XI
2

BIOLOGICAL CLASSIFICATION

SYLLABUS

Five kingdom classification; salient features and classification of Monera; Protista and Fungi into major groups; Lichens; Viruses and Viroids.

KEY CONCEPTS

KINGDOM SYSTEMS OF CLASSIFICATION

1. Two Kingdom Classification

* It was given by Linnaeus.
* Traditionally all the organisms of the world were divided into two kingdoms -the animal kingdom (Animalia) and the plant kingdom (Plantae).
* The major criterion of classification was the presence or absence of cell wall.
* Other criterias were locomotion, mode of nutrition, response to external stimuli etc.

Short comings of two-kingdom system of classification:

* This system did not distinguish between the eukaryotes and prokaryotes, unicelled and multicelled organisms, photosynthetic and non-photosynthetic organisms.
* There are few organisms like Chlamydomonas, Euglena and the slime moulds which have been claimed by both zoologists and botanists (organisms which share characteristics of both animals and plants).
* Since there are certain organisms that do not fall naturally into either plant or animal kingdom, it was proposed that a new kingdom is to be established to accommodate such organisms.

2. Three Kingdom Classification

* Haeckel, a German zoologist (1866), suggested that a third kingdom Protista, be created to include all unicellular microorganisms.
* This includes a wide variety of unicellular, mostly aquatic eukaryotes like -Fungi, Protozoa, Algae, Bacteria and Slime moulds.
* Thus, he proposed three kingdoms, namely - Plantae, Protista and Animalia.

3. Four Kingdom Classification

* Copeland (1956) gave four kingdom of classification and included Monera as fourth kingdom.
* Copeland originally called it as kingdom 'Mychota'.
* It was called **'Monera'** by Daugherty and Allen.
* Kingdom Monera includes all the prokaryotic organisms i.e., eubacteria (including cyanobacteria, formerly known as blue-green algae) and archaebacteria.
* The actinomycetes (filamentous bacteria) are also included in this kingdom.

4. Five Kingdom Classification

* According to five-kingdom concept proposed by R.H. Whittaker.

* Whittaker (1969), the organisms are divided into five kingdoms namely Monera, Protista, Fungi, Plantae, Animalia, on the basis of the following criteria:

(a) Complexity of cell structure: prokaryotic vs eukaryotic organisation of cells.

(b) Complexity of body organisation: unicellularity vs multicellularity; simple multicellular forms to complex multicellular forms.

(c) Mode of nutrition: Autotrophic vs heterotrophic (parasitic or saprobic or ingestive organisms).It was the major criteria of this classification system.

(d) Reproduction.

(e) Phylogenetic or evolutionary interrelations.

* **Characterics of five kingdoms**

Characters	Five Kingdoms				
	Monera	**Protista**	**Fungi**	**Plantae**	**Animalia**
Cell type	Prokaryotic	Eukaryotic	Eukaryotic	Eukaryotic	Eukaryotic
Cell wall	Noncellular (Polysaccharide + amino acid)	Present in some	Present (without cellulose) with chitin.	Present (cellulose)	Absent
Nuclear membrane	Absent	Present	Present	Present	Present
Body organisation	Cellular	Cellular	Multiceullar/loose tissue	Tissue/organ	Tissue/organ/organ system
Mode of nutrition	Autotrophic (chemosynthetic and photosynthetic) and Heterotrophic (saprophyte/ parasite)	Autotrophic (Photosynthetic) and Heterotrophic	Heterotrophic (Saprophytic/ Parasitic)	Autotrophic (Photosynthetic)	Heterotrophic (Holozoic/Saprophytic etc.)

Merits of R.H Whittaker 5 Kingdom Classification:

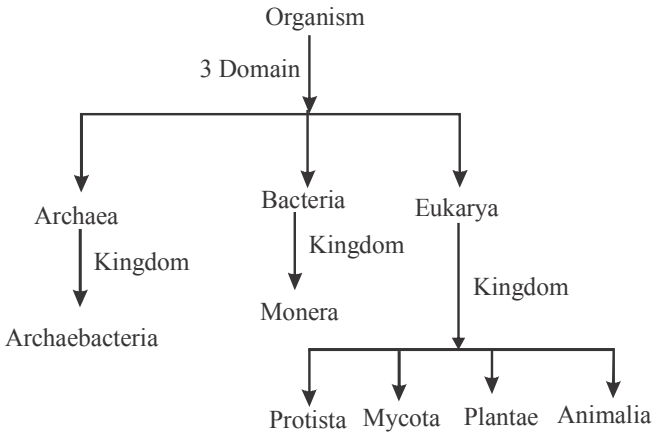
* This system of classification is more scientific and natural.
* It is the most accepted system of modern classification as the different groups of animals are placed phylogenetically.
* As the unicellular organisms are placed under the kingdom protista, it has solved many problem related to the position of organisms like euglena.
* The fungi totally differ from other primitive eukarytotes hence, placing the group fungi in a status of kingdom is justifiable.
* The kingdom Plantae and Animalia shows the phylogeny of different life styles, in the five kingdom classification, they are more homogeneous group than the two kingdom classification.
* This system of classification clearly indicates cellular organization and modes of nutrition, the character which have appeared very early in the evolution of life.

Demerits of R.H. Whittaker 5 Kingdom Classification

* This system of classification has drawbacks with reference to the lower forms of life.
* The Kingdom of Monerans and the Protists include diverse, heterogenous forms of life. In both the kingdoms there are autoptrophic and hetertrophic organisms. They also include organisms which have cells with cell wall and cells without cell wall.
* All the organisms of these three kingdoms do not originate from a single ancestor.
* Multicellular organisms have originated from protists several times.
* Organisms like the unicelluar green algae like volvox and chlamydomonas have not been included under the Kingdom Protista because of their resemblance to other greeen algae.
* The general organization of the slime moulds are completely different from the members of protists.

5. Six Kingdom Classification

* **Carl Woese** proposed six kingdom classification.
* These six kingdoms are Archaebacteria, Eubacteria, Protista, Fungi, Plantae and Animalia.
* He separated the archaebacteria from eubacteria on the basis of some major differences such as the absence of peptidoglycan in the cell walls of the former and the occurrence of branched chain lipids (a monolayer instead of a phospholipid bilayer) in the membrane.
* Based on the sequence of 16S ribosomal RNA genes, Woese found that the six kingdoms naturally cluster into three main categories.
* He called these **categories as domains of life**.
* These domains are Bacteria, Archae and Eukarya and are believed to have originated from common ancestor called **progenote**.



KINGDOM : MONERA

* The Kingdom Monera includes all prokaryotes.
* Monerans are the most primitive forms of life, originating from more ancient living stock termed progenote.
* The kingdom Monera includes eubacteria and archaebacteria.
* Eubacteria includes Cyanobacteria, Actinomycetes, Mycoplasma, Rickettsiae, Chlamydiae and Spirochaetes etc.
* Actually, archaebacteria differ from eubacteria in many respects and resemble eukaryotes in some ways.

Salient features of Monera

* These are unicellular, colonial, multicellular prokaryotic organisms without nuclear membrane, nucleolus, chromatin and histone proteins.
* Cell wall is made up of peptidoglycan (exceptions are Archaebacteria and Mycoplasma).
* Membrane bound organelles are absent.
* Cyclosis is absent and ribosomes are of 70S type.
* Respiratory enzymes are found associated with plasma membrane.
* Nucleoid or genophore or incipient nucleus or prochromosome is composed of naked DNA, RNA and nonhistone proteins.
* Reproduction by asexual method.
* Cell division is amitotic type and lacks spindle formation.

Classification based on Gram's staining

Gram's staining is a test on cell walls developed by Hans Christian Gram. This method helps classifying bacteria into Gram positive bacteria and Gram negative bacteria.

(a) **Gram Positive Bacteria :** The bacteria's cell wall is made up of protein-sugar complex that takes on purple color during gram staining. Ex. *Mycobacterium.*

(b) **Gram Negative Bacteria :** The gram negative bacteria has an extra layer of lipid on the outside of the cell wall and appear pink during the Gram staining procedure. Ex. *E.coli* (coliforms).

Classification based on shapes of bacteria

* Bacteria occur in four basic forms or shapes.
* These are spherical (Cocci), rod shaped (Bacilli), Vibrio and Spiral.

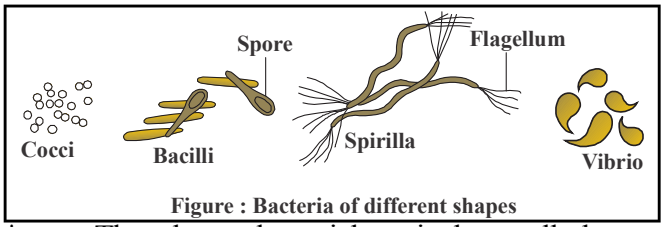


Figure : Bacteria of different shapes

* Though most bacterial species have cells that are of a fairly constant and characteristic shape, some species are pleomorphic (*i.e.*, these can exhibit a variety of shapes), *e.g., Rhizobium leguminosarum*.

(a) **Coccus :** Spherical or nearly spherical, aflagellate, sub-divided into six groups on the basis of cell arrangement:

* *Monococcus* -Only single cell represents the bacterium, *e.g.*, *Micrococcus luteus*, *M. roseus*.
* *Diplococcus* -Cocci divide in one plane and remain attached in pairs, *e.g.*, *Meningococcus*, *Gonococcus*, *Diplococcus pneumoniae*.
* *Streptococcus* -Cocci remain attached to form chains of different lengths, *e.g.*, *Streptococcus lactis*.
* *Tetracoccus* -Cocci divide in two planes at right angles to one another and form groups of four, *e.g.*, *Tetracoccus*, *Neisseria*.
* *Staphylococcus* -Cocci divide in several planes resulting in formation of irregular bunches of cells, sometimes resembling a cluster of grapes, *e.g.*, *Staphylococcus aureus*.
* *Sarcinae* -Cocci divide in 3 planes at right angles to one another and resemble cubical packets of 8 or more cells forming three dimensional geometrical figures, *e.g.*, *Sarcina lutea*.

(b) **Bacillus :** Rod-like forms, either singly or may be arranged differently. They are generally flagellate. It is the most common of all the shapes. They are of following types :

(i) **Monobacillus** -The bacteria occur singly, *e.g.*, *Bacillus anthracis*, *Lactobacillus*.

(ii) **Diplobacillus** -Bacteria are arranged in pairs. *e.g.*, *Bacillus subtilis*

(iii) **Streptobacillus**-Bacteria form a chain of rods, *e.g.*, *Streptobacillus*.

(iv) **Palisade-like** -If the cells are lined side by side like match sticks and at angles to one another. *e.g.*, *Corynebacterium diphtheriae*.

(c) **Spiral bacteria :** Coiled forms of bacteria exhibiting twists with one or more turns are called spirilla, *e.g., Spirillum volutans*.

(d) **Vibrio :** Bacteria with less than one complete twist or turn are called vibrio. These resemble a comma (,) in appearance, *e.g., Vibrio cholerae*.

(e) **Stalked bacteria :** The body of bacterium possesses a stalk, *e.g., Caulobacter*.

(f) **Budding bacteria :** The body is swollen at places, *e.g., Rhodomicrobium*.

* **Ehrenberg** first of all coined the word 'bacteria'
* Louis Pasteur is considered father of modern microbiology. He introduced the term aerobic and anaerobic for the life in the presence or absence of oxygen respectively.
* **Robert Koch**, a German doctor, demonstrated that the anthrax disease of sheep was caused by bacteria. Koch had followed four experimental steps (Koch's postulates) which help to establish a relationship between a microorganism and a disease.
* Smallest bacterium : *Dialister pneumosintes*
* Largest filamentous bacterium : *Beggiatoa mirabilis.*

ARCHAEBACTERIA

* They are believed to have evolved immediately after the origin of life on earth, as even now these are living under extremely adverse conditions such as extreme salty areas (halophiles), hot springs (thermoacidophiles) and marshy areas (methanogens).
* Very few other organisms can survive under such environmental conditions. So these are termed as "living fossils".
* These possess introns in DNA, their ribosomal proteins are highly acidic, these prokaryotes possess histone proteins different from that of eukaryotes.
* These being the most primitive and ancient most bacteria.
* Archaebacteria differ from other bacteria in having a different cell wall structure and this feature is responsible for their survival in extreme conditions.
* The cell wall in archaebacteria contains proteins and non-cellulosic polysaccharides.
* It lacks peptidoglycan, the characteristic cell wall material in bacteria and cyanobacteria.
* It consists of glycoprotein, pseudomurein and non cellulosic polysaccharide.

* Pseudomurein is like bacterial peptidoglycan, but contain N-acetyltalosaminuronic acid instead of NAM and lacks D-Amino acid.
* The cell membrane contains branched chain lipids (phytanyl side chains) which decreases membrane fluidity.
* This chemical composition of the cell membrane enables these organisms to withstand extremes of temperature and pH.
* Archaebacteria are divided into three groups· methanogens, halophiles and thermoacidophiles.

(a) Methanogens:

* They are obligate anaerobes occurring in marshy habitats.
* They are capable of converting CO_2, methanol and formic acid (HCOOH) into methane and hence the name methanogens.
* This property is exploited commercially in the production of fuel gas and methane in gobar gas plants (biogas fermenters).
* Some of the methanogens live in rumen of herbivorous animals like buffalo, cow etc. (ruminants).
* These microorganisms assist in fermentation of cellulose in such animals, e.g., *Methanococcus*, *Methanobacterium*, *Methanosarcina*, *Methanospirillum*.

(b) Halophiles:

* They are aerobic chemoheterotrophic coccoid forms and are Gram negative. They occur in high salt concentration medium like sea, salt lake, brines, marshes, salted fish etc.
* In high light intensity a reddish pigment bacteriorhodopsin develops in their membrane to trap sun light to produce ATP, but they cannot use this ATP in food synthesis.
* Sap vacuoles are absent in halophiles, hence, they cannot get plasmolysed in high salt concentration.
* They maintain a high osmotic concentration of KCl in their cells.
* These bacteria get lysed if NaCl level falls below 10%, e.g., *Halococcus*, *Halobacterium*.
* These can grow well in a medium containing 25-30% of NaCl.

(c) Thermoacidophiles:

* They are capable of tolerating high temperature as well as high acidity and hence, the name thermoacidophiles.
* They often live in hot-water springs where the temperature is as high as 80°C and the pH as low as 2.
* They oxidise sulphur to sulphuric acid under aerobic conditions and the energy obtained in this reaction is utilized for the synthesis of organic food.
* The medium becomes highly acidic due to the production of sulphuric acid. Under anaerobic conditions sulphur is reduced to H_2S, *e.g.*, *Thermoplasma*, *Thermoproteus, Thermococcus*. Hence, these are chemosynthetic in nature.

EUBACTERIA

* True bacteria.
* Rigid cellwall with or without flagellum.
* Cyanobacteria(Blue green algae) are also included in this group.

Structure of Eubacteria :

* Though the bacterial structure is very simple, they are very complex in behaviour.
* Bacterial cell has a chemically complex **cell envelope**.

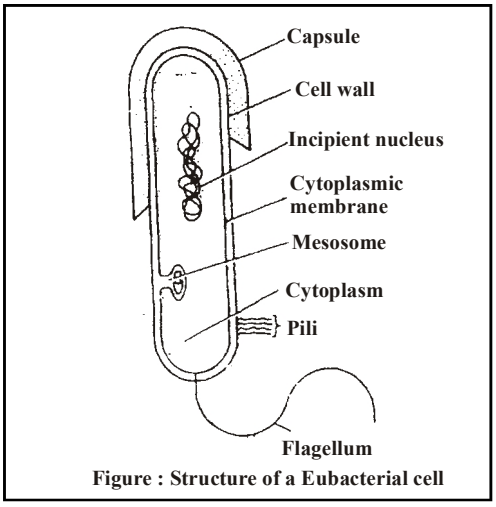


Figure : Structure of a Eubacterial cell

* The cell envelope consists of a tightly bound three layered structure.

(1) Outermost **glycocalyx** (may be capsule thick and tough or slime layer- loose sheath)

(2) Cell wall
(3) Cell membrane
Although each layer of the envelope performs distinct function they act together as a **single protective unit.**

1. Glycocalyx (Capsule or Slime layer) :

* Loose and thin layer is called slime layer and thick and tough layer is called capsule. Formation of Glycocalyx is done by cell membrane.
* Capsule is made up of **polysaccharides** and **polypeptides** while slime layer is made up of polysaccharides.
* Glycocalyx protects the bacteria from W.B.C. and also helps in colony formation.

2. Cell Wall :

* Bacterial cell wall is made up of mainly peptidoglycan.
* In Gram(+) bacteria cellwall is single layered and thick. It is made up of peptidoglycan.
* Lipids are also present but in less quantity.
* While in Gram (–) bacteria cell wall is double layered. Inner layer is thin and composed of **peptidoglycan** while outer layer is thick and made up of lipopolysaccharide.
* **L - form** - Bacterial cell wall can be dissolved by **lysozyme** enzyme. When bacterial cell wall is removed artificially by Lysozyme then, bacteria are called L - form (Lister form).

3. Cell membrane :

* Bacterial cell membrane is made up of lipoprotein (unit membrane) likethe eukaryotic membrane.

4. Cytoplasm :

* In bacterial cytoplasm membrane bound cell organelles viz. Mitochondria, Chloroplast E.R. Lysosome, Golgibody, Microbodies etc. are absent.
* Bacterial cytoplasm shows no streaming or cyclosis.

CYANOBACTERIA

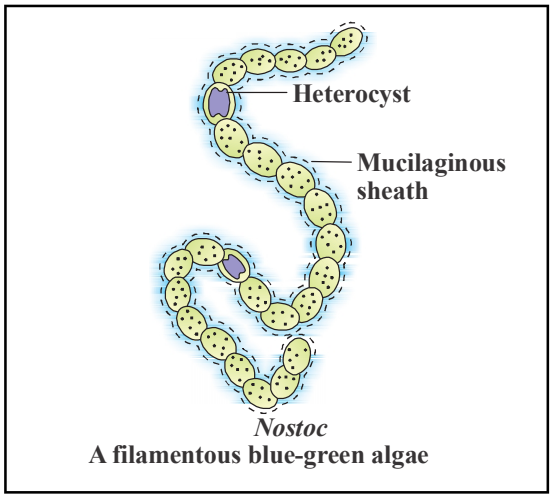
* Cyanobacteria are Gram negative photosynthetic prokaryotes, being the most primitive organisms to have **oxygenic photosynthesis.**
* They added oxygen to the atmosphere, which is indispensible for the existence of aerobic forms of living organisms.
* They are also known as BGA (Blue green algae) and are classified variously under **cyanophyceae or myxophyceae.**

Occurrence

* They are mainly fresh water forms, though few are marine.
* **Red sea** is named so because of abundant occurrence of a cyanobacterium *Trichodesmium erythraeum,* which imparts red colouration to water.
* They occur in symbiotic association with almost every group of eukaryotes *i.e.* green algae, fungi, bryophytes like mosses and *Anthoceros,* ferns, gymnosperms, angiosperms, sponge, shrimps, mammals etc.
* *Anabaena azollae* is associated with *Azolla,* an aquatic fern.
* *Anabaena cycadeae* is associated with coralloid roots of **Cycas.**
* In many lichens (symbiotic association of algae and fungi), the algal partner may be a cyanobacterium.

Structural Organization

* These may be unicelled or multicelled. The latter may be filamentous or colonial.
* Filamentous form consists of one or more cellular strands, called **trichomes**, surrounded by mucilagenous sheath.
* Cyanobacteria are characterised by the absence of flagellum throughout life cycle.



A filamentous blue-green algae

Cell Structure

* The cell structure in cyanobacteria is typically prokaryotic.
* The cell lacks a well defined nucleus and the chromatin material is centrally located, resembling the bacterial chromosome.
* The cell wall is 4 layered and is invariably covered by mucilagenous sheath, composed largely of mucopeptides.
* The characteristic feature of cyanobacterium cell is the presence of a system of photosynthetic lamellae called **thylakoids**.
* The characteristic photosynthetic pigments present in the thylakoids are chlorophyll a and phycobilins *i.e.*, phycocyanin (blue coloured), phycoerythrin (red coloured) and allophycocyanin (light blue coloured).

Metabolism

* They are the most self-dependent organisms, because most of these are capable of converting atmospheric nitrogen into ammonium compounds besides utilizing atmospheric CO_2 for synthesis of organic food during photosynthesis.
* Biological nitrogen fixation is an anaerobic process as nitrogenase enzyme required for the process acts efficiently in the absence of oxygen.
* Nitrogen fixation under anaerobic conditions occurs mainly in large, specialized cells called **heterocysts** as in Nostoc.
* Heterocyst has terminal pores which at maturity develops a polar granule.
* Thickened cell wall of these cells is impermeable to oxygen so this creates anaerobic environment in the cell even under aerobic conditions.

MYCOPLASMA

* *E. Nocard* and *E.R. Roux* (1898)-two French Scientists, discovered these organisms from pleural fluid of cattles suffering from pleuropneumonia.
* These are pleomorphic and were called PPLO (Pleuropneumonia Like Organisms) or Jokers of plant kingdom.
* Mycoplasma infects animals (eg, dog, sheep, mice and man) and plants (eg, potato, corn, brinjal).
* They are generally found in soil, sewage water, plants and animals.

