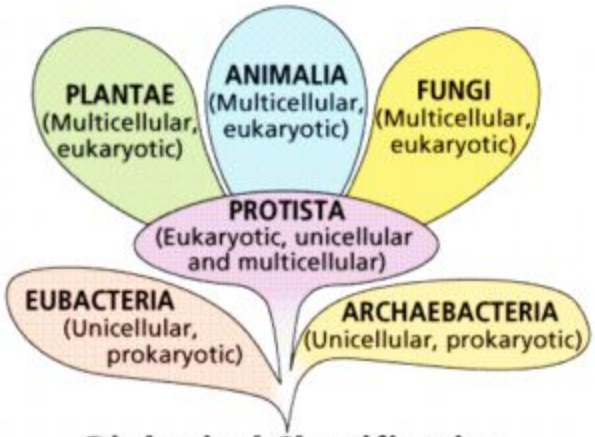
Introduction to Biological Classification

Do you understand the meaning of classification? Classification basically is the arrangement of things in taxonomic groups in accordance with the observed similarities. It helps in understanding the group as a whole with simple ease. Now, here we'll discuss with you the biological classification and how it has simplified things for us.

What is Biological Classification?

Biological classification is the scientific procedure that involves the arrangement of the organisms in a hierarchical series of groups and sub-groups on the basis of their similarities and dissimilarities.

Need for Classification



Biological Classification

Right from the archaic times, several attempts have been made to classify the living organisms. The first man to attempt a scientific basis of classification was Aristotle. He used simple morphological characters to classify plants as trees, shrubs, and herbs. He classified the animals into two groups:

1. Enaima (with red blood)
2. Anaima (without red blood)

However, a need for a proper system of biological classification was always felt.

Need for classification of living organisms

- The study of one or two organisms is not sufficient to know the essential features of the group.

- All kinds of organisms do not occur in one locality.
- Classification helps in knowing the relationship between the different groups of organisms.
- It helps in knowing the evolutionary relationship between organisms.

What is Kingdom Animalia?

Types of Classification System

Based on the types of system of classification, organisms are classified into the following kingdoms.

A. Two Kingdom Classification System

In the year 1758m Linnaeus (the father of taxonomy system) divided all the living organisms into two kingdoms. These are Plantae and Animalia.

Features of Kingdom Plantae

The significant features of the kingdom Plantae are listed here.

- They have a cell wall.

- Autotrophic mode of nutrition is followed. The reserve food is starch.
- A big central vacuole is present.
- There aren't any excretory organs, nervous system, sense organs and muscular system.
- No locomotion is seen except in some lower algae.
- Plantae absorbs inorganic nutrients from outside.
- They experience unlimited growth but have well-defined growing points.
- The response to external stimuli is slow.

What is Kingdom Fungi?

Features of Kingdom Animalia

The significant features of the kingdom Animalia are listed here.

- The cell wall is absent.
- There are no inorganic crystals present in their cells.
- Central vacuole is absent.
- Growth is limited and well-defined growing points are not present.

- Heterotrophic mode of nutrition is used.
- Show quick response to external stimuli.
- The muscular system is present.
- Locomotion is present.
- Excretory organs, nervous system and sense organs are present.
- Reserve food as glycogen.

B. Three Kingdom Classification System

In the year 1866, Ernst Haeckel, classified living organisms into three kingdoms i.e. Plantae, Protista, and Animalia. The new kingdom Protista included all those organisms, which lack the capability of tissue differentiation. This group included algae, fungi, and Protozoa. Later, kingdom Protista was reserved only for the unicellular organism.

Limitations of Three Kingdom Classification System

- No separation of Prokaryotes and eukaryotes.
- Both unicellular and multicellular organisms are classified under Protista.

C. Four Kingdom Classification System

In addition to Protista, Plantae and Animalia, the four kingdom classification system included Monera. The studies with electron microscope made it clear that bacteria and related organisms have a different nuclear structure as compared to others. These are the prokaryotes. As a result of this, Copeland in the year 1956, introduced the kingdom-Monera. Fungi continued to remain with Plantae in this system.

D. Five Kingdom Classification System

In the year 1969, this classification came into existence. RH Whittaker proposed this system. He created a separate group for fungi. The primary criterion for classification here were:

- Cell structure
- Modes of nutrition
- Reproduction
- Thallus organisation
- Phylogenetic relationships

E. Six Kingdom Classification System

Carl Woese a Professor in the Department of Microbiology, University of Illinois, came up with the Six Kingdom Classification System in the year 1990. It was also known as the three-domain system as in it organism classification was done in three domains, i.e., Archaea, Bacteria and Eukarya.

It majorly used the basic principles of the five kingdom system but divides the Monera into two domains Archaebacteria, Eubacteria and other eukaryotes in the third kingdom.

1. Archaea

Archaea domain includes prokaryotic organisms. These have a monolayer core of lipids in the cell membrane and distinct nucleotides in their 16S RNA. It contains a single kingdom called Archaebacteria. This kingdom includes early prokaryotes. These are methanogens, halophiles and thermoacidophiles.

2. Bacteria

The bacteria domain consists of typical prokaryotes that lack membrane covered cell organelles. These do not have microchambers

for separating various metabolic activities. It also has a single kingdom-Eubacteria.

Kingdom-Eubacteria

The members of this kingdom have peptidoglycan cell wall, naked DNA in coiled form, glycogen food reserves. There is no sap vacuole and 70S ribosomes are present. The members of this kingdom are bacteria, mycoplasma, Actinomycetes, rickettsiae, spirochaetes, cyanobacteria, Firmicutes.

