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## Biological Classification - Part 1

### Objectives

After going through this lesson, the learners will be able to understand the following:

- Two kingdom system of classification
- Five kingdom system of classification
- Bacteria, archaebacteria, dinoflagellates

### Content Outline

- Need for classification
- Monera
- Bacteria
- Archaebacteria
- Dinoflagellates
- Protozoan

### Need For Classification

It is impossible to study the vast number of organisms under one heading or category therefore classification is required for the systematic study of organisms on the basis of their similarities and dissimilarities.

The first system of classification was given by Aristotle , who divided the living world into plants and animals and further plants into herbs , shrubs and trees, and animals on the basis of presence or absence of RBCs.

**Two Kingdom System of Classification:** This is the oldest system of classification which was given by **Caroleus Linnaeus in 1758**. According to him , the living world was divided into **two major categories or kingdoms**.

**Animal Kingdom** – which includes all the animals.

**Plant Kingdom** – which include all the plants.

According to Caroleus, the kingdom includes bacteria, fungi, algae, liverworts, mosses, lichens, ferns, conifers and all flowering plants.

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Kingdom Animalia includes protozoans, sponges, jellyfishes, worms, insects, sharks, bony fishes, amphibians, reptiles, aves, and mammals.

### **Five Kingdom System of Classification**

It was proposed by American Ecologist Robert H. Whittaker in 1969. Whittaker divided the living world into five kingdoms.

- i. Monera
- ii. Protista
- iii. Fungi
- iv. Animalia
- v. Plantae

Five kingdom system of classification was done on the following criteria –

- 1) **Structure of cells** –
  - a) Prokaryotic Organisms
  - b) Eukaryotic Organism
- 2) **Organization of cells** –
  - a) Unicellular
  - b) Multicellular
- 3) **Mode of Nutrition** –
  - a) **Autotrophic** - It includes
    - i) Chemosynthetic
    - ii) Photosynthetic
  - b) **Heterotrophic** - It includes
    - i) Holozoic (**Ingestive**)
    - ii) Saprotrophic (**Absorptive**)
- 4) **Phylogenetic Relationship** – From the study of fossils
- 5) **Mode of Reproduction** –
  - a) Asexual Reproduction
  - b) Sexual Reproduction

### **1<sup>st</sup> Kingdom: Monera**

Monera is also known as “**Prokaryota**” as it contains all prokaryotes. The word Prokaryotes means – **Before a nucleus**, these organisms **don’t have a true nucleus**, as no nuclear

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membrane is present in the nucleus and lack of basic proteins in nucleoplasm. This kingdom includes all bacteria cyanobacteria (Blue Green Bacteria, archaebacteria, and Mycoplasma).

## **Bacteria**

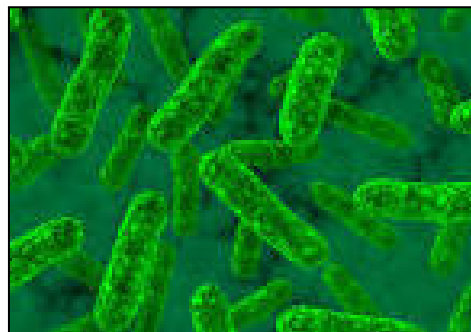
Bacterias are the main members of the kingdom Monera. They are unicellular microscopic organisms with DNA. Referred to as nucleoid. They were discovered by **Dutch Naturalist Antony Van Leuwenhoek**. Bacteria are ubiquitous, very minute, 1 mu to 10 mu in length and found in different shapes. Some bacteria are known as “**Pleomorphic**” as they have the ability to change their body shape. According to the shape of bacteria they can be grouped under four categories –

a) **Coccus** (Spherical, ellipsoidal or ovoid in shape )



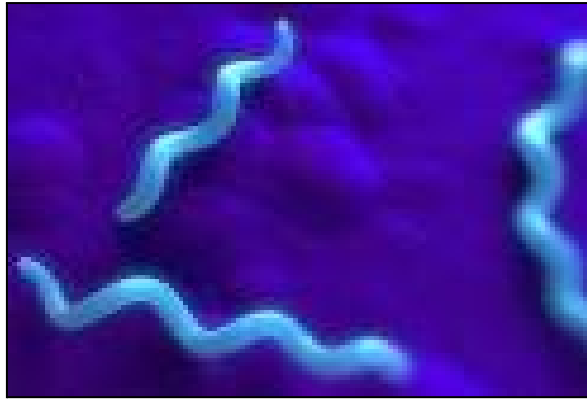
Ex: Treponema species

b) **bacillus** (straight, rod shaped or cylindrical)



