2

Biological Classification

When scientists use scientific names, they avoid the confusion that can occur when referring to an organism by its common name. For example, the name robin can refer to either the European or American robin; however, the scientific names of the robins—Erithacus rubecula and Turdus migratorius—clearly identify the species being referenced.

Topic Notes

- *Biological Classification and Its Types*

BIOLOGICAL CLASSIFICATION AND ITS TYPES

1

TOPIC 1

IMPORTANCE OF BIOLOGICAL CLASSIFICATION

Biological classification is the scientific procedure of arranging organisms into groups and subgroups on the basis of their similarities and dissimilarities, and placing the groups in a hierarchy of categories.

Classifying things in day-to-day life makes life so much easier. Similarly, classifying organisms is important because of the following aspects:

(1) It makes identification, study and research easier for diverse life forms.

(2) It gives a glance at all the organisms in one picture.

(3) To make us understand and study the characteristics, similarities and differences among organisms so that grouping can be easy.

(4) To trace the ancestry *i.e.*, evolutionary relationships among them, understand missing links and connecting links.

(5) To understand the exact position of an organism in classification.

(6) To evolve a truly natural or phylogenetic system which should indicate the origin and evolution of the species.

TOPIC 2

KINGDOM SYSTEM OF CLASSIFICATION AND ITS CHARACTERISTICS

Aristotle done the earliest attempt to classify plants into trees, shrubs and herbs. He also divided animals into two groups on the basis of the presence or absence of red blood cells in them:

(1) Enaima (animals with red blood cells in them)

(2) Anaima (animals without red blood cells in them).

Carlous Linnaeus gave two-kingdom systems of classification *i.e.*, Plantae and Animalia which segregated plants and animals into two different groups.

Drawback of this system was that it does not segregate between eukaryotes and prokaryotes, unicellular and multicellular, photosynthetic and non-photosynthetic organisms.

R.H. Whittaker (1969), proposed the most widely accepted Five-Kingdom Classification of organisms. The kingdoms were named Monera, Protista, Fungi, Plantae, and Animalia.

Main Criteria for Classification

(1) Cell structure

(2) Body organisation

(3) Mode of nutrition

(4) Reproduction

(5) Phylogenetic relationships

S. No.	Characters/ Kingdoms	Monera	Protista	Fungi	Plantae	Animalia
(1)	Cell type	Prokaryotic	Eukaryotic	Eukaryotic	Eukaryotic	Eukaryotic
(2)	Cell wall	Non-cellulosic (Polysaccharide some with chitin + amino acid)	Present in some	Present in the form of chitin (without cellulose)	Present (cell wall is made up of cellu-lose)	Absent
(3)	Nuclear membrane	Absent	Present	Present	Present	Present
(4)	Body organisation	Cellular	Cellular	Multicellular/ loose tissue	Tissue/ organ	Tissue/organ/ organ system
(5)	Mode of nutrition	Autotrophic (chemosynthetic and photosynthetic) and Heterotrophic (saprophytic / parasitic)	Autotrophic (Photosynthetic) and Heterotrophic	Heterotrophic (Saprophytic/ Parasitic)	Autotrophic (Photosyn-thetic)	Heterotrophic (Holozoic / Saprophytic, etc)

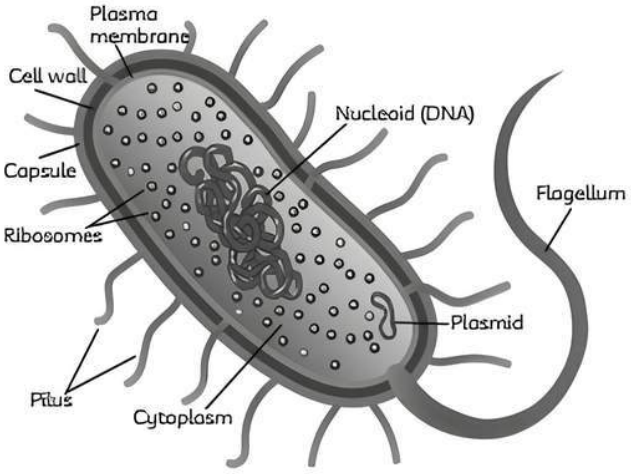
Characteristics of the Five Kingdoms

TOPIC 3

FIVE KINGDOMS

Kingdom Monera

Monera includes the most primitive form of life. They are the smallest, simplest form of an organism. Monerans are adapted to all kinds of habitats. They are the most abundant of all organisms as they are omnipresent, in oceans, dry deserts, hot springs, icebergs, and inside and outside the body of other organisms as parasites. They can tolerate extreme environmental conditions.



Bacterial cell structure

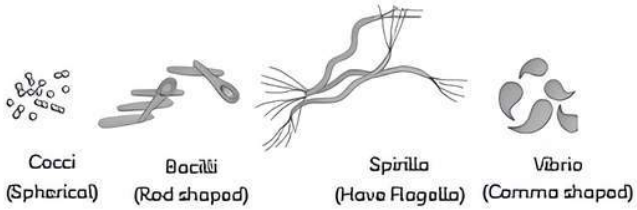
Important

➥ *Milk is converted into curd by Lactobacillus. It is rod-shaped bacteria, that enhances the nutritional quality of curd as it enriches it with vitamin B_{12}.*

Bacteria are simple, microscopic prokaryotic organisms. Although they are unicellular, in bacteria, all the metabolic functions are performed in the cell itself.

They have various modes of nutrition – some are autotrophic, which make their own food from inorganic substances, they may be photoautotrophic or chemoautotrophic, while others are heterotrophic, which depend on other organisms to obtain their nutrition, they may be saprophytic (obtaining nutrition from dead and decaying organic matter) or parasitic (obtain nutrition from other organisms by living on or inside their body).

Bacteria can be found in different forms and shapes. On the basis of their shape they are of the following types— *Coccus* (Spherical), *Bacillus* (rod-shaped), *Vibrio* (comma-shaped), *Spirillum* (spiral-shaped).



Different shapes of bacteria

Important

➥ *Bacteria was discovered by Anton van Leeuwenhoek (1632-1723). He observed bacteria in 1675. Louis Pasteur laid the foundation of Bacteriology by developing culture techniques.*

As Monera is the only kingdom that consists of prokaryotic organisms *i.e.*, bacteria (sole member of Kingdom Monera). This kingdom consists of two major groups— Archaebacteria (ancient bacteria) and Eubacteria (true bacteria).

Archaebacteria

Archaebacteria are a unique type of bacteria which can survive in extreme conditions of the environment such as:

(1) Extreme salt-rich conditions (Halophiles).

(2) They have the ability to tolerate high temperature as well as high acid, often living in hot sulfur springs (Thermoacidophiles).

(3) They are also found in marshy areas (Methanogens).

Archaebacteria are characterised by the presence of non-cellulosic polysaccharides and protein cell wall instead of peptidoglycan wall, which help them to survive in extreme conditions. Methanogens live as symbionts in the gut of other ruminant animals such as cows and buffaloes and they are responsible for the production of the methane (biogas) from the dung of these cattles.

Eubacteria

There is a vast variety of eubacteria or true bacteria. They can be identified by the presence of a rigid cell wall, and if they are motile, a flagella can be seen as locomotory organ.

Cyanobacteria: Cyanobacteria or blue-green algae (BGA) are gram positive photosynthetic prokaryotic organism which perform oxygenic photosynthesis.

Cyanobacteria are one of the most successful autotrophic organisms on the earth. They have photosynthetic pigments like chlorophyll a, carotenoids and phycobilins for photosynthesis.

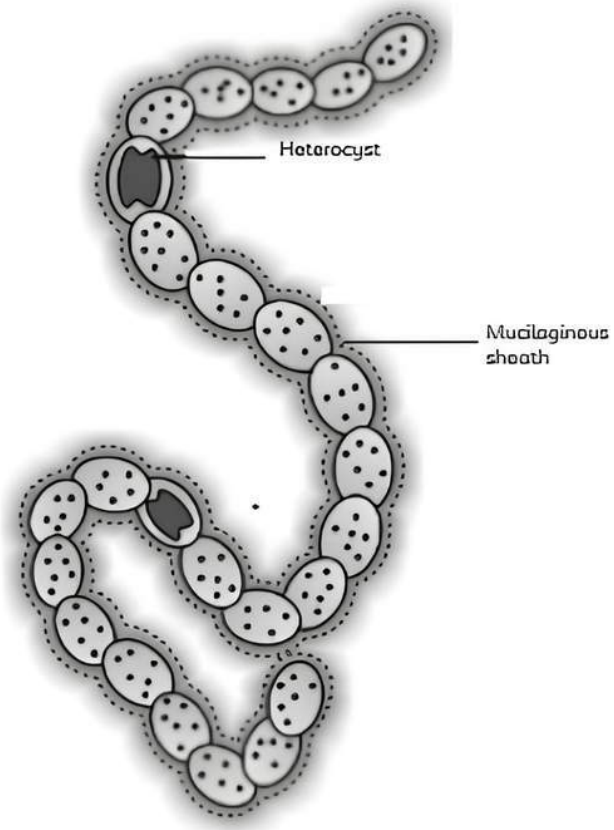
Cyanobacteria may be unicellular, colonial or filamentous. Some Cyanobacteria of filamentous forms possess special large cells called heterocysts which have the ability to fix atmospheric nitrogen. *E.g., Nostoc* and *Anabaena*.

Some bacteria are chemosynthetic autotrophs that oxidise various inorganic substances like nitrates, nitrites and ammonia and use the released energy to produce ATP.

They play a significant role in recycling nutrients like nitrogen, phosphorous, iron and sulphur.