3. Eukarya

The domain eukarya contain all the eukaryotes. The four kingdoms of this domain are:

- Protista
- Animalia
- Plantae
- Fungi

Solved Examples for You

Question: Who discovered bacteria?

Ans: Anton von Leeuwenhoek (1632-1723) discovered bacteria. He observed bacteria in 1675.

Kingdom Animalia

Man is an animal. You certainly know that. A frog is also an animal and you also know that. but, are man and frog similar? No! But, why? When both of them belong to the kingdom Animalia, why all these differences? Therefore, in this chapter, we will study the animal kingdom for more details. We will understand why there is so much difference between various animals.

Attributes of Animalia Kingdom Classification

The animalia kingdom consists of various multicellular eukaryotic animals. It is one of the kingdoms among the five kingdom scheme of classification (by Whittaker).

What is the Basis of Classification?

There are a few important characteristics that are regular to different organisms. Therefore, it is important for us to know about the various components. These components include body symmetry, nature of coelom, the arrangement of cells, notochord, patterns of circulatory, digestive and reproductive frameworks, segmentation and an

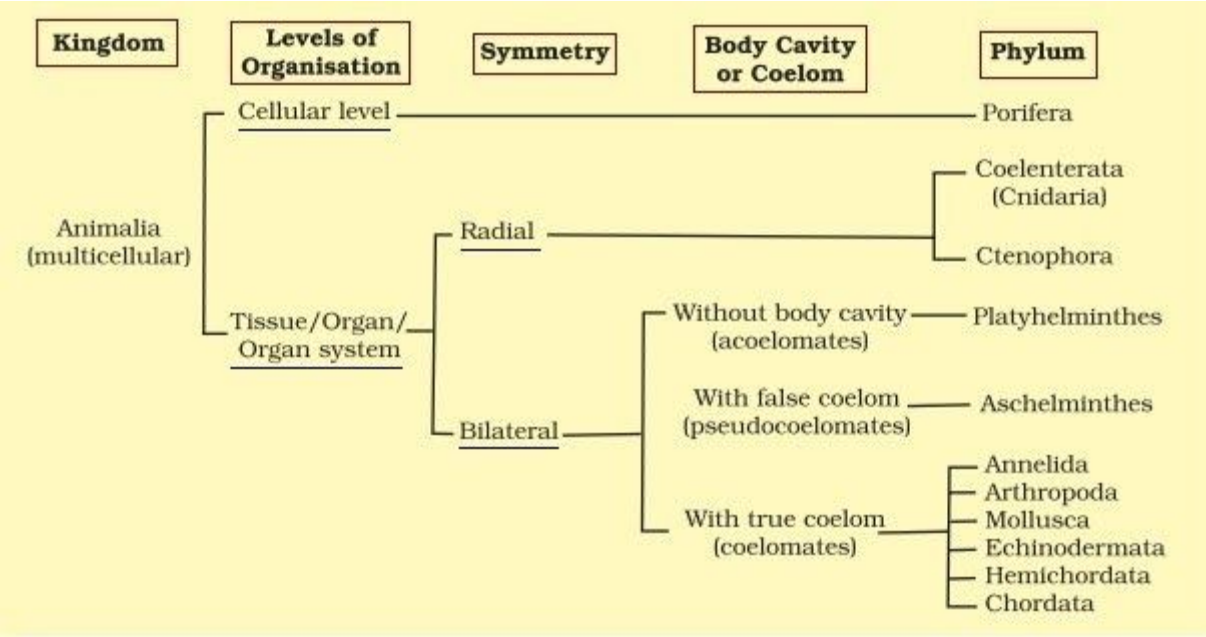
arrangement of cells in germ layers. Now we will look at these components in details.

Levels of Organization

Every organism of the Animalia kingdom is multicellular. However, they don't display the same example of cell organization. The examples of cellular organization found in animals are:

- Cellular Level of Organization – In such animals, the cells are organized as free cell lumps. We can see this sort of cellular organization in sponges. Illustration: Sponges.
- Tissue Level of Organization – Animal cells shows the division of exercises amid themselves. Cells carrying out the same capacity are organized as tissues. Illustration: Coelenterates.
- Organ Level of Organization – We group the animal tissues carrying out similar capacity into shape organs. Every organ is specific for particular capacity. Illustration: Platyhelminthes.
- Organ framework Level of Organization – In animals where organs have related to shape functional frameworks where every framework is related to a particular physiological

capacity, display organ framework level of organization. Examples include Molluscs, Chordates and Annelids etc.



Patterns of Organ Systems

Organs frameworks in various animal groups display different examples of complexities.

- Digestive System – There are two forms of digestive framework Complete and Incomplete Digestive Framework.
- Incomplete Digestive Framework – This form of digestive system has one and only opening to the outside of the body,

i.e., a solitary opening serving as both mouth and rear-end. Hence, the digestive system is incomplete.

- Complete Digestive Framework – In this form there are two different openings to the outside of the body, a mouth and a rear-end.
- Circulatory System – Circulatory framework might be of two sorts
- Open Type – In open sort circulatory framework the blood is pumped out of the heart and all the cells and tissues are straightforwardly washed in it. Hence, the circulatory system is open.
- Closed Type – In this kind of circulatory framework, the blood flows through a progression of vessels of varying size and diameters. These include the veins, arteries, and capillaries.

Body Symmetry

We can categorise animals on the basis of the symmetry of their body. The course of action of body parts around a mainline or point decides the symmetry.

- Asymmetrical: We can’t partition these animals into two equivalent parts along with any plane going through their focal point. Example: Sponges.
- Radial Symmetry – Animals tend to display spiral symmetry. This means that any plane going through the focal pivot of the body partitions the organism into two indistinguishable parts. Example: Ctenophores and Echinoderms.
- Bilateral Symmetry – Animals, where the body can be partitioned into indistinguishable right and left parts, are bilaterally symmetrical. Example: Annelids, Arthropods, etc.

