BIOLOGICAL CLASSIFICATION

KINGDOM PROTISTA

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INTRODUCTION

- Ernst Heackel coined the term Protista.
- 1. They are unicellular, eukaryotic organisms. The boundaries of this kingdom are not well defined.
- 2. What may be 'a photosynthetic protistan' to one biologist may be 'a plant' to another.
- 3. In this book we include Chrysophytes, Dinoflagellates, Euglenoids, Slime moulds and Protozoans under Protista.
- 4. Members of Protista are primarily aquatic.
- 5. This kingdom forms a link with the others dealing with plants, animals and fungi.
- 6. Being eukaryotes, the protistan cell body contains a well-defined nucleus and other membrane-bound organelles.
- 7. Some have flagella or cilia.
- 8. Protists reproduce asexually and sexually by a process involving cell fusion and zygote formation.

Living organisms included in Protista are as follow :

Dinoflagellates, Cryophytes, Euglenoids, Slime molds, Protozoans

Reproduction :-

Protists reproduce Asexually and Sexually

1. Asexual Reproduction :-

This is the most common method of reproduction in protists.

It Is Of Following Types

- (a) Binary fission :- Two daughter cells are formed by the division of one mother cell. After this each daughter cell grows to form a normal organism.
 eg. Dinoflagellates, Chrysophytes, Euglenoids
- (b) Spore formation :- Some protists have special structure known as sporangia. Spores are formed in sporangia. The sporangium bursts after sometime and all the spores become free. Every spore forms a new member.

eg. Slime moulds

2. Sexual Reproduction:-

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

Syngamy is of three types :

- (a) Isogamy :- It is the simplest way of sexual reproduction. In isogamy the fusing gametes are morphologically (i.e. shape, size, structure) similar but physiologically (i.e. functionally or genetically) they may be similar or dissimilar when fusing gametes are physiologically dissimilar, process is called physiological anis gamy.
- (b) Anisogamy :- The fusing gametes are morphologically dissimilar (smaller larger) but physiologically they may be similar or dissimilar (usually).
- (c) **Oogamy :-** It is the developed form of anisogamy. Male gamete is small and motile while female gamete is large and non motile. This female gamete is known as egg. In it the formation of male & female gametes take place in sex organs. In this process the female gamete remains within the female reproductive structure, it does not come outside.

PATTERNS OF LIFE CYCLE

(1) Life cycle showing zygotic meiosis:-

When Protest is haploid and meiosis occurs in zygote then it is known as zygotic meiosis. In this type of life cycle during sexual reproduction gametes are formed by mitosis. These gametes are haploid: These gametes fuse to form a diploid zygote. After that meiosis takes place in zygote, as a result haploid cells are formed again.

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



(2) Life cycle showing gametic meiosis :-

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

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



Chrysophytes/Bacillariophytes:

These are commonly called Jewels of plant Kingdom. The division chrysophyta includes diatoms & desmids (golden algae)

General Characters:

- 1. They are found in fresh water as well as in marine environments.
- 2. Most of **Diatoms** are **photosynthetic protists** (Chief producers in the oceans).
- **3.** Float passively in water currents (plankton) due to **stored fat**. Flagella are absent in somatic phase.
- **4.** The reserved food is **oil and chrysolaminarin or leucosin** (a polysaccharide). Proteinaceous volutin globules are also present.
- **5.** The body is covered by **two thin overlaping transparent siliceous shell (**called **frustule)** which fit together as in a soap box. (The walls are embedded with silica and thus the walls are indestructible).
- **6.** The cell wall is composed of two halves, upper larger and older half or **epitheca** and a lower smaller and younger half or **hypotheca**.
- **7.** The most common mode of multiplication is **binary fission (cell division)**. In this process, each daughter cell retains one half of the parent cell (epitheca) and the other half is synthesized (Hypotheca).

- Binary fission reduces the size of daughters due to retention of one valve of the parent. It is restored by the development of zygote or rejuvenescent cells or auxospores (sexual spores).
- **9.** Sexual Reproduction varies from **isogamy to oogamy** and is connected to a reduction in diatom cell size in order to restore them to their original size. It takes place by the fusion of gametes and auxospore formation.
- **10.** Since the diatoms are diploid (2N) in nature so they participate in gametic meiosis.