Important

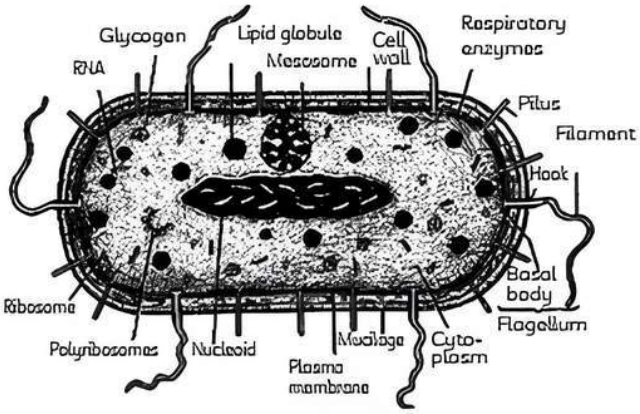
➥ *Mycoplasma is the simplest and the smallest free-living organism present on earth, which lacks a cell wall and thus, it can change its shape. Mycoplasma is heterotrophic in nature. Some live as saprophytes but mostly are parasitic in nature. They can survive in the absence of oxygen as well.*



Nostoc (Filamentous blue-green algae)

Example 1.1: Case Based:

Is Monera a kingdom? Yes, a kingdom containing unicellular organisms with Prokaryotic Cell organisation with no nuclear membrane is the Kingdom Monera, and in Greek, it means single or solitary. An example of the Kingdom Monera is Bacteria which are single-celled and have no true nuclear membrane and are referred to as prokaryotic organisms. It means their DNA is not enclosed within the defined nucleus. Most of the bacteria fall under Monera, however, cyanobacteria or also called blue-green algae were initially present in Kingdom Plantae because of their ability to synthesise food through photosynthesis.



Prokaryotic cell

(A) The structural material of bacterial cell wall is:

(a) Fungal cellulose (b) Cellulose

(c) Peptidoglycan (d) Peptide chains

(B) Bacteria having flagella all over the cell body surface are:

(a) Peritrichous (b) Atrichous

(c) Cephalotrichous (d) Lophotrichous

(C) Give two examples of rod-shaped bacteria.

(D) How bacteria are useful in the industry?

(E) Assertion (A): Mesosomes are the inward fold of the plasma membrane.

Reason (R): This structure helps in the respiration of bacteria.

(a) Both A and R are true and R is the correct explanation of A.

(b) Both A and R are true and R is not the correct explanation of A.

(c) A is true but R is false.

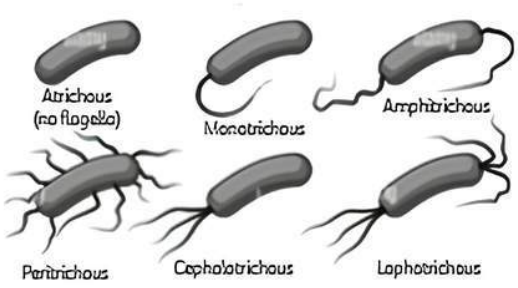
(d) A is false but R is true.

Ans. (A) *(c) Peptidoglycan*

Explanation: Bacterial cell wall is the outer rigid covering and is made up of different compounds like muramic acid, a peptide chain of amino acids. These all together form a polymer called Peptidoglycan. Plant cell wall is made up of cellulose.

(B) *(a) Peritrichous*

Explanation: Peritrichous bacteria are those which possess multiple flagella attached all over the cell body surface. Whereas Atrichous means flagella is absent, Cephalotrichous means many flagella attached to one end and lophotrichous means a group of flagella attached at each of two ends.



Types of flagellar arrangement

(C) Rod-shaped bacteria are *E.coli* and *Salmonella typhi*.

(D) Bacteria are very useful in industry, as vinegar is the fermentation product of cane juices and molasses. It is produced in two steps—first conversion of sugars into alcohols by alcoholic fermentation by yeast and second conversion of alcohol to acetic acid by the action of bacteria *Acetobacter*.

(E) *(a) Both A and R are true and R is the correct explanation of A.*

Explanation: The mesosomes are present in bacteria; it is inward foldings of the plasma membrane. Its main function is to increase the surface area of the cell, thus, helping in aerobic respiration.

Example 1.2: **Case Based:**

A child accidentally inoculated warm milk with some curd in the morning. He left it undisturbed and in the evening he saw that milk was converted into curd. He was surprised to see that. He curiously asked his teacher about the process the next day in school. She explained to him the reason and told him about the bacteria that was responsible for causing such a change in the milk. She also told her about some more bacteria, how they survive in different conditions and their shapes.

(A) Bacteria responsible for the above mentioned conversion were:

(a) rod-shaped **(b) vibrio**

(c) spiral-shaped **(d) spherical**

(B) Bacteria responsible for curdling was .....

(a) *Lactobacillus*

(b) *Salmonella*

(c) *Pseudomonas*

(d) *Pneumonococcus*

(C) Name the kingdom to which these bacteria belong and mention some of its characteristics.

(D) Mention the names of the different shapes of bacteria.

(E) Assertion (A): In addition to changing the milk into curd, *Lactobacillus* also enhances the nutritional quality of curd.

Reason (R): *Lactobacillus* increases the content of vitamin B_{12} in the curd.

(a) Both A and R are true and R is the correct explanation of A.

(b) Both A and R are true and R is not the correct explanation of A.

(c) A is true but R is false.

(d) A is false but R is true.

Ans. **(A)** *(a) rod-shaped*

Explanation: *Lactobacillus* is a rod-shaped bacteria that converts milk to curd.

(B) *(a) Lactobacillus*

Explanation: *Lactobacillus lacti* is the bacteria which convert milk to curd.

(C) Bacteria belong to the Kingdom Monera which includes all the bacteria, the most abundant microorganisms, prokaryotes having a cell wall (made up of amino acids and polysaccharides) occurs almost everywhere, is found in all habitats, from the surface to deep oceans, and survives in extreme temperatures *i.e.*, hot springs and snow, some found as parasites on other living organisms.

(D) Bacteria are of four types depending on the shape of their body:

(1) *cocci* (spherical-shaped)

(2) *bacillus* (rod-shaped)

(3) *vibrio* (comma-shaped)

(4) *spirillum* (spiral-shaped).

(E) *(a) Both A and R are true and R is the correct explanation of A.*

Explanation: *Lactobacillus* converts milk into curd, as well as it improves the nutritional quality of curd by increasing the content of vitamin B_{12}.

Kingdom Protista

Protista includes all the unicellular, microscopic and eukaryotic organisms. They are mostly aquatic. They have well-developed cell structures with a defined nucleus and other membrane-bound organelles. They possess special features for locomotion like cilia and flagella. They can reproduce by both asexual (Binary, multiple fission and spore formation) and sexual methods (fusion of gametes and cell fusion). Protists can be considered as a connecting link between Monera and multicellular Fungi, Plants and Animals.

Chrysophytes, Dinoflagellates, Slime moulds and Euglenoids groups come under the Kingdom Protista.

Chrysophytes

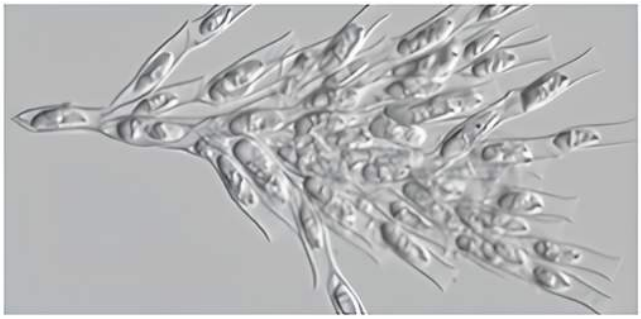
Chrysophytes include diatoms and golden algae (desmids). Diatoms occur in all aquatic and moist terrestrial habitats.

They may be free-floating or bottom dwellers. They constitute the major part of the phytoplankton of oceans.

They are microscopic, unicellular, photosynthetic organisms. The body wall of Diatoms is composed of cellulose and covered by a siliceous shell.

Cell wall is also composed of two overlapping halves which fit together like a soap box. These siliceous walls do not decay easily and were collected over millions of years on the seafloor and formed a big heap called diatomaceous earth. This diatomaceous earth is mined and used in industrial filtration and in metal polishing.

Diatoms are the main source of food for aquatic animals. **Example:** *Triceratium*



Chrysophytes

Example 1.3: What is the nature of the cell wall in diatoms?

Ans. Diatom cells are made up of siliceous shell. The structure of their cell walls is called a frustule. Two thin shells overlap and fit inside each other. The silica in diatoms; cell walls deposit as diatomaceous earth when they die. Diatomaceous earth is used for the filtration of oils and sugar, and has other industrial applications as well.

Dinoflagellates

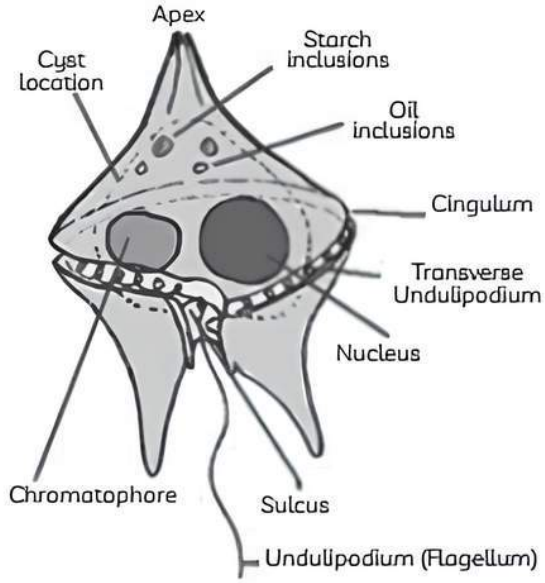
Dinoflagellates are unicellular photosynthetic organisms found in both marine as well as freshwater. Some Dinoflagellates *(Gonyaulax)* grow in large numbers on the sea surface and make the sea red, also called red tides.

They are yellow-brown to dark brown due to the presence of pigments. Most of them are motile and flagellated.

The cell wall of Dinoflagellates is composed of plates made up of cellulose.

The cell possesses two flagella if present— one is transverse and the other is longitudinal, lying in a furrow between the plates.

Some Dinoflagellates are poisonous to vertebrates; they release a toxin which kills the fish.



Dinoflagellate

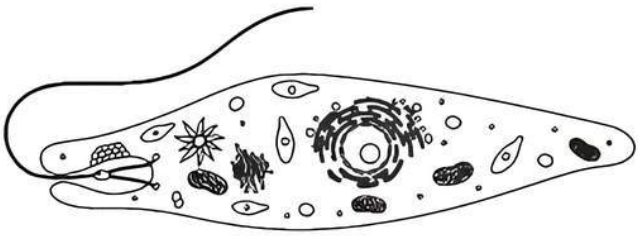
Euglenoids

Euglenoids usually occur in freshwater and some forms can be found in damp soil.