Ex: Coxiella burnetii

c) **Spirillum** (spiral or coiled like a corkscrew )



Ex: *Borrelia hermsii*

d) **Vibrio** (C-shaped, rod shaped with a slight curve, or comma shaped )



Ex: **Vibrio cholera**, a marine bacterium that causes **cholera** (with severe **diarrhea**)

**On the basis of nutrition**, bacteria can be classified as –

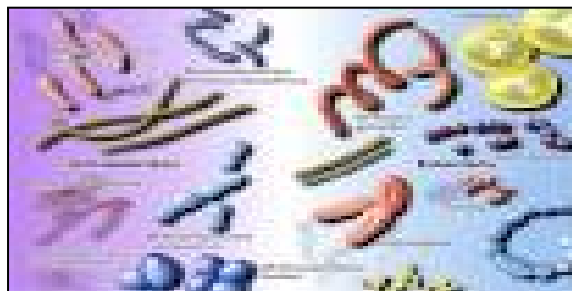
- a) **Autotrophic** (can prepare their own food)
- b) **Heterotrophs** (depend on others for their food)
- c) **Saprophytes** (feed on dead and decaying organisms)
- d) **Parasitic** (live on other host cells)
- e) **Symbiotic** (mutual relationship with other organisms)

### **Archaeobacteria**

Archaeobacterias are believed to be very early forms of life, hence the name “Archaeobacteria” (**Oldest of living fossils**). **Due to absence of peptidoglycan** in their cell wall they can live in extreme conditions of environment, so they can be grouped together under the following categories –

- a) **Halophiles** (salty areas)
- b) **Thermoacidophiles** (hot springs)

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- c) **Methanogens** (Marshy areas), help in production of **Bio Gas** when mixed with waste of animals like cow and buffalo dung.



Some examples of archaeobacteria have cell walls in their cells while some examples don't have cell walls. In some forms the cell wall is made up of non – cellulosic polysaccharides, while in some it is made up from proteins.

**Halophiles** – These occur in extreme salty conditions, aerobically living, some forms can survive in extreme high temperatures even at the great depth under the earth. Some examples of Halophiles are – **Halococcus and Halobacterium**.

**Methanogens Archaeobacteria** – These are anaerobic chemosynthetic, and symbiotic in nature. They help in decomposition of cellulose (organic matter) and produce Methane.

**Thermoacidophiles** – These archaeobacteria can live aerobically as well as anaerobically both. They used to live in hot and acidic water therefore the name thermoacidophiles.

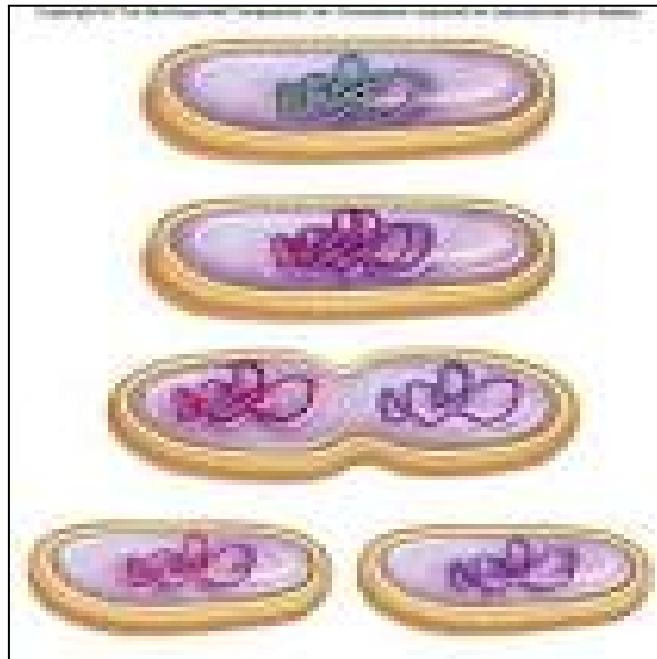
**Eubacteria** – Eubacterians are characterized by the presence of rigid cell wall. On the basis of nutrition, Eubacteria can be classified as –

