**Classification of Bacteria| by Shapes & Characteristics**

Bacteria are unicellular plant cells present in entire biosphere.They have vital importance on earth and hence studied extensively in microbiology.You can study about them in detail in microbiology courses in medicine, pharmacy and even basic biology.These bacteria are unicellular (single celled) organisms and are of microscopic in size invisible to naked eye.The bacterial classification of is one of the key factors to tackle them in disease.The classification is done based on factors like their shape, nutrition requirement, cell wall staining, the cell appendages etc.Of these bacteria, those harmful and useful to humans are widely studied in medicine and pharmacy. While those pathogenic bacteria which cause disease to plants and animals are extensively studied in agriculture and animal husbandry sciences.

Some of the aspects of bacterial classification also help in identification bacteria.

**CLASSIFICATION OF BACTERIA|BY CELL WALL:**

Cell wall is a characteristic plant cell. Bacterial cell wall feature has features useful for classification.

**Staining:** Cell wall of bacteria differs based on the layers in it. Gram stain is used to classify these bacteria based on the variation in the layers.

This bacterial cell wall is made of 3 materials in general viz. carbohydrates, proteins (peptidoglycan) and lipids (lipopolysacharide).

But there is variation in the quantity of peptidoglycan and lipopolysaccharides ratio among them.

The grams staining helps in classification of bacteria as gram positive & gram negative bacteria.

In gram +ve bacteria there is thicker peptidoglycan layer while gram -ve has less peptido-glycan and more of glycolipid membrane.

So when stained with grams stain, crystal violet, peptidoglycan retains it giving violet color to gram +ve bacteria. Gram -ve bacteria cannot retain this crystal violet and instead retains saffron color.

The gram stain consists of coloring dyes like crystal violet and saffron. When a bacteria culture is added with gram’s stain, gram positive bacteria show violet color, while gram negative bacteria show saffron color.So, the bacterial species which take up blue color on grams stain is termed gram +ve bacteria. The one which takes up orange color is called gram -ve bacteria.

**CLASSIFICATION OF BACTERIA BY SHAPE OR CELL STRUCTURE**

Bacterial species are differentiated based on their shapes. They have different cell structure but most of them come under two basic shapes like. Check out the image below for an idea.

a) Bacillus (stick or filament or rod like shape)- Among them if a bacterium is

♦ Single cell then it is bacillus, if more it is bacilli like

♦ Two celled: Diplo bacilli, four celled – tetrad etc.

♦ Palisade: Here two cells of bacillus are arranged side by side like sticks in match box

♦ Streptobacilli: Bacilli bacteria arranged like a chain.

# 1 classification of bacteria

b) Coccus (These are spherical or oval shaped)- Of them

♦ Single-celled is called Monococcus,

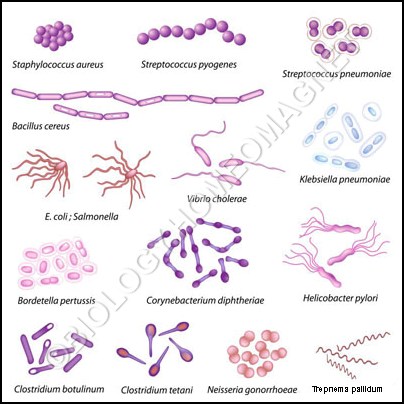
♦ Two celled: Diplococci,

♦ Chain like arrangement: Strepto bacilli.

♦ Bunch of grapes like: Staphylococci.

c) Comma shaped bacteria, Ex: Vibrio cholera bacteria causing cholera.

d) Spiral bacteria: They are also called as spirochetes. These are spiral or hair like in shape and hence called as spiral shaped bacteria. Ex: syphilis causing bacteria.



**CLASSIFICATION OF BACTERIA BASED ON FLAGELLA PRESENCE**

Flagella are appendages of movement for the bacterial. They emerge from the cell membrane. Not all bacteria have flagella but motile bacteria have flagella. Based on the number of flagella and also the location bacterial classification is done as below.

♦ Atrichous bacteria: With no flagella on the bacterial cell wall. These are non-motile bacteria

♦ Monotrichous bacteria: With one single flagella.

**Bacterial classification:**

♦ Amphitrichous bacteria: Two flagella on both sides of cell

♦ Polytrichous bacteria: Many flagella at different points

♦ Lopotrichous bacteria: Flagella at one pole or point of the cell

♦ Flagella around the cell: Peritrichous bacteria. The flagella are present all over the cell wall.