Euglenoids are unicellular flagellates and they lack a cell wall, their body is covered with a thin, flexible layer called a pellicle.

The number of flagella in euglenoids can be one or two. Out of the two, usually, one is short and the other is long.

The mode of nutrition in euglenoids is either photoautotrophic or heterotrophic in the absence of sunlight. Photoautotrophs possess chloroplast and photosynthetic pigments which are similar to pigments present in higher plants which is why euglenoid's some members are considered as connecting links between plants and animals. **Example:** *Euglena.*



Euglena

Slime Moulds

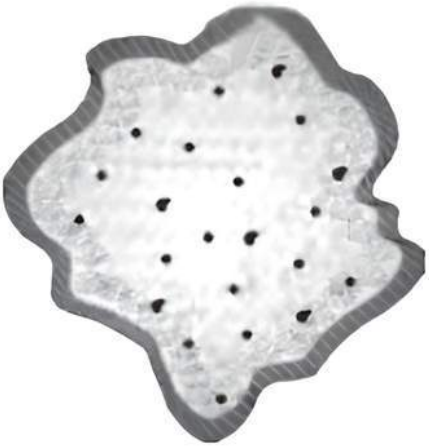
Slime moulds are generally found on dead, decaying leaves, twigs and other decaying matter.

Their mode of nutrition is saprotrophic.

The vegetative part or somatic phase does not possess a cell wall, and forms aggregation called *Plasmodium.*

All the nuclei in the *Plasmodium* divide simultaneously and spread over several feet. However, the reproductive structure (spores) is produced when *Plasmodium* reaches maturity, differentiates and forms fruiting bodies (sporangia) under unfavourable conditions. These sporangia undergo meiotic division and become spores which have a true cell wall.

They are dispersed by air. They can even survive in adverse conditions for many years.



Slime mould

Protozoans

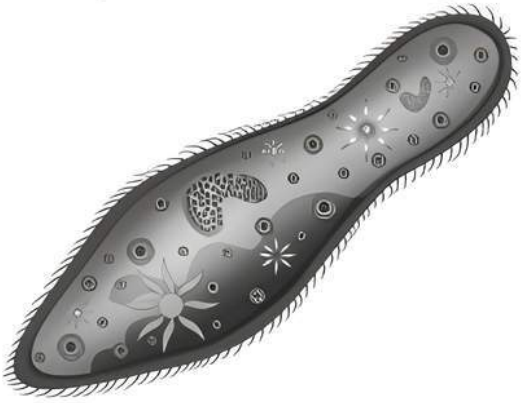
Protozoans may be aquatic, terrestrial, free-living or parasitic. Their mode of nutrition is mainly heterotrophic (holozoic). On the basis of locomotory organelles, the protozoans are divided into four major groups:

(1) **Amoeboid protozoans:** They are mostly found in freshwater and free-floating in seawater and also live on damp or moist soil. They are parasitic in nature; they develop temporary outgrowth of protoplasm called pseudopodia for locomotion and capturing of food. Reproduction can be asexual or sexual type. For example, *Amoeba*.

(2) **Flagellated protozoans:** Flagellated protozoans are free-living aquatic organisms. They are parasitic, some of them are human parasites which cause diseases like sleeping sickness. They possess flagella for locomotion. For example, *Trypanosoma*.

(3) **Ciliated protozoans:** They live as free-living organisms in fresh and marine water. The most unique feature of these organisms is the presence of a number of cilia on their whole body surface for locomotion attachment and food capture. They also have a cavity (gullet) that opens to the outside of the cell surface and the food is carried into it. For example, *Paramecium*.

(4) **Sporozoans:** All sporozoans are generally endoparasitic in nature and cause diseases. Their life cycle may include two different hosts like *Plasmodium* which causes malaria, and requires two hosts. The infective stage of *plasmodium* is the formation of sporozoites present in salivary glands of mosquito, which are then injected into humans. For example, *Plasmodium* and *Monocystics*.



Paramecium

Example 1.4: **State two economic importance of:**

(A) Heterotrophic bacteria

(B) Archaebacteria

Ans. **(A)** (1) These bacteria are natural scavengers because they decompose the organic matter.

(2) These are used in sewage disposal and used in agriculture for improving soil fertility.

(B) (1) These bacteria live as symbionts in the gut of ruminants who chew their cud and help in digestion of cellulose.

(2) These are also used in gobar gas (methane) production.

Kingdom Fungi

The Kingdom Fungi is unique kingdom that have a great diversity in habital and morphology. All the members of this kingdom show a heterotrophic mode of nutrition. They are mostly found in warm and humid areas.

Fungi are diverse organisms ranging from unicellular yeasts to highly complex multicellular organisms. Their body is typically thalloid. In most fungi, the body consists of long, tubular branched filaments called hyphae. The network of this hyphae is called mycelium. The hyphae can be of two types—aseptate or septate.

In aseptate, there are no cross walls or septa in their hyphae which makes hyphae multinucleated during nuclear division and if mycelium is without septa it is called coenocytic hyphae. On the other hand, in hyphae having septae or cross walls, cell may have one, two or more nuclei in a single chamber or cell. The cell wall contains chitin along with other polysaccharides.

Fungi

The mode of nutrition in fungi is heterotrophic as they lack chlorophyll so they obtain their food from other organisms either dead, decaying or living. If they obtain their food from non-living decaying organic matter they are called saprophytes. If they depend on other living plants or animals they are called parasites. Some fungi grow in symbiotic association with algae to form lichens, and some form associated with the roots of higher plants and form mycorrhiza.

The fungi reproduce by vegetative, asexual and sexual methods. Vegetatively it reproduces by Fragmentation, Budding, and Fission. Asexual means of reproduction occur by special reproductive structures – Zoospores, conidia, sporangiospores and sexual method takes place through oospores, as cospores and basidiospores. The sexual reproduction in fungi completes in three steps:

(1) **Plasmogamy:** In this, the protoplasms of two motile or non-motile gametes fuse with each other. The nuclei of two sex cells do not fuse. Thus, the cell becomes a binucleate or dikaryon, and the phase is known as dikaryophase.

(2) **Karyogamy:** It is the fusion of two nuclei.

(3) **Meiosis:** After the fusion of nuclei, the diploid nucleus divides by meiosis and leads to formation of haploid nuclei or haploid spores.

Kingdom Fungi is further divided into various classes on the basis of morphology of mycelium, mode of spore formation and fruiting bodies.

Phycomycetes

The important characteristic feature of this class is mycelia, in which the hyphae are aseptate and multinucleate (coenocytic). Asexual reproduction takes place by formation of spores produced inside the sporangium – aplanospores (non-motile), and zoospores (motile). Sexual reproduction occurs through fusion of two gametes. It may be isogamous (morphologically similar) and anisogamous or oogamous (morphologically dissimilar). They are aquatic organisms found in damp and moist areas, on decaying matter and as parasites on plants. **Examples:** *Mucor, Rhizopus (bread mould) and Albugo (parasitic).*

Ascomycetes

Ascomycetes is a class of diverse fungi, mostly terrestrial and they are multicellular except yeast, which is basically unicellular. They may include morels and truffles which are edible. They are saprophytic, decomposers, parasitic or coprophilous (growing on dung). The main characteristic feature of this class is that mycelium consists of septate and branched hyphae. Mostly ascomycetes reproduce asexually by formation of conidia which are non – motile and are produced exogenously from hyphae. The sexual reproduction takes place by fusion of gametes and formation of haploid ascospores which remain inside the sac-like structure called asci and these asci are produced inside the complex fruiting bodies called ascocarps whereas ascospores are liberated from asci and germinate to produce new mycelia.

Examples: *Aspergillus, Claviceps and Neurospora* (used in biochemical and genetic work).

Basidiomycetes

They are a diverse type of fungi- some are parasitic which cause diseases such as smuts and rusts in crops, some are edible like mushrooms, and some are decomposers which decompose wood material. The characteristic feature of this class is their mycelium composed of branched, filamentous and septate hyphae. The asexual spores are absent but they reproduce asexually by the process of fragmentation. In sexual reproduction, the sex organs are absent so plasmogamy is achieved by somatogamy in which fusion of two vegetative cells takes place and results in the formation of dikaryon which gives rise to basidium. Each basidium forms four haploid basidiospores which are inside the basidium. These basidia produce fruiting bodies called basidiocarps.

Examples: *Agaricus* (mushroom), *Ustilago* (smut) and *Puccinia* (rust).

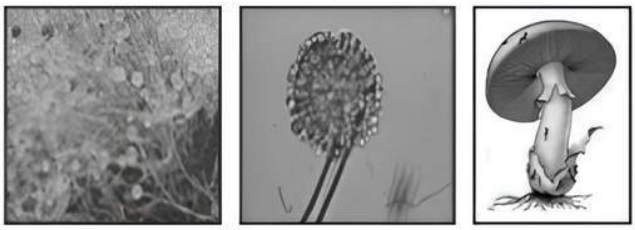
Deuteromycetes

They are saprotrophs, decomposers and parasitic in nature. The characteristic feature is that the mycelium is septate and branched. Reproduction only takes place by asexual method by formation of conidia. It is also known as imperfect fungi as these fungi are those in which the sexual stage is not known.

When the sexual forms of these fungi were discovered they were moved into classes they rightly belong to. The members of this class help in mineral cycling. **Examples:** *Alternaria, Colletotrichum* and *Trichoderma.*

Important

➥ *In the year 1973, Gaspard Bauhin gave the term fungus. The plural form of fungus was coined by Carolus Linnaeus. He named its fungi.*



Mucor *Aspergillus* *Agaricus*

Different types of fungi

Example 1.5: **Case Based:**

The members of the kingdom – Fungi are eukaryotic, heterotrophic and achlorophyllous. They are either unicellular or multicellular forms that are made up of hyphae. The network of hyphae forms the mycelium. These cell walls exhibiting organisms reproduce by both sexual and asexual modes. On the basis of spore formation, fungi are classified as Phycomycetes, Ascomycetes, Basidiomycetes and Deuteromycetes. Based on the mode of nutrition, fungi are classified as saprophytic and parasitic forms. These are also found in symbiotic associations with other organisms.

(A) The spores which are motile and flagellated help them to swim in aquatic habitat is:

(a) Sporangiospores (b) Zoospores

(c) Conidia (d) None of these

(B) Which group of fungi is commonly called the club fungi?

