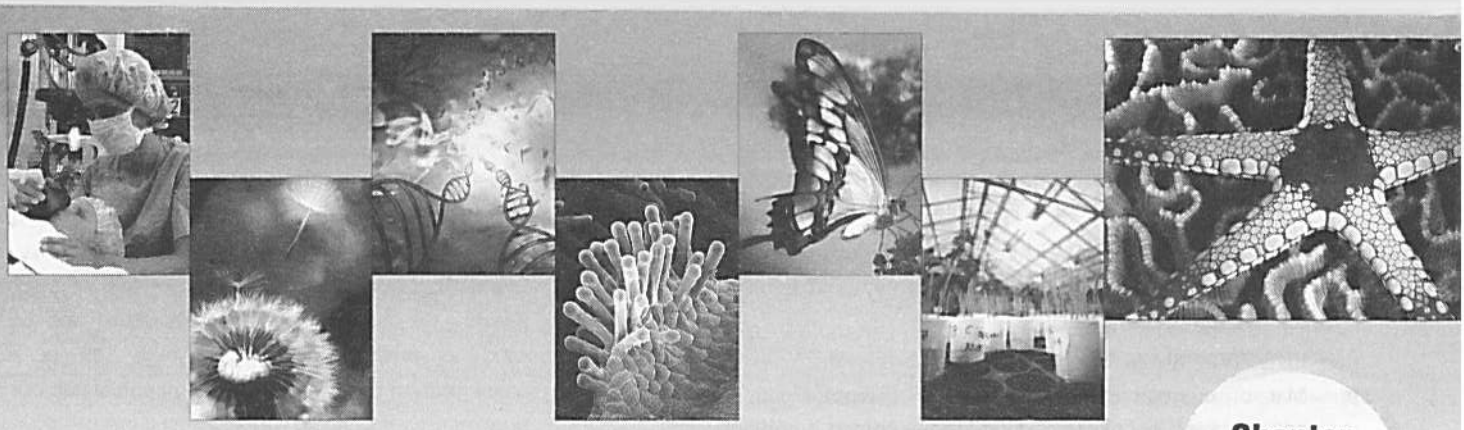


Chapter

1.3

Protista (Unicellular eukaryotes)

Characteristics of protista

Protista (*Protistos* = Primary) includes unicellular eukaryotes and show the following characters :

(1) Protists include solitary unicellular or colonial unicellular eukaryotic organisms which do not form tissues.

(2) The single cell may be naked or covered by cell wall, pellicle, cuticle or shell.

(3) Simple multinucleate organisms or stages of life cycles occur in a number of groups.

(4) The organisms possess double and porous nuclear membranes, mitochondria, golgibody, plastids (in many), vacuoles, lysosomes and ribosomes are also present. Centrosome occur in many cases.

(5) In many forms, plastids, (9+2 strand) flagella and other organelles are present.

(6) Some protists possess contractile vacuole for regulation of their water content.

(7) Their reproductive cycles typically include both asexual divisions of haploid forms and true sexual processes with karyogamy and meiosis.

(8) The organisms move by flagella or by other means or are non-motile.

(9) It may be photosynthetic, holotrophic, saprotrophic, parasitic and symbionts. Some have mixotrophic nutrition (holotrophic + saprobic). The photosynthetic, floating protists are collectively called **phytoplankton**. The free-floating, holozoic protozoans are collectively termed **zooplankton**.

(10) Asexual reproduction is the most common method in protists. It involve binary fission (*Paramecium, Euglena, Amoeba*), multiple fission (*Amoeba*), plasmotomy (*Opalina*), budding (*Paracineta, Arcella*) and spore formation (Slime moulds).

(11) Sexual reproduction is believed to have originated in primitive protists. It involve isogamy (*Monocystis*), anisogamy (*e.g.*, *Ceratium*) and oogamy (*e.g.*, *Plasmodium*).

Classification of protista : Unicellular protists have been broadly divided into three major groups :

(i) Photosynthetic protists : *e.g.*, Dinoflagellates, Diatoms, Euglenoids.

(ii) Consumer protists : *e.g.*, Slime moulds or Myxomycetes.

(iii) Protozoan protists : *e.g.*, Zooflagellata, Sarcodina, Sporozoa, Ciliata.

Photosynthetic protists

Dinoflagellates

General characters

(1) This is well defined group of unicellular, golden-brown photosynthetic organisms. Majority of them are motile and flagellated but a few are non-motile and non-flagellated. Flagellated forms exhibit peculiar spinning movement. Hence, they are called **whorling whips.**

(2) The cell wall of dinoflagellates, if present, is composed of a number of plates made up of cellulose. It is called **theca** or **lorica**. The theca contains two grooves-longitudinal **sulcus** and transverse **girdle** or **annulus**.

(3) Usually the cells possess two **flagella** which are of different types (heterokont).

(4) Trichocysts are rod like or spindle shaped ejective structures which occur just below the cell membrane.

(5) Cells possess a relatively large and prominent nucleus known as **mesokaryon**. DNA is without association with histone.

(6) There are numerous discoid chloroplasts without pyrenoids. They are yellow-brown to dark-brown in colour due to presence of characteristic **pigments** – Chlorophyll *a*, *c*, α-carotene and xanthophylls (including dinoxanthin and peridinin).

(7) The cells possess an osmoregulatory organelle called **pusule** which superficially looks like contractile vacuole.

(8) In dinoflagellates it is mainly holophytic or photosynthetic. However, some forms are saprobic, parasitic, symbiotic or holozoic. For example, a colourless *Blastodinium* is parasite on animals.

(9) Dinoflagellates reproduce asexually through cell division or by the formation of zoospores and cysts. The cell division starts from posterior end. During cell division, centromeres and spindle are not seen.

(10) If sexual reproduction occurs, is isogamous or anisogamous. Two cells conjugate by a conjugation canal where the two amoeboid gametes fuse to form a diploid zygote. Life cycle involves zygotic meiosis (*e.g., Ceratium, Gymnodinium* etc.) or gametic meiosis (*e.g., Noctiluca*).

Examples : *Glenodinium, Peridinium, Gymnodinium, Gonyaulax, Ceratium, Noctiluca.*

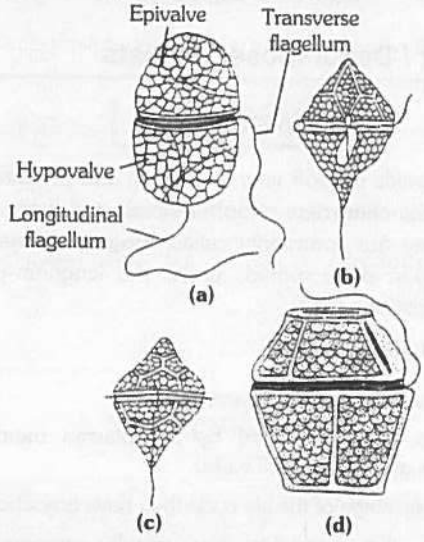


Fig : 1.3-1 Some dinoflagellates (a) Glenodinium (b) Peridinium (c) Gynnodium (d) Gonyaulax

Diatoms

General character

(1) Most of the diatoms occur as **phytoplanktons** both in fresh and marine waters. A few forms occur as benthos the bottom of water reservoirs. Diatoms constitute a major part of phytoplankton of the oceans.

(2) The cells of diatoms are called frustules or shell. They are microscopic, unicellular, photosynthetic organisms of various colours and diverse forms. They may be circular, rectangular, triangular, elongated, spindle-shaped, half-moon shaped, boat-shaped or filamentous. Incipient filament occur in *Melosira*.

(3) They exhibit mainly two types of symmetry-radial symmetry as in **centrales** (*e.g., Cyclotella, Biddulphia, Triceratium, Melosira*) and isobilateral symmetry as in **Pennales** (*e.g., Pinnularia, Synedra, Actinella, Navicula*).

(4) The cell wall is chiefly composed of cellulose impregnated with glass-like silica. It shows sculpturings and ornamentations. It is composed of two overlapping halves (or theca) that fit together like two parts of a soap box. The upper half (lid) is called **epitheca** and the lower half (case) is called **hypotheca**.

(5) Diatoms do not possess flagella except in the reproductive stage. They show **gliding** type of movement with the help of mucilage secretion. They float freely on the water surface due to presence of light weight lipids.

(6) Each cell has a large central vacuole in which a prominent nucleus is suspended by means of cytoplasmic strands. The cells are **diploid** (2*N*). In case of centrales, the nucleus lies in the peripheral region.

(7) Some species of diatoms are devoid of chromatophores, *e.g., Nitzschia alba*. They are saprotrophic in nutrition.

(8) The reserve food material is **oil** and a polysaccharide – **chrysolaminarin** (or **leucosin**).

(9) Most common method of multiplication is **binary fission** (cell division) that occurs at night.

(10) Sexual reproduction takes place by the fusion of gametes. Meiosis is gametic *i.e.,* takes place during the formation of gametes.

Examples : *Triceratium, Pleurosigma, Navicula, Cymbella, Amphipleura, Nitzschia, Melosira, Pinnularia.*

Euglenoid

General characters

(1) Euglenoids and their non-motile relatives are unicellular flagellate protists.

(2) These protists are devoid of cellulose cell wall. The body is covered by thin and flexible pellicle. The pellicle has oblique but parallel stripes called myonemes. The pellicle is composed of fibrous elastic protein and small amount of lipid or carbohydrates.

(3) The euglenoids have two flagella, usually one long and one short. Each flagellum arises from a basal granule (blepharoplast). The flagella bear hair.

(4) They can undergo creeping through expansion and contraction of body called metaboly.

(5) The apical end bears an invagination having three parts– cytostome (mouth), cytopharynx (gullet or canal) and reservoir. The cytostome is generally eccentric.

(6) The two flagella join with each other at a swelling called paraflagellar body. An orange red coloured eye-spot or stigma is located at the base of flagellum attached to the membrane of reservoir at the level of paraflagellar body. They contain red pigment **astaxanthin**. Both paraflagellar body and eye spot act as photoreceptors and direct the organism towards the optimum light.

(7) An osmoregulatory contractile vacuole occurs in the anterior part of the cell below the reservoir.

(8) Nutrition is holophytic (photoautotrophic), saprobic (*e.g., Rhabdomonas*) or holozoic (*e.g., Peranema*). Even holophytic forms can pick up organic compounds from the outside medium. Such a mode of nutrition is called mixotrophic.

(9) Product of photosynthesis is paramylon which is stored in the form of paramylum granules in the paramylum bodies in cytoplasm.

(10) Sexual reproduction has not yet been definitely proved. Under favourable conditions, euglenoids multiply by longitudinal binary fission.

(11) These protists perennate during unfavourable periods as cysts.

Example : *Euglena, Phacus, Eutreptia, Trachelomonas, Peranema.*

Euglena

General characters

(1) *Euglena* is a connecting link between animals and plants.

(2) *Euglena* resembles the ancestral form from which the plants and animals evolved.

(3) *Euglena* is a free swimming fresh water flagellate which moves by two different methods :

(i) Euglenoid movement (wriggling movement), by contraction and expansion of the body.

(ii) Flagellar movement, with the help of sticonematic type flagellum.

(4) Body is covered by pellicle, a small cytostome (cell mouth) and cytopharynx is present at the anterior end of the body.

(5) *Euglena* contains chlorophyll, yet it resembles animals, because it feeds like animals in the absence of sunlight.

(6) Nutrition in *Euglena* is mixotrophic, when light is available it is photosynthetic, in darkness it is saprophytic absorbing food from surrounding water.

(7) Reserve food is stored in the form of paramylum or paramylon.

(8) Asexual reproduction occurs by longitudinal binary fission, no sexual reproduction.

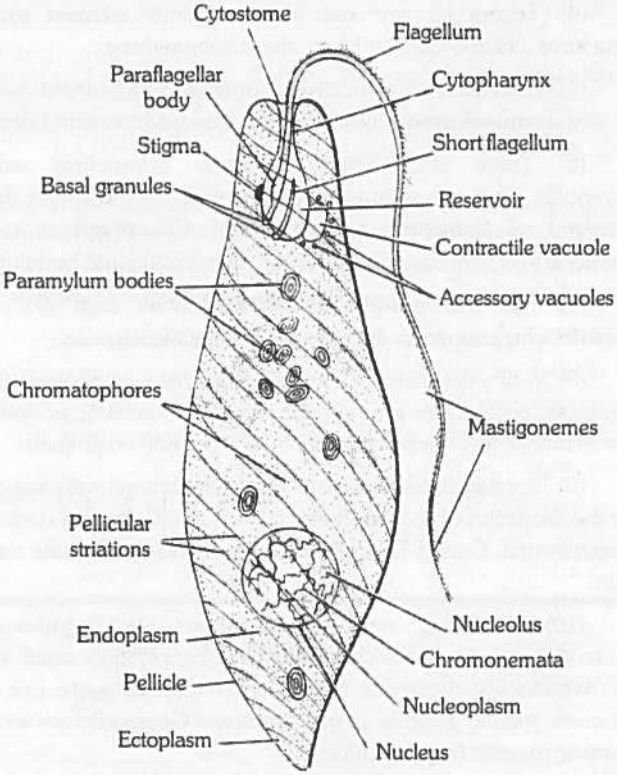


Fig : 1.3-2 Euglena viridis

Consumer / Decomposer protists

Slime moulds

Slime moulds include very interesting and peculiar organisms which share the characters of both animals and fungi. Due to this peculiarity they are commonly called **fungus animals**. Modern biologist include slime moulds under the kingdom-protista and called them protistan fungi.

General characters

(1) They do not have chlorophyll.

(2) They are surrounded by the plasma membrane only (somatic parts are without cell walls).

(3) At one stage of the life cycle they have amoeboid structure.

(4) The slime moulds live usually amongst decaying vegetation. They are quite common on lawns and moist fields.

(5) They have phagotrophic or saprotrophic nutrition. Parasitic forms are not known

(6) The sporangia produce spores. Each spore possesses a cellulose cell wall.

Acellular (Plasmodial) Slime moulds

General characters

(1) Acellular slime moulds commonly grow as slimy masses on damp places rich in dead and decaying organic matter.

(2) The somatic phase is diploid and consists of a free living organic matter multinucleated protoplasm called plasmodium.

(3) The plasmodium slowly streams or glides over decaying organic matter putting out blunt finger like pseudopodia showing amoeboid movement.

