Biological Classification

CHAPTER 2

EXAM DRILL

ANSWERS

1. **(a) :** Transduction is the transfer of foreign genes by means of viruses.

OR

(b) : The given figures are showing transduction in bacteria. It is the transfer of foreign genes by means of viruses.

2. **(b) :** *Clostridium botulinum* is an obligate anaerobe. It respires only anaerobically and generally gets killed under aerobic conditions.

3. **(d)**

4. **(d) :** *Ceratium* is a heavy armoured dinoflagellate. It occurs in marine, brackish and freshwater.

5. **(b) :** Basidiomycetes are commonly called club fungi.

6. **(b) :** Plasmodium stage in acellular slime moulds is multinucleate amoeboid structure.

7. (i) Halophiles – living in salty areas
(ii) Thermoacidophiles – hot springs
(iii) Methanogens – Marshy areas

8. *Nostoc, Anabaena*

9. *Gonyaulax*, a dinoflagellate possesses two flagella, one lies longitudinally and other transversely in a furrow between the wall plates.

10. Mycoplasma are smallest living cells and can survive without oxygen. They completely lack cell wall.

11. **(b)** **12.** **(b)**

13. **(d) :** *Bacillus subtilis* is obligate aerobe. It generally gets killed in anaerobic conditions. It can respire only aerobically.

14. **(a)**

15. **(i) (c) :** Prions are highly resistant glycoprotein particles which function as infectious agents. They are formed due to mutation in gene *PRNP*.

(ii) **(d) :** In viroids, protein coat is absent.

(iii) **(c) :** H5N1 is a bird flu, a human viral disease.

(iv) **(a)**

(v) **(d) :** Prions cause bovine spongiform encephalopathy commonly called as mad cow disease.

16. **(i) (a) :** In lichens, the fungal partner is usually an ascomycetes and sometimes, a basidiomycetes.

(ii) **(c) :** Major function of phycobiant (or alga) is photosynthesis.

(iii) **(a)**

(iv) **(c)**

(v) **(a) :** Lichens are early or pioneer colonisers of barren, dry and naked rocks, cliffs, mountains and new terrains. During their growth lichens etch the rock and cliffs by secreting acids. It produces minute crevices where organic matter accumulates. It paves the way for growth of mosses and grasses.

17. Deuteromycetes are a large number of true fungi whose sexual stages (perfect stages) are either unknown or not commonly found. Since only the imperfect stages (asexual stages) of these fungi are known, they are called the fungi imperfecti. Two characteristics are: (i) The majority of fungi imperfecti are saprophytic on decaying organic matter and in the soil, but a number of species are parasitic on plants, animals and human beings, causing number of serious diseases. (ii) The mycelium consists of well developed septate, branched hyphae.

OR

Euglena is a taxonomic puzzle since, it shows both plant and animal characters. Absence of cell wall is an animal feature and presence of chloroplast is a plant character of *Euglena*. They also have mixotrophic nutrition. In the presence of sunlight, they can photosynthesise their food and in absence of sunlight, they are heterotrophs by absorping nutrients from surrounding medium.

18. **(a) :** Bracket fungi are basidiomycetes which produce bracket or shelf-shaped hard, leathery basidiocarp on the tree trunk, *e.g., Fomes applanatus*, etc.

(b) Edible mushrooms possess coloured basidiospores. Examples : *Agaricus campestris*.

19. Features of Kingdom Animalia as per five kingdom classification are :
(i) Animal cell lacks rigid cell wall, has only small vacuoles instead of a large central vacuole and usually contains a centrosome.
(ii) Growth in animals takes place proportionately in all parts of the body. It is limited and stops after the size fixed for the species is reached.

(iii) Nutrition in animals is mostly heterotrophic.
(iv) Animals store food in the form of glycogen as reserve food material.
(v) Animals show locomotion. They can often move their parts rapidly because of the muscles present. They also move from place to place in search of the necessities of life.

20. Features of Kingdom Plantae as per five kingdom classification are :
(i) Plant cell is bounded by a thick, rigid cell wall, contains a large central sap vacuole and usually lacks centrosome.
(ii) Growth in plants occurs at the growing points only. It is unlimited and continues as long as the plant lives.
(iii) Nutrition in plants is generally autotrophic due to the presence of chlorophyll and consequent photosynthesis.
(iv) Plants store food in the form of starch as reserve food material.
(v) Plants are mostly rooted and incapable of locomotion except some lower algae.