(a) Ascomycetes (b) Basidiomycetes

(c) Zygomycetes (d) Deuteromycetes

(C) On what basis the fungi were earlier included in the plant kingdom?

(D) Mention any traits in which Fungi resemble Animalia.

(E) Assertion (A): Fungi are widespread in distribution and even live on or inside other plants and animals.

Reason (R): Fungi have a variety of pigments, including chlorophyll, carotenoids and phycoerythrin.

(a) Both A and R are true and R is the correct explanation of A.

(b) Both A and R are true and R is not the correct explanation of A.

(c) A is true but R is false.

(d) A is false but R is true.

Ans. **(A)** *(b) Zoospores*

Explanation: The zoospores are motile and flagellated spores produced inside the zoosporangia. They are usually naked and have flagella help them to swim in aquatic habitats for proper dispersal whereas sporangiospores produced in an enclosed sac like structures are non-motile and conidia are non-motile spore.

(B) *(b) Basidiomycetes*

Explanation: Basidiomycetes are called club fungi because they bear club-shaped basidia as sexual spores.

(C) The Fungi were earlier included in the plant kingdom as the fungi have the cell wall and are non-motile like plants.

(D) The two traits in which fungi resemble Animalia are:

(1) Heterotrophic mode of nutrition.

(2) Glycogen as reserve food.

(E) *(c) A is true but R is false.*

Explanation: The fungi are widely distributed where organic material is available. Fungi are decomposers and parasitic. The fungi possess definite cell walls and true nuclei but lack chlorophyll.

Example 1.6: **Case Based:**

A scientist discovered a plant-like organism. He carried it to his lab for experimentation purposes and he found that the cell wall present in it was made up of chitin, not cellulose, it also consisted of spores as reproducing units. He further investigated and came to the conclusion that it belongs to another kingdom.

(A) Name the kingdom to which the organism discovered by him belongs.

(a) Monera (b) Protista

(c) Fungi (d) Animalia

(B) They are ..... type of organism.

(a) autotrophic (b) heterotrophic

(c) chemosynthetic (d) photosynthetic

(C) Give any two characteristics of this kingdom.

(D) Comment on their reproduction.

(E) Assertion (A): Cell wall is made up of chitin.

Reason (R): The function of chitin is to protect it from the environment.

(a) Both A and R are true and R is the correct explanation of A.

(b) Both A and R are true and R is not the correct explanation of A.

(c) A is true but R is false.

(d) A is false but R is true.

Ans. **(A)** *(c) Fungi*

Explanation: The organism belongs to Kingdom Fungi, as its cell wall is made up of chitin and they reproduce through spores.

(B) *(b) Heterotrophic*

Explanation: Fungi cannot make their own food. So they do not show autotrophism and photosynthetic mode of nutrition. In fact, the majority of them are saprophytes *i.e.*, feed on dead decaying matter.

(C) (1) They are heterotrophic organisms, they show great diversity in morphology, are found in diverse habitats, they are cosmopolitan *i.e.* occurs in air, water, soil, plants and animals.

(2) Their cell wall is made up of chitin, grow in warm and humid places and are saprophytes (fungi that feed on dead substrates) or parasites (those that depend on other organisms for food).

(3) Reproduction may be vegetative by fragmentation, fission and budding. (*Any two*)

(D) Reproduction may be vegetative by fragmentation, fission and budding, asexually reproduces by spores called conidia and sexual reproduction by oospores, ascospores and basidiospores. Their spores are produced within special structures called fruiting bodies.

(E) *(a) Both A and R are true and R is the correct explanation of A.*

Explanation: Cell walls of fungi are made up of chitin to protect them from environmental stresses including changes in osmotic pressure.

Kingdom Plantae

This kingdom contains all photosynthetic organisms and their non-photosynthetic relatives.

The Kingdom Plantae is eukaryotic, multicellular with photosynthetic pigment called chlorophyll. The mode of nutrition is mainly autotrophic using chlorophyll, whereas some are partial heterotrophs - parasitic (*Cuscuta*) or insectivorous plants (Venus Flytrap and bladderwort). The plant cell contains a rigid cell wall made up of cellulose, large vacuole and prominent chloroplasts. Life cycle consists of alternating haploid gametophyte and diploid sporophyte generation and this phenomenon is known as alternation of generation. The Kingdom Plantae is further classified into Algae, Bryophyta, Pteridophyta, Gymnosperms and Angiosperms.

Plant Kingdom

Example 1.7: Plants are autotrophic. Can you think of some plants that are partially heterotrophic?

Ans. Some members of Kingdom Plantae are partially heterotrophic organisms such as Bladderwort and Venus Fly Trap. They are Insectivorous plants *i.e.*, trap insects whereas; *Cuscuta* is a parasitic plant.

Partially heterotrophic plants are those which have chlorophyll and can perform photosynthesis, but depend on some other organisms for obtaining other nutrients like nitrogen which is usually deficient in soil.

Kingdom Animalia

This kingdom has maximum number and most diverse types of organisms.

They are multicellular, eukaryotic and heterotrophic organisms. Their cells lack a cell wall and plastids and they have smaller vacuoles. The mode of nutrition is holozoic and digestion takes place within the cavity and stores food as glycogen or fat. Reproduction is generally sexual. Zygote is formed by fusion of male and female gamete and then develops into embryo takes place. They follow a definite pattern of growth.

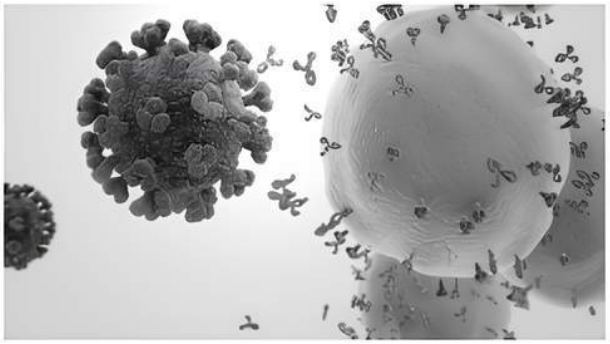
Animal Kingdom

TOPIC 4

ACELLULAR ORGANISMS

Viruses

When you hear the phrase "Virus," what comes to your mind? Perhaps an ordinary cold, a cold sore, or perhaps a global pandemic, like the one we were experienced, in the year 2020, caused by a coronavirus that began in bats.



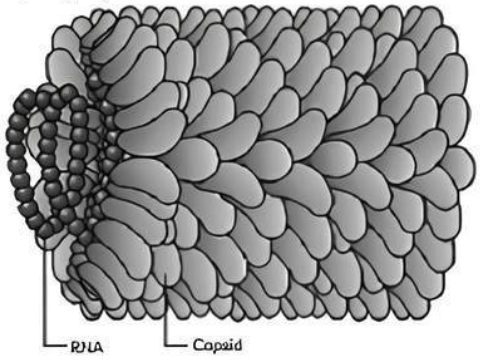
Viruses

Viruses, in reality, are ubiquitous in the living world, infecting, altering, and interacting with all organisms, from the smallest to the largest, and may be found in every ecosystem on the planet. They are as much a part of our daily lives. But what are they, exactly? Is it true that they are alive? What exactly do they do ?

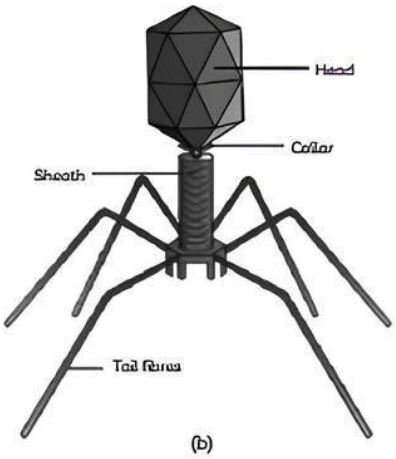
Important

➥ *Whittaker did not included viruses and lichens in his five kingdom classification as viruses are a group of non-cellular, ultramicroscopic and highly infectious agents that multiply inside the living host. Outside the host they are non-living. They are sub-microscopic entities capable of being introduced into specific living cells and reproducing inside the host cells only.*

Viruses are a group of non-cellular/acellular, infectious organisms. They require the host body to multiply or replicate. Outside the host body, they act as an inert particles. They are the connecting link between living and non-living organisms. Dmitri Ivanovsky gave the name virus which means poisonous fluid while extracting an infectious agent causing mosaic disease in the tobacco plants and M.W. Beijerinck named the fluid Contagium vivum fluidum (infectious living fluid) which is extracted from infected plants. W.M. Stanley stated that viruses are obligate parasites and exist in crystalline form outside the host body. Viruses have proteins and contain genetic material that is either RNA or DNA as their genetic material. DNA- containing viruses are known as deoxyviruses while RNA-containing viruses are termed riboviruses. Each of them has two subtypes, double-stranded or single-strand. The viruses which infect bacteria (bacteriophages) have double-stranded DNA.



(a)



(b)

(a) Tobacco mosaic virus (b) Bacteriophage

It has an outer coat of protein called capsid and capsid is made up of several subunits of capsomeres and is closely packed and arranged in helical forms.

Human diseases caused by viruses are mumps, smallpox, herpes, influenza and AIDS, etc.

In plants, the viruses cause various diseases and their symptoms are mosaic formation, leaf rolling and curling, yellowing and vein clearing, dwarfing and stunted growth.

Viroids

Viroids are the smallest self-replicating particles which were discovered by a scientist named T.O. Diener in year 1971.

Viroids are infectious agents composed of free RNA with low molecular weight and lack capsid or protein coat. They are responsible for a plant disease called potato spindle tuber.

Prions

They are misfolded proteins which cause infectious diseases. It can be transmitted from one organism to another. They are similar in size to viruses. The diseases caused by prions are Bovine Spongiform Encephalopathy (BSE) *i.e.*, Mad cow disease in cattle and Cr–Jakob disease (CJD) in humans.

Lichens

Lichens are symbiotic organisms which are formed by a permanent association of a fungus and an alga. The fungal partner of a lichen is called mycobiont whereas the algal partner is called phycobiont. The fungus provides shelter water, minerals and protects the alga from unfavourable conditions and the alga prepares food by the process of photosynthesis. Both are associated in such a manner that if someone actually saw a lichen in nature would never imagine that it is made up of two different organisms. Lichens are very good pollution indicators as they are sensitive to sulphur dioxide. So, they do not grow in polluted areas.