Structure

* These are unicellular, simplest free living prokaryotes.
* They do not have cell wall so they are highly pleomorphic and can assume various shapes like spherical, granular, filamentous, coccoid etc.
* Organized nucleus, endoplasmic reticulum, plastids, mitochondria, golgi bodies, lysosomes, centrioles, flagella, etc. are absent.
* Mycoplasma has both RNA and DNA.
* *Mycoplasma* can pass through bacteriological filters and lack cell wall.
* This shows that they are not bacteria.
* Since they can multiply in abiotic medium having sterols, so they are not considered as virus.
* Due to many similarities with bacteria they are said to be **"Bacteria with their coats off"**.
* Mode of nutrition is heterotrophic.
* Some are saprophytic, but mostly they are parasitic.

Bacterial Life Processes

(1) **Respiration:** On the basis of mode of respiration, the bacteria are divided into two main groups: *i.e.,* aerobes and anaerobes. Each group is further of two types *i.e.* strict or obligate and facultative.

(a) **Obligate or strict aerobes :** These bacteria can live only in presence of oxygen as they possess the enzyme system for aerobic respiration only. In the absence of oxygen, they cannot respire and thus, die, *e.g., Bacillus subtilis*.

(b) **Facultative anaerobes :** They normally respire aerobically. However, they are capable of switching over to anaerobic mode to get energy for their survival, if sufficient oxygen to sustain aerobic respiration is not available in the environment, *e.g., Pseudomonas*.

(c) **Obligate or strict anaerobes:** These bacteria respire anaerobically only. The growth of such bacteria will certainly be slower as anaerobic respiration liberates much less amount of energy as compared to aerobic respiration.

They lack enzymes necessary for carrying out aerobic respiration *e.g., Clostridium botulinum*.

(d) **Facultative aerobes:** They normally respire anaerobically, but are capable of respiring aerobically as well, if oxygen is available. Most of the photosynthetic bacteria are facultative aerobes *e.g., photosynthetic bacteria Chlorobium*.

(2) Nutrition :

* Nutrition in bacteria is of two types i.e. autotrophic and heterotrophic.
* Bacteria having autotrophic mode of nutrition may be photoautotrophs and chemoautotrophs, carrying out photosynthesis and chemosynthesis, respectively.

(I) Autotrophic Nutrition

(i) Photoautotrophic bacteria:

* These bacteria are capable of entrapping solar energy and utilizing it for the synthesis of complex food materials due to the presence of pigments like bacteriochlorophyll (bacteriopurpurin) and bacterioviridin.
* Purple sulphur bacteria (*e.g., Thiospirillum*) and green sulphur bacteria (*Chlorobium limicola*) are the most familiar examples containing pigment bacteriochlorophyll, bacteriopurpurin and bacterioviridin respectively.
* Bacterial photosynthesis, however, differs from photosynthesis of higher plants in not liberating oxygen.
* This type of photosynthesis, characteristic of bacteria, is termed as anoxygenic.
* Normal photosynthesis, occurring in higher plants, is termed as oxygenic.
* In bacterial photosynthesis water is not the source of electron that acts as reducing power to convert CO_2 into glucose.
* The bacteria obtain reducing power from various compounds such as hydrogen sulphide, thiosulphate or even some organic compounds.
* No oxygen is evolved as it does not involve splitting of water.
* Most of the photosynthetic bacteria are anaerobes (facultative aerobes).

(ii) Chemoautotrophic Bacteria:

* Bacteria belonging to this category obtain energy for the synthesis of food by oxidising certain inorganic substances like ammonia, nitrates, nitrites, ferrous ions etc.
* Thus, they do not utilise light as energy source.
* The chemical energy thus obtained, is trapped in ATP molecules.
* This energy is then used in carbon assimilation with the help of hydrogen from some source other than water, e.g., hydrogen bacteria, nitrifying bacteria, sulphur bacteria, etc.
* They play a great role in recycling nutrients like nitrogen, phosphorous, iron, sulphur.

(a) Hydrogen bacteria : These bacteria oxidise hydrogen in the presence of oxygen, e.g., Hydrogenomonas.

(b) Nitrifying bacteria obtain energy by oxidizing ammonia into nitrate, oxidation of ammonia occurs in two steps. Each step is carried out by a specialised group of bacteria.

* In the first step, ammonia is oxidised into nitrites by the species of the genus *Nitrosomonas* and *Nitrococcus*.
* In the second step, the nitrite is converted into nitrate. This is brought about by species of the genus *Nitrobacter* and *Nitrocystis* which use this energy for chemosynthesis.

(c) Sulphur bacteria : These bacteria obtain energy either by the oxidation of elemental sulphur or oxidation of H_2S.

* **Oxidation of elemental sulphur :** Sulphur bacteria (*Thiobacillus thioxidans*) oxidise elemental sulphur to sulphuric acid and utilise energy produced in this process. These bacteria can survive even in extreme acidic environment.
* **Oxidation of H_2S to S :** Some bacteria like *Beggiatoa* use the energy from oxidation of H_2S and store the sulphur so produced in the form of granules.

(d) Iron bacteria : These bacteria (*e.g., Ferrobacillus, Leptothrix*) inhabit water which contain iron compounds. These bacteria convert ferrous ions to ferric form.

The ferric ion is deposited as insoluble ferric hydroxide. The energy so released, is utilised in $2\cdot$

(e) Methane bacteria : *Methanomonas*, is one example which oxidises methane to carbon dioxide.

(II) Heterotrophic bacteria :

* These bacteria are most abundant in nature and are incapable of synthesizing their own food from simple raw materials.
* They obtain nourishment either from dead and decaying organic matter or directly from a living host.
* All heterotrophic bacteria are segregated into three main categories, *i.e.*, saprophytic, symbiotic and parasitic forms.

(i) Saprophytic bacteria :

* They are free living bacteria, obtaining nourishment from organic remains such as dead animals, animal excreta, fallen leaves, decaying vegetables, fruits, bread and other products of animal and plant origin.
* These bacteria secrete digestive enzymes into the substrate and the complex insoluble. Substances are converted into simple soluble compounds like water, hydrogen sulphide, ammonia, CO_2 etc.
* Some of the simpler substances are absorbed and assimilated by the bacteria, whereas the others are added to the soil and atmosphere to complete the nature's material cycle.
* Anaerobic breakdown of carbohydrates and proteins is termed fermentation and putrefaction respectively.
* Aerobic breakdown of organic compounds is called **decay**.

(ii) Symbiotic bacteria :

* They are mainly Gram negative type.
* A familiar example of symbiotic bacteria is *Rhizobium leguminosarum*, associated with roots of leguminous plants.
* They are capable of fixing atmospheric nitrogen as ammonia, inside the nodule only and not in free state.
* However, some bacteria like *Azotobacter*, *Beijerinckia*, *Klebsiella* are free living, aerobic and capable of nitrogen fixation in free state, enriching the soil.
* *Clostridium pasteurianum* is anaerobic N_2 fixing bacteria.

(iii) Parasitic bacteria :

* These bacteria draw nourishment and obtain special organic compounds required for growth from living organisms, either plants or animals, called **hosts**.
* The disease causing bacteria are termed pathogenic and the ones not causing any disease are termed as non-pathogenic.

Reproduction

* Bacteria produce several types of asexual spores like, sporangiospores, oidia, conidia and endospores. However, the most common mode of asexual reproduction is binary fission.
* Under favourable conditions of nutrient availability, moisture and temperature, daughter cells may repeat binary fission many times and may forms a large population.

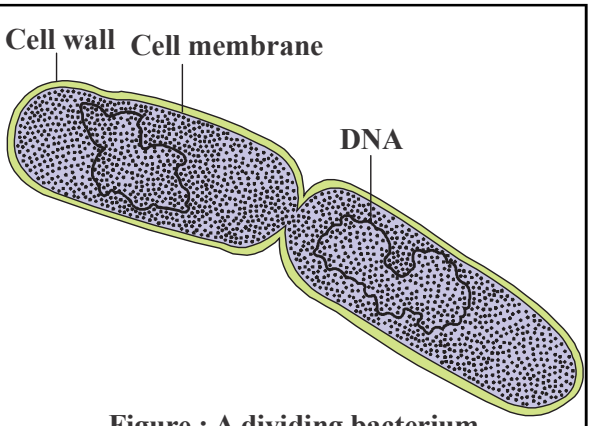


Figure : A dividing bacterium

* The bacteria exhibit a primitive form of sexual reproduction which differs from eukaryotic sexual reproduction because there is no gamete formation and fusion.
* However, the essential feature of sexual reproduction, i.e., exchange of genetic material does take place and is called genetic recombination.

* Three methods are known by which genetic recombination is achieved by bacteria.
* In the order of their discovery, these are transformation, conjugation and transduction.

(a) **Transformation :** Absorption of DNA segment from the surrounding medium by a living bacterium.

(b) **Conjugation:** Transfer of genes from donor to recepient by conjugation tube.

(c) **Transduction :** Transfer of genes by viruses.

Economic importance of bacteria

A. Beneficial activities

Sewage disposal :

* The bacteria decompose the organic matter present in the sewage, converting into simpler inorganic substances.
* The inorganic substances thus formed, being soluble, pass out through filter along with water which is highly useful for irrigation purposes, *e.g., Clostridium*, *E. coli*.

Nitrogen cycle :

* The proteins present in dead remains of living organisms are converted into amino acids by different types of saprophytic bacteria.
* Amino acids are converted into ammonia by ammonifying bacteria (*Bacillus vulgaris*, *B. ramosus*).
* Nitrifying bacteria convert ammonium salts first into nitrites (*Nitrosomonas, Nitrococcus*) which are subsequently converted into nitrates (*Nitrobacter*).
* In presence of denitrifying bacteria (*Pseudomonas denitrificans*), nitrates and nitrites of soil are converted to gaseous nitrogen.

Nitrogen fixation :

* It is the biological process in which atmospheric nitrogen is converted into nitrogenous compounds by nitrogen fixing bacteria.
* These bacteria are of 2 types :
  (a) Free living (b) Symbiotic

(a) **Free living bacteria** are *Azotobacterand Beijerinckia* (aerobic) & *Clostridium* (anaerobic).

(b) **Common symbiotic bacteria** are *Rhizobium leguminosarum* and *Xanthomonas*.

These convert nitrogen into ammonia which is directly converted into amino acids by plants.

Role in Industry :

* Man has utilized the metabolic activities of bacteria in preparation of a number of industrial products such as :
  (i) Butter milk and sour cream (ii) Yoghurt
  (iii) Cheese (iv)Vinegar

Role in Medicine :

* Bacteria have been used extensively in preparation of antibiotics, vaccines, serums and vitamins.

(i) **Antibiotics :**

* The term antibiotic was given by **Waksman**, who discovered **streptomycin**.
* These are the organic substances produced by microorganisms which inhibit the growth of other organisms (mostly pathogens) but do not affect the growth of organisms secreting these.
* The first commercial antibiotic penicillin was discovered by **Flemming** (1959) from a fungus called ***Penicillium***.

Some antibiotics of eubacterial origin:

(a) Bacitracin .....*Bacillus licheniformis*
(b) Polymixin ..... *Bacillus polymyxa*
(c) Gramicidin .....*B. brevis*
(d) Subtilin .....*B. subtilis*

(ii) **Vaccine production**

* Vaccines and serums against typhoid, cholera TB, pertussis, tetanus and diphtheria are made with the help of bacteria or their toxins e.g., DPT (against diphtheria, pertussis and tetanus), TI(against tetanus), BCG (Bacille of Calmette-Guerin against TB), DT (against diphtheria and tetanus).

(iii) **Vitamins :**

* *Escherichia coli* present in human intestine produces large quantities of B-complex vitamins and vitamin *K. Bacteria* are utilized in industrial production of a number of vitamins like riboflavin from *Clostridium butylicum*, Cobalamine (B12) from *Bacillus megatherium* and *Pseudomonas denitrificans*.

(iv) Pollution control :

* *Pseudomonas putida* degrades petroleum wastes.
* *Flavobacterium* can decompose 2, 4-0. DDT can be decomposed by **Acetobacter aerogens**.
* Gange's water contains *Bdellovibrio bacteriovorus* that maintains purity of its water.

(v) Poly-b-hydroxybutyrate is used to produce biodegradable plastic.

B. Harmful activities

(i) Spoilage of food : Saprophytic bacteria cause decay of vegetables, fruit, meat, bread and other foods, making these unfit for human consumption. Some bacteria even produce strong toxins in the infected food stuffs which cause food poisoning when consumed.

(ii) Deterioration of Domestic Articles : Some saprophytic bacteria like *Cellulomonas*, *Spirochaete cytophaga* cause deterioration of domestic articles of daily use such as leather, woolen, canvas articles etc.

(iii) Denitrification of Soils : Denitrifying bacteria like *Thiobacillus denitrificans*, *Micrococcus denitrificans* and *Pseudomonas* convert nitrates and nitrites present in the soil into gaseous nitrogen, thus depleting the soil nitrogen, thereby decreasing soil fertility.

(iv) Desulphurification : *Desulphovibrio desulphuricans*.

(v) Diseases : Common disease of humans, animals and plants are listed below respectively –

* **Name of Disease**	**Bacteria**
In human beings	
Pneumonia -	*Diplococcus pneumoniae*
Typhoid -	*Salmonella typhosa*
Cholera -	*Vibrio cholerae*
Plague (Black death)	*Pasteurella pestis*
Gonorrhoea -	*Neisseria gonorrhoeae*
Diorrhoea -	*Bacillus coli*
Gastroenteritis-	*E.coli*
Gangarin -	*Clostridium perfringens*
Whooping cough -	*Haemophilus pertussis*
Tetanus (lockjaw) -	*Clostridium tetani*
In plants	
* Soft rot of potato	*Pseudomonas solanacearum*
* Citrus canker	*Xanthomonas citri*
* Bacterial blight of paddy	*Xanthomonas oryzae*
* Tundu disease in wheat	*Corynebacterium tritici*
* Potato wilt	*Pseudomonas solanacearum*
* Fire blight of apple and peach	*Erwinia amylovora*
* Crown gall of sugar beet	*Agrobacterium tumefaciens*
* Black rot of cabbage	*Xanthomonas compestris*

KINGDOM : PROTISTA

* All unicellular eukaryotes, irrespective of their mode of nutrition, are included in the kingdom **Protista** in Whittaker's system.
* The term protista was coined by **Ernst Haeckel.**
* This kingdom forms a link between kingdom Monera on one hand and other three kingdoms *i.e.*, Plantae,Fungi and Animalia on the other hand.
* Protistans are ancestors of all multicellular eukaryotes (plants, fungi and animals).
* Living organisms included in Protista are : Dinoflagellates, Chryosophytes, Euglenoids, Slime molds, Protozoans.

General Characteristics of Protista

1. Unicellular, eukaryotic organisms. Some are colonial without much cellular differentiation. Organisation at tissue level is absent.

2. Mostly aquatic organisms.

3. Cell structure is eukaryotic type having all kinds of membrane bound organelles and **80S cytoplasmic** ribosomes and cells may possess cellulosic cell wall.

4. Flagella and cilia have **(9+2)** pattern of microtubule organization consisting of **tubulin** protein.
5. Movement by pseudopodia, flagella or cilia where ciliary mode is fastest.
6. Mode of nutrition may be photosynthetic (holophytic), holozoic (ingestive), saprobic or parasitic (absorptive). Some have **mixotrophic** nutrition (photosynthetic and saprobic) as in *Euglena.*
7. Reproduction occurs by asexual and sexual means.

Asexual Reproduction

This is the most common method of reproduction in protists. It is of following types

(a) Binary fission : Two daughter cells are formed by the division of one mother cell. After this each daughter cell grows to form a normal organism. eg. Dinoflagellates, Chrysophytes, Euglenoids.

(b) Spore formation : Some protists have special structure known as sporangia. Spores are formed in this sporangia. The sporangia bursts after sometime and all the spores become free. These spores form a new cell after germination. eg. Slime moulds

Sexual Reproduction

* Sexual reproduction was first of all seen in protists.
* In sexual reproduction two haploid gametes fuse to form a diploid zygote. This procss is known as **syngamy**.

Syngamy is of three types

(a) Isogamy :

* It is the easiest way of sexual reproduction.
* In isogamy the fusing gametes are morphologically (i.e. shape, size, structure) similar but physiologically (i.e. functionally or genetically) they may be similar or dissimilar, when fusing gametes are physiologically dissimilar, process is called physiological anisogamy.

(b) Anisogamy :

The fusing gametes are morphologically dissimilar (smaller - larger) but physiologically they may be similar or dissimilar (usually).

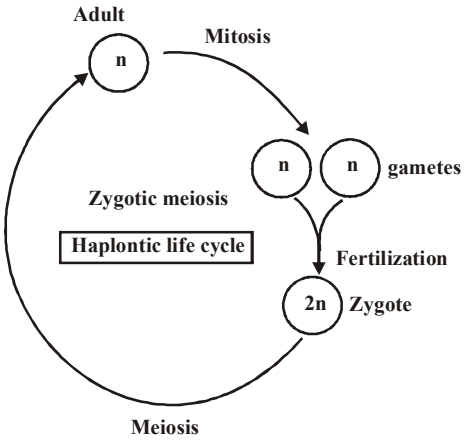
(c) Oogamy :

* It is the developed form of anisogamy.
* Male gamete is small and motile while female gamete is large and non motile. This female gamete is known as egg.
* In it the formation of male & female gametes take place in **sex organs**.

8. Life cycle is of 2 types-(i) Showing **zygotic meiosis** (ii) Showing **gametic meiosis.**

(i) Life cycle showing zygotic meiosis :

* When Protist is haploid and meiosis occurs in zygote then it is known as **zygotic meiosis**.

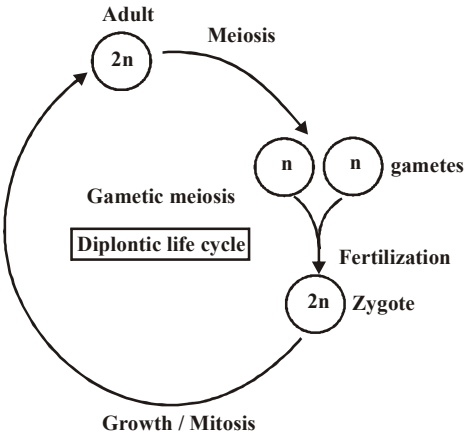


* In this type of life cycle during sexual reproduction gametes are formed by mitosis. These gametes are haploid.
* These gametes fuse to form a diploid zygote.
* After that meiosis takes place in zygote, as a result haploid cells are formed again.

Note: In this type of life cycle the zygotic phase is only diploid and remaining all the phases are haploid so this type of life cycle is known as **haplontic life cycle**. eg. Dinoflagellates.

(ii) Life cycle showing gametic meiosis

* When Protist is diploid and meiosis takes place during gamete formation, then it is called gametic meiosis.
* In this type of life cycle during sexual reproduction, meiosis takes place in diploid cell, due to which haploid gametes are formed. Now haploid gametes fuse to form diploid zygote. And after that mitosis takes place in zygote due to which diploid cells are formed again.



Note : In this type of life cycle only gametic phase is haploid and remaining all phases are diploid so this type of life cycle is known as diplontic life cycle. eg. Diatoms.

9. These are decomposers, photosynthetic or parasites. Parasitic protists may cause diseases like dysentery, malaria, sleeping sickness etc.

Chrysophytes

* Includes diatoms and **golden algae** (desmids)
* Found in freshwater or marine water.
* Mostly planktonic (passive swimmer)
* Photosynthetic.
* Cell walls overlap to fit together like a soap box.
* Cell wall contains silica hence indestructible.
* Their accumulation forms **'Diatomaceous Earth'**.
* Used in polishing, filtration of oils and syrups.
* Diatoms are the chief **'producers'** in the oceans.
* They are very good indicators of water pollution. Common examples of diatoms are *Triceratium, Melosira, Navicula, Cymbella.*

Dianoflagellates

* Marine, photosynthetic.
* Cell wall has stiff cellulose plates.
* Appears yellow, green, brown, blue or red depending on the pigments.
* Have two flagella – one longitudinal and other transversely in a furrow between wall plates.
* Red Dinoflagellates ***(Gonyaulax)*** form **red tides**.
* Some marine dinoflagellates show **bioluminescence,** i.e., emit light, e.g., *Noctiluca, Pyrodinium, Pyrocystis*. Due to phosphorescence the sea glows at night.

