Chapter-3
KINGDOM PROTISTA

The kingdom protista was created by **Haeckel** in 1886 to include all unicellular eukaryotic organisms. This kingdom includes diverse kinds of unicellular, eukaryotic microorganisms, which are predominantly water dwelling. Phylogenetically this kingdom links prokaryotic kingdom Monera with the multicellular kingdoms plantae, fungi and animalia.

Characteristics :

They have a typical eukaryotic structure with membrane bound organelles and nucleus

Some protists have an outer covering of pellicle, cuticle shell or cellulosic wall, some are without cell wall like slime moulds.

All organelles like nucleus with chromosomes, endoplasmic reticulum, mitochondria, Golgi bodies, ribosomes (80 S type), are present in their cytoplasm except chloroplast in protozoan protists and slime moulds.

The photosynthetic protists contain thylakoids.

The genetic material is linear DNA

Mesokaryotic conditions of nucleus is found in dinoflagellates.

Locomotion by flagella (flagellate structure possess 9+2 internal microtubular arrangement), cilia, pseudopodia and mucilage propulsion.

Nutrition variable : some forms are photosynthetic, some are heterotrophic and some are mixotrophic like *Euglena*.

Locomotion in Protists

Protists show locomotion by flagella, cilia and pseudopodia.

Flagella

These are long, whip-like, fine structure which help organisms to propel. Some protists have only one flagellum like *Euglena* while others may have more than one.

Cilia

These are short, fine, hair like structure present all over the body. They move in a coordinated manner to bring about the locomotion. With the help of these, ciliates move rapidly. Ex. *Paramaecium*.

Pseudopodia

These are also known as false feet. These are blunt protoplasmic extensions which given an irregular shape to the organism and help in the movement by getting extended in a particular direction. Ex. – *Amoeba*, slime moulds.

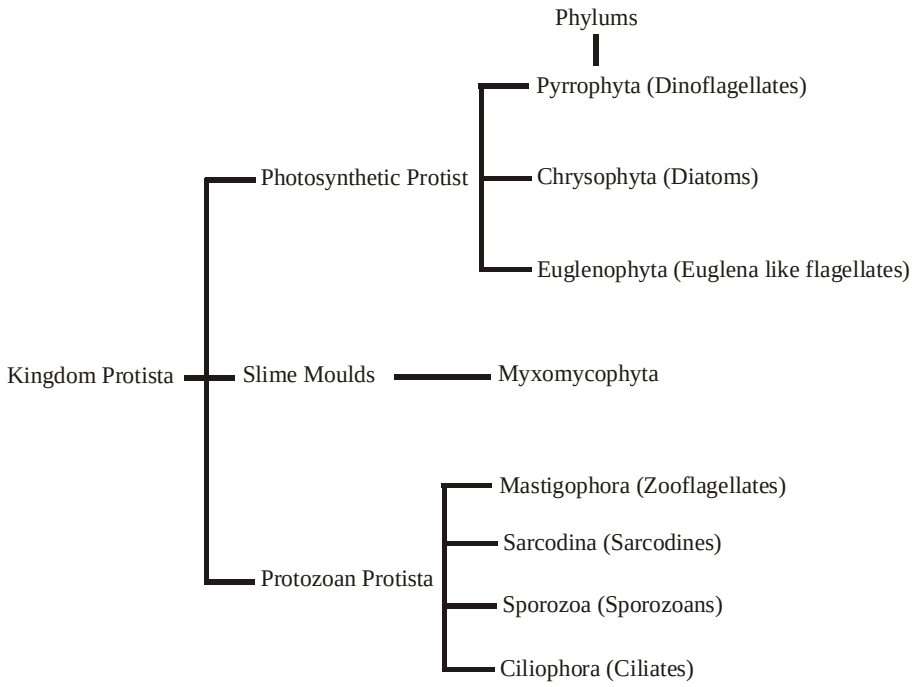
Wriggling

It is a slow worm like movement, which occurs with the help of a wave like contraction and expansion in the body. It occurs in sporozoans and non-flagellate euglenoids.

Mucilage propulsion

Some protists (such as diatoms) move from one place to another by the secretion of mucilage. This type of movement occurs in the direction opposite to that of mucilage secretion.