OBJECTIVE Type Questions

[1 mark]

Multiple Choice Questions

1. All eukaryotic unicellular organisms belong to:

(a) Monera (b) Protista
(c) Fungi (d) Bacteria
[NCERT Exemplar]

Ans. *(b) Protista*

Explanation: Protista consists of all the unicellular eukaryotes. While monerans (bacteria) are prokaryotes and fungi are heterotrophic multicellular eukaryotes.

Related Theory

Any eukaryotic organism that is not an animal, plant, or fungus is considered a protist. While protists are likely to have shared a common ancestor, the absence of other eukaryotes means that protists do not form a natural group or clade.

2. The five-kingdom classification was proposed by:

(a) R.H. Whittaker (b) C. Linnaeus
(c) A. Roxberg (d) Virchow
[NCERT Exemplar]

Ans. *(a) R.H. Whittaker*

Explanation: Five-kingdom system of classification was proposed by R.H. Whittaker in 1969.

3. Symbiotic association of fungi with algae is known as:

(a) Mycorrhiza (b) Lichens
(c) Parasitic (d) Saprophytes

Ans. *(b) Lichens*

Explanation: Lichen is a symbiotic association of fungi and algae where both partners are benefited.

Caution

Students usually don't know the exact difference between a parasite and saprophyte. Parasites are those who feed on other organisms for food. Whereas saprophytes obtain their nutrition from dead and decaying organic matter.

4. ..... is an insectivorous plant.

(a) Venus flytrap (b) *Cuscuta*
(c) *Penicillium* (d) *Aspergillus*

Ans. *(a) Venus flytrap*

Explanation: Venus flytrap is an insectivorous plant that traps insects and is dependent on them for food and nutrition, *Cuscuta* is a parasitic plant and *Penicillium and Aspergillus* are fungi.

Related Theory

Insectivorous plants prepare their own food, but they lack some essential nutrients, such as nitrogen, because they grow in nitrogen-deficient soil. They compensate for these nutrients by eating insects. As a result, they are classified as partial heterotrophs.

5. Which of the following includes only prokaryotes?

(a) Monera (b) Protista
(c) Animalia (d) Fungi

Ans. *(a) Monera*

Explanation: Monera is also known as the Kingdom of Prokaryotes since it includes all the prokaryotes, protists are unicellular eukaryotes and Fungi and Animalia are multicellular eukaryotes.

6. Two-kingdom classification was given by:

(a) R.H. Whittaker (b) C. Linnaeus
(c) A. Roxberg (d) Virchow [Diksha]

Ans. *(b) C. Linnaeus*

Explanation: C. Linnaeus gave the two-kingdom system of classification. He divided all the organisms into plants and animals.

7. Which among the following is not a criterion for classification?

(a) Cell structure
(b) Mode of nutrition
(c) Reproduction
(d) Number of organisms

Ans. *(d) Number of organisms*

Explanation: Main criteria used for classification include thallus organisation, mode of reproduction, mode of nutrition, phylogenetic relationships, and cell structure.

8. Sexual reproduction in fungi takes place through:

(a) Conidia (b) Sporangiopores
(c) Zoospores (d) Oospores

Ans. *(d) Oospores*

Explanation: Sexual reproduction in fungi takes place through oospores, ascospores or basidiospores, these are produced within special structures called fruiting bodies.

9. Which of the following is/are correct about viruses?

(I) They did not find a place in biological classification.
(II) They are living.
(III) They are non-cellular organisms which take over the machinery of the host cell on entering it.
(IV) D.J. Ivanowsky found out that certain microbes caused Tobacco Mosaic Disease in tobacco plants.

Options:
(a) (I) and (II) (b) (II) and (III)
(c) (I), (III) and (IV) (d) All of these

Ans. *(c) (I), (III) and (IV)*

Explanation: The correct statements about viruses are:
(1) They did not find a place in biological classification.
(2) Not truly living.
(3) Non-cellular organisms which take over the machinery of host cell on entering it and become living but as such they have inert crystalline structure appear non-living. So, it is difficult to call them living or non-living.
(4) Virus means venom or poisonous fluid. Pasteur gave the term 'virus'.
(5) D.J. Ivanowsky found out that certain microbes caused Tobacco Mosaic Disease in tobacco plants.

10. **The organism which completely lack a cell wall is:**
(a) Cyanobacteria (b) *Nostoc*
(c) *Anabaena* (d) Mycoplasma

Ans. *(d) Mycoplasma*

Explanation: Mycoplasma are unicellular and pleomorphic *i.e.*, they have many forms. They have no definite shape due to the absence of a distinct cell wall and others have a well-defined rigid cell wall. Cyanobacteria, *Nostoc and Anabaena* have a thick gelatinous cell wall made up of cellulose.

11. **Which of the following organisms helps in the production of biogas?**
(a) Halophiles
(b) Methanogens
(c) Thermoacidophiles
(d) Thermoproteus

Ans. *(b) Methanogens*

Explanation: Methanogens are the only organisms which help in fermentation of cattle dung to produce fuel and it also decomposes animal waste to produce biogas which is used to run generators for electricity.

Halophiles tolerate high salinity and thermoacidophiles can grow at extremely low pH and can tolerate high temperatures.

12. **A dikaryon is formed when:**
(a) Meiosis is arrested.
(b) The two haploid cells do not fuse immediately.
(c) Cytoplasm does not fuse.
(d) None of the above [NCERT Exemplar]

Ans. *(b) The two haploid cells do not fuse immediately.*

Explanation: A dikaryon is formed when a cell becomes binucleate. In the first stage of sexual reproduction, the cytoplasm of two sex cells fuse with each other and the nuclei of two sex cells are close to each other but do not fuse, this results in the formation of dikaryotic cells.

Related Theory

In lower fungi, the plasmogamy is immediately followed by karyogamy and meiosis whereas in higher fungi karyogamy is delayed, so fungus remain dikaryotic.

13. **Statement A: Viruses are regarded as living particles.**
Statement B: Virus has enzyme activity away from its host.
(a) Both A and B are correct.
(b) Both A and B are incorrect.
(c) Only A is correct.
(d) Only B is correct.

Ans. *(b) Both A and B are incorrect.*

Explanation: Viruses are considered biological systems because they contain molecular information in the form of nucleic acid (DNA or RNA), which is transcribed and replicated within host cells. Viruses are classified as non-living particles because none of them have enzymatic activity outside their host.

Related Theory

Study of science which deals with algae is known as Phycology or algology.

14. **Among these, which major group of Protista shows Bioluminescence?**
(a) Diatoms (b) Dinoflagellates
(c) Protozoans (d) Slime moulds

Ans. *(b) Dinoflagellates*

Explanation: The majority of dinoflagellates are plankton and cover the surface of water.

Their bodies impart colors which make the sea surface glow in the dark. And other classes do not possess the feature of imparting color from the body.

15. Identify the group which have indestructible cell walls.

(a) Chrysophytes **(b) Dinoflagellates**
(c) Euglenoids **(d) Protozoans**

Ans. *(a) Chrysophytes*

Explanation: The group, chrysophyte includes diatoms. The siliceous cell wall of these diatoms are indestructible *i.e.*, do not decay easily. They were collected over millions of years on the sea floors and form diatomaceous earth while others cell wall are mainly made up of cellulose.

16. The viruses which infect plants have genetic material as:

(a) single-stranded RNA
(b) double-stranded RNA
(c) single-stranded DNA
(d) double-stranded DNA

Ans. *(a) single-stranded RNA*

Explanation: The viruses which infect plants have a single-stranded RNA and the virus which infect animals have either single or double-stranded RNA or double-stranded DNA and bacteriophage have double-stranded DNA.

17. An association between roots of higher plants and fungi is called:

(a) Lichen **(b) Fern**
(c) Mycorrhiza **(d) BGA**

[NCERT Exemplar]

Ans. (c) *Mycorrhiza*

Explanation: Mycorrhiza is the symbiotic association of fungi with roots of higher plants. The fungus is dependent for food and shelter while plants are benefitted as the fungus is involved in absorption of water and minerals from soil. Lichens are symbiotic association with algae and fungi, ferns are from plantae kingdom having a vascular system and BGA are blue-green algae.

18. Difference between Virus and Viroid is:

(a) Absence of protein coat in viroid but present in virus.
(b) Presence of low molecular weight RNA in virus but absent in viroid.
(c) Both (a) and (b)
(d) None of the above

Ans. *(a) Absence of protein coat in viroid but present in virus.*

Explanation: Both virus and viroids are infectious agents and both of them require a host for survival. There is a difference in their genetic material and a protein coat is present in viruses but absent in viroids.

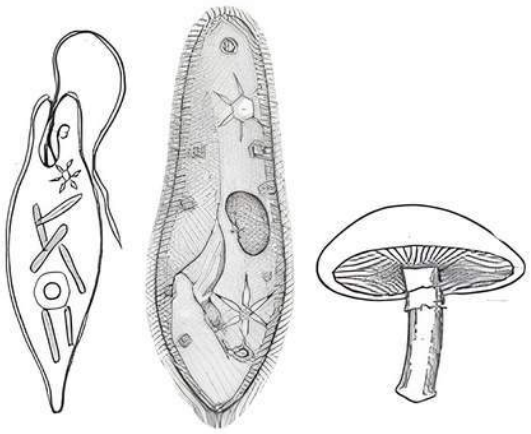
19. Which of the following is not the locomotory organ of protozoa?

(a) Cilia **(b) Flagella**
(c) Parapodia **(d) Pseudopodia**

Ans. *(c) Parapodia*

Explanation: Locomotory organs for protozoa are cilia, flagella or pseudopodia whereas parapodia are the organ of worms used in locomotion as well as in respiration.