(4) They also absorb dissolved organic substances from the substratum showing saprotrophic nutrition.

(5) Each plasmodium reproduces asexually by the formation of several, small, sessile or stalked, brightly coloured sporangia.

(6) When fully mature, the wall of the sporangium bursts to release the spores. The spores are dispersed by air.

(7) On germination, a spore generally releases one biflagellate, spindle-shaped swarm cell or a non-flagellate myxamoeba. The myxamoebae feed on bacteria and yeasts and multiply in number. The swarm cells swim about actively and finally fuse in pairs at the posterior nonflagellate ends to form zygotes.

(8) The diploid nucleus of zygote undergoes repeated mitotic divisions. As a result, the zygote gradually changes into a multinucleate amoeboid structure, the plasmodium. The plasmodium repeats the life cycle.

Examples : *Physarum, Physarella, Fuligo, Dictydium, Lucogala, Tubifera.*

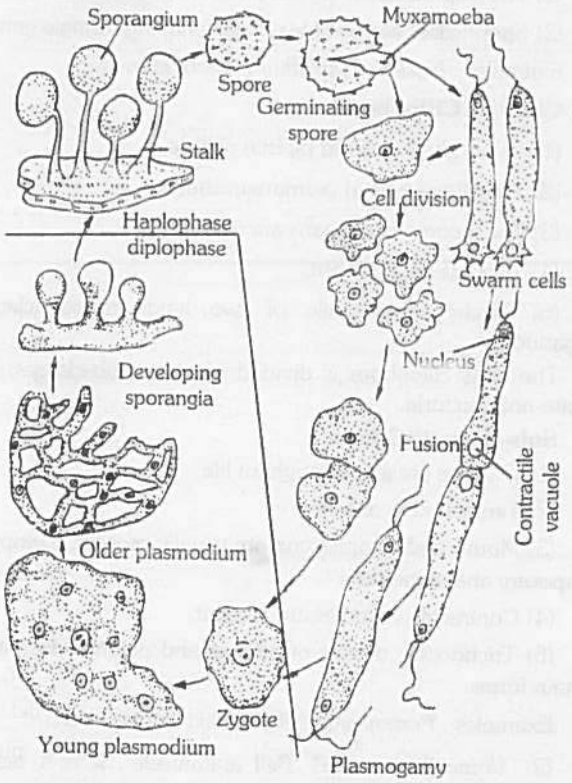


Fig : 1.3-3 Diagramatic life cycle of acellular Slime mould (*e.g., Physarum*)

Cellular Slime moulds

General characters

(1) The cellular slime moulds occurs in the form of haploid uninucleated, naked (without cell wall) cell covered by plasma membrane. These cells are called myxamoebae.

(2) The myxamoebae move freely with the help of amoeboid movement and phagotrophic or holozoic nutrition.

(3) Under unfavourable condition a myxamoeba secrete a rigid cellulose wall to form the microcyst. Microcyst formation is a means of perennation.

The microcysts can be dispersed. On the return of favourable conditions, the microcyst wall ruptures to release a myxamoeba. The latter resumes its function of feeding, growth and multiplication forming amoeboid cells.

(4) When the food supply is exhausted the amoeboid cells get aggregated without any fusion. The stimulus for the aggergation process is due to release of cyclic 3',5' adenosine monophosphate (cyclic AMP) from the amoeboid cells. This aggregated mass of cells is called pseudoplasmodium. It is a sort of community association. Because of this reason, cellular slime moulds are called the communal slime moulds.

(5) The stalk of sporocarp may remain upright or bend. Finally the spores are released and disseminated.

(6) The most important character of cellular slime moulds is the complete absence of flagellated cells in their life cycle.

(7) The cellular slime moulds resemble plant in having cellulose cell wall in spores and resemble animals in having amoeba-like myxamoebae.

Examples : *Dictyostelium, Polysphondylium.*

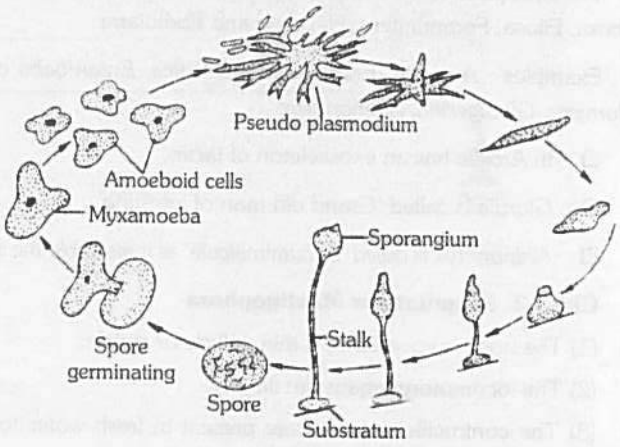


Fig : 1.3-4 Diagramatic life cycle of cellular slime mould

Protozoan protists (Gr. *Protos* = first ; *zoon* = animal)

It include all unicellular (or acellular) eukaryotic animals. These are most primitive organisms considered as animals because of heterotrophic nutrition and motility. About 50,000 species (30,000 present and 20,000 extinct) are so far known.

Brief history : Protozoans were first studied by *Leeuwenhoek* (1677). The name "Protozoa" was coined by *Goldfuss* (1817). The branch of their study is called Protozoology.

General characters

(1) Protozoans are the simple and primitive organisms.

(2) They are free living or parasitic.

(3) They are asymmetrical or radially symmetrical or bilaterally symmetrical.

(4) They are unicellular (acellular).

(5) They have protoplasmic grade of organization.

(6) Locomotion is effected by flagella, cilia or pseudopodia.

(7) Nutrition is holophytic, holozoic, saprozoic or parasitic.

(8) Digestion is intracellular.

(9) Excretion and respiration occurs by diffusion.

(10) In fresh water protozoans osmoregulation is carried out by the contractile vacuoles.

(11) Reproduction occurs by asexual and sexual methods.

Classification of Protozoans

Protozoans are classified on the basis of locomotory organelles into following classes.

Class 1. Rhizopoda or Sarcodina

(1) There is no definite cell wall or pellicle.

(2) There is no definite shape.

(3) The locomotory organs are pseudopodia.

(4) There is no permanent mouth or anus.

(5) The contractile vacuoles are present in the fresh water forms.

The rhizopoda has been divided into five orders. They are as Lobosa, Filosa, Foraminifera, Heliozoa and Radiolaria.

Examples : *Amoeba, Entamoeba histolytica, Entamoeba coli, Pelomyxa, Globigerina, Actinophryx.*

- In *Arcella* has an exoskeleton of tactin.
- *Giardia* is called 'Grand old man of intestine'.
- *Actinophryx* is called 'Sun animalcule' as it resemble the sun.

Class 2. Flagellata or Mastigophora

(1) The body is covered by a thin pellicle or cuticle.

(2) The locomotory organs are flagella.

(3) The contractile vacuoles are present in fresh water forms with accessory vacuoles.

(4) Chloroplast are found in some forms.

(5) They may be free living or parasitic.

The class flagellata has been divided into eight orders. They are as Chrysomonadina, Cryptomonadina, Euglenoidea, Phytomonadina, Dinoflagellata, Cystoflagellata, Protomonadina and Polymastigina.

Examples : *Chrysamoeba, Cryptomonas, Volvox, Chlamydomonas, Noctiluca, Mastigamoeba, Monal, Bado, Trypanosoma, Leishmania, Proterospongia* etc.

- *Trychonymph* (symbiotic) live in alimentary canal of termite that is digest to cellulose.
- *Noctiluca* shows bioluminiscense due to luciferin protein. It is also called the 'Fire of sea'.

Class 3. Sporozoa

(1) They are exclusively endoparasitic.

(2) The body is covered by pellicle.

(3) Reproduction takes place by spore formation.

The class is divided into two sub-classes, namely, Telosporidia and Neosporidia.

Sub-class (i) Telosporidia

(1) The spores do not contain polar capsules or filaments.

(2) The life history ends with the formation of spores.

(3) The spore cases are simple and contain many spores.

Examples : *Monocystis, Gregarina, Isopora, Eimeria, Plasmodium, Babesia* etc.

- *Babesia* causes the 'Taxas cattle fever' in animals. This disease also called 'Red water fever' or Haemoglobin uric fever.
- *Monocystis* is found in seminal vesicle of earthworm, and causes sterlity in earthworm. It is monogenetic in nature.
- *Eimeria* is found in epithelial cells of liver of Rabbit.

Sub class (ii) Neosporidia

(1) The trophozoite is amoeboid multinucleated.

(2) Spore cases are complex usually having a single germ.

Examples : *Nosema, Myxidium, Globidium* etc.

Class 4. Ciliophora

(1) The body is covered by thin pellicle.

(2) They have a fixed permanent shape.

(3) The locomotory organs are cilia.

(4) Tentacles are present.

(5) Nuclei are usually of two kinds micronucleus and meganucleus.

The class ciliophora is divided into two sub-classes, namely Ciliata and Suctoria.

Sub-class (i) Ciliata

(1) Cilia are present throughout life.

(2) Tentacles are absent.

(3) Mouth and cytopharynx are usually present. Cytopyge is a temporary anal apperture.

(4) Contractile vacuoles are present.

(5) Trichocysts, organs of offense and defence are present in certain forms.

Examples : *Paramecium, Stylonchia Vorticella* etc.

- *Vorticella* is called 'Bell animalcule'. It is a pedicellate protozoan.
- *Nyctotherus* is a parasite in the rectum of frog. It is also found in the rectum of cockroach.

Sub-class (ii) Suctoria

(1) Cilia are present only in the young conditions and adults are devoid of them.

(2) Tentacles are present in the adult.

(3) One to many contractile vaculoes are present.

Examples : *Acineta, Ephelota, Dendrocometes, Dendrosoma* etc.

Some representative protozoan protists

Amoeba proteus

General characters

(1) *Amoeba* belongs to the class Sarcodina or Rhizopoda of the phylum protozoa. It is discovered by Russel Von Rosenhoff in 1755.

(2) The most common species is *Amoeba proteus*. Proteus is the name of the mythical sea god who could change shape.

(3) *Amoeba* is cultured in laboratory by Hay infusion method.

(4) Body is covered by plasmalemma. It is a trilaminar and selectively permeable membrane. Plasmalemma is excretory, ammonia diffuses out through it. It is also respiratory diffusion of oxygen and carbon dioxide takes place through it.

(5) The body bears a number of temporary and blunt pseudopodia. The type of pseudopodium found in *Amoeba proteus* is lobopodium. Pseudopodia are composed of both ectoplasm and endoplasm.

(6) Pseudopodium at its forward end gets its firm consistency by hyaline cap which is made of ectoplasm.

(7) Pseudopodia in *Amoeba* are meant for feeding and locomotion.

(8) Pseudopodia are found in *Amoeba* and leucocyte of higher animals.

(9) Cytoplasm is differentiated into outer ectoplasm and inner endoplasm. Endoplasm is divided into outer plasma gel and inner plasma sol.

(10) Locomotion of *Amoeba* is known as amoeboid movement. Sol gel theory of amoeboid movement was first given by Hyman supported by Pantin and Mast. According to this theory amoeboid locomotion is due to change in the viscosity of cytoplasm. This is the most accepted theory.

Table : 1.3-1 Theories of Amoeboid Movement

Surface tension theory	Berthold	(1886)
Rolling movement theory	Jennings	(1904)
Walking movement theory	Dellinger	(1906)
Sol-gel theory	Hyman	(1917)
Folding and unfolding theory	Goldacre and Lorch	(1950)
Contraction-hydraulic theory	Rinaldi and Jahn	(1963)

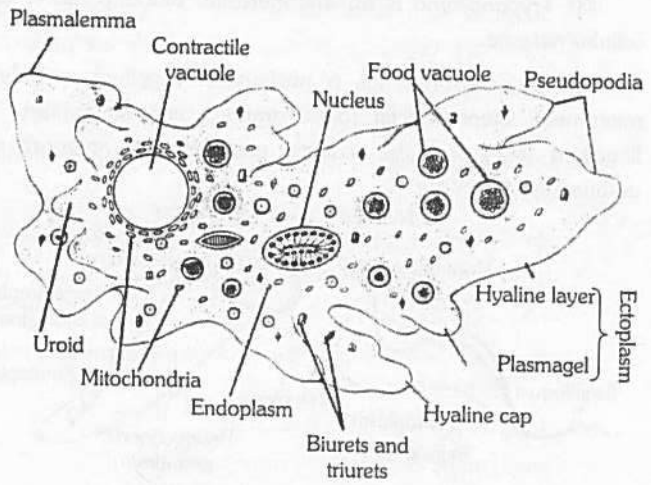


Fig : 1.3-5 Structure of *Amoeba proteus*

(11) Sol gel conditions are due to contraction and relaxation of long chains of proteins.

(12) *Amoeba* contains a nucleus, a contractile vacuole, a number of food vacuoles and other cell organelles.

(13) Vacuole is found only in fresh water forms. It is absent in marine and parasitic forms.

(14) If an *Amoeba* is placed in distilled water its contractile vacuole works faster while in salt water, its contractile vacuole will disappear.

(15) Contractile vacuole of *Amoeba* is analogous (similar in function) to uriniferous tubules of frog.

(16) Food of *Amoeba* consists of bacteria, diatoms, small protozoa and algae.

(17) The process of ingesting solid food is phagocytosis, *Amoeba* ingest food by import, circumfluence, circumvallation and invagination.

(18) Import involves passive sinking of food into body by rupture of plasmalemma, *e.g.*, Ingestion of algae.

(19) Circumfluence is the ingestion of less active or motionless organisms like bacteria.

(20) Circumvallation is the engulfment of active prey like ciliate or flagellate. In this way a food cup is formed containing the organism.

(21) Digestion in *Amoeba* is intracellular. *Amoeba* secretes digestive enzymes for hydrolysing starch, protein, fat etc.

(22) Food vacuole of *Amoeba* is analogous to the alimentary canal of an animal or gastro vascular cavity of *Hydra*. The contents of food vacuole in *Amoeba* first becomes acidic then alkaline.

(23) *Amoeba* responds to environmental conditions. Response to the stimuli is called taxis. Different taxis are thermotaxis (temperature) phototaxis (light), thigmotaxis (touch), chemotaxis (chemicals), galvanotaxis (electric current), geotaxis (gravity) and rheotaxis (water current).

(24) Normal method of asexual reproduction is binary fission. Binary fission is a process of mitosis. It takes place when food is abundant and temperature is suitable.