21. Six kingdom classification system was introduced by Carl Woese. This system is also named as three domain system as in it organisms are classified into three domains, *i.e.,* Archaea, Bacteria and Eukarya.
It mainly uses basic principles of five kingdom system but divides the Monera into two domains Archaebacteria, Eubacteria and other eukaryotes in third kingdom.
(i) Domain Archaea : Archaea domain includes prokaryotic organisms. These are characterised by a monolayer core of lipids in the cell membrane and distinct nucleotides in their 16S RNA. It contains a single kingdom called Archaebacteria. Kingdom Archaebacteria includes early prokaryotes which live in extreme conditions of the environment. These are methanogens, halophiles and thermoacidophiles.
(ii) Domain Bacteria : The bacteria domain consists of typical prokaryotes that lack membrane covered cell organelles. These do not have microchambers for separating various metabolic activities. It also has a single Kingdom Eubacteria. The members of this kingdom have peptidoglycan cell wall, naked DNA in coiled form, glycogen food reserves. The sap vacuole is not present and 70S ribosomes are present. The members of this kingdom are bacteria, mycoplasma, actinomycetes, rickettsiae, spirochaetes and cyanobacteria.
(iii) Domain Eukarya : The domain eukarya contains all the eukaryotes. These living forms have originated by symbiotic association between some archaebacteria and eubacteria.

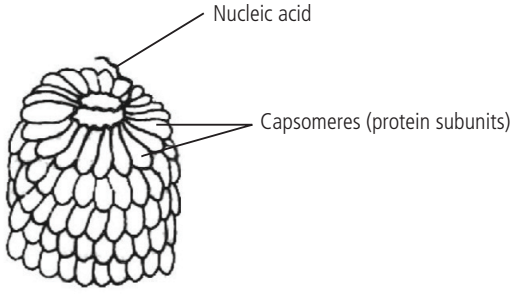
22. The three types of archaebacteria are :
(i) Methanogens : These are strictly anaerobes. They live anaerobically in gut of several ruminants such as cows, buffaloes, goat, etc. These bacteria help in fermentation of cellulose. They produce almost 65% of atmospheric methane. Examples : *Methanobacterium, Methanobacillus*, *Methanosarcina* and *Methanococcus*.
(ii) Halophiles : These are found in extreme saline environments like salt lakes, salt marshes, salt pans, salt solutions, etc. They are mostly anaerobes. They contain a chemical called halorhodopsin to pump in chlorides into the cell to prevent cellular dehydration. *Halobacterium* develops purple membrane having photoreceptor pigment bacteriorhodopsin. In light, it acts as a proton pump and helps in synthesis of ATP. The formation of ATP is a survival mechanism under anaerobic condition. Examples: *Halobacterium* and *Halococcus*.
(iii) Thermoacidophiles : These archaebacteria can live in both extreme high temperature (upto 80°C) and acidic pH (around 2) environment. Under anaerobic conditions, these organisms oxidise sulphur to sulphuric acid. Examples : *Thermoproteus*, *Thermoplasma*.

23. Cyanobacteria are Gram +ve prokaryotes which perform oxygenic photosynthesis like plants. They were the first organisms to make the atmosphere aerobic. They are capable of performing 'oxygenic photosynthesis' and fix nitrogen also. Cyanobacteria can be unicellular (*e.g., Spirulina*), colonial (*e.g., Nostoc*) or filamentous (*e.g., Oscillatoria*). Filaments contain one or more trichomes inside a mucilage sheath. Trichomes may be homocystous (without heterocysts, *e.g., Oscillatoria* which shows apical oscillations) or heterocystous (with heterocysts, *e.g., Nostoc, Anabaena*). The cell wall possesses an outer sheath (outside) which is jelly-like, slimy and mucilaginous. The cell contents are divided into two regions–outer chromatoplasm having photosynthetic pigments in free thylakoids and inner colourless centroplasm. Like bacteria, blue green algae lack mitochondria, true vacuoles, endoplasmic reticulum and true nucleus. Thylakoid membranes contain chlorophyll *a*, carotenes and xanthophylls. Attached to thylakoids are minute structure called phycobilisomes. The reserve food is in the form of cyanophycean starch. Heterocysts formation is characterised by the presence of thick wall and yellowish contents. In many filamentous forms asexual reproduction occurs by hormogonia formation. Hormogonia are motile filaments function in dispersal, phototaxis and establishment of nitrogen fixing symbiosis.