Notochord

Chordates are the animals with a notochord. On the other hand, non-chordates are the animals lacking a notochord. Example: Porifera to Echinoderms.

System of Classification of Animal Kingdom

There is a wide range of animals which are comparative and distinctive to each other in numerous angles. Therefore, individuals

from a specific group of animal share a specific trademark. This is the component that characterizes the group.

Swedish botanist Carolus Linnaeus (1707-1778), discovered Modern System of Scientific Classification. The frameworks most researcher use classify every living thing into seven groups or taxons. These classifications in the hierarchical framework are from top most and most comprehensive to the lowest and more particular are:

- Kingdom – Kingdom is the most astounding essential division in which all articles are set. The Animal Kingdom involves all animals in the world.
- Phylum – We can separate each kingdom into smaller subdivisions called phyla. For example, Chordates are a phylum with individuals having the notochord.
- Class – We can separate chordates into classes. For example Mammalia, Birds, Reptilia, and Amphibians.
- Family – We can divide classes into families. Families contain more than one genus.
- Genus – Families are sub-partitioned into genera. Animals that have the same genus are fundamentally the same.

- Species – Species is the most crucial and contains only one kind of animal.

Learn more about Kingdom Protista here.

Solved Examples for You

Question: Write a note on invertebrates and vertebrates.

Answer: We can divide animals into two central groups: invertebrates (without spine) and vertebrates (with spine). Spine or notochord is the detectable component which characterizes whether the animal is vertebrate or invertebrate. Insects, starfish, spiders, obelia, sponges, worms are the sub-groups of the Invertebrate group, they don't have a spine. On the other hand, mammals, birds, snakes, frogs and fishes have a spine. Therefore, they are the sub-group of the Vertebrate group.

Kingdom Fungi

You must have seen fungus on your stale food. Haven't you? It feels so disgusting and yucky! Isn't it? But, do you know that fungi have a kingdom of their own? We are going to learn about them in this chapter. We will look at the characteristics and classifications of fungi.

Characteristics of Fungi

Now, we will look at the various characteristics of the fungi kingdom.

Thallus Organisation

The plant body of true fungi is a thallus. It may be non-mycelial or mycelial. The non-mycelial forms are unicellular. However, they may form a pseudomycelium by budding. In mycelial forms, the plant body is made up of thread-like structures called hyphae(sing. hypha).

Browse more Topics under Biological Classification

- Introduction to Biological Classification
- Kingdom Animalia
- The Kingdom Monera
- Kingdom Plantae

- Kingdom Protista
- Viruses, Viroids and Lichens

Cell Organisation

The cell wall of fungi is mainly made up of chitin and cellulose. Chitin is a polymer of N-acetyl glucosamine. On the other hand, cellulose is nothing but a polymer of d-glucose. Besides, the cell wall may be made up of cellulose-glycogen, cellulose-chitin or polygalactosamine-galactan.

Nutrition

The fungi are achlorophyllous organisms. Hence, they cannot prepare their food. They live as heterotrophs *i.e.*, as parasites and saprophytes. Some forms live symbiotically with other green forms.

- Parasites: They usually obtain their food from a living host. A parasite could be facultative or obligate. The obligate parasites survive and settle on a living host throughout their life. The facultative parasites are saprophytes that have turned parasitic.
- Saprophytes: These organisms procure their nutrition from dead and decaying organic matter. The saprophytes are either

obligate or facultative. An obligate saprophyte remains saprophytic during its entire lifetime. While a facultative saprophyte is nothing but a parasite that has secondarily become saprophytic.

- Symbionts: Some fungi develop in symbiotic association with the green or blue-green algae. These constitute the lichen. Here the algal component is photosynthetic. While the fungal component plays the reproductive part.

Reproduction

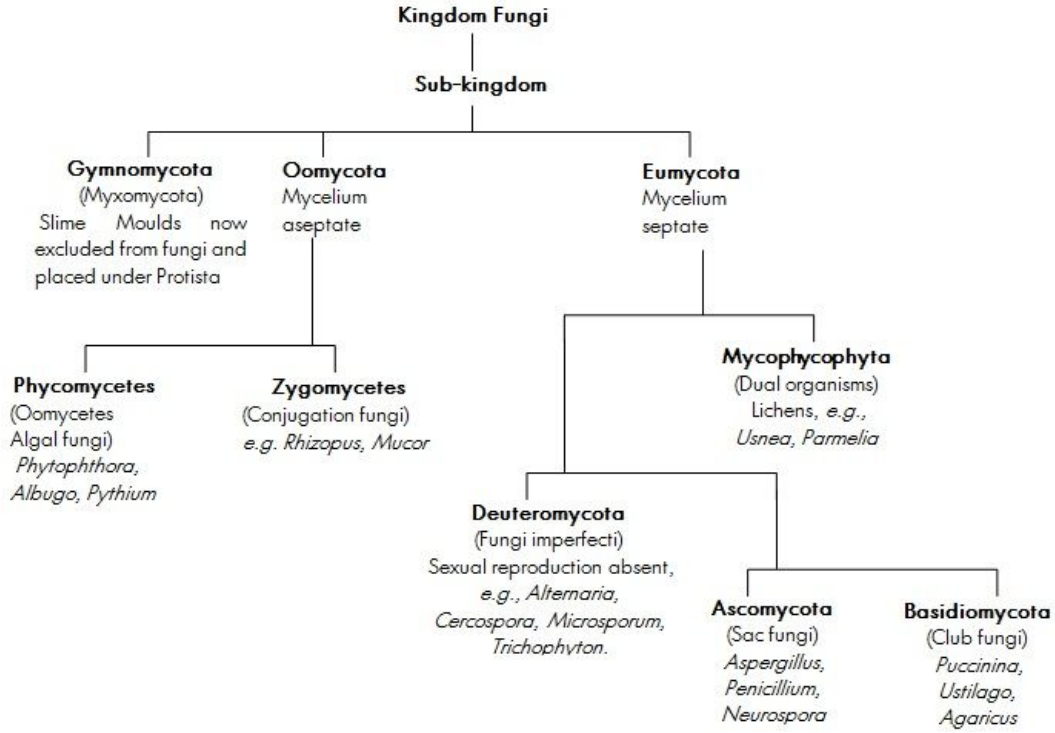
The fungi either reproduces vegetatively, asexually or sexually:

- Vegetative Reproduction
    - Fragmentation: Some forms belonging to Ascomycotina and Basidiomycotina multiply by breakage of the mycelium.
    - Budding: Some unicelled forms multiply by budding. A bud arises as a papilla on the parent cell and then after its enlargement separates into a completely independent entity.

    - Fission: A few unicelled forms like yeasts and slime moulds multiply by this process.
- Asexual Reproduction
    - Sporangiospores: These are thin-walled, non-motile spores formed in a sporangium. They may be uni-or multinucleate. On account of their structure, they are also called as aplanospores.
    - Zoospores: They are thin-walled, motile spores formed in a zoosporangium.
    - Conidia: In some fungi, the spores are not formed inside a sporangium. They are born freely on the tips of special branches called conidiophores. Thus, these spores are conidia.
- Sexual reproduction: With the exception of Deuteromycotina (Fungi imperfecti), we find sexual reproduction in all groups of fungi. During sexual reproduction, the compatible nuclei show a specific behaviour which is responsible for the onset of three distinct mycelial phases. The three phases of nuclear behaviour are as under:
    - Plasmogamy: Fusion of two protoplasts.
    - Karyogamy: Fusion of two nuclei.

- Meiosis: The reduction division.

Classification of Fungi



What is Kingdom Animalia ?.

Phycomycetes

We can find these in aquatic habitats and on decaying wood in moist and damp places. The mycelium is aseptate and coenocytic. Asexual

reproduction takes place by zoospores (motile) or by aplanospores (non-motile).

Rhizopus/Mucor

They are the cosmopolitan and saprophytic fungus, living on the dead organic matter. Rhizopus stolonifera occurs very frequently on moist bread. Hence, they are black bread mould.

Albugo

Albugo is a member of Phycomycetes. It is an obligate parasite and grows in the intercellular spaces of host tissues. It is parasitic mainly on the members of families Cruciferae, Compositae, Amaranthaceae and Convolvulaceae. The disease caused by this fungus is white rust or white blisters. The most common and well-known species is Albugo candida. It attacks the embers of the mustard family (Cruciferae).

Ascomycetes

They are saprophytic, decomposers, parasitic or coprophilous (growing on dung). Some examples are Aspergillus, Claviceps and

Neurospora. Neurospora is used extensively in biochemical and genetic work.

Yeast

Antony Von Leeuwenhoek in 1680 first described yeast. Yeast is nonmycelial or unicellular, which is very small and either spherical or oval in shape. Individual cells are colourless but the colonies may appear white, red, brown, creamy or yellow. Yeast reproduces by vegetative or asexual and sexual methods.

Basidiomycetes

The most common forms of basidiomycetes are puffballs, mushrooms and bracket fungi. They grow in soil, on logs and tree stumps and in living plant bodies as parasites, e.g., rusts and smuts. They have branched and septate mycelium. These organisms do not have sex organs. But, plasmogamy takes place by fusion of two vegetative or somatic cells of different strains or genotypes.

Solved Examples for You

Question: Write a note on Deuteromycetes.

Answer: They are imperfect fungi because we only know about the asexual or vegetative phases of these fungi. The Deuteromycetes reproduce only by asexual spores. These spores are conidia. Some members are saprophytes or parasites. However, a large number of them are decomposers of litter. They are very helpful in mineral cycling. Examples: Alternaria, Colletotrichum and Trichoderma.

Kingdom Monera

You have suffered from a lot of diseases that bacteria cause. But, do you think all bacteria are bad? No! The bacteria have a huge kingdom of their own that consists of a number of varieties of them. Each bacteria has a different role to play. They belong to the kingdom Monera. Here, we will know all about the kingdom Monera. We will look at both their characteristics and divisions in greater detail.

Characteristics of Monera

Monera (Monos – single) includes prokaryotes and shows the following characters:

- They are typically unicellular organisms (but one group is mycelial). The genetic material in these organisms is the naked circular DNA. A nuclear envelope is absent. Both, ribosomes and simple chromatophores, are the only subcellular organelles in the cytoplasm.
- Sap vacuoles do not occur. Instead, gas vacuole may be present.

- The predominant mode of nutrition is absorptive but some groups are photosynthetic (holophytic) and chemosynthetic.
- The organisms are non-motile or move by the beating of simple flagella or by gliding.

Learn more about the Different type of Kingdom Classifications here.

Bacteria Shape

- Cocci: They are oval or spherical in shape.
- Bacilli: They are rod-shaped. They may or may not have flagella.
- Vibrios: These are small and ‘comma or kidney’ like. They have a flagellum at one end and are also motile. Vibrio bacteria has a curve in its cell.
- Spirillum: They are spiral or coiled like a corkscrew. The spiral forms are usually rigid and bear two or more flagella at one or both the ends e.g., Spirillum, Spirochaetes etc.
- Filament: Just like fungal mycelia, the body of the bacterium is filamentous. The filaments are very minute in size. Examples include Beggiota, Thiothrix etc.