(25) Multiple fission or sporulation takes place during unfavorable conditions after encystment. There are three layers of cysts.

(26) *Amoeba* regenerates from nucleated bits.

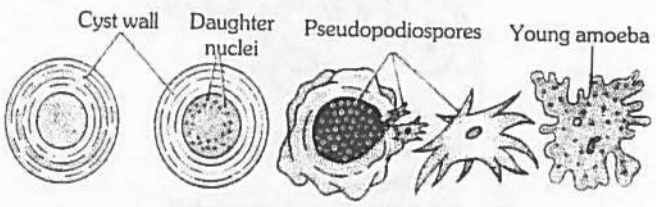


Fig : 1.3-6 Encystment and multiple fission in Amoeba

Pseudopodia : These are found in those forms which do not possess a definite pellicle. According to size, structure, and shape pseudopodia may be of different types as :

Lobopods : These are short, blunt and thick finger like out growth of ectoplasm with an axial core of endoplasm *e.g., Amoeba, Arcella* etc.

Filopods : They are cylindrical thread like, formed entirely of ectoplasm and radiate from the body in all directions *e.g., Euglypha, Radiolaria.*

Reticulopods : They are filamentous which form a network of pods *e.g., Polystomella, Chlamydophrys.*

Axopods : These are long stiff semi-transparent extensions of cytoplasm with pointed distal ends *e.g., Actinophrys.*

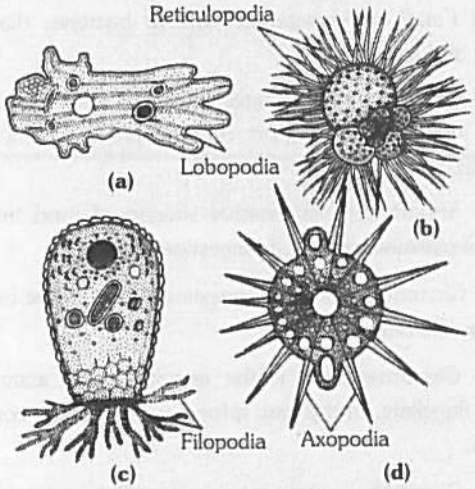


Fig : 1.3-7 Structure of Lobo, Filo, Reticulo and Axopods

Entamoeba histolytica

General characters

(1) *Entamoeba histolytica* is a monogenetic parasitic and pathogenic protozoan protists which resides in the upper part of large intestine in human beings. It causes amoebic dysentery or amoebiasis.

(2) Lamble (1859) discovered *E. histolytica.* Friedrick Losch, a Russian Zoologist, discovered its pathogenic nature in 1875.

(3) It has two forms, adult trophozoite or magna, pathogenic form found in the mucosa and sub-mucosa of intestine forming ulcers and minuta, nonpathogenic form found in the lumen of intestine.

(4) *Entamoeba* has no contractile vacuole.

(5) Trophozoite of *Entamoeba* reproduces by binary fission. Minuta form encysts. A mature cyst is called quadrinucleate cyst. It has four nuclei and two chromatoid bodies.

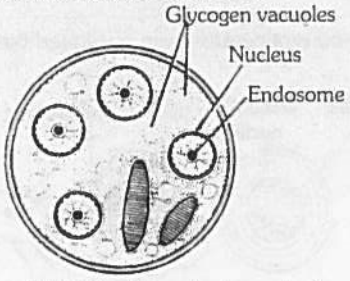


Fig : 1.3-8 Quadrinucleate cyst of *Entamoeba histolytica*

(6) Quadrinucleate cyst is the infective stage. Infection is oral through contaminated food and water.

(7) The reserve food material in cyst of *E. histolytica* is glycogen. A single cyst of *E. histolytica* produces eight amoebulae.

(8) It damages instestinal mucosa by secreting an enzyme-histolysin.

(9) It completes its entire life-cycle in one host only; Man.

Entamoeba gingivalis

Entamoeba gingivalis is a parasite of human teeth, found in the abscesses of gum and in pus pockets of pyorrhoea, bleeding gums. It increase pyorrhoea disease but does not cause it. Pyorrhoea is caused by *Trichomonastinax.* Adult is called trophozoite and has 2-3 pseudopodia. It feeds on WBCs, bacteria and pus cells. Cyst is not formed in *E. Gingivalis* and infection occurs by direct contact like kissing.

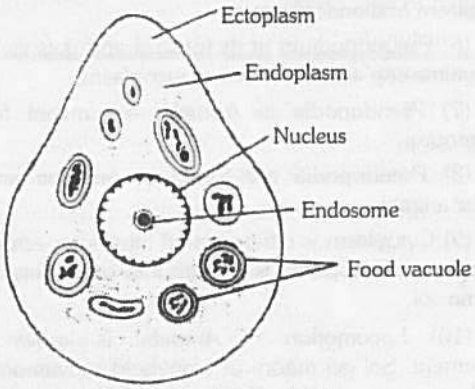


Fig : 1.3-9 *Entamoeba gingivalis*

Trypanosoma gambiense

General characters

(1) *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.

(2) *Trypanosoma* is usually found in the blood of vertebrates, finally invading cerebrospinal fluid.

(3) *Trypanosoma* is an endoparasite, blood parasite, extra cellular parasite.

(4) *Trypanosoma* has a nucleus, a flagellum, undulating membrane, blepharoplast (basal granule) and kinetoplast. The flagellum arises from the posterior end and runs anteriorly with undulating membrane.

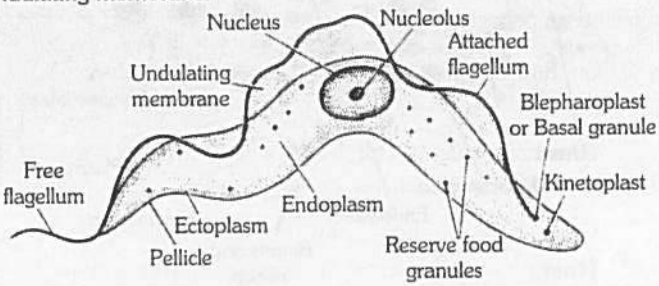


Fig : 1.3-10 *Trypanosoma gambiense*

(5) *Trypanosoma* reproduces asexually by longitudinal binary fission. It does not form cysts.

(6) *Trypanosoma* is polymorphic and has four forms: *Leishmania, Leptomonad, Crithidial* and *Trypanosomal* (= Metacyclic) stages.

(7) *Trypanosoma* is digenetic, it completes its life cycle in two hosts. The primary or principal or definite host is man and the intermediate or secondary host or vector is the insect, tse-tse fly or bug.

(8) Three important species of *Trypanosoma* for which man is host are : *Trypanosoma gambiense, T. rhodesiensi* and *T. cruzi.*

(9) The chief vector host of *T. gambiense* transmitting the disease from one man to another is the tse-tse fly, *Glossina palpalis*. Occasionally, *Glossina tachinoides* also act as a vector.

(10) *T. rhodesiensi* causes Rhodesian trypanosomiasis, it is confined to east central parts of Africa, particularly Rhodesia. The insect vectors for *T. rhodesiense* are tse-tse flies mainly *Glossina morsitans* and *G. pallidipes.*

(11) *T. cruzi* is the causative agent of South American trypanosomiasis or Chaga's disease *T. cruzi* is transmitted by bugs like *Triatoma* and *Panstrongylus*. Symptoms of Chaga's disease are fever, diarrhoea, anaemia and enlargement of lymphoid glands etc.

Plasmodium vivax

They are spore forming parasitic protists which lack locomotory structure and contractile vacuoles. The body is covered by pellicle or cuticle.

Systematic position

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

History : The term malaria was coined by Mucculoch in 1827.

Lancisi first suspected a relationship between malaria and mosquito.

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*.

Grassi and Feletti (1898) was the first to describe the life cycle of *Plasmodium* in *Anopheles*.

Golgi (1885) Studied erythrocytic cycle of plasmodium.

Host : It is digenetic *i.e.*, life cycle is completed in two hosts –

(1) Man (medically primary but biologically secondary host)

(2) Female *Anopheles* (medically secondary but biologically primary host).

Life cycle : During life cycle two important phases are present.

(1) Endogenous or Asexual phase : passes in man.

(2) Exogenous or Sexual phase : passes in female *Anopheles* mosquito.

In Man (Schizogony)

Infective stage : It is spindle shaped sporozoite introduced by female *Anopheles* along with saliva (for anticoagulant anophilin) during blood sucking. Sporozoite enters liver cells. In liver they produce several stages.

Pre-erythrocytic stage : Each sporozoite enters inside the liver cell and becomes spherical and termed as cryptozoite. It undergoes a pre-erythrocytic cycle completed in 10 days and multiplies asexually by schizogony. After rupturing schizont numerous cryptomerozoites are liberated.

Exo-erythrocytic stage : Cryptomerozoites enter in new liver cells and reproduce asexually to give rise to a large number of meta-cryptomerozoites, few are smaller in size and called micro-metacryptomerozoites.

Erythrocytic stage : Micro metacryptomerozoites enter into the blood stream and each enters the RBCs and assumes rounded disc like shape with single nucleus. It develops a vacuole which gives a ring like appearance. This stage is known as signet ring stage. During further development the vacuole is lost and parasite feeds on the cytoplasm of R.B.C. This stage is known as amoeboid stage or trophozoite stage. The matured trophozoite develops to become a schizont. It multiplies asexually by erythrocytic schizogony.

Formation of gametes : Some merozoites do not enter schizogony but instead form gametocytes in RBCs. Gametocytes are of two types :

(1) **Macro-gametocytes :** These are female cells which are large in size, laden with food material and having nucleus at one end.

(2) **Micro-gametocytes :** These are male cells, small in structure and nucleus placed centrally.

In Mosquito (Sporogony)

When female *Anopheles* bites a patient of malaria, the parasites enter the alimentary canal of the insect. In the stomach of mosquito the asexual forms are digested and only gametocytes survive. Gametocytes are released in blood plasma in large numbers during mid night. They die by morning. Megagametocyte produces only one megagamete. Microgametocyte produces 4-8 motile microgametes by exflagelation.

Fertilization : Both mega and microgamete fuse, form zygote which narrows to becomes ookinete. Ookinete pierces the stomach wall and forms a cyst on its outer surface.

Sporogony : Oocyst undergoes a process of sporogony. The irregular cells thus formed are known as sporoblasts. The nucleus of sporoblast divides several times to give rise to daughter nuclei which migrate in the projections of sporoblast.

These minute projections change into the form of sporozoites. After maturity oocyst burst out and numerous sporozoites are liberated into the body cavity of mosquito. The sporozoites move towards salivary glands and bore into them. In this way they are ready for transmission.

Control of malaria

(1) Prevention from infection is called prophylaxis.

(2) Quinine is obtained from bark of *Cinchona* (discovered in Peru) which is most commonly used against malaria.

(3) Peludrine, atabrine, camoquinine, Chloroquinine are few other drugs effective against malaria.

(4) G.B.P. is General Blood Picture *i.e.*, blood film made for the test of malaria.

(5) Spraying of oil upon stagnant water controls malaria because larva cannot breath and die.

(6) Gambusia (Mosquito fish) feeds on larvae and pupa of mosquito. This fish is used in biological control of mosquito.

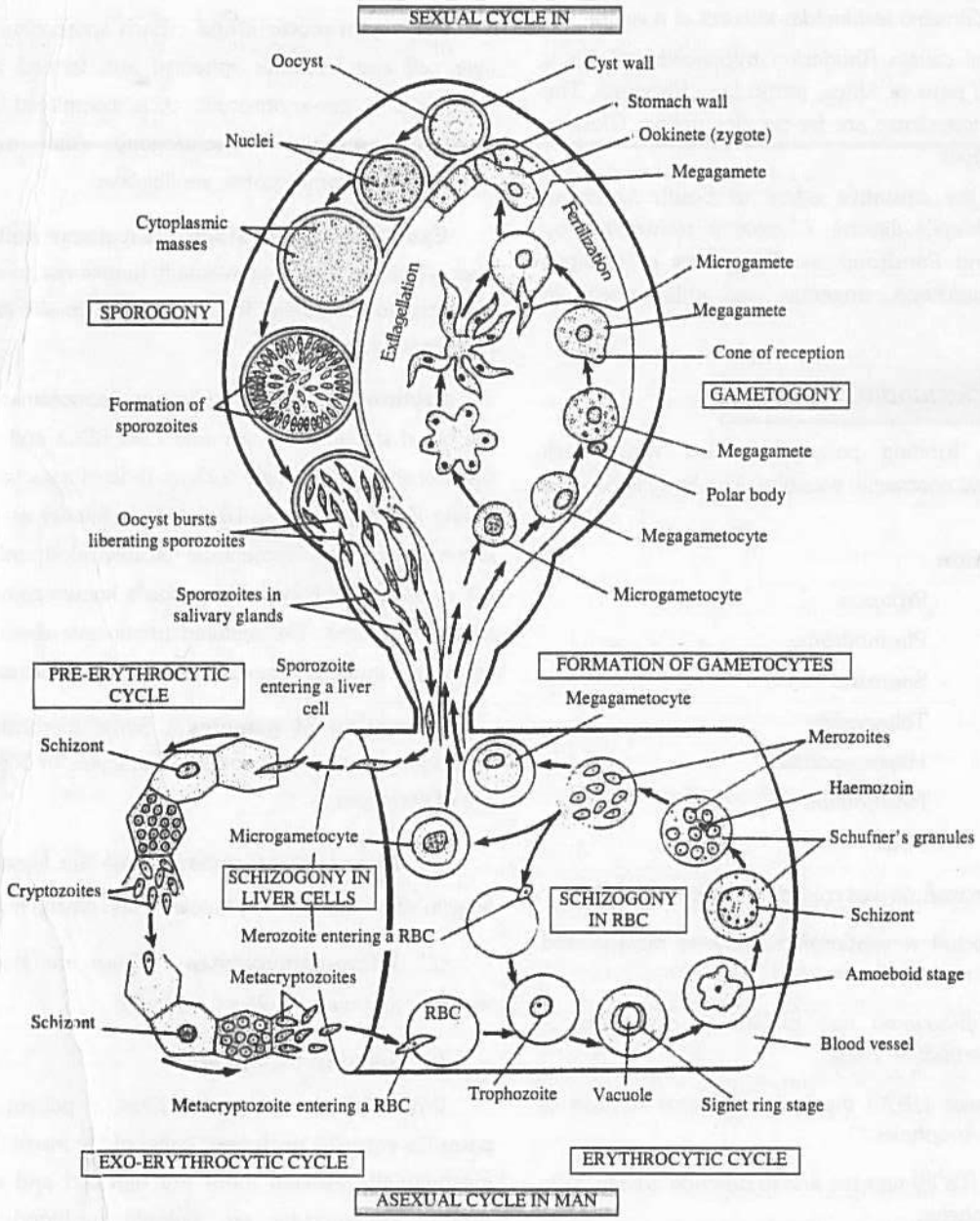


Fig : 1.3-11 Life cycle of *Plasmodium vivax*

Table : 1.3-2

Name	*P. vivax*	*P. malariae*	*P.ovale*	*P. falciparum*
1. Site	Liver and RBC of man	Liver and RBC of man	Liver and RBC of man	Liver and RBC of man
2. Distribution	Tropical countries subtropical	Tropical countries subtropical	West Africa and South America	Tropical countries
3. Duration of exoerythrocytic cycle or prepatent period	8 days	14-15 days	9 days	5 days
4. Duration of erythrocytic cycle	48 hours	72 hours	48 hours	48 hours
5. Incubation period	12-14 days	20-24 days	14 days	12 days
6. Duration of sexual cycle	10 days	26-28 days	16 days	10-12 days
7. Disease (Type of malaria fever)	Benign and tertian malaria / relapse malaria	Quartan malaria clinical malaria	Ovale and tertian recuris every third day	Malignant tertian malaria Pernicious malaria Estivoautmnal malaria
8. Pigment and color	Schuffner's granules Yellow / brown	Zeiman's dot Dark brown	Schuffner's dots Dark brown	Maurer's dots Dark green

Paramecium

(1) *Paramecium* is a holotrichous ciliate protozoan. It is discovered by Hill in 1752.