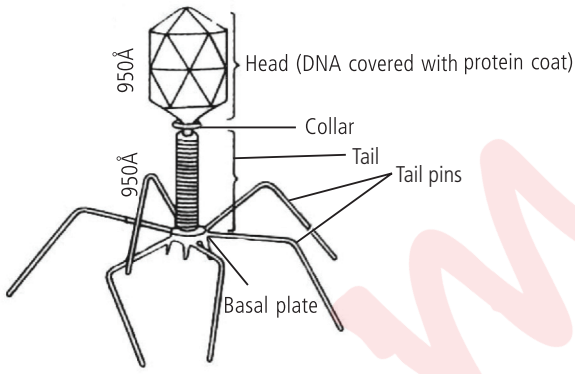
24. Diatoms are economically important in the following ways:
(i) Diatoms are very important photosynthesisers.
(ii) Diatomite deposits are often accompanied by petroleum fields.
(iii) These are used as a cleaning agent in tooth pastes and metal polishes and are used in filtration of oil and syrups.
(iv) Diatoms are used as insulation material in refrigerators, boilers and furnaces. These are also used to make sound-proof rooms.
(v) Diatoms are also very good pollution indicators.

25. The fruiting body is part of the sexual phase of a fungal life cycle. The sporocarp of a Basidiomycetes is known as basidiocarp while the fruiting body of an ascomycete is known as ascocarp.
In ascomycetes, the asci may occur freely or get aggregated with dikaryotic mycelium to form fructifications called ascocarps. Ascocarps are of many types : cup-like (apothecium, *e.g.*, *Peziza*), flask-shaped (perithecium *e.g.*,*Neurospora*) and closed cleistothecum e.*g., Penicillium*.

26. (a) The labelled diagram of TMV, *i.e.*, tobacco mosaic virus is as follows :



(b) The labelled diagram of bacteriophage is a follows :



27. Viruses are host specific. Based on the type of host, viruses are of different types:
(i) Plant viruses (Phytophages) : These viruses principally attack plants, *e.g.*, cauliflower mosaic virus, tobacco mosaic virus.
(ii) Animal viruses (Zoophages) : These viruses principally attack animals. *e.g.*, polio virus, influenza virus, small pox virus, hepatitis virus.
(iii) Bacteriophages : These viruses infect bacteria *e.g.*, T_2, T_4.
(iv) Cyanophages : These viruses infect blue-green algae, *e.g.*, SM-1, LPP-1.
(v) Zymophages : These viruses infect yeasts.
(vi) Mycophages : These are fungal viruses.

OR

The merits of five kingdom classification system are as follows:
(i) It brings out phylogeny in the living world.
(ii) The system is based on levels of organisation and modes of nutrition. The latter became established very early during evolution.
(iii) Kingdom Animalia has become more homogeneous with the exclusion of protozoa. Evolutionary tendencies and pathways are more clearly defined.
(iv) Kingdom Plantae has become more coherent after exclusion of bacteria, fungi and some unicellular algal forms.
(v) Fungi are separated from plant as well as slime moulds and are placed in a separate kingdom.
(vi) Early eukaryotic forms such as *Euglena*, etc. which have flexible modes of nutrition and life styles have been separated and placed in Kingdom Protista.
(vii) Creation of Kingdom Monera for prokaryotes is fully justified as they have their own level of structural and biochemical organisation.

28. (i) Viroid is the infectious agent.
(ii) The disease is Potato spindle tuber disease.
(iii) The viroids are infectious free RNA particles that lack protein coat and the RNA of the viroid has low molecular weight.

29. (i) A-Prokaryotic, B-Non-cellulosic, C-Present D-Multicellular
(ii) *Puccinia graminis tritici* causes stem rust of wheat. It belongs to Kingdom Fungi.
(iii) Blue green algae, nitrogen fixing bacteria and methanogenic archaebacteria are included in Kingdom Monera. All these organisms are prokaryotic and primitive, thus including them in the Kingdom Monera as prokaryotes differentiate them from all other organisms in their genetic, cellular, reproductive and physiological organisation.