20. Identify the figures A, B and C given below.



A B C

(a) A-*Euglena*, B-*Paramecium*, C-*Agaricus*
(b) A-*Euglena*, B- *Planaria*, C - *Agaricus*
(c) A-*Planaria*, B-*Paramecium*, C-*Agaricus*
(d) A-*Euglena*, B-*Paramecium*, C-*Aspergillus*

Ans. *(a) A-Euglena, B-Paramecium, C-Agaricus*

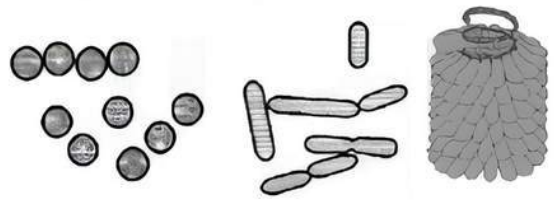
21. **Statement A:** **Heterocysts are specialised cells of green algae for phosphorus fixation.**
Statement B: **Heterocyst cells lack photo-synthetic oxygen evolution.**

(a) Both A and B are correct.
(b) Both A and B are incorrect.
(c) Only A is correct.
(d) Only B is correct.

Ans. *(d) Only B is correct.*

Explanation: Cyanobacteria (also known as blue-green algae) are photosynthetic autotrophs with chlorophyll a similar to green plants. Cyanobacteria are freshwater marine or terrestrial algae that are unicellular, colonial, or filamentous. A gelatinous sheath surrounds the colonies in general. They frequently form blooms in polluted bodies of water. Some of these organisms, such as *Nostoc* and *Anabaena*, can fix atmospheric nitrogen in specialised cells called heterocysts.

22. Identify the following.



A B C

(a) A - Tobacco mosaic virus, B - Coccus, C-Bacillus

(b) A- Coccus, B - Bacillus, C -Tobacco mosaic virus

(c) A-Bacillus, B - Coccus, C-Tobacco mosaic virus

(d) A - Coccus, B - Tobacco mosaic virus, C- Bacillus

Ans. *(b) A- Coccus, B - Bacillus, C -Tobacco mosaic virus*

Explanation: The given figures represent different types of organisms. Figure 'A' is Coccus, 'B' is Bacillus and 'C' is Tobacco mosaic virus.

23. Statement A: All the organisms of Kingdom Animalia lack a simple cellular character.

Statement B: All organisms of Kingdom Animalia have cell wall.

(a) Both A and B are correct.

(b) Both A and B are incorrect.

(c) Only A is correct.

(d) Only B is correct.

Ans. *(c) Only A is correct.*

Explanation: Members of Kingdom Animalia are multicellular organisms which do not possess chlorophyll. They are eukaryotic organisms. Cell wall is absent.

Assertion-Reason (A-R)

Given below are two statements labelled as Assertion (A) and Reason (R). Select the most appropriate answer from the options given below:

(a) Both A and R are true and R is the correct explanation of A.

(b) Both A and R are true and R is not the correct explanation of A.

(c) A is true but R is false.

(d) A is false but R is true.

24. Assertion (A): *Penicillium* is used to make antibiotics.

Reason (R): It is a protist.

Ans. *(c) A is true but R is false.*

Explanation: *Penicillium* belongs to Kingdom Fungi, it is used as a source of antibiotics because it stops bacteria from developing the walls that enclose them, preventing them from growing.

Related Theory

Fungi are organisms that are heterotrophic. Their cell wall is made up of chitin. It has a wide range of morphologies. It may be found in a variety of environments. They are cosmopolitan, meaning they may be found in the air, water, soil, and on plants and animals. They grow well in warm, humid environments. Fungi that feed on dead substrates are known as saprophytes.

25. Like small signposts, these curious organisms can tell us a lot about the air we are breathing.

Why not just look at an air quality index? While an index is helpful in some cases, lichens are able to tell us the effects of air pollution on ecosystems, not just of the number of pollution particles in the air. This is handy if you want to know how air pollution is changing ecological communities and what that means for the people who live in and rely on them.

If you don't yet know what lichens look like, once you start searching you might see them growing everywhere, even in the unlikeliest of places.

Assertion (A): Lichen is a symbiont.

Reason (R): It is a mutual association of algae and fungi.

Ans. *(a) Both A and R are true and R is the correct explanation of A.*

Explanation: A symbiont is an organism that lives in a symbiotic relationship. Symbiosis refers to long-term relationships between organisms of different species in which both symbionts benefit from each other. For example, Lichens.

Caution

It is important to note that if Lichens do not grow in an area; pollution is indicated. Lichens are pollution indicators that identify the presence of pollution. Therefore it is said that Lichens do not grow in polluted areas.

26. Assertion (A): *Cuscuta* is a parasitic plant.

Reason (R): It feeds on insects.

Ans. *(c) A is true but R is false.*

Explanation: A parasite is a creature that lives on or in the body of its host and feeds on or at the cost of that host. For example, *Cuscuta* derives valuable nutrients from the host plant and deprives them, it is a leafless plant with yellow stem, chlorophyll is absent *i.e.*, does not synthesise its own food.

27. **Assertion (A):** **Fungi reproduces sexually by oospores.**

Reason (R): **Spores are produced in distinct structures called fruiting bodies.**

Ans. *(b) Both A and R are true and R is not the correct explanation of A.*

Explanation: The majority of fungus reproduce by producing spores that can withstand harsh circumstances like cold and lack of water. Depending on the species and circumstances, both sexual meiotic and asexual mitotic spores can be formed. Oospore is a thick-walled sexual spore. Fruiting bodies are structures that carry spores.

28. **Assertion (A):** **The mushrooms are considered as plants.**

Reason (R): **Mushrooms are heterotrophs.**

Ans. *(d) A is false but R is true.*

Explanation: Mushrooms are heterotrophs which cannot make their own food due to lack of chlorophyll, and they feed on organic matter. They are not regarded as plants and are included in fungi. They are saprotrophic in nature.

29. **Assertion (A):** ***Amoeba*, *Euglena* and protozoans all belong to Kingdom Protista.**

Reason (R): **Protista includes all unicellular eukaryotic organisms.**

Ans. *(a) Both A and R are true and R is the correct explanation of A.*

Explanation: The main feature possessed by all the Protists:

(1) They are unicellular and eukaryotic.

(2) They have diverse types of nutrition which either derive their nourishment from surrounding or prepare their own food.

CASE BASED Questions (CBQs)

[**4** & **5** marks]

Read the following passages and answer the questions that follow:

30. *The organism shown in the given picture is an example of a symbiotic relationship between two organisms in which one of the partners is algae and it is a good pollution indicator. It is also found associated with roots of higher plants as mycorrhiza.*

(A) Name the organism shown in the picture given above.

(B) Name the kingdom to which this organism belongs.

(C) Write about the relationship shown above. Explain with example.

Ans. (A) Lichen is shown in the above given picture. It is an association of fungus and algae in which both are mutually benefitted and show mutualism.

(B) Lichens are often referred to as lichenized fungi and they belong to the Kingdom fungi.

(C) Lichens have a symbiotic relationship between a fungus and a chlorophyll-containing partner, such as green algae, cyanobacteria, or both. The fungus creates a proper environment for the partner, which feeds the system with photosynthetically fixed carbon as an energy source.

Examples: *Saccharomyces*, *Penicillium* and *Aspergillus*.

31. *The Kingdom Plantae and the Kingdom Animalia are the two kingdoms that were classified by a scientist. The mechanism of nourishment, reproduction, and the presence or absence of a cell wall were used to classify these organisms. However, there were several flaws in this system, such as the lack of differentiation between eukaryotes and prokaryotes. The three-kingdom classification followed, with single-celled bacteria and protozoans classified as Protista. Additionally, this method failed to classify all living species into relevant categories. Finally, a five-kingdom*

classification system was devised, which divided all organisms into five kingdoms and was adopted as a modern classification system.

(A) Whittaker's definition of classification does not include:

(a) Algae **(b) Protista**

(c) Plantae **(d) Fungi**

(B) Linnaeus proposed which kingdom of classification?

(a) Two kingdom **(b) Three kingdom**

(c) Four kingdom **(d) Five kingdom**

(C) Classification is not based on:

(a) Cell structure

(b) Phylogenetic relationships

(c) Reproduction

(d) Gross morphology

(D) Which among the following is not a significance of classification?

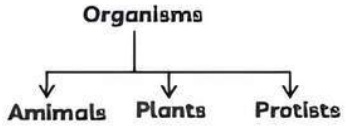
(a) To make identification and the study and research easier for diverse life forms.

(b) Gives a glance of all the organisms in one picture.

(c) To determine inter-relationships among the organisms.

(d) To know the number of total organisms.

(E) Who proposed the following classification?



(a) Ernst Haeckel **(b) Linnaeus**

(c) R.H. Whittaker **(d) Edward Jenner**

Ans. (A) *(a) Algae*

Explanation: Algae is not included in the classification system proposed by Whittaker.

(B) *(a) Two kingdom*

Explanation: Linnaeus gave two-kingdom classification *i.e.*, Plantae and Animalia which segregated plants and animals. Drawback of this system was that it does not segregate eukaryotes and prokaryotes, unicellular and multicellular, and photosynthetic and non-photosynthetic organisms.

(C) *(d) Gross morphology*

Explanation: Gross morphology is not a parameter that is used for classification in taxonomy. The most important characteristics for the classification of organisms are:

Cell structure- cell wall present or absent. Thallus organisation. Mode of nutrition- autotrophic or heterotrophic.

Reproduction - sexual or asexual. Phylogenetic relationships.

(D) *(d) To know the number of total organisms.*

Explanation: Importance of classification includes:

(1) To make identification and the study, research easier for diverse life forms.

(2) Gives a glance of all the organisms in one picture.

(3) To make us understand and study the similarities, characteristics and differences among organisms so that grouping can be easy.

(4) To trace the ancestry *i.e.*, evolutionary relationships among them, understand missing links, connecting links.

(5) To understand the exact position of an organism in classification.

(6) To determine inter-relationships among the organisms.

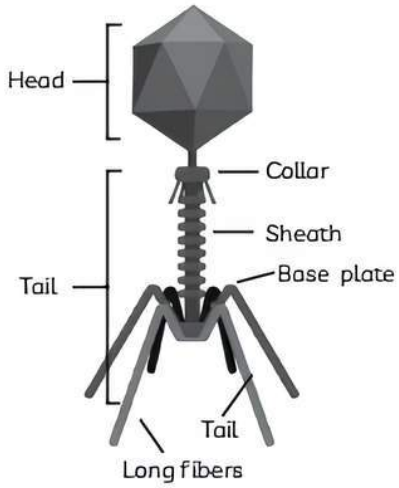
(E) *(a) Ernst Haeckel*

Explanation: Given classification is three- kingdom classification. Ernst Haeckel proposed a three-kingdom categorisation scheme in which he classified organisms into Animalia, Plantae, and Protista.

