genera](https://en.wikipedia.org/wiki/Genus):

* pairs or [diplococci](https://en.wikipedia.org/wiki/Diplococcus) (e.g. [*Neisseria*](https://en.wikipedia.org/wiki/Neisseria) [spp.](https://en.wikipedia.org/wiki/Species))
* groups of four or eight known respectively as [tetrads](https://en.wiktionary.org/wiki/tetrad) and [sarcina](https://en.wikipedia.org/wiki/Sarcina%22%20%5Co%20%22Sarcina) (e.g. [*Micrococcus*](https://en.wikipedia.org/wiki/Micrococcus) spp.)
* chains (e.g. [*Streptococcus*](https://en.wikipedia.org/wiki/Streptococcus) spp.)
* clusters (e.g. [*Staphylococcus*](https://en.wikipedia.org/wiki/Staphylococcus) spp.)

## 2-Bacillus[[edit](https://en.wikipedia.org/w/index.php?title=Bacterial_cellular_morphologies&action=edit&section=3" \o "Edit section: Bacillus)]

A [**bacillus**](https://en.wikipedia.org/wiki/Bacillus_%28shape%29) (plural bacilli) is a [rod-shaped](https://en.wikipedia.org/wiki/Rod-shaped) [bacterium](https://en.wikipedia.org/wiki/Bacterium). Although [*Bacillus*](https://en.wikipedia.org/wiki/Bacillus), capitalized and [italicized](https://en.wikipedia.org/wiki/Italics), specifically refers to the genus, the word ***bacillus*** (plural *bacilli*) may also be used to describe any rod-shaped bacterium, and in this sense, bacilli are found in many different taxonomic groups of bacteria. There is no connection between the shape of a bacterium and its colors in the Gram staining.

### Arrangements**[[edit](https://en.wikipedia.org/w/index.php?title=Bacterial_cellular_morphologies&action=edit&section=4" \o "Edit section: Arrangements)]**

Bacilli usually divide in the same plane and are solitary, but can combine to form diplobacilli, streptobacilli, and palisades.[[5]](https://en.wikipedia.org/wiki/Bacterial_cellular_morphologies#cite_note-5)

* Diplobacilli: Two bacilli arranged side by side with each other.
* Streptobacilli: Bacilli arranged in chains.[[6]](https://en.wikipedia.org/wiki/Bacterial_cellular_morphologies#cite_note-6)[[7]](https://en.wikipedia.org/wiki/Bacterial_cellular_morphologies#cite_note-7)

## 3-Spiral

[Spiral bacteria](https://en.wikipedia.org/wiki/Spiral_bacteria) are another major bacterial cell morphology. Spiral bacteria can be sub-classified as spirilla, spirochetes, or vibrios based on the number of twists per cell, cell thickness, cell flexibility, and motility.

[Bacteria](https://en.wikipedia.org/wiki/Bacteria) are known to evolve specific traits to survive in their ideal environment. Bacteria-caused illnesses hinge on the bacteria’s physiology and their ability to interact with their environment, including the ability to [shapeshift](https://en.wikipedia.org/wiki/Shapeshifting). Researchers discovered a protein that allows the bacterium [*Vibrio cholerae*](https://en.wikipedia.org/wiki/Vibrio_cholerae) to morph into a corkscrew shape that likely helps it twist into — and then escape — the protective mucus that lines the inside of the gut.[[1](https://en.wikipedia.org/wiki/Bacterial_cellular_morphologies#cite_note-:0-12)