30. The body of the fungus consists of microscopic threads or filaments called hyphae which form a web called mycelium. The hyphae may be aseptate and multinucleate (coenocytic), however, in reproductive phase, septa may be formed, *e.g.*, *Rhizopus*, *Albugo*, *Phytophthora*, etc., or may be septate. In septate forms, each cell may be uninucleate (monokaryotic) or dikaryotic or with many nuclei.
Definite cell wall is present in hyphae which is made of chitin (a polymer of N-acetyl glucosamine) or fungal cellulose. Inside cell wall is cell membrane, followed by protoplasm having usual cell organelles like ER, mitochondria, dictyosomes, etc., and also some non-living inclusions like glycogen granules and lipid granules, etc. Fungal hyphae are associated to form perennating structures of two types : rhizomorphs and sclerotia.

31. The two kingdom system of classification was accepted for a long time. However, some difficulties arised from this classification as several new living organisms were discovered. Some of these difficulties are:
(i) The first formed organisms were neither plants nor animals.

(ii) Fungi do not show similarity with structure, physiology and reproductive system of plants.
(iii) It is not easy to recognise the lower organisms as plants or animals. For example, *Euglena* has mixotrophic (dual) mode of nutrition, while sponges are fixed, branched and irregular creatures like plants.
(iv) Slime moulds, a group of fungi, are wall-less in vegetative phase. They develop cell wall in the reproductive phase. Slime moulds can neither be placed in fungi, nor plants.
(v) Lichens are formed by the symbiotic association of an alga and a fungus. They neither resemble plants nor animals.
(vi) Prokaryotes do not have an organised nucleus. They have single envelope organisation, absence of spindle apparatus, meiosis and sexual reproduction. Eukaryotes have a well-defined nucleus, a double envelope organisation, spindle apparatus, meiosis and sexual reproduction. On the other hand, viruses have no protoplasm and metabolic machinery of their own. Therefore, all of these cannot be kept in a single group.
(vii) Unicellular algae like diatoms, euglenoids, dinoflagellates and protozoa resemble each other.

OR

Whittaker has used five criteria for delimiting the different kingdoms.
(i) Complexity of cell structure; prokaryotic and eukaryotic.
(ii) Complexity of body structure; unicellular and multicellular.
(iii) Mode of nutrition is divergent in multicellular kingdoms - photoautotrophy in Plantae, absorptive heterotrophy in Fungi and ingestive heterotrophy in Animalia.
(iv) Presence or absence of sexual reproduction; mode of sexual reproduction.
(v) Phylogenetic relationship.

32. Protists reproduce by both asexual and sexual methods.
(a) Asexual reproduction : It involves only one parent. All the young ones produced asexually have the same genetic constitution as that of the parent and are called clones. Asexual reproduction can occur in the following ways.
(i) Binary fission - It is the division of the parent body into two equal daughter individuals by mitosis. Examples : *Amoeba*, *Euglena* and *Paramecium*.
(ii) Multiple fission - It is the division of the parent organism into several daughter individuals. Examples : *Amoeba* and *Plasmodium*.
(iii) Plasmotomy - It is the division of the multinucleate protist into two or more multinucleate offspring by the division of cytoplasm without nuclear division. It occurs in *Opalina*.
(iv) Spore formation - In some protists spores are formed for asexual reproduction. Spores have some sort of covering to withstand unfavourable conditions. On germination, each spores give rise to a new individual. Example : Slime moulds.
(v) Budding - In budding a small outgrowth develops from the parent body which separates and develops into a new individual. Example : *Arcella* (a Sarcodine).
(b) Sexual reproduction : It originated in protists. Sexual reproduction involves two fundamental processes; meiosis, that reduces the number of chromosomes from 2n to 1n and fertilisation or fusion of two gametes to form a 2n zygote (fertilised egg). Meiosis is essential in sexual reproduction since it reduces the chromosome number to half in gametes so that after fertilisation the number of chromosomes is kept constant in a species. There are two methods of sexual reproduction.
(1) Syngamy - It is complete fusion of two gametes to produce a diploid zygote. Syngamy is of three types : (i) Isogamy (two fusing gametes are similar *e.g.*, *Monocystis*); (ii) Anisogamy (two fusing gametes are dissimilar, *e.g.*, *Ceratium*) and (iii) Oogamy (large non-motile) gametes are fertilised by smaller motile gametes, *e.g.*, *Plasmodium*).
(2) Conjugation - It is temporary union of two individuals to exchange their haploid pronuclei to from a zygote nucleus. Each individual with zygote nucleus produces daughter individuals by binary fission. It occurs in *Paramecium*.