32. *The emergence of pathogenic bacteria resistant to most, if not all, currently available antimicrobial agents has become a critical problem in modern medicine, particularly because of the concomitant increase in immunosuppressed patients. The concern that humankind is reentering the "pre antibiotic" era has become very real, and the development of alternative anti-infection modalities has become one of the highest priorities of modern medicine and biotechnology.*

Prior to the discovery and widespread use of antibiotics, it was suggested that bacterial infections could be prevented and/or treated by the administration of bacteriophages.

Observe the diagram of bacteriophage shown alongside and answer the following questions:



(A) The viruses which attack the bacterial cells are:

(a) Bacteriophages (b) Cyanophages

(c) Plasmid (d) None of these

(B) The genome of bacteriophage consist of:

(a) either DNA or RNA

(b) both DNA or RNA

(c) DNA only

(d) RNA only

(C) When viral genome is integrated into the bacterial genome they are known as:

(a) Prophage (b) Plasmid

(c) Peplomers (d) Capsid

(D) The structure of head of bacteriophage is:

(a) spirally coiled

(b) hexagonal

(c) cylindrical

(d) elongated rod-shaped

(E) Which of the following is the example of the figure shown above ?

(a) TMV (b) Pseudomonas

(c) T_4 virus (d) Retrovirus

Ans. (A) *(a) Bacteriophages*

Explanation: The virus which infects bacteria is called bacteriophage.

(B) *(a) either DNA or RNA*

Explanation: Bacteriophages have either DNA or RNA as their genetic material.

(C) *(a) Prophage*

Explanation: When the viral genome integrates with a bacterial genome it is called Prophage. They carry DNA that can behave as genetic material (episome) in bacteria.

(D) *(b) hexagonal*

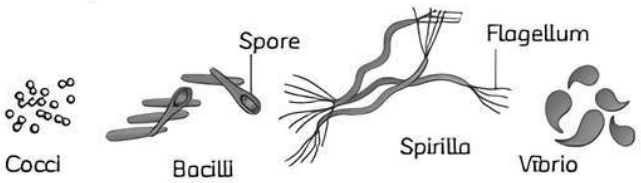
Explanation: The head of bacteriophage is polyhedral *i.e.*, hexagonal prism shaped with pyramidal ends.

(E) *(c) T_4 virus*

Explanation: T_4 virus is a bacteriophage which invades *E.coli* for its life cycle.

33. *The first issue to get settled is that the shape of a bacterium has biological relevance. One argument favouring this assertion is that even though bacteria have a wide variety of shapes, any one genus typically exhibits a limited subset of morphologies, hinting that, with a universe of shapes to choose from, individual bacteria adopt only those that are adaptive. Another clue is that some bacteria can modify their morphology in response to environmental cues or during the course of pathogenesis, suggesting that shape is important enough to merit regulation.*

The figures show different types of bacterial cells on the basis of their shape. Observe the figures and answer the following questions.



(A) What type of shape does the genus of bacteria *Bacillus* have?

(B) Name the organism which has one or more flagella at one pole and are rod-shaped with a single curve.

(C) (i) Name the organism whose body is filamentous like a fungal mycelia.

(ii) What do you mean by pleomorphic?

Ans. (A) *Bacillus* bacteria are straight rod or cylindrical-shaped. Its ends may be pointed or flat.

(B) Vibrio

(C) (i) Thiothrix.

(ii) Those bacteria who are able to change their shape under environmental conditions are called pleomorphic.

VERY SHORT ANSWER Type Questions (VSA)

[1 mark]

34. Are chemosynthetic bacteria autotrophic or heterotrophic? [NCERT Exemplar]

Ans. Chemosynthetic microorganisms are naturally autotrophic as they utilise the energy

generated from oxidising inorganic compounds including nitrates, nitrites, and ammonia to produce ATP.

35. What is the salient feature of viruses?

Ans. They do not have an independent metabolism.

36. Name the major groups of fungi.

Ans. Phycomycetes, Ascomycetes, Basidiomycetes and Deuteromycetes.

37. *Nostoc* and *Anabaena* have specialised cells called heterocysts. What is the function of these cells? [Delhi Gov. QB 2022]

Ans. Heterocysts help in nitrogen fixation as they provide the anaerobic (oxygen-free) environment necessary for the operation of the nitrogen-fixing enzymes.

Related Theory

Heterocyst are thick-walled cell inclusions that are impermeable to oxygen.

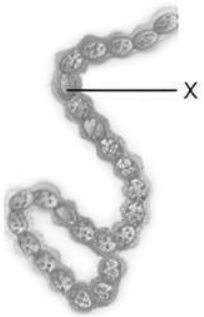
38. Some symbiotic organisms are very good pollution indicators and composed of a chlorophyllous and a non-chlorophyllous member. Describe them. [Delhi Gov. QB 2022]

Ans. Lichen is a symbiotic association of an algae (chlorophyllous) and a fungi (non-chlorophyllous).

39. Food can be kept for a longer time in a cold house than in normal conditions. Why?

Ans. The activity of bacteria found in food items decreases exponentially when it is stored in cooler temperatures. The chemical reactions in the meal are delayed as a result of this reduction. This has the effect of making microorganisms inactive.

40. The given figure shows the structure of filamentous blue-green algae *Nostoc* with a structure marked as "X".



What does 'X' denotes here?

Ans. 'X' is heterocyst. Heterocysts are colourless cells found in cyanobacteria that act as a nitrogen fixer. They are the site of nitrogen fixation as they contain the enzyme nitrogenase required for nitrogen fixation.

41. A scientist "P" demonstrated that extract of infected plants of "Q" could cause infection in healthy plants and called the fluid as "Contagium vivum fluidum". Identify P and Q.

Ans. P is M. W. Beijerinek and Q are tobacco plants.

Related Theory

M. W. Beijerinek demonstrated that extract of infected plants of tobacco could cause infection in healthy plants and called the fluid as "Contagium vivum fluidum".

42. Protozoans are not included in Kingdom Animalia. Discuss.

Ans. Protozoans come under the Kingdom Protista which are single-celled eukaryotes as they are heterotrophs and live as predators or parasites.

43. When a moist bread is kept exposed in air, it becomes black. What is the reason for this?

Ans. When moist bread is kept exposed in air, it becomes black due to the growth of mould. Mould is a type of fungi, whose spores are frequently present in the air. They germinate on the bread when kept in the open for a long time.

SHORT ANSWER Type-I Questions (SA-I)

[2 marks]

44. A farmer grows tomato and many crops in his fields. What would you call these crops in terms of nutrition? Name their types. [Diksha]

Ans. Tomato plant is an autotroph. Autotrophs refers to those organisms that have capability of making their own food by using simple inorganic substances as raw materials, using energy from outside like Sun to make their food. It can be Chemoautotrophs, Anoxygenic Photoautotrophs and Oxygenic Photoautotrophs.

45. Not all organisms show photosynthetic activity. One such example is chemoautotrophs. Define them.

Ans. Chemoautotrophs are creatures that get their energy from a chemical process, but their carbon source is carbon dioxide, which is the most oxidised form of carbon (CO_2). Chemolithoautotrophs, which utilise inorganic

energy sources such as ferrous iron, hydrogen, hydrogen sulphide, elemental sulphur, or ammonia, and CO_2 as their carbon source, are the most well-known chemoautotrophs.

46. How is the five-kingdom classification advantageous over the two-kingdom classification? [NCERT Exemplar]

Ans. Linnaeus gave the two-kingdom classification *i.e.*, Plantae and Animalia which segregated plants and animals. Drawback of this system was that it did not segregate eukaryotes and prokaryotes, unicellular and multicellular, photosynthetic and non-photosynthetic organisms. R.H. Whittaker (1969) proposed the most widely accepted five-kingdom classification of organisms. The kingdoms defined by him were Monera, Protista, Fungi, Plantae, and Animalia. In comparison to the two-kingdom categorisation, the animal and plant kingdoms become more homogeneous. As a result, it is better than the two-kingdom classification system.

47. What was the main criteria used for classification?

Ans. The main criteria used by R.H. Whittaker for classification were:

(1) Cell structure – Cell wall present or absent
(2) Thallus organisation
(3) Mode of nutrition – Autotrophic or heterotrophic
(4) Reproduction – Sexual or asexual
(5) Phylogenetic relationships

48. Define each of the following with an example.

(A) Insectivorous plants

(B) Parasitic plants

Ans. (A) Insectivorous plants are those that get the majority of their sustenance from catching and eating insects. They fulfil their requirement of obtaining nutrients such as nitrogen from insects. For example, Venus flytrap and Bladderwsort.

(B) A parasitic plant is one that receives some or all of its sustenance from another living organism. For example, *Cuscuta*.

49. Define the following terms with one example of each.

(A) Saprophytes

(B) Symbionts

Ans. (A) Saprophytes mean *sapro*-dead matter, *phytes*-plants, it refers to plants that feed on dead and decaying organic matter. For example, Mushrooms and moulds.

(B) A symbiont is an organism that lives in a symbiotic relationship. Symbiosis refers to long-term relationships between organisms of different species in which both symbionts benefit from each other. For example, Lichens.

50. What do the terms 'algal bloom' and 'red-tides' signify? Describe briefly.

Ans. Algal blooms are found in contaminated water. This is the excessive growth of algae, especially blue-green algae (cyanobacteria) which leads to water pollution.

Rapid multiplication of red-pigmented dinoflagellates, such as *Gonyaulax*, gives sea a red colour, and this phenomenon is known as red tides. These algae produce toxins that kill fish and other aquatic organisms.

51. How diatomaceous earth is formed?

Ans. The siliceous cell wall of diatoms does not decay easily. They pile up at the bottom of water reservoirs and form big heaps called diatomite. These deposits may extend for several hundred meters in certain areas. This results in the formation of diatomaceous earth.

52. Explain about the locomotion found in Protista.

Ans. The protists show different types of locomotion. They use different types of structures like pseudopodia, in which protoplasmic outgrowth occurs and this type of locomotion is slow. Flagella is the whip-like structure that moves independently and causes movement and cilia are hair-like projections which work by beating. They also show wriggling and mucilage propulsion.