Fig :- Diatoms : Diagrammatic representation of Cell division

- **11.** They bear plate like or discoid chromatophore having **Chl a, Chl c, carotenes, fucoxanthin**, diadinoxanthin and diatoxanthin pigments.
- **12.** Due to the presence of different types of pigments, the colour of diatoms may be yellow, brown or green. Hence these are called **golden brown algae**.



Fig :- Some common diatoms, (i) Triceratium, (ii) Pleurosigma, (iii) Navicula, (iv) Cymbella, (v) Amphipleura

Economic importance:

- (i) Siliceous shells of diatoms do not deccay but pile up and forms heaps called diatomaceous earth or diatomite or kiselgurh. The latter is used as insulation material in refrigerators, boilers and furnaces.
- (ii) Diatomite is also used as cleaning agent in tooth pastes and metal polishing.
- (iii) Diatomite is porous and chemically inert. Therefore, it is used in **filtration of oil, syrup**, alcohols and antibiotics.
- (iv) Diatoms are chief producers of oceans in the form of phytoplanktons and they are major sources of food to aquatic animals.
- (v) Diatomaceous earth is used to make **sound proof rooms**.
- (vi) The oils extracted from some fishes and whales are actually the ones produced by diatoms.

DINOFLAGELLATES- Armoured algae / Night light.

"Protist with two flagella"

- Dinoflagellates are mainly marine. They are found on the surface of water. They appear yellow. Green, brown blue or red depanding on the main pigments present in their cells.
- In Dinoflagellates, the nutrition is mainly holophytic (Plant like nutrition I Photosynthesis). eg. of dinoflagellates -

Ceratium, Gonyaulax, Gymnodinium, Pyrocystis

Structure :-

- (A) Their cell wall is divided in to plates, which is made up of cellulose. Therefore the covering of Din flagellates is seen as armored so they are called armored algae.
- (B) Din flagellates have two flagella one lies longitudinally and the other transversely in a furrow between the wall plates. Din flagellates show a special type of movement which is like whirling whips, therefore they are called as "whirling whips".
- **(C)** Cell is eukaryotic but histone protein is absent in its chromosome. Due to this reason Din flagellates are called mesokaryote.

(D) Din flagellates are yellow-brown or golden brown in colour. These colour of Din flagellates are due to the pigments present in them- Chlorophyll'a', Chi. 'c' and Xanthophylls (Dinoxanthin & Didinoxanthin).

Stored food- Starch

Some informations of Dinoflagellates -

- Dinoflagellates show 'bioluminescence' due to presence of photogenic granules in cytoplasm, so these dinoflagellates are also known as 'night light'. Dinoflagellates are also called "fire algae", because they appear as glowing light due to bioluminescence.
- 2. Gonyaulax spreads on the surface of sea water. through rapid multiplication due to which the sea water appears red. It is called red tide.
- 3. Both Gymnodinium & Gonya.u lax are toxic. They secrete toxins. These toxins cause paralysis in human beings. Humans acquire these toxins through food chain. These algae also affect the marine animals (water bloom).

This group includes diatoms and golden algae (desmids). They are found in fresh water (mainly desmids) as well as in marine (mainly diatoms) environment.

Structure of diatom :-

- **1.** They are found in different shapes such as circular, rectangular, triangular, elongated and boat shaped.
- 2. The cell wall of diatoms is made up of cellulose in which silica particles are embedded in at many places. Due to which the cell wall appears to be made up of silica. This silicated cell wall is called "shell" or "frustule".

Note : Their cell wall is made up of two halves, which are arranged like the lids of soap box. Their cell wall have silica in very large quantity. Due to this reason their cell wall is hard. The cell wall does not get descomposed after their death so at the bottom of sea, very huge rocks of dead diatoms are formed which is known as "diatomite" or "diatomaceous earth" or "keiselgurh".

- **3.** Diatoms have pigments Chlorophyll 'a', Chi 'c', and xanthophyll (fucoxanthin).
- **4.** They are chief producers in the ocean.
- 5. Stored food- Leucosin (Chrysolaminarin) & fats (Oil).

6. Movement- They are irnmotile, because flagella are absent in them. They float passively on the surface of water.

Note : In diatoms, during reproduction special type of spores are formed which are known as "Auxospore".

Use of Diatoms :-

- (A) Sound proofing (B) Filteration of oils and syrups (C) Stone polishing
- (D) As "Heat insulator" in steam boilers because the keiselgurh is bad conductor of heat.