OR

All bacteria do not require oxygen for their growth and metabolism. On the basis of oxygen requirement they are termed as follows:
(a) Aerobes : These bacteria can function metabolically in presence of free or atmospheric oxygen.
(i) Obligate aerobes (*e.g.*, *Bacillus subtilis*) can respire only aerobically.
(ii) Facultative aerobes can respire aerobically in presence of oxygen and anaerobically in absence of free or atmospheric oxygen, most photosynthetic bacteria, *e.g.*, *Rhodopseudomonas*.
(b) Anaerobes : These bacteria cannot grow in presence of free oxygen.
(i) Obligate anaerobes (like *Clostridium botulinum*) respire only anaerobically. They (occasionally called aerophobes) may live by fermentation, anaerobic respiration, bacterial photosynthesis or by the process of methanogenesis. In case of these bacteria, oxygen is a toxic substance which either kills or inhibits their growth.
(ii) Facultative anaerobes (*e.g.*, *Escherichia coli*) can switch between aerobic and anaerobic types of metabolism depending on oxygen availability.

33. In fungi, asexual reproduction takes place during favourable conditions. Asexual reproduction in fungi may be of the following types :

(i) Zoospore formation : Zoospores are uninucleate, thin walled, formed in zoosporangia. They may be uniflagellate, *e.g., Synchytrium* or biflagellate, *e.g., Saprolegnia, Pythium*.
(ii) Aplanospores : These are thin-walled, non-motile spores formed inside sporangium, which give rise to new mycelium, *e.g., Rhizopus, Mucor.*
(iii) Conidia : These are non-motile, thin-walled exogenously produced spores on a conidiophore and sometimes they are arranged in chains upon the conidiophore, *e.g., Aspergillus* and *Penicillium* or singly in *Pythium*, *Phytophthora*. The tip of the conidiophore is spherical and gives out a number of peg-like branches, sterigmata bearing chains of conidia.
(iv) Pycniospores : These are small conidia-like bodies produced in flask-shaped cavities called the pycnia, *e.g., in Puccinia*.
(v) Ascospores : These are uninucleate, unicellular, non-motile, usually eight in number, produced in sac-like structures called ascus.
(vi) Basidiospores : These are produced exogenously by club-shaped basidium or sterigmata. Usually four basidiospores are produced.

OR

Mycorrhiza is a symbiotic association between a fungus and the root of a plant. Mycorrhizal roots often show wooly covering of fungal hyphae on the surface and remain in the upper layers of the soil where organic matter is abundant.
A fungus can form association with roots of many plants and the roots of a plant can form association with many fungi.
Mycorrhizae are of the following two types:
(i) Ectomycorrhizae : In this type, the bulk of the fungus grows over the surface as a mantle. The only part of it lives in the intercellular spaces of the cortex of the root.
(ii) Endomycorrhizae : In this type, the fungus grows inside the cortex of the root with some intracellular hypae tips. In some forms of endomycorrhizae, the fungal hyphae develop some special organs called vesicles with the root cortical cells. This kind of mycorrhizae are called Vesicular Arbuscular Mycorrhizae (VAM). The VAM occur in large number of crop plants. Vesicles and arbuscules help in absorption of nourishment from cortical cells. A single endomycorrhizal fungus can form association with the roots of a number of plants.
Importance of mycorrhizal association are:
(i) Mycorrhizae help in absorption of minerals from the soil and provide it to the root.
(ii) These help in increased absorption of water.
(iii) These produce growth hormones. In the absence of fungus, *Pinus* and *Betula* show stunted growth despite of providing all types of nutrients.
(iv) Fungus help in preventing the root from parasitic fungi and harmful bacteria secreting antimicrobial substances.
(v) Mycorrhizae enable the plants to grow in mineral deficient soil, saline soil and unfavourable pH and temperature.
(vi) In case of orchids, the fungus absorbs nourishment from outside and deliver to the germinating seed as the same is devoid of stored food.
(vii) Mycorrhiza have antimicrobial substances which protect the root from parasitic fungi and harmful bacteria.

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