Euglenoids

* Mostly fresh water form found in stagnant water.
* Instead of cell wall they have protein rich layer 'pellicle' which makes body flexible.
* They have two flagella one short and one long.
* Photosynthetic in presence of sunlight but become heterotrophs if they do not get sunlight. e.g. *Euglena.*

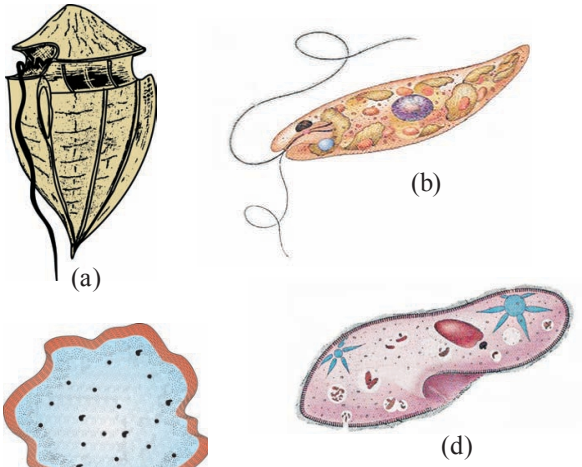


Figure :(a) Dinoflagellates
(b) Euglena
(c) Slime mould
(d) Paramoecium

* **Comparative study of photosynthetic protists**

Character	Diatoms	Dinoflagellates	Euglenoids
Division Class	Chrysophyta Bacillariophyceae	Pyrrophyta Dinophyceae	Eug lenophyta Euglenophyceae
Habitat	Both fresh water and marine	Mostly marine	Fresh water protests found in stagnant water.(Stagnant)
Cell wall	Cellulose + Silica	Cellulose + Pectin	No cell wall, pellicle is present.
Pigment	Chl a, c, β-carotenes, Xanthophylls	Chlorophyll a, c, α-carotene, Xanthophylls	Chl a, b, β-carotene, Xanthophylls
Reserve food	Chrysolaminarin (leucosin)	Carbohydrate, Oil	Paramylon

Slime Moulds

* Saprophytic Protists
* Form aggregates to form plasmodium grow on decaying twigs and leaves.
* Plasmodium forms fruiting bodies bearing spores at their tips.
* Spores have true walls which are extremely resistant and survive for many years.
* By taking example of slime mould, now we can justify that protista forms a connecting link with plants, animals and fungi.
  Fungi like feature : Formation of fruiting bodies.
  Plant like feature : Cell wall around spores.
  Animal like feature : Plasmodium is without cell wall.

Protozoans

* Fresh water or marine unicellular heterotrophs.
* Primitive relative of animals.

(a) Amoeboid Protozoans -

* Free living or parasites.
* The body bears a member of temporary and blunt pseudopodia. The type of pseudopoium found in *Amoeba proteus* is lobopodium. Pseudopodia are composed of both ectoplasm and endoplasm.
* Pseudopodia are found in *Amoeba* and leucocyte of higher animals.
* Digestion in *Amoeba* is intracellular. *Amoeba* secretes digestive enzymes for hydrolysing starch, protein, fat etc.

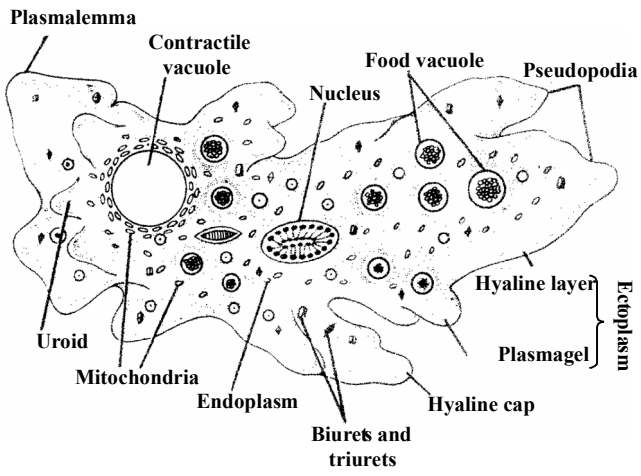


Figure : *Amoeba*

* Egestion of undigested food in *Amoeba* takes place through a temporary rupture of the surface membrane.
* Pseudopodia (false feet) formed eg. *Amoeba, Entamoeba*.

(b) Flagellated Protozoans :

* Free living or Parasitic with flagella eg.*Trypanosoma* (causessleeping sickness).
* *Trypanosoma gambiense* is the parasite zooflagellate which causes one of the deadliest ailments in human beings called African sleeping sickness or Trypanosomiasis. It was discovered by Frode in 1901.
* *Trypanosoma* is usually found in the blood of vertebrates, finally invading cerebrospinal fluid.
* *Trypanosoma* is an endoparasite, blood parasite, extra cellular parasite.

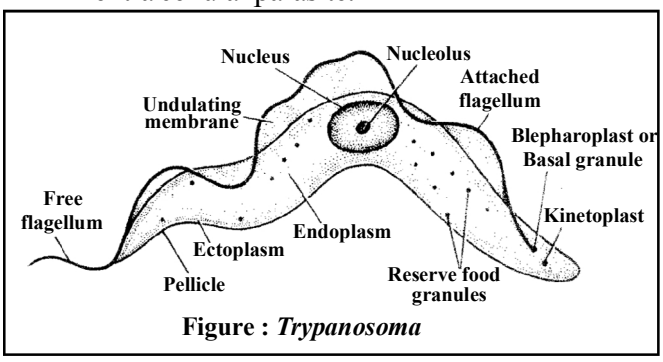


Figure : *Trypanosoma*

(c) Ciliated Protozoans -

* With cilia eg. *Paramecium* (sleeper animalcule).
* *Paramecium* is commonly called as 'Slipper animalcule'. Body is distinguished into an oral or ventral surface and an aboral or dorsal surface.
* Body is covered with a thin, firm, flexible membrane called pellicle. Entire body surface is covered by numerous cilia, the locomotory organelles. Cilia in the posterior end are longer called caudal tuft. Each cilium arises from a basal granule or kinetosome. *Paramecium* has infraciliary and neuromotor system to co-ordinate ciliary beat.
* Digestion in paramecium is intracellular. Food vacuole constantly moves along a definite courses (cyclosis) within streaming endoplasm. Food vacuole is digested in the cell body in acidic to alkaline media. Egestion of undigested food takes place through cytopyge or cytoproct, a temporary formed anus.

* *Paramecium* reproduces by transverse binary fission and nuclear reorganisation. Binary fission occurs during favourable condition. In this process, macronucleus divides amitotically and micronucleus mitotically.

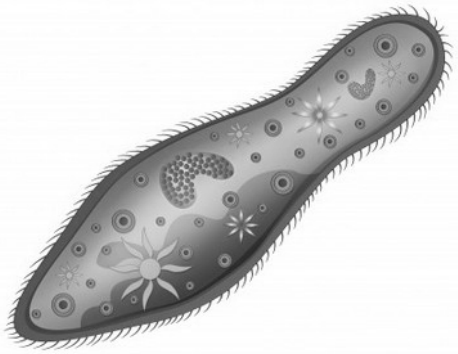


Figure : *Paramecium* (slipper animal-cule.)

(d) Sporozoans :

* This includes diverse organisms that have an infectious spore-like stage in their life cycle. The most notorious is Plasmodium (malarial parasite) which causes malaria which has a staggering effect on human population.

Plasmodium Systematic position

Phylum	–	Protozoa
Sub-phylum	–	Plasmodroma
Class	–	Sporozoa
Sub-class	–	Telosporidia
Order	–	Haemosporidia
Genus	–	*Plasmodium*
species	–	*vivax*

* Laveran (1880) discovered that malaria is caused by a protozoan parasite, *Plasmodium vivax*. Sir Ronald Ross was (1896) the first to observe oocytes of *Plasmodium* in female *Anopheles*.

Economic importance of Protists

* Some protists like kelps are edible.
* Marine protists are source of useful substances like algin, agar, carragean and antiseptics.
* Sodium laminaria sulphate, Fucoidin, Heparin are algal products used as blood coagulants. Lyngbya produces an anti-cancer compound.
* Kelps are rich in sodium, potassium, iodine etc, they are good source of minerals.

KINGDOM FUNGI

* The fungi constitute a unique kingdom of heterotrophic organisms. They show a great diversity in morphology and habitat.
* Some unicellular fungi, e.g., yeast are used to make bread and beer. Other fungi cause diseases in plants and animals; wheat rust-causing Puccinia is an important example. Some are the source of antibiotics, e.g., Penicillium.
* Fungi are cosmopolitan and occur in air, water, soil and on animals and plants. They prefer to grow in warm and humid places.
* With the exception of yeasts which are unicellular, fungi are filamentous. Their bodies consist of long, slender thread-like structures called **hyphae.** The network of hyphae is known as **mycelium.**
* Some hyphae are continuous tubes filled with multinucleated cytoplasm – these are called coenocytic hyphae. Others have septae or cross walls in their hyphae. The cell walls of fungi are composed of chitin and polysaccharides.
* Most fungi are heterotrophic and absorb soluble organic matter from dead substrates and hence are called **saprophytes**. Those that depend on living plants and animals are called parasites. They can also live as **symbionts** – in association with algae as lichens and with roots of higher plants as **mycorrhiza**.

Reproduction in Fungi

* Fungi reproduce by all the three modes, *i.e.,* **vegetative, asexual** and **sexual.**

1. Vegetative reproduction: It occurs by the following methods:

(a) Fragmentation : The mycelium breaks up into two or more fragments due to mechanical injury, decay or some other reasons. Each fragment grows into independent mycelium.

(b) Fission: Here, simple splitting of vegetative cells into two daughter cells takes place by simple constriction.

(c) Budding: Some fungi like yeast produce small outgrowths, *i.e.,* buds from their vegetative body. Eventually, the buds are cut off from parent cell and mature to form new individuals.

2. Asexual reproduction:

* It occurs through spores.
* These are single celled specialized structures which separate from the organism, get dispersed and germinate to produce new mycelium after falling on suitable substrate.
* The spores produced during asexual reproduction in fungi are formed by mitotic division and are thus termed, **mitospores.**

The various means of asexual reproduction are :

(a) Zoospore :

* Many fungi, especially aquatic members produce these types of spores.
* Zoospore may be **uniflagellate,** *e.g., Synchytrium* or **biflagellate,** *e.g., Saprolegnia, Pythium* and are **naked uninucleate** structures formed in zoosporangia.
* They germinate to give rise to new mycelium.

(b) Sporangiospore :

* Sporangiospores are thin walled non-motile spores produced **endogenously** in a sporangium during favourable conditions, which after liberation give rise to new mycelium, *e.g., Rhizopus, Mucor.*

(c) Conidia:

* Conidia are non motile, thin walled **exogenous spores** produced at the tips of erect hyphae called **conidiophore.**
* They are arranged in chains upon the conidiophore, *e.g., Aspergillus* and *Penicillium.*

(d) Chlamydospore:

* In some fungi the hyphae under unfavourable conditions, forms thick walled resting resistant spores which later get separated from each other.

(e) Oidia:

* Non-motile thin walled spores developing under sugar rich conditions in medium.
* Their budding condition is called torula stage.

3. Sexual reproduction:

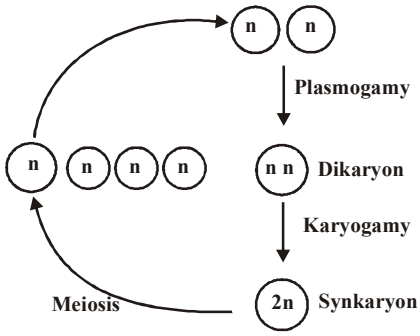
* Sexual reproduction is reduced in fungi and takes place by two fusing gametes.
* It includes 3 stages :

(a) Plasmogamy:

* There is union between two haploid protoplasts which results in bringing the fusing nuclei of different parents close together.
* In some fungi, plasmogamy is immediately followed by karyogamy.
* However, in Ascomycetes and Basidiomycetes, an intermediate dikaryotic (n + n) condition occurs. This phase is called **dikaryophase**.

(b) Karyogamy: The two haploid nuclei which come together in plasmogamy fuse and thus, a diploid zygote is produced.

(c) Meiosis: Reduction division takes place in the zygote thus, reducing the number of chromosomes to half.



Division Phycomycetes

* Members of phycomycetes are found in aquatic habitats and on decaying wood in moist and damp places or as obligate parasites on plants. The mycelium is aseptate and coenocytic.
* Asexual reproduction takes place by zoospores (motile) or by aplanospores (non-motile). These spores are endogeneously produced in sporangium. Zygospores are formed by fusion of two gametes. These gametes are similar in morphology (isogamous) or dissimilar (anisogamous or oogamous). Examples : Mucor, Rhizopus and Albugo (the parasitic fungi on mustard).

(i) ***Rhizopus/Mucor :***

* They are cosmopolitan and saprophytic fungus, living on dead organic matter.
* *Rhizopus stolonifer* occur very frequently on moist bread, hence commonly called **black bread mold** *Mucor* is called **dung mold**. Both are called **black mold** or **pin mold** because of black coloured pin head like sporangia.

* Besides, it appears in the form of white cottony growth on moist fresh organic matter, jams, jellies, cheese, pickles, etc.
* **Reproduction :** They reproduces by vegetative, asexual and sexual methods.

(a) **Vegetative reproduction :** It takes place by fragmentation. If stolon breaks accidentally into small segments, each part grows into a new mycelium.

(b) **Asexual reproduction :** It occurs by three types of non-motile mitospores, sporangiospores, chlamydospores and oidia

(c) **Sexual reproduction :** Sexual reproduction takes place by conjugation between two multinucleate but single celled gametangia. The gametes are isogamous and non-motile.

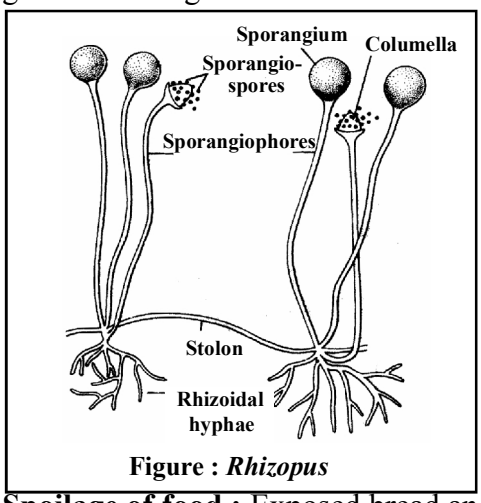


Figure : *Rhizopus*

* **Spoilage of food :** Exposed bread and other food particles are spoiled by *Rhizopus*.
* **Soft rot :** *Rhizopus* species attack sweet potato, apple and strawberry producing soft rot or leak disease. Germinating maize grains are also attacked.
* **Mucormycosis :** *Mucor pusillus* and *M. ramosissimus* may attack internal human organs, including lungs alimentary canal and nervous system.
* **Fermented foods :** Temph (a solid food from soyabean) and sufu (chinese cheese) are prepaired with the help of *Rhizopus* and *Mucor* respectively.
* **Chemicals :** Citric acid prepared by *Mucor* from molasses, fumaric acid and cortisone by *Rhizopus stolonifer,* Lactic acid by *R. stolonifer* and *R.nodosus* and alcohol by *R. oryzae* and *M. javanicus*.
* **Antibiotic :** Ramysin is produced by *Mucor ramannianus*.
* **Waste water treatment :** Growth of *Mucor arrhizus* removes heavy metal contamination of water.

(ii) **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 & Convolvulaceae. The disease caused by this fungus is known as **white rust** or **white blisters.**
* The most common and well known species is *Albugo candida* which attacks the members of the mustard family (Cruciferae).
* It is commonly found on **Capsella bursa pastoris** (Shepherd's purse) and occasionally on radish, mustard, cabbage, cauliflower, etc.
* The reserve food is oil and glycogen.

Division Ascomycetes (Sac-fungi)

* Commonly known as **sac-fungi**, the ascomycetes are unicellular, e.g., yeast (Sacharomyces) or multicellular, e.g., Penicillium. They are saprophytic, decomposers, parasitic or coprophilous (growing on dung). Mycelium is branched and septate.
* The asexual spores are conidia produced exogenously on the special mycelium called conidiophores. Conidia on germination produce mycelium. Sexual spores are called ascospores which are produced endogenously in sac like asci (singular ascus). These asci are arranged in different types of fruiting bodies called ascocarps.
* Some examples are Aspergillus, Claviceps and Neurospora. Neurospora is used extensively in biochemical and genetic work. Many members like morels and buffles are edible and are considered delicacies.

Yeast

* It was first described by Antony Von Leeuwenhoek in 1680.
* Yeast are nonmycelial or unicellular, which is very small and either spherical or oval in shape.

* However, under favourable conditions they grow rapidly and form **false mycelium** or **pseudomycelium**.
* Individual cells are colourless but the colonies may appear white, red, brown, creamy or yellow. The single cell is about 10 μm in diameter.

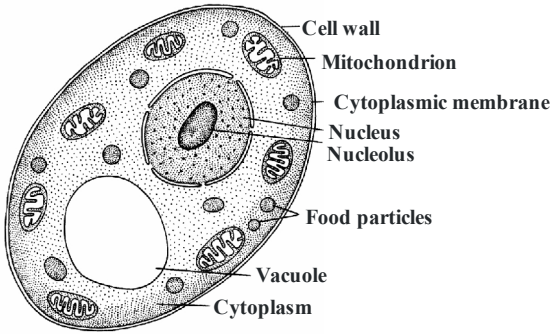


Figure : Yeast cell

* It is enclosed in a delicate membrane which is not made up of fungal cellulose but is a mixture of two polysaccharides known as mannan and glycogen.

* **Reproduction :** Yeast reproduces by vegetative or asexual and sexual methods.

(1) **Vegetative reproduction :** Yeast reproduce vegetatively either by budding or by fission.

(2) **Sexual reproduction :** Sexual reproduction in yeasts takes place during unfavourable conditions, particularly when there is less amount of food.

The sex organs are not formed in yeasts and the sexual fusion occurs between the two haploid vegetative cells or two ascospores which behave as gametes. The two fusing gametes are haploid and may be **isogamous** or **anisogamous**. Such kind of sexual reproduction is called **gametic copulation**. It is the best example of **hologamy** *i.e.*, the entire vegetative thallus is transformed into reproductive body. The sexual fusion leads to the formation of diploid zygote. The zygote behaves as an ascus and forms 4 – 8 haploid ascospores. These liberate and function as vegetative cells.

Useful activities

* **Baking industry :** Yeast are used in manufacture of bread. Kneaded flour is mixed with yeast and allowed to ferment. Yeast convert starch into sugars and sugar into CO_2 and alcohol with help of enzyme zymase, CO_2 is released when effervescence takes place due to which bread become spongy and gets swollend and is of light weight.
* **Brewing industry :** Brewer's yeast or Beer yeast is *Saccharomyces cerevisiae* and wine yeast is *Saccharomyces ellipsoidens*. They perform alcoholic fermentation.
* **Food yeast :** Yeast from brewing industry is harvested and used as food yeast. It is rich in protein and vitamins-B (Riboflavin). Special food yeasts are Torulopsis (protein), Endomyces (fat) and Cryptococus (both).

Harmful activities

* Fermentation of fruits and fruit juices by yeast cells makes their taste unpleasent.
* Parasitic species of yeast like *Nematospora* causes diseases in tomato, cotton and bean.
* Parasitic yeast cause diseases in human beings (*e.g.,* cryptococcois, blastomycosis and torulosis).

Division Basidiomycetes (Club fungi)

* Commonly known forms of basidiomycetes are mushrooms, bracket fungi or puffballs. They grow in soil, on logs and tree stumps and in living plant bodies as parasites, e.g., rusts and smuts. The mycelium is branched and septate.
* The asexual spores are generally not found, but vegetative reproduction by fragmentation is common. The sex organs are absent, but plasmogamy is brought about by fusion of two vegetative or somatic cells of different strains or genotypes. The resultant structure is **dikaryotic** which ultimately gives rise to **basidium**. Karyogamy and meiosis take place in the basidium producing four basidiospores. The basidiospores are exogenously produced on the basidium. The basidia are arranged in fruiting bodies called **basidiocarps.**
* Some common members are Agaricus (mushroom), Ustilago (smut) and Puccinia (rust fungus).

Division Deuteromycetes (Imperfect fungi)

* Commonly known as imperfect fungi because only the asexual or vegetative phases of these fungi are known.
* The deuteromycetes reproduce only by asexual spores known as **conidia.** The mycelium is septate and branched. Some members are saprophytes or parasites while a large number of them are decomposers of litter and help in mineral cycling.
* Examples : Alternaria, Colletotrichum and Trichoderma.

Various classes of fungi :

S.N.	Features	Phycomycetes	Ascomycetes	Basidiomycetes	Deuteromycetes
1.	Mycelium	Aseptate / coenocytic	Septate, branched	Septate, branched	Septate, branched
2.	Asexual spore	Zoospore (Plannospore)/ Sporangiosphere (Aplanaospore)	Conidia	Generally absent	Conidia
3.	Sexual spore	Zygospore / Oospore	Ascospore	Basidiospore	Absent
4.	Fruiting bodies	Absent	Ascocarp	Basidiocarp	Absent

Members of the Kingdom Fungi

* ***Mycorrhizae*** - More than 90% of the plants are symbionts of mycorrhizae. Myco means fungus and rhiza means root.
* ***Ectomycorrhizae*** - These are fungus forms sheath outside the root.
* ***Endomycorrhizae*** - They are also known as vesicular-arbuscular-mycorrhizae (VAM). Fungus does not form sheath around the roots.
* ***Lichens*** - They are symbionts. They have a symbiotic relationship between a fungus and a alga. Neither of the organisms can survive on their own.