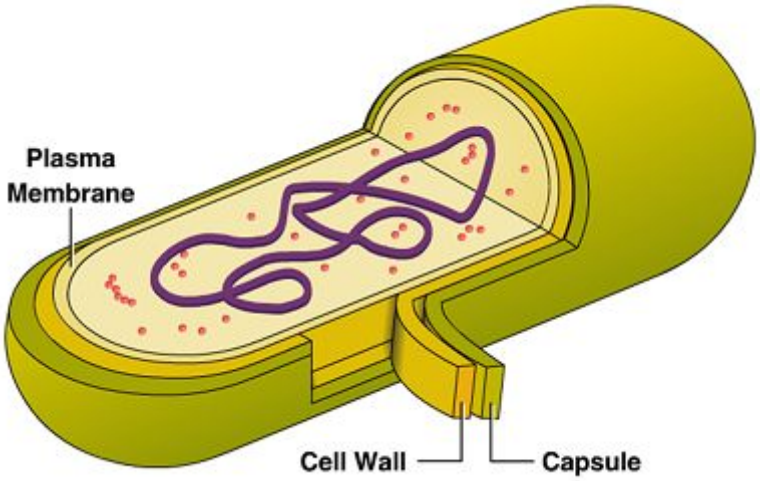
- Stalked: The body of bacterium possesses a stalk e.g., Caulobacter.
- Budded: The body of the bacterium is swollen at places e.g., Rhodomicrobiu

Learn more about Kingdom Fungi here.

Structure of Bacteria

- Capsule: In a large number of bacteria, a slimy capsule is present outside the cell wall. It is composed of polysaccharides and the nitrogenous substances (amino acids) are also present in addition. This slime layer becomes thick, called, capsule. The bacteria, which form a capsule, are' called capsulated or virulent bacteria. The capsule 'is usually found in parasitic forms e.g., Bacillus, anthracite, Diplococcus pneumoniae, Mycobacterium tuberculosis.
- Cell wall: All bacterial cells .are covered by a strong, rigid cell wall. Therefore, we classify them under plants. Inner to the capsule, the cell wall is present. It is made up of

polysaccharides, proteins and lipids. We also find D-glutamic acid and diaminopimelic acid.



- Plasma membrane: Each bacterial cell has a plasma membrane. It is situated just internal to the cell wall. It is a thin, elastic and also differentially or selectively permeable membrane.
- Cytoplasm: The cytoplasm refers to a complex and aqueous fluid or semifluid ground substance (matrix). This material consists of vitamins, salts, enzymes, carbohydrates, soluble proteins, co-enzymes, lipids, mineral and nucleic acids. The organic matter is present in the colloidal state.The cytoplasm is granular due to the presence of a large number of ribosomes.

- Nucleoid: It has other common names like genophore, naked nucleus or incipient nucleus. There is nuclear material in these, DNA. It is double helical as well as circular. Some kind of typical protein surrounds it. However, these are not histone proteins.
- Plasmids: In addition to the normal DNA chromosomes, many bacteria (e.g., E.coli) have extrachromosomal genetic elements or DNA. These elements are plasmids. They are small circular double-stranded molecules.
- Flagella: These are fine, thread-like, protoplasmic appendages. These extend through the cell wall and the slime layer of the flagellated bacterial cells. These help in bacteria to swim about in the liquid medium.
- Pili or Fimbriae: Besides flagella, some tiny or small hair-like outgrowths are present on the bacterial cell surface. These are pili. They comprise of pilin protein. They consequently measure about 0.5-2 mm in length and 3-5mm in diameter.

Learn more about Kingdom Animalia here.

Nutrition in Bacteria

On the basis of mode of nutrition, we can group bacteria into two broad categories. First is autotrophic whereas second is heterotrophic bacteria.

- Autotrophic bacteria: These bacteria are able to synthesize their own food from inorganic substances, as green plants do. They derive their carbon from carbon dioxide. The hydrogen needed to reduce carbon to organic form comes from sources such as atmospheric H_2, H_2S or NH_3.
- Heterotrophic bacteria: Most of the bacteria cannot synthesize their own organic food. They consequently depend on external organic materials. They require at least one organic compound as a source of carbon for their growth and energy. Such bacteria are heterotrophic bacteria. Heterotrophic bacteria are of three types: Parasites, Saprotrophs and Symbionts.

Learn more about Kingdom Protista here.

Solved Example For You

Question: Write a short note on cyanobacteria.

Answer: Cyanobacteria, also known as blue-green algae are photosynthetic prokaryotes. They perform oxygenic photosynthesis. Photosynthetic pigments include chlorophyll a, carotenoids and phycobilins. They primarily store the food in form of cyanophycean starch, lipid globules and protein granules. We can trace their origin to around 3 billion years back. They consequently added oxygen to the atmosphere. These bacteria also paved the path for the evolution of aerobic forms, including aerobic bacteria.

Kingdom Plantae

You see a variety of plants around you. You can see they have different leaves, stems, and fruits. Why does that happen? Wouldn't it be very boring if all the plants were alike? Who can eat only apples all through their life!! Never! So, we will study the diverse kingdom of Plantae here.