Euglenoids:

Euglena is considered as connecting link between Plant kingdom & Animal kingdom because it shows features of both plants and animals.

General characters

- **1.** Majority of them are fresh water organisms found in stagnant water.
- 2. Cell wall is absent and they have a protein rich layer called pellicle which makes their body flexible.
- Chloroplast contains pigments similar to higher plants like Chl. a, Chl. b, and xanthophyll (zeaxanthin).
- **4.** They have two flagella (tinsel flagella), a short and a long one. Out of them one is reduced while second flagellum is long and seems to have two branches at the base with each of which having its own basal granule.
- **5.** Nutrition: They are mixotrophic. e.g. Euglena, They show both holophytic and holozoic nutrition. Though they are photosynthetic in the presence of sunlight (holophytic), when deprived of sunlight they behave like heterotrophs (holozoic) by predating on other smaller organisms.
- **6. Contractile vacuole** is found fixed in the anterior part of the cell below the reservoir for osmoregulation.
- **7.** The reserve food is **paramylum** as **paramylum granules** that is stored in the cytoplasm instead of chloroplasts. Paramylum granules are polysaccharide, β-1, 3 glucan.

- **8.** They performs multiplication by **longtiudinal binary fission** in favourable conditions and by cyst formation in unfavourable conditions. Sexual reproduction has not yet been definitely proved.
- **9.** The flagellum bears a swelling at the area of union of two branches, called **paraflagellar body** or photoreceptor. **Stigma or eye spot** lies on the membrane of resevoir at the level of paraflagellar body. The former and the latter are the sites receiving light stimulus.
- **10.** The apical end has invagination containing three parts-Cytostome (mouth), Cytopharynx (canal) and reservoir.
- **11.** Single large nucleus is found in the middle part of the cell.



Fig:- Euglena : Ultrastructure

Euglena						
S.No.	Plant like characters	S.No.	Animal like characters			
1	Presence of chloroplasts with chlorophyll.	1	Presence of proteinaceous pellicle / Absence of cell wall			
2	Holophytic nutrition.	2	Presence of paraflagellar body and stigma.			
		3	Presence of contractile vacuole.			
		4	Reproduction by longitudinal binary fission.			

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Slime Moulds: Protistian fungi / False fungi.



Fig. Slime Moulds

General characters:

- (i) Cell wall is absent (Animal like character) around somatic cell but spores have cellulosic cell wall (true walls)
- (ii) The protoplasts are covered by plasmalemma.
- (iii) Slime moulds are saprophytic protists (phagotrophic nutrition). The body moves along decaying twigs and leaves engulfing organic material (Pseudopodia like structure present).
- (iv) The reserve food is Glycogen and oil.
- (v) Reproduction takes place through both asexual and sexual methods.
- **(vi)** Under **suitable conditions**, they form an aggregation called **plasmodium** which may grow and spread over several feet.
- **(vii)** During **unfavourable conditions**, the plasmodium differentiates and forms **fruiting bodies** bearing spores at their tips (Sexual reproduction).
- (viii) Spores are extremely resistant and survive for many years, even under adverse conditions due to cellulosic cell wall. The spores are dispersed by air currents.

• On the basis of structure slime moulds are of two types.

	Acellular Slime Moulds	Cellular Slime Moulds		
1.24	Diplontic life cycle and gametic meiosis.	1.	Haplontic life cycle and zygotic meiosis.	
2.	Body is multinucleatid plasmodium	2.	Uni-nucleated pseudoplasmodium / Myxomoeba.	
3.	holocarpic and Polycentric	3.	Holocarpic and monocentric	
4.	e.g. Physarum		e.g. Dictyostelium	

Protozoa: Protistian animal.

- Protozoans were first studied by Leeuwenhoek.
- Term protozoa coined by Goldfuss.
- Study of protozoans Protozoology.