KINGDOM PLANTAE

* Kingdom Plantae includes all eukaryotic chlorophyll-containing organisms commonly called plants.
* A few members are partially heterotrophic such as the insectivorous plants or parasites. Bladderwort and Venus fly trap are examples of insectivorous plants and Cuscuta is a parasite.
* The plant cells have an eukaryotic structure with prominent chloroplasts and cell wall mainly made of cellulose.
* Life cycle of plants has two distinct phases – the diploid sporophytic and the haploid gametophytic – that alternate with each other. The lengths of the haploid and diploid phases, and whether these phases are free–living or dependent on others, vary among different groups in plants. This phenomenon is called **alternation of generation.**

KINGDOM ANIMALIA

* This kingdom is characterised by heterotrophic eukaryotic organisms that are multicellular and their cells lack cell walls.
* They directly or indirectly depend on plants for food. They digest their food in an internal cavity and store food reserves as glycogen or fat.
* Their mode of nutrition is holozoic – by ingestion of food.
* They follow a definite growth pattern and grow into adults that have a definite shape and size.
* Higher forms show elaborate sensory and neuromotor mechanism.
* The sexual reproduction is by copulation of male and female followed by embryological development.
* **Anaima :** Animals without red blood e.g., sponges, cnidaria, mollusca, arthropoda, echinodermata, etc.

* **Enaima :** Animals with red blood *e.g.,* vertebrates.
* **Vivipara :** Animals which give birth to young ones are included in this subgroup *e.g.*, man, dogs, cows, etc.
* **Ovipara :** Animals which lay eggs are included in this subgroup *e.g.*, frogs, toads, lizards, snakes, birds, etc.
* **Anamniotes :** Vertebrates without embryonic membranes *e.g.,* fishes, amphibians.
* **Amniotes :** Vertebrates with embryonic membranes (chorion, amnion, allantois, yolk sac) *e.g.,* reptiles, birds, mammals.
* **Acraniata or Protochordata :** Chordates without cranium (brain box). It includes urochordata and cephalochordata.
* **Chordates :** Animals with notochord dorsal tubular nerve cord, paired pharyngeal gill slits. All urochordates, cephalochordates and vertebrates are called chordates.
* **Craniata or Vertebrate :** Chordates with cranium. It includes cyclostomes, pisces, amphibians, reptiles, birds and mammals.
* **Nonchordates :** Animals without notochord (a rod like elastic structure which supports the body). Phylum Porifera to phylum Hemichordata are called nonchordates.

  Invertebrates : Animals without vertebral coloumn (backbone). All the nonchordates, urochordates and cephalochordates are callectively called invertebrates.

VIRUS

* Term virus was coined **by Pasteur.**
* Viruses are **obligate intracellular parasites.** They are intermediate between living and non living entities.

Non living nature of virus

* Lacking protoplast.
* Ability to get crystallized, *e.g.,* TMV, poliomyelitis virus.
* Inability to live independent of a living cell. (Lack functional autonomy)
* High specific gravity which is found only in non living objects
* Absence of respiration.
* Absence of energy storing system.
* Absence of growth and division.

Living nature of virus

* Being formed of organic macromolecules.
* Presence of genetic material.
* Ability to multiply.
* Occurrence of mutations.
* Occurrence of certain enzymes like, neuraminidase (first discovered), transcriptase and lysozyme in certain viruses.
* Infectivity and host specificity.
* Viruses can be 'killed' by autoclaving and ultraviolet rays.
* They take over biosynthetic machinery of the host cell and produce chemicals required for their multiplication.
* Viruses are responsible for a number of infectious disease like common cold, epidemic influenza, chicken pox, mumps, poliomyelitis, rabies, herpes, AIDS, SARS etc.

Structural Components of Viruses

(i) **Envelope** is the outer thin loose covering composed of proteins (from virus), lipids and carbohydrates (both from host). It has smaller subunits known as **peplomers,** *e.g.,* Herpes virus, HIV, Vaccinia virus etc. If it is not present the virus is said to be naked.

(ii) **Capsid :** It is the outer protein coat made up of subunits called **capsomeres,** their number is virus specific. These possess antigenic properties.

(iii) **Nucleoid :** Viruses contain either DNA or RNA. No virus contains both DNA and RNA.

(a) DNA containing viruses are called deoxyviruses. These are of two types:

- Double stranded DNA (**dsDNA**) virus, *e.g.,* Pox virus, Cauliflower mosaic virus.
- Single stranded DNA **(ssDNA)** virus, *e.g.,* Coliphage $\phi \times 174$, M 13 phage.

(b) RNA containing viruses or riboviruses are of two types.

- Double stranded RNA (**ds RNA**) virus, *e.g.,* Reo virus, Wound Tumour Virus.

- Single stranded RNA (**ss RNA**) virus, *e.g.,* TMV, Influenza virus, Foot and Mouth disease virus, Retroviruses (HIV).

Classification of Virus

* **Holmes** (1948) has divided viruses into three groups on the basis of specific hosts.

(a) **Phytophagineae** are plant viruses. They generally have ssRNA, *e.g.,* TMV, Potato Mosaic Virus, Yellow Vein Mosaic virus, Cauliflower Mosaic virus.

(b) **Zoophagineae** are animal viruses. They commonly have ssRNA or dsRNA or dsDNA. *e.g.,* Poliomyelitis virus, Influenza viruses, Small pox virus, Mumps virus, Rabies virus.

(c) **Phagineae** attack lower organisms

(i) **Bacteriophages** are bacterial viruses and they usually possess dsDNA, *e.g.,* T_2, T_4, lambda(λ) phage.

(ii) **Coliphages** are viruses of *E.coli, e.g.,* Coliphage fd.

(iii) **Cyanophages** attack blue green algae, *e.g.,* LPP-1, SM-1 .

(iv) **Phycophages** attack algae.

(v) **Mycophages** attack fungi.

(vi) **Zymophages** attack yeast.

Reproduction

It is of two main types: **Phagic** and **Pinocytic**

(a) **Phagic Reproduction** : It is further of two types:

(i) **Lytic cycle :** Occurs in virulent phages, *e.g.,* T_4 bacteriophages.

(ii) **Lysogenic cycle :** Occurs in temperate viruses such as λ phage.

(b) **Pinocytic Reproduction:** It is found in viruses like TMV, HIV, Hepatitis B etc., in which whole of virus particle enters host cell except envelope (if present).

Structural details of some viruses

(1) **Tobacco Mosaic Virus (TMV)** is elongated rod like, 3000 Å long, 180 Å in diameter with 10^6 dalton. 2130 capsomeres are arranged helically to form the capsid. RNA strand is helical. ssRNA consists of 6400 nucleotides. Thus, the ratio of nucleotides : capsomeres = 3 : 1

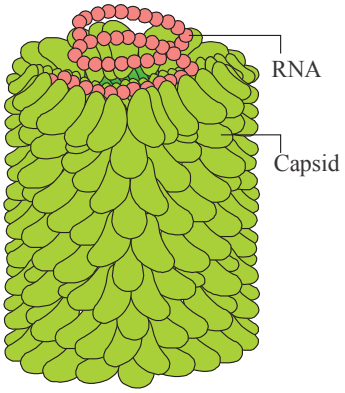


Figure : Tobacco Mosaic Virus (TMV)

(2) **Pox virus/variola** is the causal agent of small pox. These are among the largest of animal viruses, are rectangular (brick shaped), 300 × 230 nm in size. Genome is dumbell shaped with central core of dsDNA. The core has two enzymes RNA polymerase and ATP phosphohydrolase.

(3) **AIDS virus** consists of single stranded RNA. It has 2 copies of ssRNA. Outer cover has 5 layers, *i.e.,* outer most glycoprotein, followed by double lipid layer and the innermost has two protein layers.

(4) **T_4 Bacteriophage** has a tadpole like structure with polyhedral head connected to a helical tail (binal). The head consists of nucleic acid surrounded by a protein coat or capsid. Nucleic acid is double stranded DNA. Tail is proteinaceous tube-like, core surrounded by sheath. At one end, tube is joined to the head by thin collar. At the other end, it has a hexagonal base plate with six small tail pins and six tail fibres which help in attachment of the phage to the host cell.

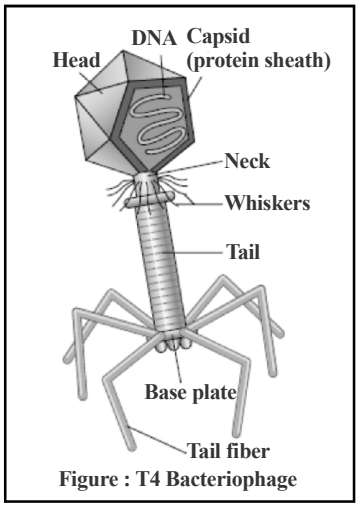


Figure : T4 Bacteriophage

Sub Viral Agents

These are viruses which lack one of the essential component, *e.g.,* viroids, virusoids, prions

(1) Viroids (L. *virus* -poison, *eidos* -diminutive)

* They are the smallest self replicating particles which were discovered by **Diener** (1971). Viroids are infectious RNA particles which are devoid of protein coat.
* They are obligate parasites. Molecular weight of a viroid is low.
* The RNA is tightly folded to form circular or linear structures. Viroids are known to cause diseases (some 20) in plants only, *e.g.,* Potato spindle tuber disease (PSTD), *Chrysanthemum* stunt and *Citrus* exocortis.

(2) Virusoids

* Discovered by **Randle** *et. al.,* these are RNA viruses but inside the capsid of other larger virus. They replicate within the host and do not cause any infection.

(3) Prions

* In modern medicine certain infections neurological diseases were found to be transmitted by an agent consisted of abnormally folded protein.

  The agent was similar in size to viruses. These agents were called prions.
* The most notable diseases caused by prions are bovine spongiform encephalopathy (BSE) commonly called mad cow disease in cattle and its analogous variant Cr-Jacob disease (CJD) in humans.

Lichens

* Lichens are symbiotic associations i.e. mutually useful associations, between algae and fungi.
* The algal component is known as **phycobiont** and fungal component as **mycobiont**, which are autotrophic and heterotrophic, respectively.
* Algae prepare food for fungi and fungi provide shelter and absorb mineral nutrients and water for its partner.
* Lichens are very good pollution indicators – they do not grow in polluted areas.

CONCEPT REVIEW

* Biological classification of plants and animals was first proposed by Aristotle on the basis of simple morphological characters.
* Linnaeus later classified all living organisms into two kingdoms -Plantae and Animalia.
* Whittaker proposed an elaborate five kingdom classificatlon -Monera, Protista, Fungi, Plantae and Animalia. The main criteria of the five kingdom classification were cell structure, body organisation, mode of nutrition, reproduction and phylogenetic relationship out of which mode of nutrition was most important.
* In the five kingdom classification, bacteria are included in Kingdom Monera.
* Bacteria are cosmopolitan in distribution.
* These organisms show the most extensive metabolic diversity, although they have a simple structure.
* Bacteria may be autotrophic or heterotrophic in their mode of nutrition.
* Kingdom Protista includes all single-celled eukaryotes such as Chrysophytes, Dinoflagellates, Euglenoids, Slime moulds and Protozoans.
* Many protists reproduce both sexually, often by **syngamy** (union of gametes), and asexually; others reproduce only asexually.
* Protists have defined nucleus and other membrane bound organelles. They reproduce both asexually and sexually.
* Members of Kingdom Fungi show a great diversity in structures and habitat.
* Most fungi are saprophytic in their mode of nutrition.
* They show asexual and sexual reproduction.
* Phycomycetes, Ascomycetes, Basidiomycetes and Deuteromycetes are the four classes under this kingdom.
* **Ascomycetes** produce asexual spores called **conidia**; sexual spores called **ascospores** are produced in asci. Ascomycetes include yeasts, cup fungi, morels, truffles, and pink, brown, and blue-green molds.
* **Basidiomycetes** produce sexual spores called **basidiospores** on the outside of a basidium;

basidia develop on the surface of gills in mushrooms, a type of **basidiocarp**. Basidiomycetes include mushrooms, puffballs, bracket fungi, rusts, and smuts.

* **Imperfect fungi,** or **deuteromycetes**, are a polyphyletic group that lack a sexual stage. Most reproduce asexually by forming conidia. Members of this group include *Aspergillus tamarii* (used to produce soy sauce), some species of *Penicillium*, and fungi that cause certain human infections.
* The plantae includes all eukaryotic chlorophyll-containing organisms. Algae, bryophytes, pteridophytes, gymnosperms and angiosperms are included in this group.
* The life cycle of plants exhibit alternation of generations-gametophytic and sporophytic generations.
* The heterotrophic eukaryotic, multicellular organisms lacking a cell wall are included in the Kingdom Animalia. The mode of nutrition of these organisms is holozoic.
* They reproduce mostly by the sexual mode.
* Some acellular organisms like viruses and viroids as well as the lichens are not included in the five kingdom system of classification.
* No virus contains both RNA and DNA.

IMPORTANT POINTS

* A unicellular organism often considered connecting link between plants and animals is *Euglena*.
* Blue-green algae are placed in the kindom Monera.
* Five kingdom classification is based on mode of nutrition.
* A phylum common to unicellular animals and plants is protista.
* In Five kingdom classification, bacteria belong to monera.
* Cynobacteria is the modern name of Myxophyceae.
* *Escherichia* belongs to monera.
* *Nostoc* can fix nitrogen.
* In bacteria, sex is determined by presence of pili.
* Land becomes slippery during rains due to growth of blue-green algae.
* Mitochondria are absent in blue-green algae.
* Antibiotics are bactericides
* Plague is caused by *Pasteurella pestis*.
* The most primitive of monerans are Archaebacteria.
* Flagella are absent in Cyanophyta.
* Shape of *Staphylococcus* bacteria is circular.
* Rod-shaped bacteria are called Bacillus.
* *Salmonella* causes Typhoid.
* *Streptosymces* = Source of antibiotics.
  Rhizobium = Nitrogen fixation
  Nitrosomonas = Nitrification
  Acetobacter = Vinegar synthesis
* *E. coli* is a prokaryote.
* *Spirulina* belongs to the kingdom Monera.
* Shape of cocci bacteria is spherical.
* Nutrition in Amoeba is holozoic.
* Slime Moulds belong to protista.
* *Euglena* can photosynthesise its food.
* *Euglena* is a flagellate.
* Common malaria parasite of India is *P. vivax*.
* Euglena =
  (i) Presence of chlorophyll
  (ii) Presence of proteinaceous pellicle.
  (iii) Presence of flagellum.
* Amoeba = (i) Omnivory (ii) Holozoic nutrition
  (iii) Pseudopodia feeder
* Malaria is caused by sporozoan.
* *Paramecium* is protozoan.
* *Trypanosoma* is flagellated protozoan.
* Coenocytic mycelium occurs in Phycomycetes.
* Lichens show symbiotic relationships between fungus and alga.
* Study of fungi is mycology.
* *Rhizopus* belongs to Zygomycetes.
* The fungus that may cause disease in human beings is *Aspergillus*.
* Mushroom is *Agaricus*.
* Lichens –
  (i) Some species are eaten by Reindeers.
  (ii) Lichen are indicators of pollution.
  (iii) They have symbiotic relationship between alga and fungus.
* Bakane disease of rice is due to *Giberella*.
* Black colour of Bread mould is due to sporangia.
* Reindeer Moss is Lichen.
* Edible part of Mushroom is basidiocarp.

* Fungi imperfecti –
  (i) They do not have sexual phase.
  (ii) They do not include *Aspergillus*, the fungus used in making soya sauce.
  (iii) They include species that prey on nematodes.
* Athlete's foot disease in humans is caused by fungus.
* *Rhizopus* = Phycomycetes
  Penicillium = Ascomycetes
  Ustilago = Basidiomycetes
  Altermaria = Deuteromycetes
* A virus is a nucleoprotein and the genetic material is infectious. In general, viruses that infect plants have single stranded RNA and viruses that infect animals have either single or double stranded RNA or double stranded DNA. Bacterial viruses or bacteriophages (viruses that infect the bacteria) are usually double stranded DNA viruses.
* The protein coat called capsid made of small subunits called capsomeres, protects the nucleic acid. These capsomeres are arranged in helical or polyhedral geometric forms.
* Viruses cause diseases like mumps, small pox, 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.
* Algae prepare food for fungi and fungi provide shelter and absorb mineral nutrients and water for its partner.
* Lichens are very good pollution indicators – they do not grow in polluted areas.
* **Kingdom Protista Examples**
  - Green algae - *Spirogyra, Ulva, Chlamydomonas, Volvox.*
  - Red algae - *Porphyra, Rotalgen.*
  - Brown algae - *Laminaria, Nereocystis.*
  - Water moulds - *Saprolegnia.*
  - Phylum Ciliata - *Paramecium, Vorticella.*
  - Phylum Dinoflagellata - *Ceratium, Gonyaulax.*
  - Phylum Mastigophora - *Trypanosoma, Trichonympha.*
  - Phylum Sarcodina - *Amoeba.*

* **Some Important Antibiotic:**

	Antibiotic	Fungi
1.	Penicillin B	*P. notatum*
2.	Notatin or Panetin	*P. notatum*
3.	Penicillin	*P. chrysogenum*
4.	Puberulic acid	*P. puberulum*
5.	Albidin	*P. albidum*
6.	Gresio - flavin	*P. genseni*
7.	Spinulosin	*P. spinulosum*
8.	Citrinin	*P. citrinum*
9.	Flavisin	*A. flavus*
10.	Clavisin or Petulin	*A. clavatus*
11.	Fumagatin	*A. fumigatus*
12.	Peracytisin	*A. parasiticus*
13.	Aspergillin	*A. niger*
14.	Spinulosin	*A. spinulosum*
15.	Geodin	*A. termus*

* **Some common names of fungi**

Myxomycetes	-	Slime fungi or slime molds or mycocetozoa
Eumycetes	-	True fungi
Phycomycetes	-	Algal fungi or aquatic fungi
Ascomycetes	-	Sac fungi
Basidiomycetes	-	Club fungi
Saprolegenia		
Allomyces	-	Water molds or aquatic fungi
Blastocladiella		
Pythium	-	Damping off fungus
Mucor	-	Black or Bread mold
Mucor mucedo	-	Dung mold
M. Stolonifer	-	Bread mold
Penicillium	-	Green or blue mold
Pezzia	-	Cup fungi
Polyporus	-	Pore fungi
Morchella	-	Morel or sponge mushroom
Agaricus compestris	-	Common edible mushroom
Poisonous mushroom	-	Toadstool
Corinus comatus	-	Inky cap mushroom
Synchytrium	-	Chytrid
Aspergillus	-	Conidial fungus

Neurosporoa - Red bread mole or Bakery mold or Genetical fungus or Drossophila of Plant kingdom
Puccina - Rust fungs
Ustilago - Smut fungus
Lycoperdon - Puff ball or Earth star
Cyathus, Nidula Nidularia - Bird's nest fungi of Fairy purse
Plasmophora Peranospora - Downy mildew
Aspergillus niger - Black mold or weed of laboratory
Saccharomcyes - Yeat of commerce crevisiae
Marasimusoreaders - Fairy rings fungi
Yeast - SCP, sprouting fungi, sugar fungi
Mucor stolonifer - Bread mold
Claviceps - Ergot fungi
Marchella - Edible sac fungi
Auricularia - Jelly fungi
Dictyophora - Stink horn fungi duplicate
Fomes - Shelf fungi
Clavicornona - Coral fungi
Armillariella mellea - Honey mushroom
Psilocybe Geastrum - Hallucinogenic fungi
Astraeus - Earth stars
Labryrinthula - Net slime molds
Rhizopus - Conjugation fungi

QUESTION BANK

EXERCISE - 1 (LEVEL-1) [NCERT EXTRACT]

SECTION - 1 (VOCABULARY BUILDER)

Choose one correct response for each question.
For Q.1-Q.6
Match the column I with column II.

Q.1 Match the following columns.

	Column I	Column II
a.	Two kingdom system of classification	i. RH Whittaker
b.	Five kingdom system of classification	ii. Carl Woese
c.	Six kingdom system of classification	iii. Carolus Linnaeus

Codes
(A) a-ii, b-i, c-iii (B) a-i, b-ii, c-iv
(C) a-iv, b-iii, c-i (D) a-iii, b-i, c-ii

Q.2 Match the following columns.

	Column I	Column II
a.	Chief producer in the oceans	i. Diatoms
b.	Red tides	ii. Dinoflagellates
c.	Connecting link between plants and animals	iii. Euglenoids
d.	Fungus-animals	iv. Slime mould

Codes
(A) a-ii, b-iii, c-iv, d-i
(B) a-iii, b-iv, c-i, d-ii
(C) a-i, b-ii, c-iii, d-iv
(D) a-iv, b-i, c-ii, d-iii

Q.3 Match the following columns.