(2) *Paramecium* is free-living and aquatic form. In laboratory, *Paramecium* is cultured by 'Hay-infusion method'.

(3) *Paramecium* is commonly called as 'Slipper animalcule'. Body is distinguished into an oral or ventral surface and an aboral or dorsal surface.

(4) 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.

(5) Trichocysts are peculiar bottle-shaped organelles present in the ectoplasm of *Paramecium*. Trichocysts are the organelles of offence and defence.

(6) *Paramecium* is heterokaryotic (dimorphic nuclei) *i.e.*, macronucleus and micronucleus. Macronucleus is one, large, kidney shaped, controls vegetative functions (metabolism). Micronuclei, one (*P. caudatum*), two (*P aurelia*) and several (*P. multimicronucleatum*) are only concerned with reproduction.

(7) Oral apparatus consists of cytopharynx and cytostome (mouth), cytopyge or cytoproct (anus). Nutrition or food intake in paramecium is holozoic. Paramecium is a filter feeder and feeds on small protozoa, unicellular plants (algae), diatoms, yeast etc. and small bits of animals and vegetables. Most favourite food is Tetrahymena, another ciliate protozoa.

(8) 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.

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

(10) *Paramecium* undergoes several kinds of nuclear reorganisation such as conjugation, autogamy, cytogamy, endomixis and hemimixis. Nuclear reorganisation takes place for rejuvenation.

(11) Conjugation occurs between two mating types of same species of *Paramecium*. It is a modified form of cross fertilization. Each conjugant produces a female stationary and a male migratory nucleus by three successive divisions of micronucleus. They are called pronuclei.

(12) Synkaryon is the diploid nucleus formed by the fusion of stationary and migratory nuclei in conjugant. Synkaryon divides thrice to form eight nuclei. At the end of the conjugation each *Paramecium* (exconjugant) produces four daughter Paramecia.

(13) Autogamy is a process of self fertilization. It occurs in a single animal of *P. aurelia*. Autogamy results in the production of two daughter paramecia from each.

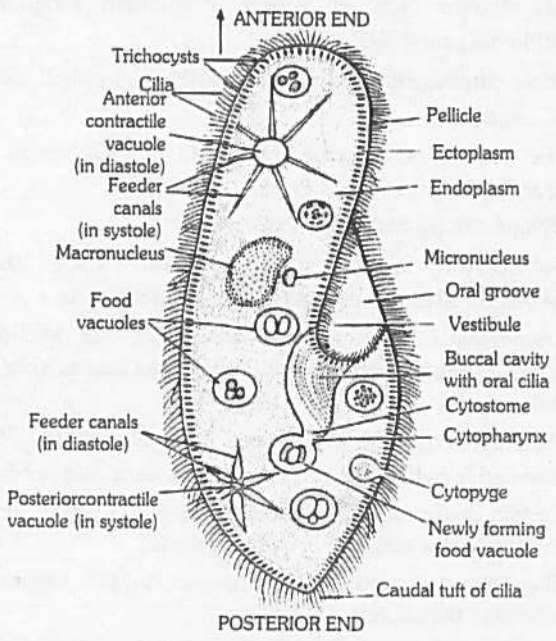


Fig : 1.3-12 *Paramecium caudatum*

(14) Cytogamy occurs in *P.caudatum*. The two cytogamonts do not exchange their male pronuclei. Endomixis occurs in *P.aurelia*. It is an asexual reproduction and one individual produces four daughter paramecia. Hemimixis is the process of purification act on the part of meganucleus.

(15) Paramecium has kappa, Lambda, *Mu* and *Pi* particles in cytoplasm. They differentiate paramecia between sensitive and killer forms.

Tips & Tricks

- Dinoflagellates with bioluminescence/phosphorescence due to light producing protein luciferin are called **fire algae**. *e.g.*, *Noctiluca*, *Pyrocystis*, *Pyrodinium* etc. *Noctiluca* is also called 'night light'.
- Dinoflagellates symbionts in other protists and invertebrates are called zooxanthellae.
- Some dinoflagellates produce red tides of oceans. *e.g.*, *Gonyaulax*, *Gymnodinium* etc.
- Photosynthetic protists fix about 80% of CO_2 in the biosphere.
- The siliceous frustules of diatoms do not decay easily. They pile up at the bottom of water reservoirs and form big heaps called diatomite or diatomaceous earth. Diatomite is porous and chemically inert.
- 29th August is celebrated as the 'mosquito day' because Sir Ronald Ross established mosquito malaria relationship on August 29, 1897. He got Nobel prize in 1902.
- 20th August is malaria day. Ministry of health, government of India started National Malaria Eradication Programme (NMEP) in the year 1953.
- Some protozoans have a loose exoskeleton called "Lorica hourse" on them.
- The fastest reproducing protozoan is 'Glaucoma'. It produces 6-generation within 24 hrs.
- Oblique binary fission in *Ceratium*.
- Polystomella is dimorphic rhizopod which shows metagenesis or alternation of generation in its life cycle.
- *Leishmania* is an intracellular parasite of man and other mammals. It causes Leishmaniasis. *L.donovani* causes Kala-azar in man.
- Proterospongia is a fresh water colonial and free living flagellate and is connecting link between protozoa and porifera.
- Certain protozoan like *Colonympha* and *Trichonymphya* help in digestion of cellulose in certain insects.
- Flagellates are more simplest protozoan while ciliates are most complex protozoans.
- *E. coli* found as an endocommensal in the colon of about 50% population. It is non-pathogenic.

Ordinary Thinking

Objective Questions

Photosynthetic and consumer protists

1. Nutrition in protists is **[AFMC 2008]**
(a) Holophytic (b) Holozoic
(c) Saprozoic (d) All of these

2. Which of the following is a slime mould **[CBSE PMT 2007]**
(a) *Rhizopus* (b) *Physarum*
(c) *Thiobacillus* (d) *Anabaena*

3. The thalloid body of a slime mould (Myxomycetes) is known as **[CBSE PMT 2006]**
(a) Fruiting body (b) Mycelium
(c) Protonema (d) Plasmodium

4. Which of the following are the characters of dinoflagellates
A. Planktonic golden yellow algae with soap box like structure
B. Marine red biflagellated protista
C. Appear yellow, green, brown, blue and red in colour
D. Biflagellated organisms with pellicle
E. Saprophytic (or) parasitic unicellular forms **[Kerala PMT 2012]**
(a) A, B and C only (b) B, D and E only
(c) B and C only (d) B and E only
(e) C, D and E only

5. Planktons are organisms which
(a) Float on water surface (b) Are free swimmers
(c) Are deep sea forms (d) Are burrowing forms

6. If phytoplanktons are destroyed in the sea, then
(a) No effect will be seen
(b) Primary consumers will grow luxuriently
(c) It will affect the food chain
(d) Algae will get more space to grow

7. Which one of the following is a saprophytic protist **[NCERT; Kerala PMT 2012]**
(a) Desmid (b) Slime mould
(c) *Euglena* (d) *Gonyaulax*
(e) *Nostoc*

8. Slime moulds in the division Myxomycota (true slime moulds) have **[AFMC 2006]**
(a) Pseudoplasmodia
(b) Spores that develop into free living amoeboid cells
(c) Spores that develop into flagellated gametes
(d) Feeding stages consisting of solitary individual cells

9. Auxospores and hormocysts are formed respectively by **[CBSE PMT 2005; AIIMS 2007]**
(a) Some cyanobacteria and many diatoms
(b) Several cyanobacteria and several diatoms
(c) Some diatoms and several cyanobacteria
(d) Several diatoms and a few cyanobacteria

10. Flagellum of *Astasia/Euglena* is **[APMEE 2002]**
(a) Pantonematic (b) Acronematic
(c) Pantachronematic (d) Stichonematic

11. The slime moulds are characterized by the presence of **[MH CET 2003; BHU 2004]**
(a) Elaters (b) Pseudoelaters
(c) Capillitium (d) Capitulum

12. Diatoms are **[BHU 2000]**
(a) Fungi (b) Plantae
(c) Protista (d) Protozoans

13. Red oceanic tides can be due to
(a) Diatoms (b) Dinophyceae
(c) Red algae (d) Blue-green algae

14. Murein is not found in the cell wall of **[KCET 2004]**
(a) *Nostoc* (b) Eubacteria
(c) Cyanobacteria (d) Diatoms

15. Slime moulds belong to
(a) Fungi (b) Protista
(c) Monera (d) Plantae

16. Spore producing body of a cellular slime mould is
(a) Pseudoplasmodium (b) Plasmodium
(c) Sporangium (d) Sporophore

17. Tranverse groove present in dinoflagellates is
(a) Sulcus (b) Cingulum
(c) Annulus (d) Both (b) and (c)

18. Protistan genome has **[CBSE PMT 1994]**
(a) Membrane bound nucleoproteins embedded in cytoplasm
(b) Free nucleic acid aggregates
(c) Gene containing nucleoproteins condensed together in loose mass
(d) Nucleoprotein in direct contact with cell substance

19. Which protist reproduces both by binary fission and conjugation
(a) *Amoeba* (b) *Paramecium*
(c) *Euglena* (d) *Monocystis*

20. Protists obtain food as **[CBSE PMT 1994]**
(a) Photosynthesisers, symbionts and holotrophs
(b) Photosynthesisers
(c) Chemosynthesisers
(d) Holotrophs

21. Which one is not a protozoan protist **[Manipal 1995]**
(a) *Plasmodium vivax*
(b) *Paramecium caudatum*
(c) *Enterobius vermicularis*
(d) *Trypanosoma gambiense*

22. Which of the following animal is having longitudinal binary fission **[Kerala PMT 2007]**
(a) *Euglena* (b) *Plasmodium*
(c) *Planaria* (d) *Paramecium*
(e) *Hydra*

23. *Euglena* is a **[CPMT 1998]**
(a) Ciliate (b) Sporozoan
(c) Flagellate (d) Sarcodine

24. Protozoans are able to live efficiently due to their **[AMU (Med.) 1999]**
(a) Motility
(b) Rapid reproduction
(c) Ability to manufacture food
(d) Specialised organelles

25. Characteristic spores of diatoms are **[KCET 1999; Kerala PMT 1999]**
(a) Ascospores (b) Basidiospores
(c) Auxospores (d) Zoospores

26. Unlike other algae, diatoms do not readily decay due to **[NCERT; BHU 1999]**
(a) Siliceous wall
(b) Mucilaginous wall
(c) Water proof cell wall
(d) Nonliving cells

27. Which one of the following can photosynthesise its food **[JIPMER 1997; KCET 1999; CPMT 2003; VITEEE 2008]**
(a) *Hydra* (b) *Paramecium*
(c) *Monocystis* (d) *Euglena*

28. Sexual reproduction in protists with diploid chromosomes involves **[RPMT 1999; Chd. CET 2000]**
(a) Cyst formation (b) Zygotic meiosis
(c) Gametangial meiosis (d) Binary fission

29. Diatom frustule/shell is made of **[NCERT; BHU 1998; Manipal 2001]**
(a) Silica (b) Lime
(c) Magnesium carbonate (d) Calcium

30. Which one of the following is a unicellular, nonmotile desmid **[KCET 2010]**
(a) *Chlorobium* (b) *Clostridium*
(c) *Chromatium* (d) *Cosmarium*

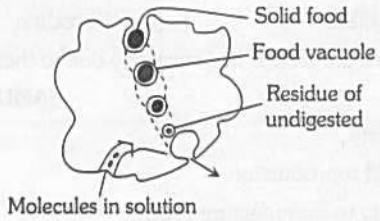
31. Protista contains **[Odisha JEE 2002]**
(a) *Euglena*, Dinoflagellates and Yeast
(b) *Amoeba, Paramaecium, Hydra*
(c) *Euglena, Paramaecium*, Mushroom
(d) *Amoeba, Paramaecium* and Dinoflagellates

32. *Ceratium* is **[APMEE 2002]**
(a) Dinoflagellate (b) Diatom
(c) Slime mould (d) Sporozoan

Protozoan protists

1. The class of phylum protozoa to which '*Noctiluca*' belongs, is
(a) Rhizopoda (b) Sporozoa
(c) Mastigophora (d) Ciliata

2. In the diagram, which of the following processes are shown in *Amoeba*



[KCET 2007]

(a) Exocytosis (b) Phagocytosis
(c) Pinocytosis (d) All of these

3. Slimy mass of protoplasm with many nuclei and an *Amoeba* like thalloid body is a characteristic feature of **[NCERT; Kerala PMT 2009]**