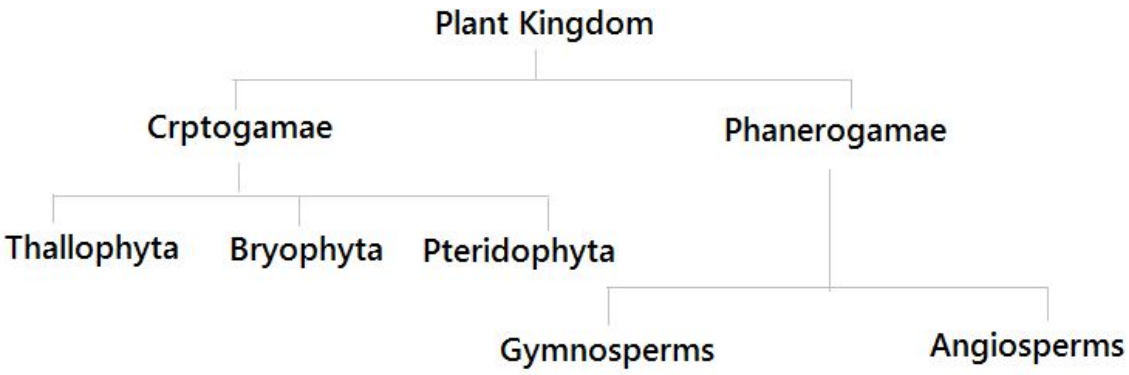
Kingdom Plantae

Kingdom Plantae includes green, brown and red algae, liverworts, mosses, ferns and seed plants with or without flowers. They have the following characteristics:

- They are multicellular organisms with walled and frequently vacuolate eukaryotic cells.
- These contain photosynthetic pigment in plastids. The principle mode of nutrition is photosynthesis.
- They are primarily non-motile and live anchored to a substrate.
- Reproduction is primarily asexual or sexual. The reproductive organs are multicellular. They form a multicellular embryo

during development from the zygote. Algae lack the embryo stage.

- The life cycle consists of alternating haploid gametophyte and diploid sporophyte generation. This phenomenon is called the alternation of generation.



Thallophyta (Algae)

They are simple, autotrophic non-vascular plants. They have unicelled sex organs and no embryo formation. These grow in specialized habitats:

- Cryophytes: These grow on snow or ice.
- Thermophytes: These grow in hot water.

- Epiphytes: These are those algae that grow on other plants (algae, angiosperms). Examples include Oedogonium, Cladophora, Vaucheria, etc.
- Endophytes: Some blue-green algae grow as endophytes inside other plants e.g., Anabaena growing inside the leaf of Azolla (fern).
- Parasites: The alga Cephaleuros virescens grows a parasite on the tea leaves.

Know more about Kingdom Animalia

Bryophyta

Bryophyta (Gk: Bryon = moss; phyton = plants) is the grouping that consists of the simplest and primitive land plants. We also regard these as ‘the amphibians of the plant kingdom’. Bryophytes are most common in moist and shady places. Some bryophytes also grow in diverse habitats like extremely dry or watery habitats. They reproduce sexually. Antheridium is the male sex organ. On the other hand, archegonium is the female sex organ.

Pteridophyta

The pteridophytes (Gk. Pteron = feather and phyton = plants) refers to all those plants with feathers like fronds of ferns. They do not have flowers or seeds. These plants are mostly terrestrial. They prefer shady habitats. They have a Sporophytic plant body. The pteridophyte usually has a single apical cell with three cutting faces in the shoot apex. Let us now look at the sub-phyla of this group.

- Sub-phylum: Psilopsida: These are the oldest known vascular plants; most of them (except Psilotum and Tmesipteris) are fossils. The body of the plant is relatively less differentiated. Roots are absent in these plants. Instead, you can find a dichotomously branched rhizome.
- Sub-Phylum: Lycopsida: The plant body is differentiated into root, stem, and leaves. Leaves are usually small (i.e., microphyllous) with a single unbranched vein. Sporangia develop in the axil of the sporophylls.
- Sub-Phylum: Sphenopsida: The stem is differentiated into nodes and internodes. The leaves are microphyllous. You can find them in whorls at each of the nodes.

- Sub-Phylum: Pteropsida: The plant body is well-differentiated into root, stem, and leaves. The leaves are megaphyllous, pinnately compound.

You know about Kingdom Fungi

Angiosperms

The angiosperms, or flowering plants, are the most dominant and ubiquitous vascular plants of present-day flora. These plants are primarily responsible for changing the green and yellow melancholy of the earth's vegetation. They do so by their beautiful and colorful brightness and fragrance of their flower.

The term angiosperm means 'enclosed seed'. This is so because the ovules or potential seeds are enclosed within a hollow ovary. We can divide the plants of Angiosperms into two major groups as – Dicotyledons and Monocotyledons.

Dicotyledons

They show the following distinguishing characteristics:

- We see taproots in the members of this group.
- The leaves in members of these classes exhibit reticulate (net-like) venation.
- The flowers are tetramerous or pentamerous having four or five members in the various floral whorls, respectively.
- The vascular bundles arranged in a ring, number 2–6, open and with cambium.
- The seeds of dicotyledons are with two cotyledons as the name indicates.

Monocotyledons

They show the following distinguishing characteristics:

- We see adventitious roots in the members of this group.
- The leaves are simple with parallel venation.
- The flowers are trimerous. They have three members in each floral whorl.
- The vascular bundles scattered in the ground tissue, many in number, closed and without cambium.

- The seeds of monocotyledons are with one cotyledon as the name indicates. e.g., Cereals, bamboos, sugarcane, palms, banana, lilies and orchids.

Solved Example For You

Question: Write a short note on gymnosperms from Kingdom Plantae.

Answer: Living gymnosperms are mostly perennials, xerophytic, evergreen, arboreal and woody plants. We can find them growing as wood trees, bushy shrubs or rarely as climbers (e.g., Gnetales). They are never herbs or annuals. The external features of these are:

- The plant body is sporophyte and differentiated into root, stem, and leaves.
- The plant possesses a well-developed tap root system. In some cases, the roots are symbiotically associated with algae (e.g., Coralloid roots of Cycas) or with fungi (e.g., Mycorrhizal roots of Pinus).