	Column I	Column II
a.	Halophiles	i. Bacteria which survive in alkaline medium
b.	Thermoacidophiles	ii. Bacteria which survive in marshy area
c.	Methanogens	iii. Bacteria residing in hot springs
d.	Basophiles	iv. Bacteria residing in salty areas

Codes
(A) a-iv, b-iii, c-ii, d-i (B) a-iii, b-ii, c-i, d-iv
(C) a-ii, b-i, c-iv, d-iii (D) a-i, b-iv, c-iii, d-ii

Q.4 Match the following columns.

	Column I	Column II
a.	Coccus	i. Rod-shaped
b.	Bacillus	ii. Spherical
c.	Vibrio	iii. Spiral-shaped
d.	Spirillum	iv. Comma-shaped

Codes
(A) a-iii, b-ii, c-i, d-iv (B) a-ii, b-i, c-iv, d-iii
(C) a-iv, b-iii, c-ii, d-i (D) a-i, b-iv, c-iii, d-ii

Q.5 Match the following columns.

	Column I	Column II
a.	Chrysophytes	i. *Paramecium*
b.	Dianoflagellates	ii. Saprophytic protists
c.	Euglenoids	iii. *Euglena*
d.	Slime moulds	iv. *Gonyaulax*
e.	Protozoans	v. Diatoms and golden algae

(A) a-ii, b-i, c-v, d-iv, e-iii
(B) a-v, b-iv, c-iii, d-ii, e-i
(C) a-iv, b-iii, c-ii, d-i, e-v
(D) a-iii, b-ii, c-i, d-v, e-iv

Q.6 Match the following columns

	Column I	Column II
a.	Phycomycetes	i. Algal fungi
b.	Ascomycetes	ii. Imperfecti fungi
c.	Basidiomycetes	iii. Bracket fungi
d.	Deuteromycetes	iv. Sac fungi

Codes
(A) a-ii, b-i, c-iv, d-iii
(B) a-iv, b-iii, c-ii, d-i
(C) a-i, b-iv, c-iii, d-ii
(D) a-iii, b-ii, c-i, d-iv

SECTION - 2 (BASIC CONCEPTS BUILDER)

For Q.7 to Q.24 :
Choose one word for the given statement from the list.

Heterocyst, True bacteria, Plasmodium, Mycelium, Plasmogamy, Cheese, Beer, White, *Albugo candida*, *Alternaria*, Zoospores, Aplanospore, Parasites, Karyogamy, Capsid, Imperfect fungi, Ernst Haeckel, 1886, Stainier and Von Niel, Chitin, Non-cellulosic, Polysaccharide, Monera, Saprophytes

Q.7 Eubacteria is also known as _____.

Q.8 In fungi, the network of hyphae is known as ___.

Q.9 Some of the cyanobacteria blue green algae can fix atmospheric nitrogen in specialised cells called _____.

Q.10 The protein coat of a virus is known as ____.

Q.11 The free living thalloid body of the slime mould is known as _____.

Q.12 In fungi, the fusion of protoplasm between two motile or non-motile gametes is called ____.

Q.13 Deuteromycetes is also known as _____.

Q.14 In fungi, the fusion of two nuclei is called

Q.15 Three kingdom system of classification was proposed by ____ in the year ____.

Q.16 Four kingdom system of classification was proposed by ____.

Q.17 The fungi had ____ and ____ in their walls.

Q.18 ____ includes prokaryotic microorganism like bacterias.

Q.19 Yeast are used to make ____ and ___.

Q.20 ____ spots seen on mustard leaves are due to ____.

Q.21 Mycelium is septate and branched in ____.

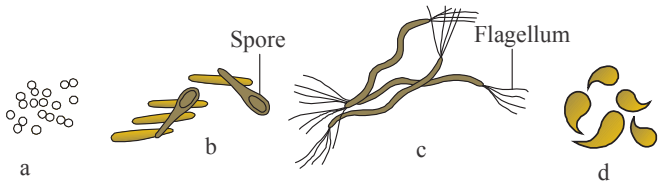
Q.22 In Phycomycetes asexual reproduction takes place by ____ or by ____.

Q.23 Fungi that absorbs nutrients directly from the living host cytoplasm are called _____.

Q.24 Fungi that absorbs soluble organic matter from dead substrates are called _____.

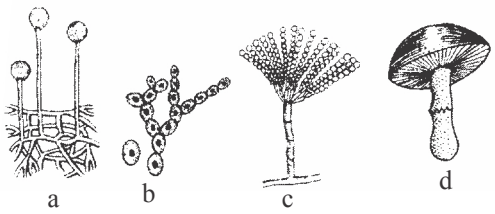
SECTION - 3 (ENHANCE DIAGRAM SKILLS)

Q.25 Bacteria are grouped under four categories based on their shape. Study the given figure and identify a, b, c and d.



(A) a-Vibrio, b-Cocci, c-Bacilli, d-Spirilla
(B) a-Cocci, b-Bacilli, c-Spirilla, d-Vibrio
(C) a-Bacilli, b-Spirilla, c-Vibrio, d-Cocci
(D) a-Spirilla, b-Vibrio, c-Cocci, d-Bacilli

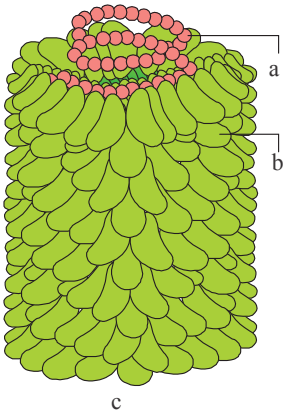
Q.26 Select the correct option that correctly identifies the different genera (a, b, c & d) of kingdom Fungi shown in figure.



(A) a-*Mucor*, b-*Saccharomyces*, c-*Morchella*, d-*Amanita*

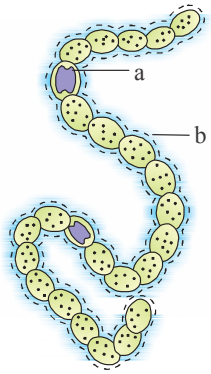
(B) a-*Mucor*, b-*Saccharomyces*, c-*Penicillium*, d- *Agaricus*
(C) a-*Rhizopus*, b-*Saccharomyces*, c-*Aspergillus*, d-*Morchella*
(D) a-*Aspergillus*, b-*Rhizopus*, c-*Penicillium*, d-*Agaricus*

Q.27 Given below is the diagram of a virus. In which one of the options, all the three a, b and c (name of the virus) are correct?



(A) a-RNA, b-Capsomere, c-TMV
(B) a-DNA, b-Capsid, c-Bacteriophage
(C) a-RNA, b-Capsid, c-Tobacco mosaic virus
(D) a-DNA, b-Capsid, c-Bacteriophage

Q.28 Given figure is of a filamentous blue-green algae. Identify the algae and name a and b in the following figures.

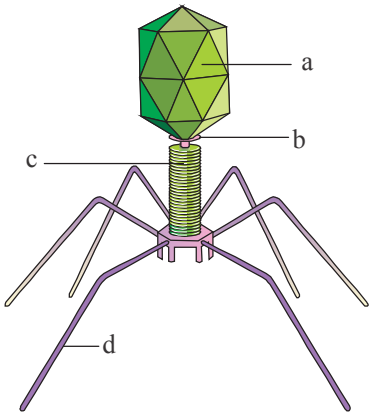


(A) *Gelidium*, a-Vegetative cell, b-Heterocyst
(B) *Volvox*, a-Somatic cell, b-Mucilaginous sheath
(C) *Chara*, a-Mucilaginous sheath, b-Heterocyst
(D) *Nostoc*, a-Heterocyst, b-Mucilaginous sheath

Q.29 Which group of organisms is represented by the given figure?

(A) Dinoflagellates (B) Protozoans
(C) Slime mould (D) Euglenoids

Q.30 Identify the label a, b, c and d in the following figures.



Codes
(A) a-Head, b-Collar, c-Sheath, d-Tail fibres
(B) a-Collar, b-Head, c-Sheath, d-Tail fibres
(C) a-Head, b-Collar, c-Tail fibres, d-Sheath
(D) a-Collar, b-Tail fibres, c-Head, d-Sheath

SECTION - 4 (ENHANCE PROBLEM SOLVING SKILLS)

Choose one correct response for each question.

PART - 1 : DIFFERENT CLASSIFICATIONS

Q.31 In five kingdom classification the unicellular prokaryotic organisms were classified under kingdom
(A) Protista (B) Monera
(C) Animalia (D) Plantae

Q.32 Aristotle classified the plants on the basis of their morphological characters and categorised them into
(A) tree, shrubs and herbs
(B) algae, bryophytes, pteridophytes, gymnosperms and angiosperms
(C) embryophytes and tracheophytes
(D) algae and embryophytes

Q.33 Which is the only kingdom occupied by BGA, nitrogen fixing bacteria and methanogenic bacteria in five kingdom classification?
(A) Plantae (B) Protista
(C) Monera (D) Fungi

Q.34 Who proposed two kingdom system of classification and named kingdoms as Plantae and Animalia?
(A) Carolus Linnaeus (B) RH Whittaker
(C) Carl Woese (D) Herbert Copeland

Q.35 In five kindgom classification, the eukaryotes were assigned under how many kingdoms?
(A) Only four kingdom (B) All five kingdom
(C) Only two kingdom (D) Only three kingdom

Q.36 In the five kingdom classification, *Chlamydomonas* and *Chlorella* are included in
(A) Plantae (B) Algae
(C) Protista (D) Monera

Q.37 Which of the following characters served as the criteria for five kingdom system of classification as used by R.H. Whittaker?
(A) Cell structure and thallus organisation
(B) Mode of nutrition and reproduction
(C) Phylogenetic relationships
(D) All of these

Q.38 The phylogenetic system of classification was proposed by –
(A) Carolus Linnaeus
(B) George Bentham and Joseph Dalton Hooker
(C) Aristotle
(D) Adolf Engler and Karl Prantl

Q.39 Five kingdom classification was given by
(A) Huxley (B) Hooker
(C) Whittaker (D) Linnaeus

PART - 2 : KINGDOM-MONERA

Q.40 Bacteria which survive in marshy areas and also present in the gut of many ruminant animals like cows and buffaloes are
(A) halophiles (B) basophiles
(C) thermoacidophiles (D) methanogens

Q.41 Which one of the following is an incorrect statement regarding mycoplasma?
(A) They lack a cell wall.
(B) They are the smallest living cells.
(C) They cannot survive without oxygen.
(D) They are pathogenic in plants and animals.

Q.42 All eubacteria have –
(A) rigid cell wall (B) flagellum
(C) silica (D) Both (A) and (B)

Q.43 According to five kingdom system of classification, bacteria belongs to
(A) Protista (B) Monera
(C) Plantae (D) Archaea

Q.44 Which one of the following forms of the bloom is present in polluted water?
(A) Blue-green algae (B) Red algae
(C) Blue algae (D) Brown algae

Q.45 Which of the following statements is incorrect regarding the structure of a typical bacterial cell?
(A) Cells possess naked circular DNA which is folded to form nucleoid.
(B) Cells are surrounded by a peptidoglycan cell wall and a mucilaginous sheath.
(C) Cells possess well developed membrane bound cell organelles.
(D) Ribosomes in these cells are 70S in nature.

Q.46 Eubacteria includes
(A) blue-green algae
(B) archaebacteria and blue-green algae
(C) cyanobacteria and prokaryotes
(D) bacteria and eukaryotes

Q.47 _____ are important decomposers that cause decay and decomposition of dead bodies of plants and animals.
(A) Saprotrophic bacteria
(B) Saprotrophic fungi
(C) Plants, like Sarracenia
(D) Both (A) and (B)

Q.48 Most abundant bacteria are
(A) chemosynthetic
(B) heterotrophic
(C) heterotrophic decomposers
(D) archaebacteria

Q.49 Some bacteria thrive extreme environment conditions such as absence of oxygen, high salt concentration, high temperature and acidic pH. Identify the type of bacteria
(A) cyanobacteria (B) eubacteria
(C) archaebacteria (D) mycobacteria

Q.50 Mycoplasmas are classified under which of the following kingdoms?
(A) Animalia (B) Protista
(C) Monera (D) Fungi

Q.51 Archaebacteria do not show –
(A) Peptidoglycan and D-amino acids in cell wall
(B) Introns in DNA
(C) Branched chain lipids in cell membrane
(D) Ribosomal proteins with highly acidic nature

Q.52 Eubacteria have rigid cell wall made up of
(A) murein (B) peptidoglycan
(C) cellulose (D) chitin

Q.53 *Nostoc* and *Anabaena* belongs to
(A) eubacteria (B) archaebacteria
(C) cyanobacteria (D) cocci bacteria

Q.54 Which one is the most abundant microorganism?
(A) Algae (B) Viruses
(C) Protists (D) Bacteria

PART - 3 : KINGDOM-PROTISTA

Q.55 Which of the following groups are placed under the kingdom-Protista?
(A) Crysophytes
(B) Dianoflagellate and euglenoids
(C) Slime moulds and protozoans
(D) All of the above

Q.56 Silica gel is obtained by
(A) red algae (B) diatoms
(C) *Euglena* (D) Mycoplasma

Q.57 Flagellate protozoans are
(A) free living only
(B) parasites only
(C) either free living or parasites
(D) saprophytes

Q.58 Which of the following protist releases toxins that may even kill fishes and other marine animal?
(A) *Euglena* (B) *Gonyaulax*
(C) *Paramecium* (D) *Plasmodium*

Q.59 Acellular slime moulds show –
(A) Haploid uninucleate plasmodium
(B) Naked sporangia
(C) Autotrophic nutrition
(D) Isogamous type reproduction

Q.60 Single-celled eukaryotes are included in
(A) Protista (B) Fungi
(C) Archaea (D) Monera

Q.61 Protozoans are
(A) heterotrophs (B) autotrophs
(C) producer (D) saprophytes

Q.62 Members of Protista are primarily
(A) terrestrial (B) aquatic
(C) phathogenic (D) photosynthetic

Q.63 Which of the following group always produce an infectious spore like stage in their life cycle?
(A) Amoebiod protozoans
(B) Ciliated protozoans
(C) Flagellated protozoans
(D) Sporozoans

Q.64 In which of the following groups, the cell wall has stiff cellulose plate on the outer surface?
(A) Diatoms (B) Red algae
(C) Dinoflagellates (D) Slime moulds

Q.65 Which of the following groups belong to protozoans?
(A) Amoeboid, flagellates, ciliates, sporozoans
(B) Diatoms, amoeboid, ciliates, sporozoans
(C) Desmids, ciliates, flagellates, amoebiod
(D) Dinoflagellates, ciliates, Plasmodium, amoeboid

Q.66 Which of the following kingdoms have no well defined boundaries?
(A) Plantae (B) Protista
(C) Monera (D) Algae

Q.67 Chrysophytes are –
(A) planktons (B) nektons
(C) benthic organisms (D) active organism

Q.68 Slime moulds are
(A) phathogenic (B) parasite
(C) saprophytic protists (D) autotrophic

Q.69 Which of the following statements about Euglena is correct?
(A) *Euglena* is a flagellate organism.
(B) *Euglena* when placed in continuous darkness, loses its photosynthetic activity and dies.
(C) The pigments of *Euglena* are quite different from those of green plants.
(D) *Euglena* is a marine protist.

Q.70 Red tides in warm coastal water develops due to the presence of
(A) dinoflagellates (B) euglenoid farms
(C) diatoms and desmids (D) slime moulds

Q.71 Slime moulds are
(A) photosynthetic protists
(B) saprophytic protists
(C) both (A) and (B)
(D) none of these

Q.72 Which of the following groups of organisms are placed under the group chrysophytes?
(A) Diatoms only
(B) Desmids only
(C) Diatoms and golden algae
(D) Desmids and Paramecium

PART - 4 : KINGDOM-FUNGI

Q.73 Which of the following is a parasitic fungi on mustard?
(A) *Rhizopus* (B) *Albugo*
(C) *Agaricus* (D) *Neurospora*

Q.74 Which of the following fungus is used extensively in biochemical and genetic work?
(A) Neurospora (B) Mucor
(C) Rhizopus (D) Aspergillus

Q.75 In some fungi, two haploid cells results in diploid cells. In some cases, dikaryon stage occurs in which two nuclei are present within a cell. This phase is known as
(A) monokaryophase (B) dikaryophase
(C) plasmogamy (D) karyogamy

Q.76 Which one is an incorrectly matched pair?
(A) Phycomycetes : Mucor, Albugo
(B) Ascomycetes : Penicillium, Aspergillus
(C) Basidiomycetes : Puccinia, Agaricus
(D) Deuteromycetes : Ustilago, Colletotrichum

Q.77 The body of a fungus is made up of a number of elongated, tubular filaments called
(A) hyphae (B) woronin bodies
(C) mycelium (D) thallus

Q.78 Ascomycetes is commonly known as
(A) toad stool (B) sac fungi
(C) imperfect fungi (D) bracket fungi

Q.79 Basidiospores are produced by
(A) yeasts (B) diatoms
(C) *Agaricus* (D) bacteria

Q.80 Phycomycetes is a class in kingdom –
(A) Protista (B) Fungi
(C) Plantae (D) Animalia

Q.81 Asexual reproduction in fungi occurs by –
(A) ascospores (B) conidia
(C) basidiospores (D) oospores

Q.82 Coenocytic mycelium is
(A) uninucleate, septate
(B) multinucleate, septate
(C) multinucleate, aseptate
(D) both (B) and (C)

Q.83 Members of Ascomycetes are
(A) sporophytic
(B) decomposers
(C) parasitic or coprophilous
(D) All of these

Q.84 Cell wall of fungi is made up of –
(A) fungal cellulose (B) hemicellulose
(C) fungal chitin (D) Both (A) and (C)

Q.85 Fungi imperfecti includes
(A) *Aspergillus* and *Penicillium*
(B) *Alternaria* and *Trichoderma*
(C) *Ustilago* and *Puccinia*
(D) *Alternaria* and *Penicillium*

Q.86 Sac fungi includes
(A) *Penicillium* and yeast
(B) *Ustilago* and *Puccinia*
(C) *Alternaria* and *Trichoderma*
(D) *Colletotrichum* and yeast

Q.87 In Basidiomycetes, the vegetative reproduction takes place by
(A) endospore (B) conidia
(C) akinetes (D) fragmentation

Q.88 Fungi producing 8 spores in a sac belong to the class
(A) Phycomycetes (B) Ascomycetes
(C) Basidiomycetes (D) Deuteromycetes.

Q.89 The hyphae of *Rhizopus* are
(A) unbranched, aseptate and uninucleate
(B) branched, aseptate and multinucleate
(C) branched, spetate and uninucleate
(D) unbranched, septate and coenocytic

Q.90 Name the class of the Mycota which is commonly called fungi imperfecti?
(A) Deuteromycota (B) Ascomycota
(C) Zygomycota (D) Basidiomycota

Q.91 Mark the odd one (w.r.t. fungi)
(A) Unicisternal golgi bodies.
(B) Show a great diversity in morphology and habitat.
(C) Most of the members are aquatic.
(D) Reverse food material is stored in the form of oil and glycogen.

Q.92 Select incorrectly matched pair
(A) *Rhizopus* -Sporangiospore
(B) *Penicillium* -Ascocarp
(C) *Mucor* -Dikaryophase
(D) *Aspergillus* -Conidia

Q.93 Which of the following are the common parasite of class-Basidiomycetes?
(A) *Ustilago* and *Puccinia*
(B) *Agaricus* and *Trichoderma*
(C) *Alternaria* and *Colletotrichum*
(D) *Colletotrichum* and *Puccinia*

Q.94 Deuteromycetes is commonly known as imperfect fungi because –
(A) only the asexual phase of these fungi is known.
(B) only the vegetative phase of these fungi is known.
(C) only the asexual or vegetative phases of these fungi are known.
(D) only sexual phase of these fungi are known.

Q.95 Which of the following is an edible fungi?
(A) *Mucor* (B) *Penicillium*
(C) *Agaricus* (D) *Rhizopus*

Q.96 Parasitic and saprophytic conditions are more familiar in
(A) fungi (B) bacteria
(C) algae (D) ferns

Q.97 In Phycomycetes, asexual reproduction takes place by
(A) zoospores (B) aplanospores
(C) Both (A) and (B) (D) conidia

Q.98 An unicellular sac-fungus is –
(A) *Claviceps* (B) *Saccharomyces*
(C) *Penicillium* (D) *Neurospora*

Q.99 Regarding sexual reproduction in fungi. Which of the following statement is correct?
(A) plasmogamy followed by karyogamy
(B) karyogamy followed by plasmogamy
(C) karyogamy and plasmogamy occur together
(D) sexual reproduction is absent in fungi

PART - 5 : VIRUSES, VIROIDS AND LICHENS

Q.100 Tobacco mosaic virus is
(A) spherical-shaped (B) rod-shaped
(C) cuboidal (D) oval-shaped

Q.101 Select the incorrect statement.
(A) Most plant viruses are RNA viruses.
(B) Bacteriophages possess ds DNA.
(C) Virus having an arthropod as vector is called as arbovirus.
(D) Prions possess only nucleoid & no proteins.