(a) Ascomycetes (b) Actinomycetes
(c) Phycomycetes (d) Basidiomycetes
(e) Myxomycetes

4. The class of *Trichonympha* is **[MP PMT 2000]**

(a) Calcaria (b) Scyphozoa
(c) Sporozoa (d) Mastigophora

5. The infection of *Entamoeba histolytica* takes place by **[CPMT 2009]**

(a) Trophozoite (b) Binucleated cyst
(c) Trinucleated cyst (d) Quadrinucleated cyst

6. *Paramecium* is a **[Odisha JEE 2008]**

(a) Protozoan (b) Bacterium
(c) Virus (d) Annelid

7. Which is not the locomotory organ of protozoa **[AFMC 2003, 05; MP PMT 2003]**

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

8. *Monocystis* belongs to the order **[MP PMT 2002]**

(a) Gregarinida (b) Coccidia
(c) Microsporidia (d) Sarcosporidia

9. Which protozoan is unlikely to have a contractile vacuole **[BHU 2001; CBSE PMT 2001]**

(a) *Euglena* (b) *Paramecium*
(c) *Amoeba* (d) *Plasmodium*

10. *Entamoeba histolytica* is a human parasite usually found in **[KCET 1999]**

(a) Liver (b) Lung
(c) Mouth (d) Intestine

11. The protozoan parasite which possesses a food vacuole is **[EAMCET 1998]**

(a) *Leptomonas* (b) *Plasmodium*
(c) *Trypanosoma* (d) *Leishmania*

12. Which one of the following pairs is correctly matched **[RPMT 2005]**

(a) Aedes – plague (b) Anopheles – malaria
(c) House fly – yellow fever (d) Body louse – typhoid

13. Total parasites belong to protozoan group **[CPMT 2001, 09; BHU 2002]**

(a) Sporozoa (b) Ciliata
(c) Sarcodina (d) Zooflagellata

14. Which of the following classes of protozoa is exclusively endoparasite **[CPMT 1998]**

(a) Mastigophora (b) Sarcodina
(c) Opalinata (d) Sporozoa

15. Match the following and choose the correct combination from the options given

Column I (Group Protista)		Column II (Example)	
A.	Chrysophytes	i.	Paramecium
B.	Dinoflagellates	ii.	Euglena
C.	Euglenoids	iii.	Gonyaulax
D.	Protozoans	iv.	Diatoms

[NCERT; Kerala PMT 2008; AMU (Med.) 2012]

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

16. Which is not true for *Paramecium* **[Odisha JEE 2009]**

(a) Under unfavourable conditions, form cysts
(b) Presence of large number of cilia on whole body surface
(c) Contain contractile vacuoles for osmoregulation
(d) Use pseudopodia for capturing prey

17. Which of the following combination of characters is true of slime moulds **[DUMET 2009]**

(a) Parasitic, *Plasmodium* with true walls, spores dispersed by air currents
(b) Saprophytic, *Plasmodium* without walls, spores dispersed by water
(c) Parasitic, *Plasmodium* without walls, spores dispersed by water
(d) Saprophytic, *Plasmodium* without walls, spores dispersed by air currents

18. Slipper animalcule is **[Manipal 2005]**

(a) *Paramecium* (b) *Trypanosoma*
(c) *Entamoeba* (d) Protozoa

19. In life cycle of *Plasmodium*, exflagellation is seen in **[CPMT 2005]**

(a) Microgametocytes (b) Trophozoites
(c) Macrogametocytes (d) Merozoites

20. Man in the life cycle of *Plasmodium* is **[AFMC 2005]**

(a) Primary host (b) Secondary host
(c) Intermediate host (d) None of these

21. Which of the following unicellular organism has a macronucleus for trophic function and one or more micronuclei for reproduction **[AMU (Med.) 2005; CBSE PMT 2005]**

(a) *Euglena* (b) *Amoeba*
(c) *Paramecium* (d) *Trypanosoma*

22. Pseudopodia is a characteristic feature of which class

(a) Mastigophora (b) Sarcodina
(c) Sporozoa (d) Ciliata

23. Animals of class ciliata

(a) Have two nuclei (b) Are autotrophs
(c) Reproduce sexually (d) Possess cilia

24. Excretion in *Amoeba* occurs through **[CPMT 1999]**
(a) Nucleus (b) Parapodia
(c) Plasmalemma (d) Contractile vacuole

25. The reason of pseudopodium formation is **[RPMT 1999]**
(a) Chemical changes
(b) Difference in the viscosity
(c) Difference in the pressure
(d) Change in the temperature

26. Who discovered malaria parasite **[CPMT 1996; RPMT 1999]**
(a) Sir Ronald Ross (b) Charles Laveran
(c) Patrick Manson (d) Grassi

27. Sporogony of malarial parasite occurs in **[APMEE 1996; BHU 1996, 2002; AIIMS 1999; DPMT 2004]**
(a) Liver of man
(b) RBCs of man
(c) Stomach wall of mosquito
(d) Salivary glands of mosquito

28. Which of the following is not true for nutrition in *Amoeba* **[Odisha JEE 2005]**
(a) Photoheterotrophic (b) Phagocytosis
(c) Intracellular (d) Holozoic

29. Which is filter feeder **[MP PMT 1995]**
(a) *Amoeba* (b) *Leech*
(c) *Spider* (d) *Paramecium*

30. Sexual mode of reproduction in protozoa is **[Odisha JEE 2005]**
(a) Anisogamy (b) Plasmotomy
(c) Autogamy (d) Schizogony

31. Paramoecium exhibits cytoplasmic inheritance through **[BHU 2012]**
(a) Chromosome (b) Nuclear gene
(c) Kappa particles (d) DNA

32. Class sporozoa of phylum protozoa is characterised by **[CMC Vellore 1993]**
(a) Flagella (b) Cilia
(c) Parasitism (d) None of these

33. Primary grouping of protozoan protists is based on **[MP PMT 1996, 99, 2002, 10; CPMT 1998; AIIMS 1999; Pb. PMT 2002; DPMT 2002; AFMC 2009]**
(a) Locomotor organelles (b) Size and shape
(c) Mode of feeding (d) Mode of reproduction

34. *Amoeba* was described in detail by **[RPMT 1999]**
(a) Ronald Ross (b) Aristotle
(c) Hirshfield (d) Rossenhoff

35. Conjugation in protozoa is found in **[RPMT 2001]**
(a) Sarcodina (b) Flagellata
(c) Sporozoa (d) Ciliata

36. Which one of the following represents class Mastigophora **[MP PMT 2001]**
(a) *Monocystis* (b) *Paramecium*
(c) *Trypanosoma* (d) *Amoeba*

37. Maurer's dots occurs in human RBCs infected by **[MP PMT 2002]**
(a) *Plasmodium falciparum* (b) *Plasmodium ovale*
(c) *Plasmodium vivax* (d) *Plasmodium malariae*

38. Which one show bioluminiscence **[BHU 2003]**
(a) *Noctiluca* (b) *Polystomella*
(c) *Entamoeba* (d) *Suctoria*

39. Protists are
1. Unicellular and prokaryote
2. Unicellular and eukaryote
3. Multicellular and eukaryote
4. Autotroph and heterotroph

[BHU 2003]
(a) 1 + 2 + 3 (b) 2 + 3 + 4
(c) 3 + 4 (d) 2 + 4

40. Locomotory organ of sporozoa is **[Bihar MDAT 1995]**
(a) Tentacles (b) Reticulocytes
(c) Legs (d) None of the above

41. *Paramecium* ingests food through **[CMC 2002]**
(a) Cytoproct (b) Cytopyge
(c) Cytopharynx (d) Cytostome

42. When a fresh-water protozoan possessing a contractile vacuole, is placed in a glass containing marine water, the vacuole will **[CPMT 1993; DPMT 2001; CBSE PMT 2004; KCET 2010, 11]**
(a) Increase in size (b) Decrease in size
(c) Increase in number (d) Disappear

43. Which is false for nutrition in *Amoeba* **[Odisha JEE 2004]**
(a) Omnivorous (b) Pseudopodia feeder
(c) Holozoic nutrition (d) Photoautotroph

44. Which is not related with the sexual reproduction in protozoans **[Odisha JEE 2004]**
(a) Cytogamy (b) Autogamy
(c) Conjugation (d) Schizogony

45. All protozoans have **[Odisha JEE 2004]**
(a) Pseuopodia (b) Eukaryotic organisation
(c) Contractile vacuole (d) Holozoic nutrition

46. ..... is not true for *Euglena* **[Odisha JEE 2004]**
(a) Presence of chl. – 'a' and 'b'
(b) Presence of protoplasmic capsule
(c) Presence of cellulose cell wall
(d) Presence of proteinaceous pellicle

47. A metazoa without tissue organisation is called **[Pb. PMT 2004]**
(a) Parazoa (b) Protozoa
(c) Eumetazoa (d) Dermatozoa

48. Passive food ingestion in *Amoeba* is known as **[DPMT 2004; BHU 2004]**
(a) Import (b) Invagination
(c) Circumfluence (d) Circumvallation

49. Reproduction in *Paramecium* is controlled by **[BVP 2001]**
(a) Flagella (b) Micronucleus
(c) Macronucleus (d) Cell wall

50. *Trichonympha* is a symbiont in alimentary canal of **[APMEE 2002]**
(a) Earthworm (b) Snails
(c) Hermit Crab (d) Termite

51. In which of the following binary fission is not seen **[Odisha JEE 2005]**
(a) Plasmodium (b) Amoeba
(c) Euglena (d) Paramecium

52. Amoeba is a member of Phylum **[MP PMT 2012]**
(a) Porifera (b) Protozoa
(c) Annelida (d) Mollusca

53. Which of the following is a flagellated protozoan **[Kerala PMT 2010, 12]**
(a) *Amoeba* (b) *Entamoeba*
(c) *Plasmodium* (d) *Trypanosoma*
(e) *Paramecium*

54. Mammalian kidney resemble contractile vacuole of *Amoeba* in excretion of **[MP PMT 2006]**
(a) Glucose (b) Excess water
(c) Urea (d) Ammonia

55. In *Paramecium*, both autogamy and conjugation are sexual processes because of
(a) Gene recombination
(b) Involvement of two individuals
(c) Fusion of two haploid nuclei
(d) Rejuvenation

56. All stages of *Plasmodium* are digested in stomach of female *Anopheles* except **[CPMT 2002; RPMT 2005]**
(a) Sporozoites (b) Gametocytes
(c) Erythrocytes (d) Merozoites

57. Which one of the following genus of insects prefer to breed in clean water and their larvae lie parallel to the surface of water **[WB JEE 2012]**
(a) Anopheles (b) Culex
(c) Aedes (d) Phlebotomus

58. The stage of *Entamoeba histolytica* that causes intestinal ulceration is **[RPMT 2000]**
(a) Trophozoite (b) Metacystic trophozoite
(c) Binucleate stage (d) Tetranucleate stage

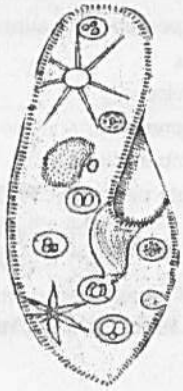
59. If a pond dries, *Amoeba*
(a) Reproduces (b) Encysts
(c) Degenerates (d) Behaviour is uncertain

60. Which of the following is not correct with respect to malaria **[KCET 2015]**
(a) RBC's rupture and release haemozoin which causes chills
(b) Sporozoites multiply in blood
(c) Female anopheles mosquito is the vector
(d) Malignant malaria is caused by *Plasmodium falciparum*

61. The active form of *Entamoeba-histolytica* feeds upon **[AIPMT (Cancelled) 2015]**
(a) Mucosa and submucosa of colon only
(b) Food in intestine
(c) Blood only
(d) Erythrocytes; mucosa and submucosa of colon

62. Microphagial nutrition occurs in **[Kerala PMT 2006]**
(a) Amphioxus (b) Insects
(c) Paramecium (d) Hydra
(e) Euglena

63. Which structure is formed at the time of exchange of gamete nuclei in given animal during sexual reproduction **[GUJCET 2015]**



(a) Plasmodesmata (b) Cytoplasmic filaments
(c) Internal tubule (d) Cytoplasmic bridge

64. *Entamoeba* differs from *Amoeba* is not having **[RPMT 1995; AMU (Med.) 2002; MP PMT 2004; BHU 2005]**
(a) Nucleus (b) Pseudopodia
(c) Ectoplasm (d) Contractile vacuole

65. The cilia in *Paramecium* are
(a) All equal (b) All unequal
(c) Longer at posterior end (d) Longer at anterior end

66. Sprinkling oil over ponds would control malaria because **[AFMC 2001]**
(a) Fishes die (b) Water gets polluted
(c) Larvae are asphyxiated (d) Mosquitoes are repelled

67. Which of the following is not a character of protista **[Kerala PMT 2010]**
(a) Protists are prokaryotic
(b) Some protists have cell walls
(c) Mode of nutrition is both autotrophic and heterotrophic
(d) Body organization is cellular
(e) Membrane bound organelles are present in cells

68. Transverse binary fission occurs in **[DPMT 2007]**
(a) *Euglena* (b) *Amoeba*
(c) *Hydra* (d) *Paramecium*

69. Living *Amoeba* is
(a) Pale blue (b) Transparent
(c) Light green (d) Transluscent

70. Discovery of *Amoeba* was made by
(a) Jenner (b) Rossenhoff
(c) Hofkins (d) Twait

71. Chrysophytes, Euglenoids, Dinoflagellates and Slime moulds are included in the kingdom **[NEET (Phase-I) 2016]**
(a) Monera (b) Protista
(c) Fungi (d) Animalia

72. *Paramecium* moves about by
(a) Pseudopodia (b) Cilia
(c) Flagella (d) Looping and crawling

73. In which group of organisms the cell walls form two thin overlapping shells which fit together **[AIPMT 2015]**
(a) Euglenoids (b) Dinoflagellates
(c) Slime moulds (d) Chrysopytes

74. Locomotory structures of *Amoeba* are **[BHU 2001]**
(a) Cilia (b) Flagella
(c) Pseudopodia (d) None of the above

75. Mode of nutrition in *Trypanosoma* is **[DPMT 2006]**
(a) Saprozoic (b) Parasitic
(c) Autotropic (d) Phototropic

76. Quartan malaria is due to
[NCERT; RPMT 1995; Bihar CECE 1995; Odisha JEE 1995, 2005; BHU 1996; MP PMT 2001]
Or
Your patient shows paroxysms of malaria after every 72 hours. Which species of plasmodium will be considered responsible to cause the infection **[NCERT]**
(a) *Plasmodium falciparum* (b) *P. vivax*
(c) *P. ovale* (d) *P. malariae*