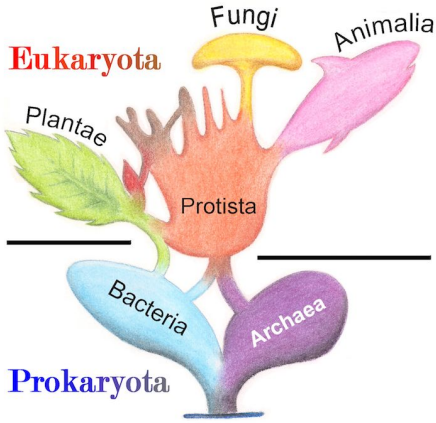
- The stem is erect, aerial, solid, woody and branched (unbranched in Cycadales) but almost tuberous in Zamia. The leaves may be microphyllous or megaphyllous.

Kingdom Protista

You must have seen ponds covered with green plants. You always thought that those are mosses. Didn't you? Well no! We will see what those are. It is time to peek deeper into another kingdom in this chapter: Protista. We will look at some of the most interesting groupings of this kingdom. We will also take a look at their characteristics and examples.

Characteristics of Kingdom Protista

We place all single-celled eukaryotes under Protista. However, the boundaries of this kingdom are not well defined. Members of Protista are primarily aquatic. This kingdom forms a link with the others dealing with plants, animals and fungi. Being eukaryotes, the protistan cell body contains a well-defined nucleus and other membrane-bound organelles.



Some have flagella or cilia. Protists reproduce asexually and sexually by, the process involving cell fusion and zygote formation. It may be photosynthetic or holotrophic. These could also be saprotrophic, parasitic and symbionts. On the other hand, some could have mixotrophic nutrition (holotrophic + saprobic). Phytoplanktons are photosynthetic, floating protists. Zooplanktons are free-floating, holozoic protozoans.

Grouping of Unicellular Protists

We can classify unicellular protists into three major groups:

- Photosynthetic Protists. Example: Dinoflagellates, Diatoms, Euglenoids
- Consumer Protists. Example: Slime moulds or Myxomycetes

- Protozoan Protists.Example: Zooflagellate, Sarcodina, Sporozoa, Ciliata

Life Cycles in Protists Showing Zygotic Meiosis

By life cycle, what we mean is nothing but a sequence of events between any given phase in one generation and that similar phase in the succeeding generation. It occurs in some dinoflagellates (Example: *ceratium, gymnodinium;* von stosch, 1973) and cellular slime moulds.

The zygote is in the form of 2n. It usually divides by meiosis (also called zygotic meiosis). These produce vegetative cells with the chromosome number of 1n. These cells divide repeatedly by mitosis. The resultant daughter cells maintain the 1n number of chromosomes. Some of the vegetative cells produce gametes. When these gametes combine in fertilization, a zygote forms and the life cycle gets complete.

Major Groups of Protists

Chrysophytes

This group comprises of the diatoms and golden algae (desmids). We find them in fresh water as well as in marine environments. They are microscopic. These organisms float passively in water currents (plankton).

Dianoflagellates

These organisms are usually marine and photosynthetic. They have an appearance of various colours like yellow, green, brown, blue or red. Their colour is influenced and decided by the main pigments present in their cells. The cell wall has stiff cellulose plates on its outer surface. These organisms usually have two flagella; one lies longitudinally and the other transversely in a furrow between the wall plates.

Euglenoids

These are mostly freshwater organisms. We can find them in stagnant water. They do not have a cell wall. Rather, they are built with a protein-rich layer, pellicle that makes their body flexible. They have two flagella. One is short and the other is a long one. The two flagella join with each other at a swelling called paraflagellar body.

Euglena is a connecting link between animals and plants. Nutrition in Euglena is mixotrophic, when the light is available it is photosynthetic, in darkness, it is saprophytic absorbing food from surrounding water.

Slime Moulds

Slime moulds are saprophytic protists. Their body is capable of moving through decaying twigs and leaves engulfing organic material. Under suitable conditions, they form an aggregation called Plasmodium which may grow and spread over several feet. During unfavourable conditions, the plasmodium differentiates and forms fruiting bodies bearing spores at their tips.

The spores possess true walls. The spores are dispersed by air currents. They are extremely resistant to changes in the atmosphere. They are capable of surviving for many years, even under adverse conditions.

Protozoans

All protozoans are heterotrophs and live as predators or parasites. They are believed to be primitive relatives of animals. There are four major groups of protozoan:

- Flagellated Protozoans: They possess flagella for locomotion. They may be free-living aquatics, parasites, commensals or symbionts. Zooflagellates are generally uninucleate, occasionally multinucleate.
- Amoebid Protozoans: They develop pseudopodia which are temporary protoplasmic outgrowths. These are used for locomotion and engulfing food articles. Sarcodines are mostly free-living, found in fresh water, sea water and on damp soil.
- Sporozoans: All sporozoans are endoparasites. Some sporozoans such as Eimeria cause severe diseases like coccidiosis in the birds. Nutrition is parasitic (absorptive). Phagotrophy is rare.
- Ciliated Protozoans: Ciliates are protozoan protists. These develop a number of cilia during a part or whole of the life cycle. They use cilia for locomotion and driving food. There is a high degree of morphological and physiological specialisation. There are definite regions for ingestion and

egestion. The region of ingestion consists of an oral groove, cytostome (mouth) and gullet.

Solved Examples for You

Question: Give some examples of disease-causing protozoans.