Q.102 Viroids were discovered by
(A) TO Diener (B) DJ Ivanowsky
(C) MW Beijerinck (D) WM Stanley

Q.103 Viruses possess
(A) DNA only
(B) nucleic acid, either DNA or RNAonly
(C) protein only
(D) nucleic acid and protein

Q.104 Bacteriophage are
(A) bacteria that attacks viruses
(B) viruses that attacks bacteria
(C) free living viruses
(D) free living bacteria

Q.105 Viruses did not find a place in classification since
(A) they are not truly living
(B) they are non-cellular
(C) they are obligate parasite
(D) they are pathogenic

Q.106 A new infectious agent that is smaller than virus is
(A) prions (B) viroids
(C) bacteria (D) mycoplasma

Q.107 Virion is
(A) nucleic acid of virus
(B) antiviral agent
(C) protein of virus
(D) completely assembled virus outside host.

Q.108 Which one of the following organisms are intracellular obligate parasites?
(A) Bacteria (B) Viruses
(C) Slime moulds (D) Blue-green algae

Q.109 In plants, mosaic formation, leaf rolling and curling, yellowing of plant parts, vein clearing, dwarfing and stunted growth, necrosis etc. are the symptoms of –
(A) bacterial diseases (B) mycoplasmal diseases
(C) viral diseases (D) fungal diseases

Q.110 _____ give the name virus, which means venom or poisonous fluid.
(A) Pasteur (B) MW Beijerinck
(C) Stanley (D) Robert Hooke

Q.111 Common cold is a
(A) bacterial disease (B) viral disease
(C) protozoan disease (D) fungal disease

Q.112 Viruses are also known as –
(A) nucleoprotein particle (B) virion
(C) lipoprotein particles (D) core

Q.113 Who crystallised and isolated viruses for the first time?
(A) WM Stanley (B) FC Bawden
(C) KM Smith (D) DJ Ivanowsky

Q.114 Which one of the following is an incorrect pair?
(A) Louis Pasteur – Coined the term 'vaccine'
(B) Beijerinck – *Contagium vivum fluidum*
(C) Ivanowsky – Discovered retroviruses
(D) Stanley – Crystallised TMV

Q.115 Lichen are mutualistic and have symbiotic associations between –
(A) fungi and virus
(B) fungi and algae
(C) fungi and root of higher plants
(D) fungi and mosses

EXERCISE - 2 (LEVEL-2)

Choose one correct response for each question.

Q.1 State whether the statements are true or false.
I. Bacteria shows both autotrophic and heterotrophic nutrition.
II. Some of the bacteria are autotrophic. They may be photosynthetic autotrophic or chemosynthetic autotrophic.
III. Heterotrophic nutrition involves the obtaining of readymade organic nutrients from outside sources.
(A) I and II are true
(B) I is true, II and III is false
(C) I, II and III are true
(D) Only I is true

Q.2 Fungi show sexual reproduction by all of the following processes except
(A) oospores (B) ascospores
(C) basidiospores (D) zoospores

Q.3 Citrus canker is a
(A) viral disease (B) bacterial disease
(C) fungal disease (D) protozoan disease

Q.4 Which of the following is a red dinoflagellate?
(A) *Euglena* (B) Diatoms
(C) *Gonyaulax* (D) *Plasmodium*

Q.5 Which of the following is the correct sequence of three steps in the sexual cycle of fungi?
(A) Mitosis → fusion of two nuclei → meiosis
(B) Meiosis → fusion of two nuclei → fusion of protoplasms
(C) Fusion of two nuclei → meiosis → fusion of protoplasm.
(D) Fusion of protoplasm → fusion of two nuclei → meiosis

Q.6 Specialised cells called heterocysts are present in
(A) dinoflagellates (B) chrysophytes
(C) archaebacteria (D) cyanobacteria

Q.7 Which of the following is a flagellated protozoan?
(A) *Amoeba* (B) *Entamoeba*
(C) *Plasmodium* (D) *Trypanosoma*

Q.8 Mycorrhiza are mutualistic and have symbiotic associations between
(A) fungi and vascular plants
(B) fungi and non-vascular plants
(C) fungi and roots of higher plants
(D) fungi and bryophytes

Q.9 Asexual reproduction takes place by conidia formation
(A) *Aspergillus* (B) *Penicillium*
(C) *Colletotrichum* (D) All the above

Q.10 The genome of bacteriophage can be
(A) DNA only
(B) RNAonly
(C) Both DNA & RNA
(D) Either DNA or RNA

Q.11 Which of the following options describes the coenocytic condition in fungus?
(A) Uninucleate hypha without septum
(B) Multinucleate hypha without septum
(C) Multicellular hypha
(D) Multiciliate hypha

Q.12 In Basidiomycetes, the mycelium is
(A) branched and aseptate
(B) branched and septate
(C) unbranched and septate
(D) coenocytic

Q.13 Dikaryophase of fungus occurs in
(A) Ascomycetes and Basidiomycetes
(B) Phycomycetes and Ascomycetes
(C) Phycomycetes and Basidiomycetes
(D) Basidiomycetes and Deuteromycetes

Q.14 *Paramecium*
I. is a ciliated protozoan.
II. has a cavity that opens to the outside the cell surface.
III. shows water current maintained by cilia which helps the food to be steared into gullet.
Which of the statement given above are correct?
(A) I and II (B) I and III
(C) II and III (D) I, II and III

Q.15 Which of the following group of diseases is caused by viruses?
(A) Mumps, smallpox, herpes, influenza
(B) AIDS, diabetes, herpes, tuberculosis
(C) Anthrax, cholera, tetanus, tuberculosis
(D) Cholera,tetanus, smallpox, influenza

Q.16 Which of the following group is considered to be primitive relatives of animals?
(A) Chrysophytes (B) Protozoans
(C) Euglenoids (D) Slime moulds

Q.17 *Claviceps* is a member of
(A) Ascomycetes (B) Basidiomycetes
(C) Zygomycetes (D) Phycomycetes

Q.18 Viroids have
(A) dsDNA enclosed by protein coat
(B) ssDNA enclosed by protein coat
(C) ssRNA not enclosed by protein coat
(D) dsRNA enclosed by protein coat

Q.19 I. Commonly known as sac-fungi.
II. Mycelium is branched and septate.
III. Conidiophore produces conidia exogenously in chain.
IV. The fructifications are edible and considered delicacies.
V. *Neurospora crassa* is often employed in studies conducted in experimental genetics.
The above statements are assigned to
(A) Ascomycetes (B) Phycomycetes
(C) Basidiomycetes (D) Deuteromycetes

Q.20 A non-hyphal unicellular fungus is –
(A) Yeast (B) *Puccinia*
(C) *Ustilago* (D) *Alternaria*

Q.21 Yeast and *Penicillium* are the example of class
(A) Phycomycetes (B) Ascomycetes
(C) Deuteromycetes (D) Basidiomycetes

Q.22 Difference between virus and viroid is
(A) absence of protein coat in viroid and its presence in viruses.
(B) presence of low molecular weight RNA in virus but absent in viroid.
(C) Both (A) and (B)
(D) None of the above

Q.23 Which of the following class of fungi helps in mineral cycling?
(A) Deuteromycetes (B) Basidiomycetes
(C) Ascomycetes (D) Phycomycetes

Q.24 Which of the following class consists of coenocytic, multinucleate and aseptate mycelium?
(A) Basidiomycetes (B) Ascomycetes
(C) Phycomycetes (D) Deuteromycetes

Q.25 The genetic material of viruses consists of
(A) ds or ss DNA only
(B) ds or ss RNA only
(C) DNA or RNA (Both ds and ss)
(D) ssDNA or ssRNA and

Q.26 Which of the following bacteria plays a main role in recycling the nutrients like nitrogen, phosphorus, iron and sulphur?
(A) Chemoheterotrophic bacteria
(B) Chemosynthetic autotrophic bacteria
(C) Parasitic bacteria
(D) Saprophytic bacteria

Q.27 Smut and rust belongs to class
(A) Basidiomycetes (B) Deuteromycetes
(C) Phycomycetes (D) Ascomycetes

Q.28 Match the following columns.

	Column I	**Column II**
a.	Morels	1. Deuteromycetes
b.	Smut	2. Ascomycetes
c.	Bread mould	3. Basidiomycetes
d.	Imperfecti fungi	4. Phycomycetes

Code
(A) a-3, b-4, c-1, d-2
(B) a-4, b-1, c-2, d-3
(C) a-2, b-3, c-4, d-1
(D) a-3, b-4, c-2, d-1

Q.29 Yeast belongs to the class
(A) Zygomycetes (B) Basidiomycetes
(C) Ascomycetes (D) Phycomycetes

Q.30 Read the following statements regarding archaebacteria and select the correct option.
I. Archaebacteria differs from other bacteria in having different cell wall structure.
II. Their cell wall is made up of cellulose and contains high amount of unsaturated fatty acid, which is responsible for their survival in extreme conditions.
III. Thermoacidophiles have dual ability to tolerate high temperature as well as high acidity.
(A) I and II are true (B) I and III are true
(C) II and III are true (D) I, II and III are true

Q.31 Multinucleated filament of *Rhizopus* is
(A) coenocytic (B) conidia
(C) heterothallus (D) homothallus

Q.32 *Mucor* and *Rhizopus* are included in class
(A) Ascomycetes (B) Phycomycetes
(C) Basidiomycetes (D) Deuteromycetes

Q.33 Septate and branched mycelium is found in –
(A) Basidiomycetes (B) Deuteromycetes
(C) Ascomycetes (D) All the above

Q.34 Which of the following is photoautotrophic bacteria?
(A) *Nostoc* & *Anabaena* (B) *Clostridium*
(C) *Salmonella* (D) *Escherichia coli*

Q.35 *Trypanosoma* causes
(A) sleeping sickness (B) cholera
(C) malaria (D) food poisoning

Q.36 In Deuteromycetes, the mycelium is
(A) septate and branched
(B) septate and unbranched
(C) coenocytic
(D) multinucleated

Q.37 Which of the following are examples of insectivorous plants
(A) Bladder wort (B) Venus fly trap
(C) *Cuscuta* (D) Both (A) & (B)

Q.38 Which of the following are not considered in five kingdom system of classification?
(A) Lichen (B) Virus
(C) Viroid (D) All the above

Q.39 Mode of nutrition in fungi –
(A) They photosynthesize their nutrients.
(B) They ingest their food.
(C) They secrete enzymes to digest the nutrients in their substrate and then absorb them.
(D) None of these

Q.40 Which of the following phylum includes species that produce mushrooms?
(A) Chytridiomycota (B) Ascomycota
(C) Basidiomycota (D) Zygomycota

Q.41 In ascomycetes and basidomycetes, the dikaryotic cell is –
(A) Haploid (B) Diploid
(C) Triploid (D) Polyploid

Q.42 Which is not a member of class phycomycetes?
(A) *Albugo* (B) *Mucor*
(C) *Rhizopus* (D) *Neurospora*

Q.43 Orange rots disease is caused by –
(A) Bacterium (B) Fungus
(C) Cirus (D) Mycoplasma

Q.44 The feeding stage of plasmodial slime molds is a multinucleate
(A) plasmodium (B) pseudoplasmodium
(C) pseudopodium (D) gametangium

Q.45 Archaebacteria differ from other bacteria in having a –
(A) Different cell wall sructure
(B) Different cellular organization
(C) Parasitic nature
(D) All of these

Q.46 The mycelium is aseptase and Coenocytic in –
(A) Phycomycetes (B) Basidiomycetes
(C) Deuteromycetes (D) Basidiomycetes

Q.47 Which of the following phyla includes species that produce 4-8 haploid sexual spores in a sac?
(A) Chytridiomycota (B) Ascomycota
(C) Basidiomycota (D) Zygomycota

Q.48 Which of the following correctly describes the relationship between mycorrhizae and plant roots?
(A) parasitic (B) decomposers
(C) symbiotic (D) None of these

Q.49 Fungal partner in a lichen is referred to as the–
(A) mycobiont
(B) photobiont
(C) mycobiont and photobiont.
(D) None of these

Q.50 Photosynthetic protists with shells composed of two halves that fit together like a petri dish are –
(A) golden algae (B) diatoms
(C) euglenoids (D) brown algae

Q.51 Soredia are –
(A) clusters of fungal spores.
(B) clusters of algal spores.
(C) clusters of fungal and algal cells.
(D) None of these

Q.52 Which of the following is not classified under the plant kingdom?
(A) Conifers (B) Fungi
(C) Ferns (D) Mosses

Q.53 What do the whales & sardines have in common?
(A) They are cold-blooded.
(B) They have scales.
(C) They breathe through lungs.
(D) They have streamlined body shape.

Q.54 Which of the following may not be referred to as living organisms by some scientists?
(A) Viruses (B) Corals
(C) Bacteria (D) Sea anemone

Q.55 Which character indicates that Cyanobacteria are similar to higher green plants –
(A) Type of cell wall
(B) Nitrogen fixation ability
(C) Presence of chlorophyll 'a'
(D) Presence of gelatinous sheath

Q.56 Typhoid and tetanus are caused by :-
(A) Bacteria (B) Virus
(C) Viroids (D) Fungi

Q.57 Which unicellular, photosynthetic eukaryote lacks cell wall
(A) Mycoplasma (B) Amoeba
(C) Euglena (D) Slime mould

Q.58 Bacteriophages are generally –
(A) ss DNA virus (B) ds DNA virus
(C) ss RNA virus (D) ds RNA virus

Q.59 In fungi, vegetative reproduction takes place by–
(A) Fragmentation (B) Conidia
(C) Zygospore (D) Oospore

Q.60 The condition described as n + n is said to be
(A) monokaryotic (B) diploid
(C) a primary mycelium (D) dikaryotic

Q.61 With the exception of chytridiomycetes, fungi are generally disseminated by –
(A) water currents (B) fragmentation of hyphae
(C) soredia (D) airborne spores

Q.62 The kingdom(s) containing organisms that have a true nucleus and are unicellular is/are –
(A) Eubacteria (B) Protista
(C) Fungi (D) Plantae

Q.63 Decomposers such as molds and mushrooms belong to kingdom –
(A) Plantae (B) Protista
(C) Archaebacteria (D) Fungi

Q.64 The vast majority of bacteria are –
(A) Symbiotic (B)Autotrophic
(C) Heterotrophic (D) Nitrogen fixing

Q.65 Which prokaryotes lack cell wall –
(A) Virus (B) Cyanobacteria
(C) Mycoplasma (D) Protozoa

Q.66 Which organisms have silica in their cell wall –
(A) Dinoflagellates (B) Slime mould
(C) Diatoms (D) Euglenoids

EXERCISE - 3 (LEVEL-3)

Choose one correct response for each question.

Q.1 I. *Noctiluca* is a colourless dinoflagellate, which is an important constituent of coastal plankton of both temperate & tropical seas.
II. The cellular slime moulds have the characters of both plants and animals.
Which of the statements given above is/are correct?
(A) Only I (B) Only II
(C) I and II (D) None of the above

Q.2 Consider the following statements.
I. All prokaryotic organism were grouped together under kingdom-Monera.
II. The unicellular eukaryotic organism were placed in kingdom-Protista.
III. Chlorella and Chlamydomonas, both were having cell walls.
IV. Paramecium and Amoeba lack cell walls.
V. Kingdom-Protista has brought together *Chlamydomonas, Chlorella* with *Paramecium* and *Amoeba*.
Which of the statements given above are correct?
(A) I, II, III and IV (B) II, III, IV and V
(C) I, II, III and IV (D) I, II, III, IV and V

Q.3 Match the following columns.

Column I	**Column II**
a. Amoeboid protozoans	1. *Plasmodium*
b. Flagellated protozoans	2. *Paramecium*
c. Ciliated protozoans	3. *Trypanosoma*
d. Sporozoans	4. *Entamoeba histolytica*
	5. *Leishmania*
	6. *Pelomyxa*
	7. *Vorticella*
Codes	8. *Monocystis*

(A) a-1, 8 ; b-2, 7 ; c-3, 6 ; d-4, 5
(B) a-3, 7 ; b-2, 8 ; c-1, 6 ; d-4, 5
(C) a-4, 6 ; b-3, 5 ; c-2, 7 ; d-1, 8
(D) a-2, 5 ; b-1, 6 ; c-4, 8 ; d-3, 7

Q.4 Which one of the following is a characteristics feature of group-Chrysophyta?
(A) They are parasitic forms which cause disease in animals.
(B) They have a protein rich layer called pellicle.
(C) They have indestructible wall layer deposited with silica.
(D) They are commonly called dinoflagellates.

Q.5 Lichens shows
(A) mutualism (B) commensalism
(C) parasitism (D) saprophytism

Q.6 Which of the following statements are correct?
(A) Slime moulds are haploid
(B) Protozoans lack cell wall
(C) Dinoflagellates are immotile
(D) Pellicle is absent in *Euglena*

Q.7 The multinucleate slimy mass of protoplasm which forms the body of slime moulds is called as
(A) plasmodium (B) myxamoeba
(C) sporocytes (D) periplasmodium

Q.8 _____ is a parasite of large intestine of human beings and causes the disease _____.
(A) *Escherichia coli*, amoebic dysentery
(B) *Entamoeba histolytica*, amoebic dysentery
(C) *Plasmodium vivax*, malaria
(D) *Trypanosoma gambiense*, sleeping sickness

Q.9 Select incorrect statement about fungi ?
(A) The cell walls are composed of chitin & polysaccharides.
(B) These are heterotrophic organisms.
(C) They are autotrophic organsism.
(D) They are absorptive in nature.

Q.10 The protists that have been studied very closely to understand the process of differentiation belong to the group.
(A) Opisthokonts. (B) Archaeplastida
(C) Excavates. (D) Amoebozoa

Q.11 The conclusion that fungi are more closely related to animals than to plants was based in large part on comparing –
(A) molecular clocks
(B) polymerase chains
(C) nucleotides in DNA
(D) ribosomal RNA sequences

Q.12 Water molds reproduce asexually by forming _____, and sexually by forming _____.
(A) oospores; holdfasts
(B) zoospores; zooxanthellae
(C) zoospores; oospores
(D) hold fasts; isogametes

Q.13 Select correct matched pair / pairs :-
(A) *Claviceps* - Ascomycetes
(B) *Morels* - Ascomycetes
(C) *Agaricus* - Basidiomycetes
(D) All the above

Q.14 Which of the following is not true of the protists?
(A) they are unicellular,colonial, coenocytic, or simple multicellular organisms.
(B) their cilia and flagella have a 9+2 arrangement of microtubules.
(C) they are prokaryotic, like the eubacteria and archaebacteria.
(D) some are free-living, and some are endosymbionts.

Q.15 Unicellular protists that are free-living or parasitic, move by means of flagella, and do not photosynthesize are called
(A) euglenoids (B) dinoflagellates
(C) myxamoebas (D) zooflagellates

Q.16 Paramecium and other ciliates often display a sexual phenomenon called
(A) oogamy (B) conjugation
(C) anisogamy (D) red tide

Q.17 Malaria –
(A) is transmitted by the bite of a female tsetse fly.
(B) is caused by a parasitic zooflagellate, *Giardia intestinalis*.
(C) is a serious form of amoebic dysentery caused by *Entamoeba histolytica*.
(D) is caused by an apicomplexan that spends part of its life cycle in the *Anopheles* mosquito and part in humans.

Q.18 Yeast participates in the brewing of beer by –
(A) adding vital amino acids
(B) fermenting grain
(C) fermenting fruit sugars
(D) producing ethyl alcohol

Q.19 According to five kingdom classification protista includes
(A) Chrysophytes, Dinoflagellates, Protozoans
(B) Diatoms, Euglenoids, Virus
(C) Dinoflagellates, Protozoans, Red algae
(D) Chrysophytes, Bryophytes, Protozoans, Slime mould.

Q.20 Which statement is not true of the ascomycetes?
(A) their sexual spores are produced in asci
(B) their asexual spores are produced in basidia
(C) some species in this group are yeasts
(D) their asexual spores are called *conidia*

Q.21 The ascomycete life cycle typically includes –
(A) mainly diploid thalli.
(B) the formation of a thick zygosporangium.
(C) the production of eight haploid ascospores within an ascus.
(D) intertwined hyphae to form a basidiocarp

Q.22 Which statement is not true of the basidiomycetes?
(A) they have a diploid thallus that produces zoospores.
(B) their sexual spores are called *basidiospores*
(C) they produce a secondary mycelium with n + n hyphae.
(D) mushrooms & bracket fungi are examples of this group.

Q.23 Which statement is not true of deuteromycetes?
(A) many are ascomycetes that lost the ability to reproduce by forming ascospores.
(B) they are also known as imperfect fungi.
(C) they have both sexual and asexual reproduction.
(D) their asexual spores are called conidia.

Q.24 A _____ is a symbiotic association between a phototroph and a fungus.
(A) mycorrhizae (B) deuteromycete
(C) lichen (D) haustorium

Q.25 Which characteristic is true of all fungi?
(A) saprotrophic (B) parasitic
(C) nonflagellate (D) pathogenic

Q.26 *Amanita virosa*
(A) is the mushroom commonly cultivated for food.
(B) is the yeast that ferments wine and beer.
(C) produces the unique flavor of many cheeses.
(D) is a highly toxic mushroom.