- a) **Photosynthetic Autotrophs**
- b) **Chemosynthetic Autotrophs** – they help in recycling of nutrients in environment like  $N_2$ ,  $P_4$ , Fe, and Sulphur, **and helps in oxidation of various inorganic substances like  $NO_3^-$** , nitrites and ammonia and use the released energy for ATP production.
- c) **Heterotrophic Bacteria** – Some of them are also under the category of decomposers. Some heterotrophic bacteria help in production of curd, antibiotics and fixing  $N_2$  in

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leguminous plants. Some Eubacteria are pathogens that cause diseases in animals, plants and in humans.

**Reproduction in Bacteria:** Bacteria can reproduce differently according to different climatic condition, like in favorable conditions they reproduce by fission (Binary fission mainly).



During unfavorable conditions they reproduce by spores and sometimes reproduce by adopting a primitive type of DNA transfer from one bacteria to another, which is also known as Sexual Reproduction.

**Mycoplasma:** Mycoplasmas are minute, (Smallest free living microbes), unicellular, non-motile and pleomorphic (found in many forms) prokaryotes, also known as (PPLO), Pleuropneumonia Like Organisms. They can live aerobically. They can be pathogen or parasitic in nature. Their cell membrane is made up of proteins and lipids and resistant to antibiotics such as penicillin.

They are saprotrophs i.e., found in sewage water and in dead & decaying organic matter. They can be anaerobe or aerobe. Some forms of mycoplasmas cause diseases in plants, animals and in human beings hence are pathogenic in nature while some forms are parasitic in nature.

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## II Kingdom: Protista

Protists are water dwelling organisms. They live in water bodies like seas, oceans etc. Some of the protists are found on the surface of water as a plankton. Some other protists are found in the bodies of organisms as parasites. Protists are single celled (unicellular), eukaryotic, microorganisms and known as an ancestor of multicellular eukaryotic organisms. Protists can be known as photosynthetic protists or plants. Therefore they can be cut as a connecting link between the prokaryotic kingdom monera and complex multicellular kingdoms of fungi, plants and animals.

Protists have typical eukaryotic cell structure. Their protoplasm is surrounded or covered by plasma membranes. Some photosynthetic protists showing Halophytic nutrition, have distinct cell walls made up of cellulose. Locomotory structures in protists are pseudopodia (like amoeba), flagella (Leishmania, Gymnodinium) or cilia (paramecium).

The photosynthetic protists are present on the surface of water bodies and known as phytoplankton. They are the major supporters for the balance of the ecosystem as they fix maximum amounts of CO<sub>2</sub> in the biosphere.

Protists reproduce by asexual and sexual means of reproduction.

**Asexual reproduction in Protists** – asexual reproduction occurs in favorable environmental conditions. The various types of asexual reproduction are as follows :

- 1) **Fission** – It is a division of the parent cell into the number of offspring. It can be -
  - a) **binary fission** – it can be **longitudinal** (ex. Leishmania), **transverse** (ex. paramecium) or **axial** (ex. amoeba).
  - b) **multiple fission** (ex. plasmodium)
- 2) **Budding** – Exogenous budding occurs in the parent body which detaches and develops into a new individual.
- 3) **Spore formation** – Protists reproduce by spore formation which forms in sporangia which can be stalked or sessile. Spores expelled out from sporangia and on germination give rise to an individual.

Protists include chrysophytes (producers in the form of phytoplanktons), Dinoflagellates, euglenoids, slime moulds (consumers and decomposers) and Protozoan.

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**Chrysophytes** - Chrysophytes are unicellular, microscopic of various colors due to the presence of various chromatophores. They are photosynthetic protists and occur in fresh and marine water (at surface - plankton, at the bottom benthos), and some grow in moist soil. Basically they include Diatoms and Desmids (Golden algae).

