

# Lecture 5

## Bacterial Taxonomy

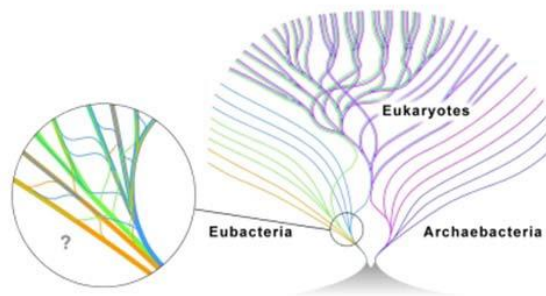
### Bacterial Taxonomy

The classification, nomenclature, and identification of bacteria; sometimes used as a term to indicate the theory of classification. The bacteria are members of the kingdom Prokaryote, which is defined in terms of the unique structural and biochemical properties of their cells; Formal system originated by Carl von Linnaeus (1701-1778). Each organism placed into a specific cluster based on selected criteria.

### Phenetic based Classification

In the past, the classification scheme has been based mostly on characteristics such as:

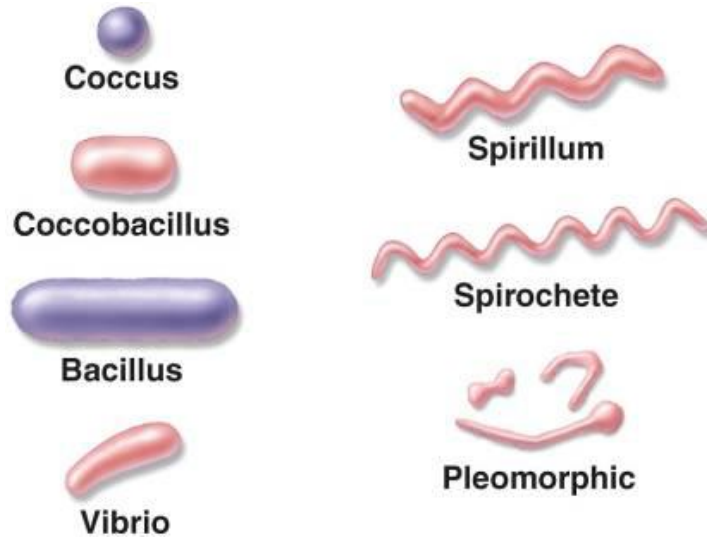
- Structural features
- Staining characteristics
- Gram Staining
- Acid Fast Staining
- Metabolic properties



### Classification based upon structural Features

#### Shapes of bacteria

Most bacteria are 0.2  $\mu\text{m}$  in diameter and 2-8  $\mu\text{m}$  in length. The three basic bacterial shapes are coccus (spherical), bacillus (rod-shaped), and spirillum (vibrio twisted, spirochete), however pleomorphic bacteria can assume several shapes.

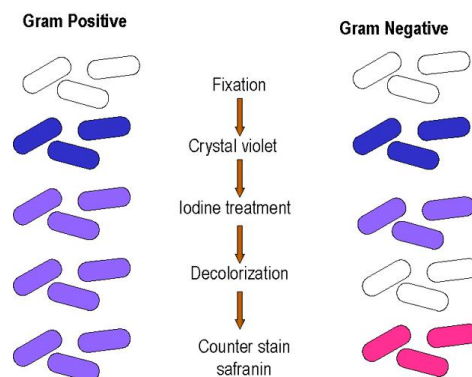


## Using Staining procedure to Identify Prokaryotes

### Gram Stain

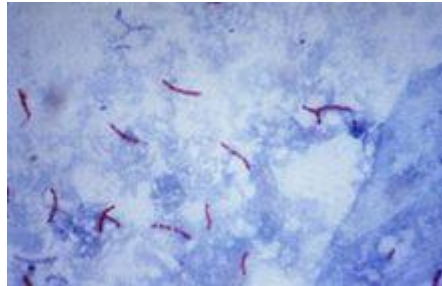
The Gram stain is a differential stain that distinguishes between Gram-positive and Gram-negative bacteria. This relatively rapid test narrows the possible identities of an organism by excluding numerous others and provides suggestive information that can be helpful in the identification process.

- **Gram-positive** bacteria tend to obtain blue color while don't survive with antibiotics. E.g. *Actinobacteria*. Gram-positive cell walls are thick and the peptidoglycan ( also known as *murein*) layer constitutes almost 95% of the cell wall in some gram-positive bacteria and as little as 5-10% of the cell wall in gram-negative bacteria
- **Gram-negative** bacteria stained red and are more resistant to antibiotics. E.g. *proteobacteria*. The chemical structure of the outer membrane's lipopolysaccharides is often unique to specific bacterial sub-species and is responsible for many of the antigenic properties of these strains.



## Differential Stains: Acid-Fast Stain

Acid-fast organisms are difficult to characterize using standard microbiological techniques. For example gram stain. Acid fast organisms like Mycobacterium contain large amounts of lipid substances within their cell walls called mycolic acids. These acids resist staining by ordinary methods such as a Gram stains. It can also be used to stain a few other bacteria, such as Nocardia. The reagents used are Ziehl–Neelsen carbol fuchsin, acid alcohol, and methylene blue. Acid-fast bacilli will be bright red after staining.



## Classification based upon Metabolism

- **Heterotrophic**
  - Saprobies
  - Parasites
- **Autotrophic**
  - Photosynthetic bacteria
  - Cyanobacteria
  - Purple sulfur bacteria
- **Chemoautotrophic**

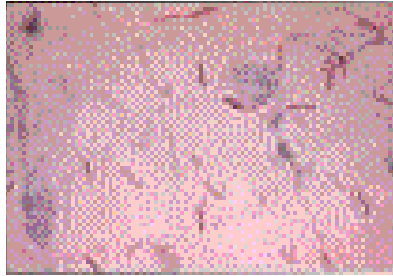
## Nutrition of bacteria

They exhibits different modes of nutrition level such as-

- **Autotrophic bacteria:** These bacteria are able to synthesize their own food. For e.g.: Photosynthetic bacteria use a special type of chlorophyll called bacteriochlorophyll. E.g. *Rhodospirillum* O<sub>2</sub> is not released in bacterial photosynthesis.



- **Heterotrophic bacteria:** These bacteria are unable to synthesize their own food, hence they depend on other organic materials.
- May feed on the remains of dead plants and animals called **Saprobies**.
- Those live on or in the organism and cause disease are called **Parasites**. For example, *Mycobacterium tuberculosis*.



- **Symbiotic bacteria:** These bacteria have a mutual benefit from other organisms. For e.g.: nitrogen fixing bacteria (or) rhizobium.
- **Parasitic bacteria:** These bacteria are present in plants, animals and human beings. These bacteria feed on host cells and causes harm to the host.

### **Chemoautotrophs**

Chemoautotroph – an organism that uses the energy of environmentally available chemical reactions to fix raw materials into energy rich compounds.

Bacteria that produce organic matter by the use of energy obtained by oxidation of certain chemicals with carbon dioxide as the carbon source.



### **References**

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