Answer: The various types of disease-causing protozoa include:

- Trypanosome gambiense: The parasite of sleeping sickness. It is transmitted by tsetse fly. It causes Gambian sleeping sickness.
- Trypansoma rhodesiense: It causes Rhodesian sickness. The parasite is transmitted by the bites of tsetse fly (Glossina palpalis and glossina morsitans). Initially parasite is present in the blood of man but later on, it enters the cerebrospinal fluid.

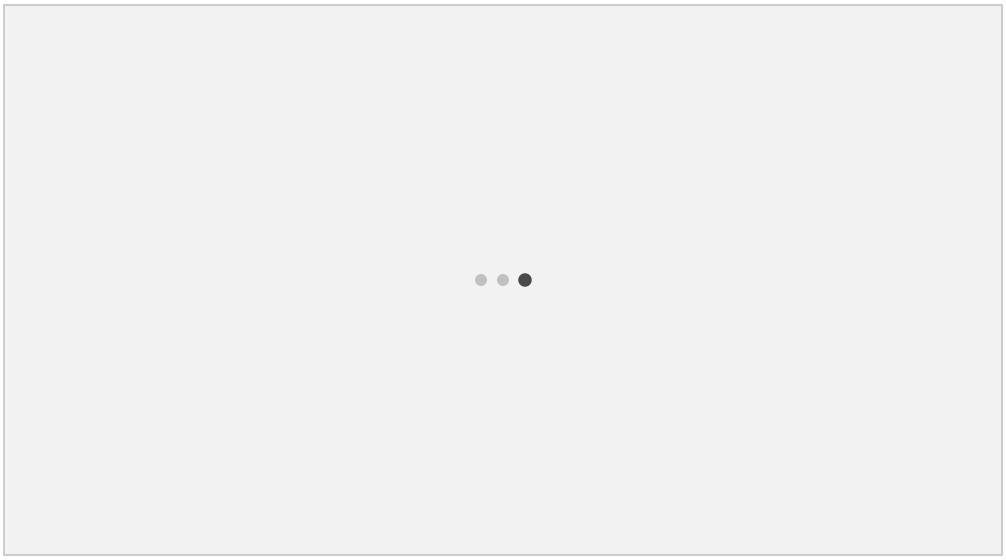
Viruses, Viroids and Lichens

After going through all the classification groups of the plant and animal kingdom, don't you feel we missed something out? What about the viruses and lichens? We hear so much about viruses but where are they on the classification list? Whittaker, in his classification of the five kingdoms, did not mention any acellular organisms like viruses and viroids, and lichens. Therefore, we will briefly introduce those to you in this chapter.

Viruses

Almost all of us have suffered the ill effects of common cold or 'flu'. Therefore, we know what effects viruses can have on us, even if we do not associate it with our condition. Viruses did not find a place in classification since they are not truly 'living'. This is based on the understanding that living organisms that have a cell structure.

The viruses are non-cellular organisms. They, in fact, have an inert crystalline structure outside the living cell. Once they infect a cell, they take over the machinery of the host cell to replicate themselves, killing the host. Would you call viruses living or non-living?



Pasteur. D.J. Ivanowsky (1892) gave the name virus. It means venom or poisonous fluid. According to his research, certain microbes caused the mosaic disease of tobacco.

These organisms were smaller than bacteria because they passed through bacteria-proof filters. M.W. Beijerinek (1898) demonstrated that the extract of the infected plants of tobacco could cause infection in healthy plants. He named the fluid as *Contagium vivum fluidum* (infectious living fluid).

W.M. Stanley (1935) discovered that viruses could be crystallised. These virus crystals are composed largely of proteins. They are inert

outside their specific host cell. Viruses are nothing but obligate parasites.

Browse more Topics under Biological Classification

- Introduction to Biological Classification
- Kingdom Animalia
- Kingdom Fungi
- The Kingdom Monera
- Kingdom Plantae
- Kingdom Protista

Genetic Material of Viruses

In addition to proteins, viruses also contain genetic material, that could be either RNA or DNA. No virus contains both RNA and DNA. A virus is a nucleoprotein and the genetic material is infectious. Speaking in strictly general terms, viruses infecting plants have single-stranded RNA. On the other hand, viruses that infect animals have either single or double-stranded RNA or they might have double-stranded DNA.

Bacterial viruses or bacteriophages usually have a double-stranded DNA structure. By bacteriophages, we mean viruses that infect the bacteria. The protein coat, capsid made of small subunits (capsomeres) protects the nucleic acid. They have these capsomeres arranged in various geometric forms like helical or polyhedral forms.

Viroids

In 1971 T.O. Diener discovered a new infectious agent. This agent was more minute than the viruses. it was responsible for causing the potato spindle tuber disease. He found a free RNA. It lacked the protein coat that is found in viruses. Hence, the name viroid. The RNA of the viroid was of low molecular weight.

Lichens

Lichens are symbiotic associations i.e. mutually useful associations, between algae and fungi. The algal component called phycobiont. And, the fungal component is what we call as mycobiont. These components are autotrophic and heterotrophic, respectively.

Algae prepare food for fungi. On the other hand, fungi provide shelter and absorb mineral nutrients and water for its partner. Their

association is so close that if one saw a lichen in nature one would never imagine that they had two different organisms within them. Lichens are very good pollution indicators – they do not grow in polluted areas.

Solved Examples for You

Question: Mention some diseases caused by a virus.

Answer: Viruses cause diseases like mumps, smallpox, herpes and influenza. AIDS in humans is also caused by a virus. In plants, the symptoms can be mosaic formation, leaf rolling and curling, yellowing and vein clearing, dwarfing and stunted growth.