The cell wall of Diatoms is composed of cellulose in the forms of two overlapping halves which are also known as theca which fit together like two parts of a soap box. These two overlapping halves are embedded with a mineral silica which make diatoms indestructible (i.e., do not decay easily) so they can be collected over millions of years as sedimentary deposits on the sea floors, called diatomite or diatomaceous earth. This is economically very useful in industries, mainly in filtration of sugars, oils, alcohols and antibiotics.

A prominent nucleus is present in chrysophytes with a large central vacuole. The cells are diploid in nature. Reproduction takes place either asexually or sexually. Asexual reproduction takes place by the common method of binary fission and sexual reproduction by the fusion of gametes, which after fusion forms zygote.

### **Dinoflagellate**

These organisms are unicellular, photosynthetic and mostly marine in nature. They are of different colors due to different pigments present in their cells. They show an armored structure due to hexagonal platelets present on the cell surface which is mainly made up of cellulose. Dinoflagellates may be motile or non-motile. If motile then locomotion is due to the presence of flagella which are two in number, one is longitudinal and one is latitudinal. Due to the presence these forms shown spinning movements.





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The cells of Dinoflagellates have proper nucleus and other organelles too. Dinoflagellates reproduce asexually as well as sexually both. Asexual reproduction takes place by spore formation, sometime in some forms cyst formation, while in others it may be from cell division. If sexual reproduction it can be occur through gametes, which can be of same type, isogamete, or of different types an isogametes. Conjugation takes place , where two gametes fuse together to form a diploid zygote.

Some examples of Dinoflagellates like Gonyaulax reproduce so fast that they make the surface of sea Red and so called “**RED TIDE**”. Some forms of Dinoflagellates release toxins when reproducing abnormally, this toxin is poisonous they may destroy or kill large numbers of marine animals.

**Euglenoids:** Euglenoids are euglena like animals which are the connecting link between animals and plants. They are microscopic, unicellular, photosynthetic organisms. They are either flagellate or non - flagellate. Euglenoids don't possess cellulose in their cell wall, instead they are covered with pellicle, which is made up of proteins with little amount of carbohydrates and lipids. Some examples show fixed body shape while some can change the shape of their body. Some forms contain chlorophyll and they show photosynthesis and act as autotrophs, when in sunlight but in the absence of sunlight they behave as heterotrophs, and feed on other smaller organisms.



Some forms of Euglenoids are parasitic or holozoic. They reproduce asexually by longitudinal binary fission during unfavorable conditions they form cyst to protect themselves from desiccation.

Locomotion in Euglenoids is by flagella. If flagellates, then they possess two flagella, one is bigger and other one is smaller which arise from their respective basal granules. Ex- Euglena

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**Slime moulds:** Slime moulds have the characters of both fungi and animals and due to this special characters, they are known as “**fungus animals**” when these organisms reproduce vegetative, then they occur in the form of slimy mass and called “Slime Mould”.



Slime moulds are different colors due to the presence of different pigments in them. They occur in moist, cool damp places around the dead and decay logs leaves, hence they are saprophytic protists. Sometimes they occur in the multinucleate amberoid mass of protoplasm and known as “**Plasmodium**” which can extend up to various heights. Slime moulds can reproduce by different means –

- a) Fragmentation
- b) By formation of sporangia which produces spores, which have true cellulosic cell walls and dispersed by air currents.
- c) Sexual reproduction – which occur due to the fusion of gametes, which can be of isogamous (same types of gametes) or anisogamous (different types of gametes).

### **Protozoan**

They are unicellular, microscopic, colorless of various shapes with different symmetry (bilateral, radial or irregular). They occur everywhere in the biosphere, like they are aquatic, terrestrial or parasitic. Some parasitic forms are disease causing in animals and in humans. The bodies of protozoans are naked, their protoplasm is surrounded by a membrane called pellicle. Locomotion in protozoans is due to the presence of fingers like pseudopodia, flagella or cilia. The forms which are parasitic do not possess locomotory organelles.

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Mode of nutrition in protozoan is holozoic. Mode of reproduction in protozoan is asexual and sexual method. Some methods of asexual reproduction is budding, multiple fission, or by binary fission, while sexual reproduction is done by conjugation, (fusion of gametes) and syngamy. In some forms during unfavorable environmental conditions they form cyst which help in protection from desiccation. Examples of protozoans are Giardia, Leishmania, and Trypanosome.