77. Malignant tertian malaria is due to **[NCERT]**
Or
Cerebral malaria is due to
[CBSE PMT 1991; APMEE 1995, 2002; Bihar MDAT 1996, 2002; RPMT 2000, 06; AIIMS 2000; MP PMT 2004; BHU 2008; Odisha JEE 2009]
(a) *Plasmodium falciparum* (b) *P. vivax*
(c) *P. ovale* (d) *P. malariae*

78. Male mosquito (*Anopheles*) does not transmit malarial parasite because
(a) It lacks blood sucking mouth parts
(b) It catches fever
(c) It is too small to carry parasite
(d) The parasite is killed in its stomach

79. Highest incubation period occurs in *Plasmodium* **[CPMT 2001]**
(a) *P. malariae* (b) *P. vivax*
(c) *P. ovale* (d) *P. falciparum*

80. *Entamoeba histolytica* infection occurs through
(a) Contaminated water and food
(b) Sweat
(c) Bird droppings
(d) Mosquito bites

81. Malarial parasite is **[Bihar PMT 2000]**
(a) Polygenetic (b) Digenetic
(c) Monogenetic (d) Monomorphic

82. Type of pseudopodia present in *Amoeba proteus* is
(a) Lobopodia (b) Axopodia
(c) Filopodia (d) Exopodia

83. Erythrocytic phase of *Plasmodium vivax* is completed in **[Bihar PMT 2000]**
(a) 24 hours (b) 72 hours
(c) 36 hours (d) 48 hours

84. Schuffner's dots observed in erythrocytes are due to
(a) Filaria (b) Malaria
(c) Kala-azar (d) Giardia

85. The part of life cycle of malarial parasite *Plasmodium vivax*, that is passed in female *Anopheles* is **[CBSE PMT 1992]**
(a) Sexual cycle
(b) Pre-erythrocytic schizogony
(c) Exoerythrocytic schizogony
(d) Post-erythrocytic schizogony

86. Erythrocytic cycle of *Plasmodium* occurs in
(a) Liver (b) Spleen
(c) RBC (d) Gut

87. Which one is correct pairing **[Manipal 2001]**
(a) *Hydra*–Anthozoa (b) *Paramecium*–Arachnida
(c) *Plasmodium*–Sporozoa (d) *Amoeba*–Ciliata

88. Presence of two types of nuclei, micronucleus and macronucleus, is characteristic of protistan group
(a) Sporozoa (b) Ciliata
(c) Flagellata (d) Sarcodina

89. Which one resides in the mouth of human beings **[MP PMT 1995]**
(a) *Entamoeba coli* (b) *Entamoeba histolytica*
(c) *Entamoeba gingivalis* (d) *Amoeba proteus*

90. Which one does not spread disease **[RPMT 1995; Pb. PMT 2000]**
(a) *Entamoeba coli* (b) *Entamoeba histolytica*
(c) *E. gingivalis* (d) *Plasmodium ovale*

91. Which one is monogenetic parasite **[RPMT 1995]**
(a) *Plasmodium* (b) Liver Fluke
(c) *Taenia solium* (d) *Entamoeba histolytica*

92. *Amoeba* touched with needle will **[RPMT 1995]**
(a) Die (b) Divide quickly
(c) Develop pseudopodia (d) Move away

93. Infective stage of *Trypanosoma gambiense* is **[APMEE 1995; AIIMS 1999; DPMT 1999]**
(a) Metacyclic (b) Crithidial
(c) Leptomonas (d) Leishmania

94. Which does not occur in sporozoa **[Bihar MDAT 1995]**
(a) Cilia (b) Pseudopodia
(c) Flagella (d) None of the above

95. In malaria, which causes chills and fever **[NCERT; BHU 1995; MPPMT 1997]**
Or
Metabolic waste responsible for malaria fever is called
Or
The poisonous substance released as a result of rupturing of schizont in RBC of malaria patient is **[RPMT 2005]**
(a) Hematinj (b) Haemozoin
(c) Schuffner's granules (d) Hematocrit

96. Development and functioning of gametocytes of *Plasmodium* in the body of Mosquito are dependent upon **[RPMT 1996]**
(a) Temperature (b) Food
(c) Position (d) All the above

97. Who was awarded Nobel Prize in 1902 for discovery of oocyst of *Plasmodium* **[RPMT 1996]**
Or
Who discovered oocysts in the stomach of female Anopheles **[MP PMT 2009]**
Or
Malaria is transmitted by "Anopheles". This was discovered by
(a) Golgi (b) Ronald Ross
(c) Laveran (d) Shortt

98. Which one is spindle-shaped mobile with microtubules **[RPMT 1996]**
(a) Sporont (b) Ookinete
(c) Cryptozoite (d) Sporozoite

99. Infection of *Entamoeba histoloytica* is prevented by **[CPMT 1996]**
(a) Avoiding kissing
(b) Avoiding clothes of patient
(c) Uncontaminated food
(d) None of the above

100. Trichocyst takes part in **[CPMT 1996]**
(a) Defence (b) Reproduction
(c) Nutrition (d) Osmoregulation

101. Cyst wall of *Euglena* is formed of **[APMEE 2000, 02]**
(a) Silica (b) Carbohydrate
(c) Proteins (d) Calcium

102. Posterior end of *Amoeba* is characterised by **[Bihar MDAT 1996]**
(a) Plasmid (b) Amphid
(c) Uripygium (d) Lack of food vacuoles

103. Multiple fission in *Plasmodium* is **[DPMT 1996]**
(a) Gamogamy (b) Schizogony
(c) Sporulation (d) None of the above

104. Development of gametocyte from merozoite of *Plasmodium* occurs in **[DPMT 1996]**
(a) Red blood corpuscles
(b) Liver cells
(c) Stomach of female *Anopheles*
(d) All the above

105. A cyst of *Entamoeba histolytica* produces trophozoites **[DPMT 1996]**
(a) 1 (b) 2
(c) 4 (d) 18

106. Which one is not a symptom of *Entamoeba histolytica* infection **[BHU 1996]**
(a) Relapsing fever (b) Abdomial pain
(c) Blood in stool (d) Irregular bowels

107. Malarial species found in South America and West Africa is **[BHU 1996]**
(a) *Plasmodium falciparum* (b) *P. vivax*
(c) *P. malariae* (d) *P. ovale*

108. Recurrence of high temperature in malaria at intervals is due to completion of **[BHU 1996; AIIMS 1996; CPMT 1997]**
(a) Erythrocytic schizogony
(b) Sporogony
(c) Gamogony
(d) Exoerythrocytic schizogony

109. Symptoms of malaria in spleen and skin are due to **[BHU 1996]**
(a) Schuffner's granules (b) Haemozoin
(c) Hamaton (d) Blood sugar

110. *Entamoeba histolytica* excretes through **[MP PMT 1996]**
(a) Food vacuole (b) General surface
(c) Contractile vacuole (d) Malpighian tubles

111. What is common about *Trypanosoma, Noctiluca, Monocystis* and *Giardia* **[CBSE PMT 2006]**
(a) They produce spores
(b) These are all parasites
(c) These are all unicellular protists
(d) They have flagella

112. Which one of the following is a characteristic feature of Chrysophytes **[Kerala PMT 2011]**
(a) They are parasitic forms which cause diseases 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
(e) They are saprophytic protista

113. Infective stage of *Entamoeba histolytica* is **[CPMT 1997; Manipal 1999; Pb. PMT 1999; BHU 2002]**
(a) Trophozoite (b) Pre-cyst
(c) Uninucleate cyst (d) Tetranucleate cyst

114. Sandfly is causative agent of **[CPMT 1997; AMU (Med.) 2001; MP PMT 2002]**
(a) Kala-azar (b) Sleeping sickness
(c) Typhoid (d) Dysentery

115. *Leishmania tropica* produces **[AMU (Med.) 1998; MP PMT 2011]**
(a) Sleeping sickness (b) Kala-azar
(c) Dysentery (d) Oriental sores

116. *Trypanosoma brucei* produces **[BHU 1998]**
(a) Sleeping sickness (b) Kala-azar
(c) Dysentery (d) A disease of animals

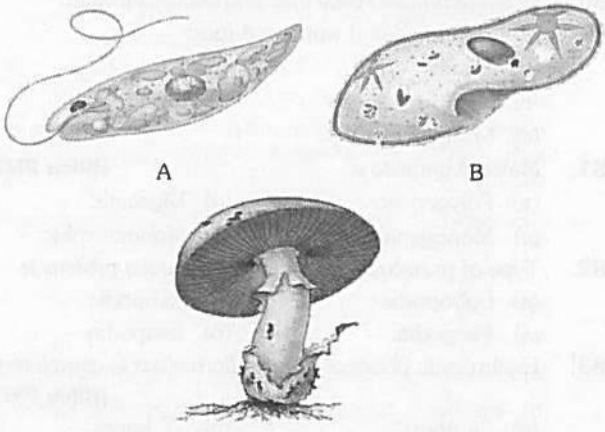
117. Which of the following does not belong to the kingdom Protista **[Kerala PMT 2011]**
(a) Chrysophytes (b) Euglenoids
(c) Ascomycetes (d) Dinoflagellates
(e) Protozoans

118. Protozoan found commensal in human colon is **[CPMT 1998; DPMT 2006]**
(a) *Entamoeba coli* (b) *P. vivax*
(c) *A. aegypti* (d) All the above

119. Symptoms of paroxysms in malaria are due to **[RPMT 1998]**
(a) Sporozoite (b) Gametocyte
(c) Pre-erythrocytic cycle (d) Erythrocytic cycle

120. Relapsing malaria is due to **[RPMT 1998]**
(a) *Plasmodium falciparum* and *P. vivax*
(b) *Plasmodium ovale* and *P. vivax*
(c) *Plasmodium falciparum* and *P. ovale*
(d) *P. falciparum* only

121. Study the following figures and identify A, B and C **[NCERT]**



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

122. Signet ring stage of *Plasmodium* represents **[MP PMT 1999; CPMT 2010]**
(a) Beginning of schizogony in liver cells
(b) End of schizogony in RBC
(c) Beginning of schizogony in RBC
(d) Beginning of sporogony in humans

123. *Amoeba* is eukaryotic because it possesses **[APMEE 1999]**
(a) Plasmid (b) Nucleus
(c) Plasmalemma (d) DNA

124. Incubation period of *Plasmodium vivax* is **[DPMT 1999; WB JEE 2009; MP PMT 2012]**
(a) 14 days (b) 20 days
(c) 30 days (d) 45 days

125. In *Amoeba*, contractile vacuole is present **[CPMT 2000; BHU 2006]**
(a) Near trailing end (b) Near advancing end
(c) At the middle of body (d) Any where inside body

126. Select the wrong statement **[NEET (Phase-II) 2016]**
(a) Diatoms are microscopic and float passively in water
(b) The walls of diatoms are easily destructible
(c) 'Diatomaceous earth' is formed by the cell walls of diatoms
(d) Diatoms are chief producers in the oceans

Critical Thinking

Objective Questions

1. The major function of contractile vacuole is **[CBSE PMT 1995; CPMT 1996; RPMT 2000; BHU 2006]**
(a) Excretion (b) Circulation
(c) Osmoregulation (d) All the above

2. Centric discoid form of diatom is **[HPMT 2001]**
(a) *Diploneis* (b) *Coscinodiscus*
(c) *Stephanodiscus* (d) *Camphyloneis*

3. Which of the following can be used as bacteriological filter **[JIPMER 2002]**
(a) *Gelidium* (b) *Batrachospermum*
(c) *Oscillatoria* (d) *Cymbella*

4. Two species of *Amoeba* X and Y were kept in fresh water and got adapted. Species X developed contractile vacuole. When both were transferred to sea water and got adapted, both X and Y lost their contractile vacuole. From these observation we conclude that
(a) Both X and Y are marine species
(b) Species Y is marine and X is fresh water
(c) Species X is marine and Y is fresh water
(d) Both X and Y are fresh water

5. *Amoeba* reacts
(a) Negatively to strong light and positively to weak light
(b) Positively to strong light and negatively to weak light
(c) Unaffected by light intensity
(d) Positive to both strong and weak light

6. Which is wrong combination **[AIIMS 2001]**
(a) Haemocyanin – Prawn
(b) Haemoglobin in mammals – RBC
(c) Haemoglobin in plasma – *Pheretima*
(d) Haemozoin – *Plasmodium* cytoplasm

7. *Plasmodium*, the malarial parasite, belongs to class **[NCERT; CBSE PMT 1990]**
(a) Sarcodina (b) Ciliata
(c) Sporozoa (d) Dinophyceae

8. Periodic appearance of malaria symptoms occurs due to periodic
(a) Entry of merozoites into erythrocytes
(b) Attack of liver cells by merozoites
(c) Formation of signet ring
(d) Release of pyrogen in blood

9. Motile elongate zygote of *Plasmodium* occurs in **[NCERT; CPMT 1999; CBSE PMT (Pre.) 2012]**
(a) Human RBCs
(b) Human liver
(c) Salivary glands of mosquito (*Anopheles*)
(d) Gut of mosquito (*Anopheles*)

10. In *Amoeba*, pseudopodia are formed due to **[RPMT 1995]**
(a) Contact with food
(b) Sol $\rightleftharpoons$ gel change
(c) Movement towards area of higher temperature
(d) All the above

11. Which stage of *Plasmodium* is infective for Mosquito **[RPMT 1996]**
(a) Trophozoite (b) Gametocyte
(c) Ookinete (d) Sporozoite

12. Chromatid bodies occurs in *Entamoeba* during **[APMEE 1996; Pb. PMT 1999; AIIMS 2002]**
(a) Precyst stage (b) Early cysts
(c) Tetranucleate cysts (d) Trophozoites

13. *Amoeba* stops producing pseudopodia during **[HPMT 2001]**
(a) Alkaline condition (b) Starvation
(c) Acidic condition (d) Touch

14. After how many days could a patient commonly feel malaria from the time of biting of mosquito **[CPMT 1998]**
(a) 2 – 8 days (b) 8 – 10 days
(c) 10 – 20 days (d) 20 – 30 days