General characters

- **1.** Whittaker included all the protozoan in a separate Kingdom- Protista, alongwith all other eukaryotic unicellular micro-organisms.
- **2.** One celled body performed all the biological activities like multicellular animals. So, they are termed as "Acellular " organism. (Physiological division of labour is found).
- **3. Habitat** They are world wide (Cosmopolitan), mostly microscopic, Aquatic, terrestrial, free living (Amoeba) or parasitic (Plasmodium), solitary or colonical (Proterospongia).
- 4. Nutrition All protozoans are heterotrophs & live as predator or parasite. Mainly holozoic (Amoeba), Parasitic (Plasmodium), sporozoic & Digestion is intracellular take place in food vacuole
- **5.** They are believed to be primitive relatives of animals.
- 6. Body level of organization Protoplasmic level.
- 7. Body form Their protoplasm is uninucleated or multinucleated, animals are naked or some have body bounded by delicate membrane or a firm pellicle / Test / Shell (loose outer covering). e.g, Forminiferans). In few groups of protozoa CaCO₃ & Silica shell's exoskeleton is found. e.g., Radiolarian group & Foraminiferan group.
- 8. Locomotion -
- Finger like Pseudopodia e.g. Amoeba

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- Whip like Flagella e.g. Trypanosoma
- Hairy cilia. e.g. Paramecium
- By Gliding e.g, Monocystis

Note: Locomotory structures are absent in the parasitic forms belonging to sporozoa group.

- **9. Respiration -** Take place by exchange of gases through body surface.
- 10. Excretion Nitrogenous waste is Ammonia. Some excretion may occure through contractile vacuole. Some fresh water protozoans get rid of excess water through contractile vacuole known as osmoregulation. Amoeba has one and paramecium has two contractile vacuoles.

REPRODUCTION -

Asexual

- 1. Binary fission-
- (a) Irregular Amoeba
- (b) Transverse fission Paramecium
- (c) Longitudinal fission Trypanosoma
- (d) Oblique fission Ceratium
- 2. Multiple fission Plasmodium.

Sexual

- **1.** Syngamy Plasmodium
- 2. Conjugation Paramecium interchange genetic material.
- Some members also form cyst which helps in reproduction under unfavourable condition. They are considered as **immortal** i.e. do not have natural death because there is no division of somatoplasm and germplasm.

Classification

- 1. Rhizopoda (Amoeboid protozoans):
- These organisms live in fresh water, sea water or moist soil. They move and capture their prey by putting out pseudopodia (false feet) as in Amoeba. Marine forms have silica shells on their surface.

• **Amoeba** - Free living, fresh water (Amoeba proteus have flattened discoidal and biconcave nucleus).

Note - Cytoplasm of amoeba show continous change in viscosity in cytoplasm (a) Sol to gel (at advanced end) and (b) Gel to sol (posterior end). Posterior end of amoeba is characterised by lack of food vacuole.

Entamoeba histolytica - Amoebic dysentery; Contractile vacuole absent.

Entamoeba gingivalis - Pyorrhoea

Foraminiforans - Globegerina, Euglypha

Heliozoans - Actinophrys (Sun animalcule)

2. Flagellata (Flagellated protozoans) : The members of this group are either free-living or parasitic. They have flagella.

Trypanosoma	-	Sleeping sickness (caused by T. gambiense) and Chagas
		disease (caused by T. cruzi) spread by Tse-Tse fly - Glossina
		palpalis.
Leishmania	-	Kala azar (caused by L. donovani) and oriental sore (caused
		by
		L. tropica) spread by send fly - Phlebotamus
Giardia	-	Giadiasis
Trichomonas	-	Trichomoniasis (characterized by whitish, frothy vaginal
discharge in		
		human females)
Lophomonas	-	Symbiont in the gut of termite, for cellulose digestion
Trichonympha	-	Symbiont in the gut of termite, for cellulose digestion
Proterospongia	_	Connecting link between protozoa and porifera

3. Ciliata (Ciliated protozoans): These are aquatic, actively moving organisms because of the presence of thousands of cilia. They have a cavity (gullet) that opens to the outside of the cell surface. The coordinated movement of rows of cilia causes the water laden with food to be steered into the gullet.

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Balantidium	-	Diarrhoea in humans
Paramoecium	-	Slipper animalcule (nuclear dimorphism present)
Opalina	-	In rectum of frog
Nyctotherus	-	In rectum of frog
Vorticella	-	Bell animalcule
Didinum	_	Water bear



Fig. Paramoecium

4. Sporozoa (Sporozoans) : This includes diverse organisms that have an infectious spore-like stage in their life cycle.

Plasmodium		-	Malaria in humans
Nosema		-	Pebrin disease in silk moth
Babesia	-	Red wa	ater fever in cattle
Eimeria		-	Coccidiosis in rabbit
Monocystis		-	Endoparasite of coelomic epithelial cells and seminal vesicles
			of earthworm