**CLASSIFICATION OF BACTERIA BASED ON NUTRITION REQUIREMENTS**

Bacteria obtain nutrition in different forms like. Because of this character, they contribute greatly to humans and environment.

♦ Autotrophs: These are bacteria which prepare their own food. Due to presence of chlorophyll like pigment they perform photosynthesis. They do this by using sun-light as source of energy. Besides they take up CO2 and water from nature. This photosynthesis helps in formation of carbohydrates. These carbohydrates provide the energy. Ex: Chlorella.

♦ Chemoautotrophs: As the name indicates they survive on chemicals. These are bacteria synthesize their own food by use of energy obtained from chemical sources. They differ from autotrophs in that they do not need sunlight.

♦ Heterotrophs: These are bacteria which do not synthesize their own food but obtain it from others They can feed on food materials like animals do.

♦ Symbiotic bacteria: (Sym + Biosis = Living together) These are bacteria which obtain food by living together with other organisms. They reside in mutual beneficial support with others.

Ex: Rhizobium bacteria in leguminous plants. Here the bacteria fix nitrogen in roots by absorbing it from air. This nitrogen acts as fertilizer to plant. In return they take nutrition from the same plant. Another example is Entero bacteria in the intestine. Hence taking too many antibiotics kills the friendly bacteria in out gut causing problems to us.

♦ Saprophytic bacteria: (sapro+phytes = rotten material + plant) These are bacteria survive by eating rotten material. They get their nutrition by consuming dead and decaying material. Thus there by help in cleaning the environment from accumulation of waste.

“Imagine the world without them, it would have been a place full of dead bodies all around…:-)”

♦ Pathogenic bacteria: (patho+genisis =disease + causing) These are bacteria responsible for diseases in humans and plants. They grow only in the body of other animals or plants. They get their nutrition from the host. In doing so, they consume the vital living elements in them and induce diseases.

**CLASSIFICATION BASED ON TEMPERATURE DEPENDANCE**

This is quite interesting method as they are differentiated based on their preference for surrounding temperature.

Bacteria can at cold temperature and even hot temperatures besides normal room temperatures. So, they are classified based on the temperature they can survive at. Like

♦ Thermophilic (thermo+phyllic=temperature loving); Thermophylic bacteria are those which can survive at high temperature of 45 to 60 degree temperatures

♦ mesothermic (medium+thermic= medium temperature) can survive at 25 to 45 degrees

♦ Hypoctermic (hypo = low ) These bacteria survive at low temperatures like 8 degree or even less.

In common most bacteria survive in between 25 to 45 degree i.e. they are mesotherms.

**CLASSIFICATION BASED ON OXYGEN REQUIREMENT:** Not all bacteria require oxygen to survive. Some can survive without oxygen. These are the microbes considered to be immortals due to cell division. But this feature adds even more weight to it.

Bacteria are classified based on the oxygen requirement as

**Aerobic:** Which require oxygen to survive.

**Anaerobic bacteria:** These bacteria do not require oxygen for survival. They are further as two types

**Obligate anaerobes:** They survive in absence of oxygen. But when exposed to oxygen they die.

**Facultative anaerobes:** These also survive in environments without oxygen but when exposed to oxygen they can survive.

**Classification of bacteria on the basis of nutrition: –**

On the basis of nutrition bacteria are classified as following:  
**1) Autotropic bacteria:** these bacteria are nonpathogenic, free living, self sustaining in nature, which prepare their own food by utilisation of solar energy and inorganic components like carbon dioxide, nitrogen etc. They are of two types:  
**i) Photoautotrophs:** these bacteria contain bacterio-chlorophyll and bacterioviridin and can prepare their own food by fixing carbon dioxide the nature by the utilisation of solar energy.  
**ii) Chemoautotrophs:** -these are the bacteria which prepare they are food by deriving the energy from oxidation of inorganic substances like nitrogen dioxide, carbon dioxide etc. and they can also fix carbon dioxide and water for their nutrition.  
**2) Heterotrophic bacteria:** – this type of bacteria cannot fix inorganic Carbone but rather depend on external organic Carbone for their nourishment. They also can be classified on the basis of presence and absence of flight and on the basis of the media on which the bacteria are growing.