15. Microfossile often present in petroleum producing formation are those of **[AMU (Med.) 2001]**
(a) Radiolarians (b) Diatoms
(c) Helizoans (d) Foraminiferans

16. *Amoeba* moves when **[RPMT 2002]**
(a) Upper part of plasma-gel changes to plasmasol
(b) Lower part of plasmasol changes into gel
(c) Upper part of plasmasol changes into plasmagel
(d) All the above

17. A person suffering from a disease caused by *Plasmodium*, experiences recurring chill and fever at the time when **[NCERT; CPMT 1998; AFMC 2001; CBSE PMT (Mains) 2010]**
(a) The sporozoites released from RBCs are being rapidly killed and broken down inside spleen
(b) The trophozoites reach maximum growth and give out certain toxins
(c) The parasite after its rapid multiplication inside RBCs ruptures them, releasing the stage to enter fresh RBCs
(d) The microgametocytes and megagametocytes are being destroyed by the WBCs

18. Destruction of nucleus in *Amoeba* results in **[RPMT 1995]**
(a) Immediate death
(b) Slowing down of metabolic activity and ultimate death
(c) Quick locomotion
(d) No change

19. Exoerythrocytic schizogony of *Plasmodium* takes place in **[MP PMT 2007]**
(a) RBC
(b) Leucocytes
(c) Liver in which cryptomerozoites are formed
(d) Liver in which metacryptomerozoites are formed

20. In *Plasmodium*, gametocytes are formed from **[Bihar PMT 1994]**
(a) Schizont (b) Trophozoite
(c) Sporozoite (d) Merozoite

21. If all ponds and puddles are destroyed, the organism likely to be destroyed is **[CBSE PMT 1993]**
(a) *Leishmania* (b) *Trypanosoma*
(c) *Ascaris* (d) *Plasmodium*

22. The chill and fever recurring after 48 hours in benign tertian malaria is due to
(a) *Plasmodium vivax* (b) *P. malariae*
(c) *P. falciparum* (d) None of the above

23. In malaria, shivering occurs when **[AFMC 2001; RPMT 2002; CPMT 2004; WB JEE 2012]**
(a) Schizonts enter R.B.C.
(b) Sporozoites enter human body
(c) Merozoites are liberated from R.B.C. alongwith toxin
(d) Signet ring stage is attained

24. Which one of the following sets of items in the options a-d are correctly categorized with one exception in it **[NCERT; CBSE PMT (Mains) 2012]**

	Items	Category	*Exception*
(a)	UAA, UAG, UGA	Stop codons	*UAG*
(b)	Kangaroo, Koala, Wombat	Australian marsupials	*Wombat*
(c)	*Plasmodium, Cuscuta, Trypanosoma*	Protozoan parasites	*Cuscuta*
(d)	*Typhoid, Pneumonia, Diphtheria*	*Bacterial diseases*	*Diphtheria*

25. Which of the following diseases is caused by a protozoan **[AIPMT 2015]**
(a) Influenza (b) Babesiosis
(c) Blastomycosis (d) Syphilis

26. All eukaryotic unicellular organisms belong to **[NCERT]**
(a) Monera (b) Protista
(c) Fungi (d) Bacteria

AR Assertion & Reason

Read the assertion and reason carefully to mark the correct option out of the options given below :

(a) If both the assertion and the reason are true and the reason is a correct explanation of the assertion
(b) If both the assertion and reason are true but the reason is not a correct explanation of the assertion
(c) If the assertion is true but the reason is false
(d) If both the assertion and reason are false
(e) If the assertion is false but reason is true

1. Assertion : Slime moulds show alternation of generation.
Reason : The sporangia bearing slime moulds represent haplophase.

2. Assertion : Sandfly transmits Kala-azar.
Reason : In Kala-azar, the parasite damages the brain.

3. Assertion : *Trichomonas vaginalis* causes infection only in women.
Reason : *Trichomonas buccalis* lives in the buccal cavity.

4. Assertion : *Euglena* is studied as an animal as well as a plant.
Reason : *Euglena* is more an animal than a plant.

5. Assertion : *Amoeba* contains a contractile vacuole.
Reason : It helps in both digestion and osmoregulation.

6. Assertion : Amoebiasis is caused by *Amoeba*.
Reason : The protist feeds on red blood corpuscles.

7. Assertion : Erythrocytic merozoites form gametocytes.
Reason : Gametocytes are of two types – male and female.

8. Assertion : *Plasmodium* causes disease in female *Anopheles* mosquitoes.
Reason : Female *Anopheles* mosquitoes feed on human blood.

9. Assertion : Malarial fever appear at merozoite stage of *Plasmodium*.
Reason : The infective stage of *Plasmodium* is sporozoite.

10. Assertion : Schizogony is an asexual reproduction of female *Anopheles* mosquito.
Reason : It takes place only in human liver cells.

Answers

Photosynthetic and consumer protists

1	d	2	b	3	d	4	c	5	a
6	c	7	b	8	c	9	d	10	d
11	c	12	c	13	b	14	d	15	b
16	c	17	d	18	a	19	b	20	a
21	c	22	a	23	c	24	d	25	c
26	a	27	d	28	c	29	a	30	d
31	d	32	a						

Protozoan protists

1	c	2	b	3	e	4	d	5	d
6	a	7	d	8	a	9	d	10	d
11	b	12	b	13	a	14	d	15	e
16	d	17	d	18	a	19	a	20	a

21	c	22	b	23	a	24	c	25	b
26	b	27	c	28	a	29	d	30	a
31	c	32	c	33	a	34	c	35	d
36	c	37	a	38	a	39	d	40	d
41	d	42	d	43	d	44	d	45	b
46	c	47	a	48	a	49	b	50	d
51	a	52	b	53	d	54	b	55	c
56	b	57	a	58	a	59	b	60	b
61	d	62	c	63	d	64	d	65	c
66	c	67	a	68	d	69	d	70	b
71	b	72	b	73	d	74	c	75	b
76	d	77	a	78	a	79	a	80	a
81	b	82	a	83	d	84	b	85	a
86	c	87	c	88	b	89	c	90	a
91	d	92	d	93	a	94	d	95	b
96	a	97	b	98	d	99	c	100	a
101	b	102	d	103	b	104	a	105	c
106	a	107	d	108	a	109	b	110	b
111	c	112	c	113	d	114	a	115	d
116	d	117	c	118	a	119	d	120	b
121	d	122	c	123	b	124	a	125	a
126	b								

Critical Thinking Questions

1	c	2	b	3	d	4	c	5	a
6	d	7	c	8	d	9	d	10	b
11	b	12	b	13	b	14	b	15	d
16	c	17	c	18	b	19	d	20	d
21	d	22	a	23	c	24	c	25	b
26	b								

Assertion and Reason

1	c	2	c	3	e	4	b	5	c
6	e	7	b	8	e	9	b	10	c

Answers and Solutions

Photosynthetic and consumer protists

5. (a) Free floating living protist are collectively called plankton, which are float on the water surface.

6. (c) Because in sea ecosystem, phytoplanktons are primary producers, if they are destroyed, naturally food chain will be disturbed.

8. (c) The slime moulds are included into the division myxomycota by mycologists. The spores of slime moulds (acellular) germinate to produce biflagellate swarm cells which function as gametes.

11. (c) Capillitium is a branched system of five tubes present in acellular slime moulds. Elaters and pseudoelaters are present in some bryophytes where as capitulum is a type of inflorescence.

12. (c) They are unicellular, photosynthetic, eukaryotes.

13. (b) Red tides of oceans are due to excessive growth of dinoflagellates like *Gymnodinium* and *Gonyaulax*.

15. (b) Slime moulds are consumer protist.

16. (c) In slime moulds the multinucleate protoplasma of a sporangium, undergoes cleavage to form spores.

17. (d) The cells of dinoflagellate are generally covered by theca or lorica. Theca contains two grooves, the longitudinal groove called sulcus and transverse groove known as cingulum or annulus or girdle.

19. (b) By binary fission the cells of *Paramecium* divide transversly. In conjugation two paramecia come in contact in the region their oral groove and establish protoplasmic bridge

21. (c) *Enterobius vermicularis* is a member of Nemathelminthes.

25. (c) Auxospores are generally called rejuvenescent cells because they help in increasing diatom size to normal one. Auxospores are commonly formed form zygote.

27. (d) Mixotrophic nutrition is found in *Euglena*, when light is available it is photosynthetic in darkness, it is saprophytic.

29. (a) Frustule of diatoms is made of silica, cellulose and pectic compounds.

31. (d) *Amoeba* and *Paramecium* are protozoan protist while dinoflagellates are photosynthetic protist.

Protozoan protists

7. (d) Parapodia is the locomotory organ of *Nereis* (Annelida).

22. (b) Animals of class sarcodina or rhizopoda have pseudopodia as locomotory organ.

24. (c) Being unicellular, no specific excretory system develop so this function can be performed by plasmalemma by diffusion process.

25. (b) Pseudopodium is formed due to different viscosity of sol and gel.

32. (c) Members of this class are exclusively endoparasites.

34. (c) *Amoeba* was discovered by Rossenhoff (1755) and described by H.I. Hirshfield.

35. (d) Conjugation is shown by *Paramecium* which strictly belongs to ciliata of Protozoa.

37. (a) Maurer's dots are green coloured structure which are found in erythrocytic cycle of *Plasmodium falciparum*.

39. (d) Protists are primitive single celled organism with well organised nucleus, which shows auto as well as heterotrophic mode of nutrition.

43. (d) *Amoeba* is omnivorous and its mode of nutrition is holozoic. It feeds by phagocytosis. *Amoeba* captures and engulfs its prey by means of pseudopodia.

48. (a) Import involves passive sinking of food into body by rupture of plasmalemma, *e.g.*, Ingestion of algae.

49. (b) Micronucleus is usually spherical, with a nuclear membrane and with diploid number of chromosomes. It controls the reproductive activities of the organism.

50. (d) *Trichonympha* is a symbiont in alimentary canal of termites. *Trichonympha* secretes cellulose digesting enzyme β glucosidase which convert cellulose into glucose.

54. (b) Single contractile vacuole is found in fresh water *Amoebae*. It appears like a bubble of clear, watery fluid, enclosed within a delicate and elastic condensation membrane resembling plasmalemma. Its function is osmoregulation, *i.e.*, excess amount of water collected in it and discharged out by it. The water collected in contractile vacuole contain trace of ammonia.

56. (b) While female *Anopheles* suck the infected blood then various phases of malaria parasite reach in their stomach, where digestive enzymes digest all phases besides gametocyte.

61. (d) Magna (Trophozoite) stage of *Entamoeba histolytica* feeds on mucus and RBC.

64. (d) Absence of contractile vacuole in *E.histolytica* is a distinguish feature from *Amoeba*.

65. (c) The cilia of extreme posterior end are longer and form a bunch called caudal tuft.

66. (c) When kerosine, paraffin and petroleum oil is sprinkling over pond, then larva and pupa of mosquito die after some time due to difficulty of breathing. Difficulty of breathing is known as asphyxia.

68. (d) During favourable conditions, *Paramecium* commonly reproduces by transverse or horizontal binary fission which is at right angles to the longitudinal axis of the body. *Paramecium* stops feeding and oral groove and buccal structures begin to disappear. The micronucleus starts dividing by the complicated process of mitosis. After separation of daughter micronuclei, the macronucleus divides amitotically.

73. (d) Diatoms (chrysophytes) body is look like soap box and fit together.

75. (b) *Trypanosoma* belongs to phylum protozoa. *Trypanosoma gambiense* is unicellular and causes African sleeping sickness in man. This is parasite and lives in the blood stream and lymph glands of infected person in early stage of disease.

Among animals *Euglena* contains chlorophyll and therefore, photo autotrophic in nature. *Euglena* is considered as connecting link between plants and animals.

Few animals secrete digestive enzymes directly into their food outside the body and they are called saprozoic *e.g.*, spiders, housefly etc.

80. (a) Infection depends upon intake of food or water contaminated with faecal matter containing tetranucleated cyst of *E. histolytica*.

81. (b) Malarial parasite is digenetic because its life cycle completed in two different hosts. Primary or principal host is man and secondary intermediate or vector host is female *Anopheles*.

85. (a) Both type of gamete are formed during sexual cycle, which occurs in female *Anopheles*.

88. (b) Two different type of nucleus, present in ciliata group are micronucleus and macronucleus. Micronucleus take part in reproduction while macronucleus is large kidney shaped which control matabolism.

90. (a) *Entamoeba coli* inhabits human colon and feed only bacteria and debris which are present there. Hence *Entamoeba coli* neither harmful nor beneficial.

92. (d) *Amoeba* will move away from contact with a foreign object or a probe while crawling or resting.

93. (a) Metacyclic form is a infective stage of *Trypanosoma gambiense* which are formed in lumen of salivary gland.

94. (d) All animals of sporozoa are endoparasite, so they have no any locomotory organs. It is a parasitic adaptation.

98. (d) Sporozoites are spindle or sickle shaped and uni-nucleated organism capable of wriggling movement. Each has a covering form but elastic pellicle containing longitudinal contractile microtubule.

103. (b) Asexual cycle passed in man by process termed schizogony (schizogony in liver and R.B.Cs). Schizogony is a type of multiple fission.

109. (b) Haemozoin is yellow brown to blackish and insoluble polymer of ferriprotoporphyrin. It is formed by haematin or breakdown product of haemoglobin. It collect in various tissues, *e.g.*, spleen, skin.

113. (d) Tetranucleate (= Quadri) cyst is infected stage of *Entamoeba histolytica*. Infection is oral through contaminated food and water.

114. (a) *Leishmania donovani* is the parasite of kala-azar or dum-dum fever. These parasite is transmitted by sand fly.

115. (d) *Leishmania tropica* produce skin ulcers known as oriental sore or Delhi sore, which is spread by sand fly.

126. (b) The cell walls of diatoms are embedded with silica and thus the walls are indestructible.

Critical Thinking Questions

1. (c) The major function of contractile vacuole is osmoregulation, *i.e.*, removal of excess of water.

5. (a) *Amoeba* responds to light, positive behaviour towards moderate lights, negative behaviour to strong light and darkness.

6. (d) Haemozoin liberated in blood plasma.

8. (d) Paroxysm is the actual attack of malaria which initially begins after a few earliest erythrocytic cycles, but it is, then repeated after every cycle. Obviously paroxysm result due to sufficient accumulation of haemozoin and other toxins in blood.