53. What observable features in *Trypanosoma* would make you classify it under the Kingdom Protista? [Diksha]

Ans. There are some features in *Trypanosoma* that make us classify it under the Kingdom Protista:

(1) It is unicellular.
(2) It has a centrally located nucleus.
(3) Method of reproduction is asexual.
(4) Reserve food material in the form of granules.

54. Give the salient characteristics of dinoflagellates.

Ans. Salient features of dinoflagellates are:

(1) They are unicellular, found in both fresh and marine water and are photosynthetic in nature.

(2) Cells are generally covered by a rigid coat called theca or lorica and sculptured plates of cellulose.
(3) Some marine dinoflagellates show bioluminescence *i.e.*, they emit light and make the sea surface glow in the dark.
(4) They reproduce asexually through cell division or by formation of cysts and in the case of sexual reproduction, it is isogamous and anisogamous.

SHORT ANSWER Type-II Questions (SA-II)

[3 marks]

55. Viruses and viroids differ in structure and the diseases they cause. How?
[Delhi Gov. QB 2022]

Ans. While viruses can have either RNA or DNA molecules enclosed in a protein coat, viroids are free, low molecular weight RNA molecules without any protein coat. Viroids are smaller than viruses in size. Viruses infect all types of creatures, but viroids exclusively infect plants. A protein covering or coat known as a capsid is present around the genetic material in viruses but is lacking in viroids.

56. Differentiate types of bacteria based on their shape. **[NCERT Exemplar]**

Ans. The different types of bacteria based on their shape are:
(1) **Cocci:** They are spherical in shape. For example, *Streptococcus pneumoniae* causes pneumonia in human beings.
(2) **Bacilli:** They are rod shaped bacteria. For example, *Lactobacillus* that helps to convert milk into curd.
(3) **Spirilla:** These are spiral shaped bacteria mostly found singly.
(4) **Vibrio:** These are comma shaped bacteria. For example, *Vibrio cholerae* that causes cholera in human beings.

57. Differentiate between Kingdom Protista and Kingdom Fungi.

Ans.

S. No.	Kingdom Protista	Kingdom Fungi
(1)	They are unicellular eukaryotes.	They are mostly multicellular eukaryotes.
(2)	They may or may not have cell wall.	Cell walls are made up of chitin.
(3)	They may be autotrophs or heterotrophs.	These are heterotrophs.
(4)	They reproduce by binary fission or gamete formation.	They reproduce by spores.
(5)	**Examples:** *Euglena, Paramecium*	**Examples:** *Aspergillus, Rhizopus*

(Any three)

58. Differentiate between Kingdom Monera and Kingdom Protista.

Ans.

S. No.	Kingdom Monera	Kingdom Protista
(1)	They are unicellular prokaryotes.	They are unicellular eukaryotes.
(2)	Possess cell wall but lack defined nucleus.	Both cell wall and well-defined nucleus are present.
(3)	Membrane bound organelles absent.	Membrane bound organelles present.
(4)	Found in all habitats.	Mostly aquatic.
(5)	***Examples:*** Bacteria	***Examples:*** *Amoeba, Paramecium*

(Any three)

59. Differentiate between Kingdom Plantae and Kingdom Animalia.

Ans.

S. No.	Kingdom Plantae	Kingdom Animalia
(1)	Cell wall is present and made up of cellulose.	Cell wall absent.
(2)	Autotrophs *i.e.*, synthesise their own food.	Heterotrophs.
(3)	Locomotion absent.	Capable of locomotion.
(4)	Growth is unlimited.	Growth is limited.
(5)	***Examples:*** Mosses, Ferm, Flowering Plants.	***Examples:*** Sponges, Worm, Insects, Fishes, Mammals.

(Any three)

60. Give suitable examples of the following:

(A) Nitrogen-fixing monerans

(B) Anaerobes that live in the rumen of herbivorous animals

(C) Wall-less monerans

Ans. (A) *Anabaena*

(B) Methanogens

(C) Mycoplasma

61. A virus is considered as a living organism and an obligate parasite when inside a host cell. But viruses are not classified along with bacteria or fungi. What are the characteristics of viruses that are similar to non-living objects? [NCERT Exemplar]

Ans. Virus act as living organisms inside a host cell. But viruses are not classified along with bacteria or fungi because they exist as an inert crystalline structure outside the living cell. They are inert outside their specific host cell and cannot multiply on their own because they lack cellular machinery to use its genetic material.

62. Why are most antibiotics ineffective against viral diseases?

Ans. Antibiotics are produced by microorganisms that act against the growth and development of other microorganisms. Many antibiotics interfere with pathogen protein synthesis. Some prevent cross linking of glycan chains in bacterial cell walls. Since the viruses do not possess cell wall and their own protein synthesis so, they are not attacked by antibiotics.

LONG ANSWER Type Questions (LA)

[**4** & **5** marks]

63. Biological classification is a dynamic and ever evolving phenomenon which keeps changing with our understanding of life forms. Justify the statement by taking any two examples. [NCERT Exemplar]

Ans. *Chlamydomonas*, *Chlorella* (both of which have cell walls and were previously seen in algae within plants), *Amoeba*, and *Paramecium* formed the Kingdom Protista (earlier placed in the animal kingdom as both lacking cell walls). Organisms such as *Chlamydomonas* and *Amoeba* that were formerly classified in various kingdoms have been grouped together in the five-kingdom categorisation. Because the categorisation criteria changed, this alteration took place. Depending on our understanding of traits and evolutionary linkages, similar changes will occur in the future as well. As a result, biological taxonomy is a dynamic and ever-changing process that changes as our knowledge of growing of living forms.

64. Rekha's teacher taught her about various types of organisms such as algae, plants, fungi, animals etc. But she is confused and unable to find similarities and differences between plants and fungi. Help her by giving a clear description of the similarities and differences between plants and fungi.

Ans. Similarities :

(1) Both the kingdoms consists of eukaryotic organisms.

(2) Cell walls are present in both.

(3) Cell comprises of numerous organelles.

(4) Both can reproduce sexually and asexually.

(5) Mostly anchored in soil or some other substrate.

(6) Stationary *i.e.*, can not move on their own.

Differences:

S. No.	Plants	Fungi
(1)	Contains one nucleus per cell.	Contains more than one nucleus per cell *i.e.*, multi-nucleated.
(2)	Mostly autotrophic.	Heterotrophic.
(3)	Food stored in form of starch.	No storage molecule.
(4)	Possess roots.	Roots absent instead mycelium is present.
(5)	Cell wall are made up of cellulose.	Cell walls are made up of chitin.
(6)	Some reproduce by seeds or by vegetative propagation.	Reproduce by sexual or asexual spores.

65. Rahul took an ascocarp and a basidiocarp for experiment. But he don't know about similarities and differences between them. Help him by giving few points of similarities and differences.

Ans. Similarities:

(1) Both are fruiting bodies of fungi.

(2) Both of the structures produce spores.

(3) They have a hymenium.

(4) They are unique to fungi.

Differences:

S. No.	Ascocarp	Basidiocarp
(1)	It is a fruiting body found in Ascomycetes.	It is a fruiting body found in Basidiomycetes.
(2)	It is simpler in construction.	It is more elaborate in construction.
(3)	It contains numerous asci.	It contains several basidia.
(4)	Ascus is generally aseptate.	Basidium may be septate or aseptate.
(5)	These are formed endogenously.	These are formed exogeneously.

66. Compare the classes of fungi under the following:

(1) Mode of nutrition

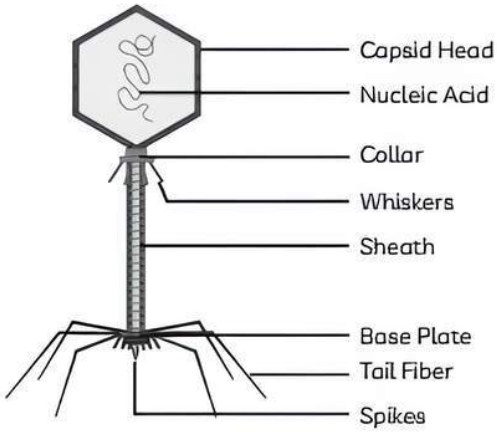
(2) Mode of reproduction

Ans.

Classes of Fungi	Mode of Nutrition	Mode of Reproduction
Phycomycetes	Mostly aquatic and parasitic in nature. They also decay wood in moist areas.	Asexual reproduction by zoospores and aplanospores and sexual reproduction by formation of oospores.
Ascomycetes	They are saprophytic, decomposers, parasitic and coprophilous (grow on dung).	Asexual reproduction by the formation of conidiophores and sexual reproduction by ascospores.
Basidiomycetes	They are saprophytes and parasites.	Asexual reproduction by fragmentation and sexual reproduction by formation of basidiospores.
Deuteromycetes	Mostly parasites.	Asexual reproduction by spores conidia and sexual reproduction is not known.

67. Explain and draw a well-labeled diagram of bacteriophage.

Ans. Bacteriophage is a virus which infects bacteria consisting of a head and a tail of approximately equal length. The head is polyhedral and it has an outer coat of protein enclosing a single molecule of DNA. Its DNA is double helix, coiled and long. The tail is narrow. It is made up of four different types of protein components. The tail sheath protein is contractile and bears disc-like hexagonal plates and at the end it bears six spikes attached to tail fibres.



T_4 Bacteriophage

68. Discuss how the system of biological classification has evolved in the past.

[Delhi Gov. QB 2022]

Ans. With time, the classification systems have undergone numerous alterations.

Aristotle made the first attempt at classification. He divided plants into three categories—trees, shrubs and herbs. On the other side, red blood cell presence or absence was used to categorise animals. The known organisms cannot all be categorised using this technique.

As a result, Linnaeus proposed a two-kingdom classification scheme. Kingdom Plantae and Kingdom Animalia are its constituent parts. However, this approach did not distinguish between eukaryotes and prokaryotes or between unicellular and multicellular creatures.

As a result, there were numerous species that fell outside of the two kingdoms.

In order to address these issues, R.H. Whittaker proposed the five-kingdom system of classification in 1969. Five kingdoms—Monera, Protista, Fungi, Plantae, and Animalia—were established based on traits such as cell shape, mode of nourishment, the presence of cell walls, etc.