Q.27 Which describes how a fungus infects a plant?
(A) infiltrates leaves with lichens.
(B) forms relationships by attaching mycorrhizae to stems.
(C) secretes powerful digestive juices onto the leaves.
(D) hyphae enter leaves through a stoma.

Note (Q.28-Q.31) :
(A) S-1 is True, S-2 is True, S-2 is a correct explanation for S-1
(B) S-1 is True, S-2 is True ; S-2 is NOT a correct explanation for S-1.
(C) S-1 is True, S-2 is False
(D) S-1 is False, S-2 is False

Q.28 **Statement 1 :** Bacteria are prokaryotic.
Statement 2 : Bacteria do not possess true nucleus and membrane bound cell organelles.

Q.29 **Statement 1 :** Bacteria have three basic shapes, i.e., round, rod, spiral.
Statement 2 : Cocci and Bacilli may form clusters or chain of a definite length.

Q.30 **Statement 1 :** Bacterial photosynthesis occurs by utilizing wavelength longer than 700 nm.
Statement 2 : Here reaction centre is P-890.

Q.31 **Statement 1 :** Symbiosis is furnished by mycorrhiza.
Statement 2 : In mycorrhiza, symbiosis is established between fungus and alga.

Q.32 Select the pair that consists of plant or animal bacterial diseases.
(A) Cholera and typhoid
(B) Citrus canker and crown gall
(C) Malaria and dengue
(D) Both (A) and (B)

Q.33 Correct statement regarding heterocysts.
(A) These are present in some filamentous cyanobacteria such as *Nostoc* and *Anabaena*.
(B) These cells are specialized to perform N_2 fixation.
(C) These cells contain enzyme nitrogenase.
(D) All of these

Q.34 The cell wall is composed of two thin overlapping shells which fit together like a soap case, in
(A) desmids (B) diatoms
(C) dinoflagellates (D) slime moulds.

Q.35 Match Column-I with Column-II and select the correct option from the codes given below.

	Column-I		**Column-II**
a.	Edible delicacies	(i)	*Penicillium*, *Streptomyces*
b.	Experimental genetics	(ii)	*Neurospora crassa*
c.	Source of antibiotics	(iii)	*Puccinia, Ustilago*
d.	Rust & smut diseases	(iv)	Morels and truffles

(A) a-(iv), b-(ii), c-(iii), d-(i)
(B) a-(iii), b-(i), c-(ii), d-(iv)
(C) a-(iv), b-(ii), c-(i), d-(iii)
(D) a-(iv), b-(iii), c-(ii), d-(i)

Q.36 Match Column-I with Column-II

	Column-I	**Column-II**
a.	*Planaria*	(i) Binary fission
b.	Fungi	(ii) Asexual spores
c.	Yeast	(iii) Budding
d.	*Amoeba*	(iv) True regeneration
		(v) Fragmentation

(A) a-(i), b-(ii), c-(iii), d-(iv)
(B) a-(iv), b-(ii), (v), c-(iii), d-(i)
(C) a-(ii), b-(v), c-(i), d-(iv)
(D) a-(v), b-(ii), (i), c-(iii), d-(iv)

EXERCISE - 4 (PREVIOUS YEARS AIPMT/NEET EXAM QUESTIONS)

Choose one correct response for each question.

Q.1 Which of the following are likely to be present in deep sea water ? **[NEET 2013]**
(A) Saprophytic fungi (B) Archaebacteria
(C) Eubacteria (D) Blue-green algae

Q.2 Pigment-containing membranous extensions in some cyanobacteria are : **[NEET 2013]**
(A) Chromatophores (B) Heterocysts
(C) Basal bodies (D) Pneumatophores

Q.3 Five kingdom system of classification suggested by R.H. Whittaker is not based on
(A) Presence or absence of a well defined nucleus
(B) Mode of reproduction **[AIPMT 2014]**
(C) Mode of nutrition
(D) Complexity of body organisation

Q.4 Which one of the following fungi contains hallucinogens? **[AIPMT 2014]**
(A) *Morchella esculenta* (B) *Amanita muscaria*
(C) *Neurospora sp.* (D) *Ustilago sp.*

Q.5 Archaebacteria differ from eubacteria in
(A) Cell membrane structure **[AIPMT 2014]**
(B) Mode of nutrition
(C) Cell shape
(D) Mode of reproduction

Q.6 Which of the following shows coiled RNA strand and capsomeres? **[AIPMT 2014]**
(A) Polio virus (B) Tobacco mosaic virus
(C) Measles virus (D) Retrovirus

Q.7 Viruses have – **[AIPMT 2014]**
(A) DNA enclosed in a protein coat
(B) Prokaryotic nucleus
(C) Single chromosome
(D) Both DNA and RNA

Q.8 The motile bacteria are able to move by
(A) Fimbriae (B) Flagella
(C) Cilia (D) Pili **[AIPMT 2014]**

Q.9 Which one of the following matches is correct? **[AIPMT 2015]**

(A) Alternaria	Sexual reproduction absent	Deuteromycetes
(B) Mucor	Reproduction by Conjugation	Ascomycetes
(C) Agaricus	Parasitic funus	Basidiomycetes
(D) Phytophthora	Aseptate mycelium	Basidiomycetes

Q.10 True nucleus is absent in : **[AIPMT 2015]**
(A) Mucor (B) Vaucheria
(C) Volvox (D) Anabaena

Q.11 The imperfect fungi which are decomposer of litter and help in mineral cycling belong to: **[RE-AIPMT 2015]**
(A) Basidiomycetes (B) Phycomycetes
(C) Ascomycetes (D) Deuteromycetes

Q.12 The structures that help some bacteria to attach to rocks and / or host tissues are: **[RE-AIPMT 2015]**
(A) Fimbriae (B) Mesosomes
(C) Holdfast (D) Rhizoids

Q.13 Pick up the wrong statement
(A) Protista have photosynthetic and heterotrophic modes of nutrition.
(B) Some fungi are edible. **[RE-AIPMT 2015]**
(C) Nuclear membrane is present in Monera.
(D) Cell wall is absent in Animalia.

Q.14 Which one is wrong statement ?
(A) *Mucor* has biflagellate zoospores.
(B) Haploid endosperm is typical feature of gymnosperms **[RE-AIPMT 2015]**
(C) Brown algae have chlorophyll a and c and fucoxanthin
(D) Archegonia are found in Bryophyta, Pteridophyta and Gymnosperms.

Q.15 Select the wrong statements **[RE-AIPMT 2015]**
(A) W.M. Stanley showed that viruses could be crystallized
(B) The term '*contagium vivum fluidum*' was coined by M.W. Bejerinek.
(C) Mosaic disease in tobacco and AIDS in human being are caused by viruses.
(D) The viroids were discovered by D.J. Ivanowski.

Q.16 Cell wall is absent in : **[RE-AIPMT 2015]**
(A) Funaria (B) Mycoplasma
(C) Nostoc (D) Aspergillus

Q.17 In which group of organisms the cell walls form two thin overlapping shells which fit together? **[RE-AIPMT 2015]**
(A) Euglenoids (B) Dinoflagellates
(C) Slime moulds (D) Chrysopytes

Q.18 Choose the wrong statements:
(A) Neurospora is used in the study of biochemical genetics. **[RE-AIPMT 2015]**
(B) Morels and truffles are poisonous mushrooms.
(C) Yeast is unicellular and useful in fermentation.
(D) Penicillium is multicellular and produces antibiotics.

Q.19 Which of the following statements is wrong for viroids? **[NEET 2016 PHASE 1]**
(A) They lack a protein coat
(B) They are smaller than viruses
(C) They causes infections
(D) Their RNA is of high molecular weight

Q.20 One of the major components of cell wall of most fungi is **[NEET 2016 PHASE 1]**
(A) Chitin (B) Peptidoglycan
(C) Cellulose (D) Hemicellulose

Q.21 Which one of the following statements is wrong?
(A) Cyanobacteria are also called blue-green algae. **[NEET 2016 PHASE 1]**
(B) Golden algae are also called desmids
(C) Eubacteria are also called false bacteria
(D) Phycomycetes are also called algal fungi

Q.22 Chrysophytes, Euglenoids, Dinoflagellates and Slime moulds are included in the kingdom **[NEET 2016 PHASE 1]**
(A) Animalia (B) Monera
(C) Protista (D) Fungi

Q.23 Which one of the following is wrong for fungi? **[NEET 2016 PHASE 2]**
(A) They are eukaryotic
(B) All fungi possess a purely cellulosic cell wall
(C) They are heterotrophic
(D) They are both unicellular and multicellular

Q.24 Methanogens belong to – **[NEET 2016 PHASE 2]**
(A) Eubacteria (B) Archaebacteria
(C) Dinoflagellates (D) Slime moulds

Q.25 Select the wrong statement. **[NEET 2016 PHASE 2]**
(A) The walls of diatoms are easily destructible.
(B) 'Diatomaceous earth' is formed by the cell walls of diatoms.
(C) Diatoms are chief producers in the oceans.
(D) Diatoms are microscopic and float passively in water.

Q.26 Viroids differ from viruses in having : **[NEET 2017]**
(A) DNA molecules with protein coat.
(B) DNA molecules without protein coat.
(C) RNA molecules with protein coat.
(D) RNA molecules without protein coat.

Q.27 Which of the following are found in extreme saline conditions? **[NEET 2017]**
(A) Archaebacteria (B) Eubacteria
(C) Cyanobacteria (D) Mycobacteria

Q.28 Mycorrhizae are the example of : **[NEET 2017]**
(A) Fungistasis (B) Amensalism
(C) Antibiosis (D) Mutualism

Q.29 Which among the following are the smallest living cells, known without a definite cell wall, pathogenic to plants as well as animals and can survive without oxygen? **[NEET 2017]**
(A) *Bacillus* (B) *Pseudomonas*
(C) *Mycoplasma* (D) *Nostoc*

Q.30 Which of the following components provides sticky character to the bacterial cell? **[NEET 2017]**
(A) Cell wall (B) Nuclear membrane
(C) Plasma membrane (D) Glycocalyx

Q.31 Which among the following is not a prokaryote? **[NEET 2018]**
(A) *Nostoc* (B) *Mycobacterium*
(C) *Saccharomyces* (D) *Oscillatoria*

Q.32 Select the wrong statement : **[NEET 2018]**
(A) Pseudopodia are locomotory and feeding structures in Sporozoans.
(B) Mushrooms belong to Basidiomycetes.
(C) Cell wall is present in members of Fungi and Plantae.
(D) Mitochondria are the powerhouse of the cell in all kingdoms except Monera.

Q.33 After karyogamy followed by meiosis, spores are produced exogenously in **[NEET 2018]**
(A) *Agaricus* (B) *Alternaria*
(C) *Neurospora* (D) *Saccharomyces*

Q.34 Ciliates differ from all other protozoans in **[NEET 2018]**
(A) using pseudopodia for capturing prey.
(B) having a contractile vacuole for removing excess water.
(C) using flagella for locomotion.
(D) having two types of nuclei.

Q.35 Which of the following organisms are known as chief producers in the oceans? **[NEET 2018]**
(A) Cyanobacteria (B) Diatoms
(C) Dinoflagellates (D) Euglenoids

Q.36 Select the correctly written scientific name of Mango which was first described by Carolus Linnaeus **[NEET 2019]**
(A) *Mangifera indica* Car. Linn.
(B) *Mangifera indica* Linn.
(C) *Mangifera indica*
(D) *Mangifera Indica*

Q.37 Which of the following statements is **INCORRECT**? **[NEET 2019]**
(A) Viroids lack a protein coat.
(B) Viruses are obligate parasites.
(C) Infective constituent in viruses is the protein coat.
(D) Prions consist of abnormally folded proteins.

Q.38 Which is of the following statements is **INCORRECT**? **[NEET 2019]**
(A) Morels and truffles are edible delicacies.
(B) *Claviceps* is a source of many alkaloids and LSD.
(C) Conidia are produced exogenously and ascospores endogenously.
(D) Yeasts have filamentous bodies with long thread-like hyphae.

Q.39 Match Column - I with Column - II **[NEET 2019]**

Column - I	Column - II
(a) Saprophyte	(i) Symbiotic association of fungi with plant roots.
(b) Parasite	(ii) Decomposition of dead organic materials
(c) Lichens	(iii) Living on living plants or animals
(d) Mycorrhiza	(iv) Symbiotic association of algae and fungi

Choose the correct answer from the option given below
(A) a-(i), b-(ii), c-(iii), d-(iv)
(B) a-(iii), b-(ii), c-(i), d-(iv)
(C) a-(ii), b-(i), c-(iii), d-(iv)
(D) a-(ii), b-(iii), c-(iv),d-(i)

ANSWER KEY

EXERCISE-1 (SECTION-1&2)

(1) (D) **(2)** (C) **(3)** (A)
(4) (B) **(5)** (B) **(6)** (C)
(7) True bacteria
(8) Mycelium **(9)** Heterocyst
(10) Capsid **(11)** Plasmodium
(12) Plasmogamy **(13)** Imperfect fungi
(14) Karyogamy
(15) Ernst Haeckel, 1886
(16) Stainier and Von Niel
(17) Chitin, Non-cellulosic polysaccharide
(18) Monera **(19)** Cheese, Beer
(20) White, *Albugo candida* **(21)** *Alternaria*
(22) Zoospores, Aplanospores **(23)** Parasites
(24) Saprophytes

EXERCISE - 1 [SECTION-3 & 4]

Q	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49
A	B	B	C	D	D	A	B	A	C	A	A	A	D	D	C	D	C	D	B	A	C	A	D	C	C
Q	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74
A	C	A	B	C	D	D	B	C	B	D	A	A	B	D	C	A	B	A	C	A	A	B	C	B	A
Q	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99
A	B	D	C	B	C	B	B	C	D	D	B	A	D	B	B	A	C	C	A	C	C	A	C	B	A
Q	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115									
A	B	D	A	D	B	A	B	D	B	C	A	B	A	A	C	B									

EXERCISE - 2

Q	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
A	C	D	B	C	D	D	D	C	D	D	B	B	A	D	A	B	A	C	A	A	B	C	A	C	C
Q	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
A	B	A	C	C	B	A	B	D	A	A	A	D	D	C	C	A	D	B	A	D	A	B	C	A	B
Q	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66									
A	C	B	D	A	C	A	C	B	A	D	D	B	D	C	C	C									

EXERCISE - 3

Q	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
A	C	D	C	C	A	B	A	B	C	D	D	C	D	C	D	B	D	D	A	B	C	A	C	C	C
Q	26	27	28	29	30	31	32	33	34	35	36														
A	D	D	A	B	B	C	D	D	B	C	B														

EXERCISE - 4

Q	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
A	B	A	A	B	A	B	A	B	A	D	D	A	C	A	D	B	D	B	D	A	C	C	B	B	A
Q	26	27	28	29	30	31	32	33	34	35	36	37	38	39											
A	D	A	D	C	D	C	A	A	D	B	B	C	D	D											

SOLUTIONS

EXERCISE-1

(1) (D) **(2)** (C) **(3)** (A) **(4)** (B)
(5) (B) **(6)** (C) **(7)** True bacteria
(8) Mycelium **(9)** Heterocyst
(10) Capsid **(11)** Plasmodium
(12) Plasmogamy **(13)** Imperfect fungi
(14) Karyogamy
(15) Ernst Haeckel, 1886
(16) Stainier and Von Niel
(17) Chitin, Non-cellulosic polysaccharide
(18) Monera **(19)** Cheese, Beer
(20) White, *Albugo candida* **(21)** *Alternaria*
(22) Zoospores, Aplanospores **(23)** Parasites
(24) Saprophytes **(25)** (B) **(26)** (B)
(27) (C) **(28)** (D) **(29)** (D)
(30) (A)

(31) **(B).** Unicellular organisms are classified in kingdom-Monera, i.e., 'kingdom of prokaryotes' of five kingdom classification, rest four kingdom are assigned to eukaryotes.

(32) (A) **(33)** (C) **(34)** (A)

(35) **(A).** Eukaryotes are assigned the kingdom-Protista, Fungi, Plantae and Animalia, while prokaryotes occupy space only in kingdom-Monera.

(36) (A) **(37)** (D) **(38)** (D)
(39) (C) **(40)** (D) **(41)** (C)
(42) (D) **(43)** (B)

(44) **(A).** Cyanobacteria produces water blooms, imparting bad odour and colour to water bodies.

(45) **(C).** In a bacterial cell, membrane bound cell organelles as found in eukaryotes are absent. Various structures present in the cytoplasm of a prokaryotic cell include mesosomes, 70S ribosomes, nucleoid, plasmids, gas vacuoles, food reserve, etc.

(46) **(A).** Cyanobacteria or blue-green algae are Gram positive photosynthesis prokaryotes, which performs oxygenic photosynthesis.

(47) **(D).** Saprophytic bacteria are free living bacteria which obtain their food from organic remains, e.g., corpses, animal excreta, fallen leaves, vegetables, fruits, meat, jams, jellies, bread and other products of plant and animal origin. Aerobic breakdown of organic compounds is known as decay. In nature saprophytic bacteria alongwith saprotrophic fungi are the decomposers of organic remains.

(48) **(C).** Heterotrophic bacteria are the most abundant in nature. The majority are important decomposers. Many of them have a significant impact on human affairs.

(49) **(C).**

(50) **(C).** There are two major group of monerans, archaebacteria and eubacteria. Some other groups of monerans are mycoplasma, rickettsiae & actinomycetes. Mycoplasmas or mollicutes are the simplest and the smallest free living prokaryotes.

(51) **(A).**

(52) **(B).** Cyanobacterial cells are larger and more elaborate than bacteria. Cell structure is typically prokaryotic one, envelope organisation with peptidoglycan wall, naked DNA 70S ribosomes and absence of membrane bound structures. The cell wall is four layered with peptidoglycans present in the second layer.

(53) (C) **(54)** (D)

(55) **(D).** Kingdom-Protista includes all unicellular eukaryotic organisms like crysophytes, dinoflagellates, euglenoids, slime moulds, protozoans, etc.

(56) **(B).** The siliceous cell walls of diatoms are indestructible *(i.e.,* do not decay easily). They were collected over millions of years on the sea floors, called diatomite or diatomaceous earth or silica gel. These deposits may extends for several hundred metres in certain areas.

(57) **(C).** Flagellated protozoans may be free living, aquatic, parasitic, commensals or symbionts.

(58) **(B).** Some dinoflagellates *(e.g., Gonyaulax catenella)* are poisonous to vertebrates. When they are in large number, they produces the toxin called saxitoxin into the

sea water, which kills fishes and other marine animals.

(59) (D) **(60)** (A)

(61) **(A).** All protozans are heterotrophs and live as the perdators or parasites.

(62) **(B).** Kingdom-Protista includes a wide variety of unicellular organisms, mostly aquatic eukaryotes. There are believed to be evolved from prokaryotic monerans and are the precursors from, which higher organisms are evolved.

(63) **(D).** Sporozaons includes diverse organisms that have an infectious spore like stage in their life cycle.

(64) **(C).** In dinoflagellates, cells are generally covered by a rigid coat, the theca or lorica of articulated and sculptured plates formed of cellulose. Because of the presence of sculptured plates, these protists are of ten types known as armoured dinoflagellates.

(65) (A) **(66)** (B)

(67) **(A).** Chrysophytes are microscopic and float passively in water current (Plankton). Chrysophytes (diatoms) constitutes an important producer in the form of phytoplanktons in aquatic ecosystem. They are the main source of food to aquatic animals.

(68) **(C).** Slime moulds lacks chlorophyll and are heterotrophic in their mode of nutrition. They generally, lives as saprotrophs except a few, which are parasites on algae, other fungi and flowering plants.

(69) **(A).** Euglenoids are unicellular flagellate protists commonly found in fresh water ponds, pools and moist mud. They lack cellulose cell wall.

(70) (A) **(71)** (B)

(72) **(C).** Chrysophytes include diatoms and desmids (golden algae). They belong to the division-Chrysophyta/Bacillariophyta.

(73) **(B).** White spots seen on mustard leaves are due to a parasitic fungus *Albugo*.

(74) **(A).** *Neurospora* is widely used in genetics as a model organism because it is quickly reproducing, easy to culture and can survive on minimal media.

(75) **(B).** In fungi, at the time of sexual reproduction, the cytoplasms of two sex cells fuses with each other. The nuclei of two sex cells come close to each other but do not fuse. Thus, the resulting cell becomes binucleate or dikaryon. The phenomenon is sometimes termed as dikaryotisation.

(76) **(D).** Deuteromycetes is an artificial class of fungi which has been created to include all those fungi in which sexual state is either absent or not known. Asexual reproduction often occurs by conidia alongwith some other types of spores. In some cases even asexual spores are absent. *Ustilago* is the member of Basidiomycetes.

(77) **(C).** The body of a fungus (except yeast) is made up of number of elongated, tubular filaments known as hyphae, The mass or network of hyphae is called mycelium.

(78) **(B).** Ascomycetes are commonly known as sac fungi, due to their sac-like appendage that holds the spores. The Ascomycetes are unicellular, *e.g.,* yeast or multicellular, *e.g.,* penicillium.

(79) **(C).** *Agaricus* belongs to class-Basidiomycetes. The class-Basidiomycetes includes those members that produces their basidia and basidiospores on or in a basidiocarp.