9. (d) The motile zygote formed by fertilization of macrogamete by a microgamete is called ookinete. It occurs in gut of mosquito.

10. (b) According to pressure or ectoplasmic concentration or sol-gel theory, pseudopodia are formed and withdrawn due to cyclic viscosity change in the colloidal cytoplasm from 'sol to gel' and 'gel to sol' states.

11. (b) Gametocyte is infective stage for female anopheles mosquito because optimum temperature for growth of gametocyte is present in their body.

12. (b) Initial stage of cyst formation, two or more transparent rod like structure are present in cytoplasm called chromatid bodies. These chromatid bodies are made of ribonucleoprotein.

13. (b) During starvation, *Amoeba* stops producing pseudopodia and covered with hard impervious and chitinous protective layer or cyst wall for the protection and survival as well as dispersal of *Amoeba*.

14. (b) The patient displays symptoms of malaria fever after a period of 8-10 days from infectious bite.

16. (c) *Amoeba* move, when cytoplasm change from sol to gel or gel to sol state.

17. (c) In malaria chill and fever is due to the release of haemozoin, a toxic substance formed by breakdown of haemoglobin present in RBC. It will be released after the rupture of RBC, in erythrocytic schizogamy.

19. (d) The cryptomerozoite formed during pre-erythrocytic schizogony may enter the human RBCs to start the erythrocytic schizogony, while some of them enter new liver cells and reproduced asexually to give rise to a large number of meta-cryptomerozoites few are smaller in size and called micro-meta-cryptomerozoites.

20. (d) Gametocytes of malarial parasite are developed from merozoites in RBCs of man.

23. (c) Infected R.B.Cs rupture that merozoites and haemozoin granules are liberated in blood. Haemozoin granules are toxic and bring about fever.

25. (b) Babesiosis is caused by sporozoan protozoan- babesia. In this disease haemoglobinuric fever occur.

26. (b) They are solitary unicellular or colonial unicellular eukaryotic organisms.

Assertion and Reason

1. (c) Slime moulds exhibit alternation of generation. The diploid *plasmodium* is a sporophyte. Under certain conditions it bears sporangia. The sporangia bearing *plasmodium* and spore producing sporangia constitute the sporophyte generation. It is diplophase reduction division takes place at the time of differentiation of resting spore. The resting spores germinate to produce the haploid, uninucleate swarm cells or myxamoebae. The latter meet and fuse in pairs to form a zygote. The haploid resting spores and the swarm cells or myxamoebae represent the haploid or gametophyte generation.

2. (c) *Leishmania donovani* causes kala-azar. The parasite is transmitted by sandfly. The parasite lives inside the cells of liver, spleen, lymph glands, white blood corpuscles and inner wall cells of blood capillaries. In sleeping sickness disease, the parasite damages the brain.

3. (e) *Trichomonas vaginalis* inhibits vagina of women and causes the disease known as leucorrhoea. In males the parasite produces irritation in urethra. *Trichomonas buccalis* resides in the buccal cavity, which is nearly harmless.

4. (b) Euglena is a typical example of mastigophora. It is phytoflagellate as it possesses both chloroplast and flagella. It is autotrophic in sunlight, but becomes heterotrophic in dark. Because of its two fold nutritional abilties, it is usually studied as a plant as well as an animal. But it is more an animal than plant because of

(a) The absence of cellulose cell wall overlying the plasma membrane.
(b) Presence of centriole forming blepharoplasts.
(c) Reserve food is paramylon which is not a true starch.
(d) Response to various stimuli like an animal.

5. (c) Contractile vacuole in *Amoeba* is a single, clear rounded pulsating structure which is filled with a watery fluid and enclosed by a unit membrane. It helps in the osmoregulation and excretory activities. Digestion in *Amoeba* occurs in the food vacuoles. These are spherical species small and large, contain water and food in various phases of digestion. As soon as the egestion of non digestible food occurs through body these get disappear.

6. (e) Person suffering from amoebic dysentry has repeated blood mixed, slimy and foul smelling motions and causes the disease known as amoebic dysentery or amoebiasis. This protist feeds on red blood corpuscles by damaging the wall of large intestine and reaching the blood capillaries.

7. (b) Some erythrocytic merozoites enter fresh RBCs. And form rounded gametocytes (gamonts). The gametocytes are of two types – (i) Smaller male gametocytes or microgamete and (ii) Larger female gametocytes or macrogametocytes.

8. (e) The sexual phase of the malarial parasite occurs in the *Anopheles* mosquito. As the female *Anopheles* mosquitoes feed on blood, only they can serve as vector hosts of malarial parasites. The parasite does not harm the mosquito.

9. (b) When the mosquito bites man, sporozoites present in the salivary gland of female *Anopheles* mosquito are injected into the blood of the man. The erythrocytic schizont gives rise to merozoites. Malaria fever occurs when schizonts in red blood corpuscles burst and set free their contained merozoites and malarial pigment (*haemozoin*) in the blood plasma. Bursting of schizonts tends to be synchronous as they all burst at the same time. Haemozoin is said to be toxic and so includes high fever and shivering (Haemozoin is an unused hematin, which is produced by the breakdown of haemoglobin). It is yellow brown to blackish in colour.

10. (c) Schizogony is an asexual reproduction in which schizont is formed. From the human blood sporozoites enter the liver cells. The sporozoite grows in size to become a rounded schizont called cryptozoite. The latter divides to form cryptomerozoites. The cryptomerozoites formed during pre-erythrocytic schizogony may enter the human RBCs to start the erythrocytic schizogony, while some of them enter new liver cells to repeat hepatic (liver) schizogony.

Protista (Unicellular eukaryotes)

SET Self Evaluation Test

1. During endocytosis, **[KCET 2009]**
   (a) The cell divides its cytoplasm during mitosis
   (b) The cell digests itself
   (c) The cell engulfs and internalises materials using its membrane
   (d) The cell enables the extracellular digestion of large molecules
2. Cell wall are well preserved as fossils in one of the following
   (a) Dinophyceae (b) Bacillariophyceae
   (c) Cyanophyceae (d) Euglenophyceae
3. The chief advantage of encystment to an *Amoeba* is **[CBSE PMT 2003]**
   (a) The chance to get rid of accumulated waste products
   (b) The ability to survive during adverse physical conditions
   (c) The ability to live for some time without ingesting food
   (d) Protection from parasites and predators
4. In which of the following animal dimorphic nucleus is found **[CBSE PMT 2002]**
   (a) *Amoeba proteus* (b) *Plasmodium vivax*
   (c) *Paramecium caudatum* (d) *Trypanosoma gambiense*
5. *Amoeba* is called immortal and it is scattered all over the world due to **[CPMT 1999]**
   (a) Conjugation (b) Regeneration
   (c) Binary fission (d) Sexual reproduction
6. Mode of feeding in free living protozoans is **[DPMT 2007]**
   (a) Holozoic (b) Saprozoic
   (c) Both (a) and (b) (d) None of these
7. Select the matching pair
   (a) *Giardia* – diarrhoea (b) *Plasmodium* – pyorrhoea
   (c) *Leishmania* – dysentery (d) *Trypanosoma* – kala-azar
8. In *Trypanosoma gambiense*
   (a) Reproduction is by multiple fission
   (b) There are two nuclei, a micronucleus and a macronucleus
   (c) There are two locomotory organelles, a flagellum and an undulating membrane
   (d) Tse-tse fly has no role to play in life cycle
9. *Trypanosoma* finally invades
   (a) Brain (b) Liver
   (c) Blood (d) Cerebrospinal fluid
10. These organisms are fungus like in one phase of their life cycle and *Amoeba* like in another phase of their life cycle **[AIIMS 2009, 13]**
    (a) Diatoms (b) Slime molds
    (c) Dinoflagellates (d) Water molds
11. Which infective stage of the plasmodium contained by the female Anopheles that transfer into human body and causes malaria **[MP PMT 2011]**
    (a) Mesozoites (b) Gametocyte
    (c) Sporozoite (d) Schizont
12. In patient suffering from malaria, the cells having Schuffner's granules are
    (a) Gametocytes (b) Signet ring trophozoites
    (c) Infected erythrocytes (d) Infected liver cells
13. Which is true about *Trypanosoma* **[CBSE PMT 1990; Odisha JEE 2005]**
    (a) Polymorphic (b) Monogenetic
    (c) Facultative parasite (d) Non-pathogenic
14. The type of nutrition present in *Entamoeba* is **[Odisha JEE 2010]**
    (a) Saprozoic (b) Parasitic
    (c) Autotrophic (d) None of these
15. Common trait between *Amoeba* and leucocyte is
    (a) Encystment (b) Pseudopodia
    (c) Sporulation (d) Contractile vacuole
16. Which is correct **[DPMT 2007]**
    (a) Slime moulds are haploid
    (b) Protozoan lack cell wall
    (c) Dinoflagellates are immotile
    (d) Pellicle is absent in *Euglena*
17. Amoeba takes food through **[RPMT 1995]**
    (a) Phagocytosis (b) Pinocytosis
    (c) Endocytosis (d) All the above
18. Which is absent in amoeba **[RPMT 1996]**
    (a) Golgi apparatus (b) Lysosome
    (c) Centriole (d) Plasmalemma
19. *Amoeba* sticks to substratum by means of **[RPMT 1996]**
    (a) Rough surface (b) Plasmalemma
    (c) Protein (d) None of the above
20. In *Plasmodium*, diploid stage is **[APMEE 1996]**
    (a) Oocyst (b) Gamont
    (c) Schizont (d) Sporozoite
21. *E.histolytica* does not show **[CPMT 2010]**
    (a) Binary fission (b) Budding
    (c) Encystation (d) Excystation
22. Just a *Xenopsylla* is to *Yersinia pestis*, so is **[AIIMS 2003]**
    (a) *Glossina palpalis* to *Wuchereria banerofti*
    (b) *Culex* to *Plasmodium falciparum*
    (c) *Homo sapiens* to *Taenia solium*
    (d) *Phlebotomus* to *Leishmania donovani*
23. Hyaline cap in *Amoeba* is formed **[RPMT 1999]**
    (a) Around food vacuole
    (b) Around contractile vacuole
    (c) Around nucleus
    (d) In front of pseudopodium
24. Binary fission in *Amoeba* involves **[RPMT 1999]**
    (a) Amitosis (b) Mitosis
    (c) Meiosis (d) None of these
25. Which animal exhibits sexual dimorphism **[RPMT 1999]**
    (a) Lobosa (b) Ciliata
    (c) Sporozoans (d) Radiolarians

26. During conjugation in *Paramecium* **[BHU 1999; Pb. PMT 2004; AFMC 2012]**
(a) Out of the four micronuclei formed, three nuclei degenerate
(b) Out of the twelve macronuclei formed, four nuclei degenerate
(c) Zygote nucleus undergoes eight successive divisions in each conjugant
(d) Out of the sixteen nuclei formed from zygote, 12 become macronuclei and 4 micronuclei

27. In humans, schizont stage of *Plasmodium* is found in **[MP PMT 2003]**
(a) Liver cells only
(b) Liver, spleen and blood cells
(c) RBCs and liver cells
(d) RBCs only

28. Malaria parasite harm liver cells **[RPMT 1999]**
(a) In erythrocytic cycle (b) After erythrocytic cycle
(c) Before erythrocytic cycle (d) None of these

29. Select the mismatch **[NEET 2017]**
(a) *Frankia* – *Alnus*
(b) *Rhodospirillum* – Mycorrhiza
(c) *Anabaena* – Nitrogen fixer
(d) *Rhizobium* – Alfalfa

Answers and Solutions

1	c	2	b	3	b	4	c	5	c
6	c	7	a	8	d	9	d	10	b
11	c	12	c	13	a	14	b	15	b
16	b	17	d	18	c	19	b	20	a
21	b	22	d	23	d	24	b	25	a
26	a	27	c	28	c	29	b		

3. (b) *Amoeba* forms a cyst and reproduces by multiple fission, during adverse environmental condition.

4. (c) *Paramecium caudatum* shows nuclear dimorphism. There are two type of nuclei – a large bean shaped polyploid vegetative nucleus called macronucleus and a small rounded diploid reproductive nucleus known as micronucleus.

5. (c) *Amoeba* reproducing by binary fission, the parent becomes wholly murged in the offspring. Thus, there exists a continuity of life, so that amoeba is potentially immortal and it is scattered all over the world.

7. (a) *Giardia intestinalis* causes Diarrhoea.

9. (d) *Trypanosoma* is usually found in the blood of vertebrates, finally invading cerebrospinal fluid.

10. (b) The cellular slime moulds are now classified with the Amoebas because of their evolutionary closeness and these slime moulds have cellular amoeboid stage. The other phyla of slime moulds are the plasmodial slime moulds or Myxomycota.

13. (a) *Trypanosoma* is polymorphic and has four forms : *Leishmania*, *Leptomonad*, *Crithidial* and *Trypanosomal* stages.

16. (b) Protozoans are acellular eukaryotic organisms included in the division protista. They are basically animals previously included under nonchordates. As because they are animals they lack any cell wall. Cell wall is present in plant cells outside cell membrane. The main function of the cell wall is to provide mechanical strength.

18. (c) The structures presents in *Amoeba* are pseudopodia, plasmalemma, nucleus, contractile vacuole, Food vacuole, water globules, endoplasmic reticulum, ribosomes, golgi bodies, mitochondria, lysosomes and microtubules.

19. (b) Plasmalemma possesses numerous fine, ridge-like extension on its outer surface. Due to presence of these it have adhesive properties and serve to bind the animalc ule to the substratum.

20. (a) The motile diploid zygote formed by fertilization (anisogamy) of macrogamete by a microgamete is called ookinete. Ookinete penetrates the stomach wall and forms encysted zygote called oocyst or sporont.

23. (d) Pseudopodium at its forward end gets its firm consistency by hyaline cap which is made of ectoplasm.

26. (a) The diploid micronucleus of each conjugant divides by meiosis. Thus, 4 haploid daughter micronuclei are produced of which 3 degenerates in each conjugant, while the remaining one divides by mitosis 2 unequal pronucleus.

27. (c) Schizont is a stage in the history of malarial parasite occuring in R.B.Cs and liver cells.

28. (c) The first cycle of *plasmodium* occurs in liver cells which is harm for liver cell because sporozoite phagocytes the cytoplasm of the liver cells.

* * *