(80) **(B).**

(81) **(B).** Conidia are the means of asexual reproduction in fungi. In some fungi, the spores are not formed inside a sporangium. They are born freely on the tips of special branches called conidiophores. The spores thus formed are called conidia. On the basis of development, two types of conidia are recognised, *i.e.,* thallospores and blastospores or true conidia.

(82) **(C).**

(83) **(D).** Members of Ascomycetes are saprophytic, decomposers, parasitic or coprophilous (growing on dung).

(84) **(D).** Fungal cell wall contains fungal cellulose or chitin. Fungal cellulose or chitin is basically made up of acetyl glucosamine. In some fungi, cellulose is also present, either alone or along with chitin.

(85) (B) **(86)** (A) **(87)** (D) **(88)** (B)

(89) **(B).** The plant body of the *Rhizopus* is mycelium, which is eucarpic. The mycelium is distinguishable into three types of hyphae namely, rhizoidal hyphae, stolons and sporangiophores. The mycelium is aseptate, branched and multinucleate (coenocytic).

(90) **(A).** Deuteromycota is commonly called as fungi imperfecti. This includes all those fungi in which sexual or perfect stage is not known.

(91) (C) **(92)** (C)

(93) **(A).** *Ustilago* and *Puccinia* are the common parasites of Basidiomycetes.
Puccinia graminis tritici belongs to class-Basidiomycetes. It causes black rust of wheat.
Ustilago is an economically important member as it causes destructive smut diseases in most of the cereal plants.

(94) **(C).** Deuteromycetes are commonly known as imperfect fungi because only the sexual or vegetative phases of these fungi are known.

(95) **(C).** Mushrooms *(Agaricus* sp.) are common edible fungi. Their fruiting bodies are used for eating.

(96) **(A).** The fungi are achlorophyllous, heterotrophic organisms, which cannot prepare their own food. They live as either parasites or saprophytes, However, some forms live symbiotically with other green forms. So, parasitic and saprophytic conditions are more familiar in fungi.

(97) **(C).** Asexual reproduction takes place through zoospores, which are motile or through non-motile aplanospores.

(98) **(B).** The members of class-Ascomycetes are called sac fungi. Yeast (Saccharomyces) is an unicellular ascomycetous fungus.

(99) **(A).** *The sexual reproduction in fungi completes in three phases* (i) Plasmogamy (ii) Karyogamy (iii) Meiosis.
Fusion of protoplasms between two motile or non-motile gametes is called plasmogamy.
- Fusion of two nuclei is called karyogamy .
- Meiosis in zygote results in the formation of haploid spores.

(100) **(B).** The tobacco mosaic virus is long, slender and rod-shaped. It is a complex structure made up of nucleoprotein (the protein and nucleic acid). The central core of ribonucleic acid is surrounded by virus protein.

(101) **(D).** Prions are highly resistant glycoprotein particles which function as infectious agents. They are formed due to mutation in gene PRNP. Prions can also act as catalyst converting normal protein into prion state. Prions are not affected by proteases, nucleases, temperature upto 800°C, UV radiations and formaldehyde. Prion was discovered by Prusiner in 1983 for the first time.

(102) **(A).** Viroids were discovered by TO Diener.

(103) **(D).** Viruses consists of nucleoprotein, *i.e.,* nucleic acid (DNA or RNA) and protein.

(104) **(B).** Bacteriophage is a virus that infects and replicates within bacteria. Bacteriophages are composed of proteins that encapsulate a DNA or RNA genome and may have relatively simple or elaborated structure.

(105) **(A).** Viruses did not find a place in classification since they are not truly living.

(106) **(B).** Viroid were discovered by TO Diener in 1971 as a new infectious agent that was smaller than viruses. Viroids lack capsid and have not proteins associated with them.

(107) **(D).**

(108) **(B).** Viruses are non-cellular, infectious, obligate intracellular parasites. These are genetic elements (DNA or RNA) wrapped in a protein coat and are not considered to be living organisms, as they cannot reproduce independently.

(109) **(C).**

(110) **(A).** The name virus that means venous or poisonous fluid was given by Pasteur. DJ Ivanowsky (1892) recognised certain microbes as causal organism of the mosaic disease of tobacco.

(111) **(B).** Common cold is a viral disease. Influenza virus is rounded or *oval* in shape, contains RNA in an inner helical core of ribonucleoprotein surrounded by mucoprotein.

(112) **(A).** Viruses are also known as nucleoprotein particle. The nucleic acid of virus is surrounded by a protein shell called capsid.

(113) **(A).** Viruses are obligate parasite. They are inert outside the specific host cell and exists in crystalline forms as demonstrated by WM Stanley.

(114) **(C).** Dmitrii Ivanowski discovered that the cause of tobacco mosaic disease could pass through a porcelain filter. Temin and Baltimore discovered retrovirus and the phenomenon of Teminism in 1972.

(115) **(B).** A lichen is structurally organised entity consisting of a permanent association of a fungus and an alga.
The fungal component of a lichen is called mycobiont and the algal component is called phycobiont.

EXERCISE-2

(1) **(C).**

(2) **(D).** Fungi shows sexual reproduction by oospores, ascospores and basidiospores. The various spores are produced in distinct sturctures called fruiting bodies.

(3) **(B).** Citrus canker is a disease affecting citrus species that is caused by the bacterium *Xanthomonas axonopodis.*

(4) **(C).** Some dinoflagellates, such as *Gymnodinium* and *Gonyaulax* grows in large number in the seas and make the water look red and causes the red tides.

(5) **(D).** Fusion of protoplasm $\rightarrow$ fusion of two nuclei $\rightarrow$ meiosis

(6) **(D).** Heterocyst is a large sized, pale coloured, thick-walled cell, which occurs in terminal intercalary or lateral position in filamentous cyanobacteria, *e.g., Nostoc.*

(7) **(D).** *Trypanosoma* is the parasitic zooflagellate protozoan. It is an endoparasite, blood parasite and extra cellular parasite.

(8) **(C).** The mutually beneficial or symbiotic association of a fungus with the root of a higher plants is known as mycorrhiza. The fungus is dependent upon the higher plants for shelter and food.

(9) (D)

(10) **(D).**

(11) **(B).** Continued nuclear division makes the hyphae multinucleate. If the whole mycelium is without septum, the same is called coenocytic.

(12) **(B).** The class-Basidiomycetes includes those members that produce their basidia and basidiospores on or in a basidiocarp. In Basidiomycetes, the mycelium is branched and septate.

(13) **(A).**

(14) **(D).**

(15) **(A).** In human, virus causes various disease like AIDS (HIV Virus), mumps (paramyxo-virus), smallpox (variola virus). Herpes(HSVI) and influenza (RNA viruses of the family-Orthomyxoviridae). Diabetes and cholera are not the viral diseases.

(16) **(B).**

(17) **(A).** *Claviceps* is a member of class-Ascomycetes. The Ascomycetes have a multicellular mycelium (except yeast) with septal pore and chitinous wall. The sexual reproduction produces dikaryophase *(n+n).* Other examples are Saccharomyces, *Penicillium, Aspergillus, Neurospora, Morchella,* etc.

(18) **(C).** Viroids have single-stranded molecules of RNA (about 300 nucleotides long.) not enclosed by protein coat. They were discovered by TO Diener in 1971. Viroid replication requires host encoded RNA polymerase.

(19) **(A).**

(20) **(A).** Yeasts are unicellular, degenerated, non-mycelial, saprophytic fungi possessing no hyphae. But sometimes, chain of buds is formed during rapid growth, which may give false appearance of a mycelium and called as pseudomycelium.

(21) **(B).** Morels, truffles, yeast and *Penicillium* are all examples of class-Ascomycetes. Yeast is single cell member of class-Ascomycetes. *Penicillium* is a genus of fungi, commonly growing as green or blue moulds on decaying food, used in making medicine (antibiotics).

(22) **(C).** Protein coat is present in virus but absent in viroids. Viroids are the infectious agents which have naked nucleic acid (mainly RNA).

(23) **(A).** In Deuteromycetes, some members are saprophytes or parasites, while a large number of them are decomposers of litter and help in mineral cycling.

(24) **(C).** Coenocytic, multinucleate and aseptate mycelium is present in class-Phycomycetes, e.g., *Albugo*.

(25) **(C).** Viruses are nucleoproteins having one or more nucleic acid molecule, either double stranded or single stranded DNA or RNA, encased in a protective coat of protein or lipoprotein.

(26) **(B).** Chemosynthetic autotrophic bacteria oxidises various inorganic substances such as nitrates, nitrites and ammonia and use the released energy for their ATP production. They plays a great role in recycling nutrients like nitrogen, phosphorus, iron and sulphur.

(27) **(A).** Basidiomycota comprises the most morphologically complex group of macrofungi. They include mushrooms and toad stools and rust and smut parasites of plants.

(28) **(C).** Morels *(Morchella)* are Ascomycetes with edible ascocarps.
Smuts *(Ustilago)* is one of the common members of class-Basidiomycetes.
The bread mould *Rhizopus* is one of the common members of class-Phycomycetes.
The members of class-Oeuteromycetes are commonly known as 'Imperfecti fungi' as sexual reproduction is absent.

(29) **(C).** Yeast is single cell member of class-Ascomycetes.

(30) (B) **(31)** (A)

(32) **(B).** *Mucor* (dung mould) and *Rhizopus* (black bread mould) are included in class-Phycomycetes. Both are the common saprotrophic fungi, that attack a variety of food stuffs.

(33) (D) **(34)** (A)

(35) **(A).** *Trypanosoma gambiense* was first observed by Forde in 1901. Fruce discovered that the parasite of sleeping sickness is transmitted by tse-tse fly. It causes gambian sleeping sickness.

(36) **(A).** In Deuteromycetes, the mycelium is septate and branched. Coenocytic forms are not known.

(37) (D) **(38)** (D) **(39)** (C)
(40) (C) **(41)** (A) **(42)** (D)
(43) (B) **(44)** (A) **(45)** (D)
(46) (A)

(47) **(B).** Ascomycota produce ascospores inside their asci.

(48) **(C).** Mycorrhizae get sugars from the plants and provide dissolved minerals to the plants.

(49) **(A).** Mycobiont is the fungal partner of a lichen.

(50) (B)

(51) **(C).** Soredia are clusters of fungal and algal cells that are used by the lichens for asexual reproduction.

(52) (B) **(53)** (D) **(54)** (A)
(55) (C) **(56)** (A) **(57)** (C)
(58) (B) **(59)** (A) **(60)** (D)
(61) (D) **(62)** (B) **(63)** (D)
(64) (C) **(65)** (C) **(66)** (C)

EXERCISE-3

(1) **(C).** *Noctiluca* (the night light) is a colourless dinoflagellate, which is an important constituent of coastal plankton of both temperate and tropical seas. This alga is famous for bioluminescence as it was the first dinoflagellate where bioluminescence was reported. The cellular slime moulds have the characters of both plants and animals. The reproductive phase is plant-like, as the spores have a cell wall composed of cellulose. However, vegetative phase is animal like having no cell wall and feeding like *Amoeba*.

(2) **(D).**

(3) **(C).** Amoeboid protozoans - *Entamoeba histolytica* and *Pelomyxa*
Flagellated protozoans - *Trypanosoma* and *Leishmania*
Ciliated protozoans - *Paramecium* and *Vorticella*
Sporozoans- *Plasmodium* and Monocystis

(4) **(C).** In chrysophytes, the cell walls forms two thin overlapping shells, which fits together as in a soap box. The walls are embedded with silica and thus, the walls are indestructible.

(5) **(A).** Mutualism is a type of association, where both the partners are benefitted. Lichens shows a permanent and obligatory associations between algae and fungi involving physiological interdependence.

(6) **(B).** Protozoans lacks cell wall. Cell wall is the characteristic feature of plant cells. Slime moulds are diploid, *e.g., Physarum*. Dinoflagellates are motile. e.g., *Noctiluca, Peridinium,* etc. The body of *Euglena* is covered with pellicle.

(7) **(A).** A free living thalloid body of the acellular slime moulds is called plasmodium. The plasmodium is wall-less mass of multinucleate protoplasm covered by slime. All the nuclei in the plasmodium divide simultaneously. Chlorophyll is always absent. The plasmodium often possesses a number of branched veins. The protoplasm present in the veins shows reversible streaming movement. The veins disappear and reappear as the plasmodium moves about.

(8) **(B).** *Entamoeba histolytica* resides in the upper part of the human large intestine and causes the disease amoebic dysentery or amoebiasis. The symptoms of the disease are abdominal pain, repeated motions with blood and mucus. It feeds on red blood corpuscles by damaging the wall of large intestine and reaching the blood capillaries. It produces ulcers.

(9) (C)

(10) **(D).** Slime molds that belong to Amoebozoa have been studied extensively to understand the process of differentiation because slime molds can go from single-celled amoeba to a differentiated fruiting body.

(11)	(D)	**(12)**	(C)	**(13)**	(D)	**(14)**	(C)
(15)	(D)	**(16)**	(B)	**(17)**	(D)	**(18)**	(D)
(19)	(A)	**(20)**	(B)	**(21)**	(C)	**(22)**	(A)
(23)	(C)	**(24)**	(C)	**(25)**	(C)	**(26)**	(D)

(27) (D)

(28) **(A).** Bacterial cell is prokaryotic. It lacks true nucleus, membrane bound organelles and sexual reproduction.

(29) **(B).** Bacteria have different shapes spherical, rod, and spiral are three important type. Cocci may be in cluster or chain form or single and bacilli may be single, in pair in chain.

(30) **(B).** Bacteria utilize the wavelengths longer than 700 nm for photosynthesis and the reaction centre is P-890 the reductant is NADH + H^+. In bacteria donor may be H_2S or malate or succinate.

(31) **(C).** Mycorrhiza represents mutualistic symbiosis between fungus and roots of higher plants. Fungus helps in absorption of minerals. Water more efficiently and protect plant roots from infection. Fungus also gets food from plant.

(32) **(D).** Pathogen of cholera is *Vibrio cholerae* bacterium. Cholera is transmitted by contaminated water. Typhoid or enteric fever spreads through contaminated water in which bacterium *Salmonella typhi* is present. Citrus canker and crown gall are bacterial diseases of plants caused by *Xanthomonas citri* and *Agrobacterium tumefaciens* respectively.

(33) **(D).** Heterocyst is a large-sized pale coloured thick-walled cell which occurs in terminal, intercalary or lateral position in filamentous cyanobacteria, e.g., *Nostoc*. The thick wall is impermeable to oxygen but permeable to nitrogen. Mucilage sheath is absent. Photosystem II is absent. Thylakoids lack phycobilisomes. Therefore, photosynthesis is absent but cyclic photophosphorylation occurs. Heterocyst is dependent for its nourishment on adjacent vegetative cells. It has enzyme nitrogenase and so, it is specialised to perform nitrogen fixation.

(34) **(B).** The body of diatoms is covered by a transparent siliceous shell (silica deposited in cell wall) known as frustule. The frustule is made of two valves, epitheca and hypotheca. The two valves fit together like

a soap box. The frustule possesses very fine markings, pits, pores and ridges.

(35) **(C).**

(36) **(B).** In *Planaria* (Phylum-Platyhelminthes), true regeneration is observed i.e., a fragmented organism regenerates the lost parts of its body and becomes a new organism.
In fungi, vegetative reproduction occurs by fragmentation, budding (in yeasts), sclerotia, rhizomorphs, etc. Asexual reproduction in fungi occurs through the formation of various kinds of asexual spores such as zoospores, sporangiospores, chlamydospores, oidia, conidia, etc.
Yeasts are a group of non mycelial or pseudomycelial Ascomycetes which multiply asexually by budding or fission and where asci are not organized into ascocarps.
Ameoba reproduces by binary fission and multiple fission.

EXERCISE-4

(1) **(B).** Archaebacteria flourish in hot springs and deep sea hydrothermal vents.

(2) **(A).** Cyanobacteria contain chlorophyll but the chlorophyll is not located in chloroplasts, rather it is found in chromatophores, infolding of the plasma membrane, where photosynthesis is carried out. Heterocysts are specialised nitrogen fixing cells formed by some filamentous cyanobacteria such as Nostoc. A basal body is an organelle formed from a centriole and a short cylindrical array of microtubules. Pneumatophores are lateral roots that grow upward for varying distance and function as the site of oxygen intake for the submerged primary roots.

(3) **(A).** The main criteria of Whittaker's system are : Cell type, Thallus organisation, Nutrition, Reprodution & phylogenetic relationship.

(4) **(B).** *Amanita muscaria* is noted for its hallucinogenic properties, with its main psychoactive constituent being the compound muscimol.

(5) **(A).** In archaebacteria cell membrane is made up of singe layer of branched chain lipid molecule, while in eubacteria it is made up of unbranched phospholipids bilayer

(6) **(B).** RNA is single stranded helically coiled with 6400 ribonucleotides.

(7) **(A).** Nucleoprotein particles

(8) **(B).** Motile bacteria have thin filamentous extensions from their cell wall called flagella.

(9) **(A).**
(i) *Alternaria* is Deuteuromycetes (fungi imperfecti), which lacks sexual reproduction.
(ii) *Mucor* also belong to Phycomycetes. They have mycelium which is coenocytic (multinucleate) and profusely branched. They reproduce vegetatively via conjugation.
(iii) *Agaricus* belongs to Basidiomycetes (where karyogamy and meiosis occur). They contain well developed filaments, branched and septate mycelium. They are saprophytic but not parasitic.
(iv) *Phytophthora* belongs to Phycomycetes (algal fungi). They contain either unicellular thallus or non-septate coenocytic mycelium. They are mostly plant damaging Oomycetes (water molds.)

(10) **(D).** All are eucaryotes except Anabaena. The later is procaryotes where true nucleus is absent.

(11) **(D).** The members of deuteromycetes do not show sexual reproduction therefore they are called fungi imperfect.

(12) **(A).** Fimbriae - Hollow tubular surface appendages, present in bacterial cell, which help in attachment to rocks and / or host tissues.

(13) **(C).** The members of kingdom-Monera are prokaryotes they lack nuclear membrane.

(14) **(A).** *Mucor* has non-motile spore i.e. sporangiospores.

(15) **(D).** The viroids were discovered by T.O. Diener.

(16) **(B).** *Mycoplasma* is wall-less smallest living organism.

(17) **(D).** Diatoms (chrysophytes) body is look like soap box and fit together.

(18) **(B).** Morel and truffles are edible and members of Ascomycetes in fungi.

(19) **(D).** Viroids have RNA of low molecular weight.

(20) **(A).** Cell wall of most fungi is made up of chitin.

(21) **(C).** Eubacteria are true bacteria.

(22) **(C).** All single celled eukaryotes like chrysophytes [diatoms and desmids], Euglenoids [*Euglena*], Dinoflagellates and slime moulds are included in kingdom-Protista.

(23) **(B).** Cell wall of fungi is made up of chitin and polysaccharides.

(24) **(B).** Methanogens, halophiles and thermoacidophiles are archaebacteria.

(25) **(A).** The cell walls of diatoms are embedded with silica and thus the walls are indestructible.

(26) **(D).** Viroids are sub-viral agents as infectious RNA particles, without protein coat.

(27) **(A).** Archaebacteria are able to survive in harsh conditions because of branched lipid chain in cell membrane which reduces fluidity of cell membrane.
Halophiles are exclusively found in saline habitats.

(28) **(D).** Mycorrhizae is a symbiotic association of fungi with roots of higher plants.

(29) **(C).** Mycoplasmas are smallest, wall-less prokaryotes, pleomorphic in nature. These are pathogenic on both plants and animals.

(30) **(D).** Sticky character of the bacterial wall is due to glycocalyx or slime layer. This layer is rich in glycoproteins.

(31) **(C).** *Saccharomyces* i.e. yeast is an eukaryote (unicellular fungi) ; *Mycobacterium* – a bacterium
Oscillatoria and *Nostoc* are cyanobacteria.

(32) **(A).** Pseudopodia are locomotory structures in sarcodines (Amoeboid)

(33) **(A).** In *Agaricus*(a genus of basidiomycetes), basidiospores or meiospores are produced exogenously.
Neurospora (a genus of ascomycetes) produces ascospores as meiospores but endogenously inside the ascus.)
Alternaria (a genus of deuteromycetes) does not produce sexual spores.
Saccharomyces (Unicellular ascomycetes) produces ascospores, endogenously.

(34) **(D).** Ciliates differs from other protozoans in having two types of nuclei.
eg. *Paramoecium* have two types of nuclei i.e. macronucleus & micronucleus.

(35) **(B).** Diatoms are chief producers of the ocean.

(36) **(B).** According to rules of binomial nomenclature, correctly written scientific name of mango is *Mangifera indica* Linn.

(37) **(C).** Infective constituent in viruses is either DNA or RNA, not protein.

(38) **(D).** Yeast is an unicellular sac fungus. It lacks filamentous structure or hyphae.

(39) **(D).** Saprophytes - Decomposition of dead organic materials.
Parasites - Grow on/in living plants and animals.
Lichens - Symbiotic association of algae and fungi
Mycorrhiza - Symbiotic association of fungi with plant roots.