Classification of Protista



Reproduction in Protists

Protists possess a great power of reproduction. They reproduce by both asexual and sexual methods.

1. Asexual Reproduction

During favourable conditions protists reproduce asexually by binary fission. With every division a parent cell produces two daughter cells which become independent organisms and divide again. It may occur several times in a day leading to population explosion.

2. Sexual Reproduction

Sexual reproduction involves meiosis, syngamy and zygote formation which are major evolutionary advancements like the development of flagella. This allows greater variation in the progeny than asexual reproduction.

During sexual reproduction, two cells fuse (along with nuclei, and cytoplasm) to form a new cell called zygote. The process of fusion of haploid cells is called syngamy or fertilization. Meiosis takes place to keep the number of chromosomes constant. It may take place before or after syngamy depending on the kind of organisms. The two kinds of divisions are as given below :

(i) Zygotic Meiosis

It occurs in haploid (n) protists.

Two haploid cells fuse to form a diploid (2n) zygote.

The zygote divides meiotically to form haploid (n) individuals again.

The haploid individuals divide asexually to increase the number (Fig. 3.1 a).

(ii) Gametic Meiosis

It occurs in diploid (2n) protists.

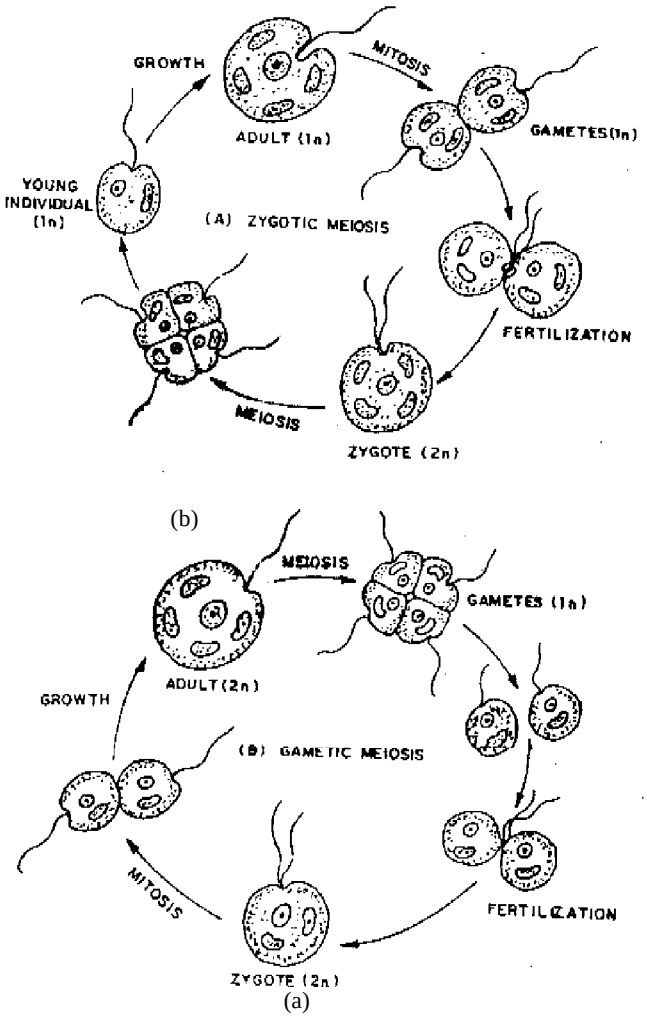


Fig. 3.1. Diagram showing both zygotic (a) and gametic meiosis (b).

The diploid (2n) cells divide meiotically to produce 4 haploid (n) gametes prior to sexual fusion.

The haploid gametes fuse in pairs to form a diploid (2n) zygote.

The zygote divides mitotically to produce 2n individuals (Fig. 3.1. b).

Gametic Meiosis	Zygotic Meiosis
1. Occurs in diploid protists	1. Occurs in haploid protists
2. Two haploid gametes fuse	2. Two haploid cells fuse
3. Meiosis takes place in individual cells and haploid gametes are formed	3. Meiosis takes place in zygote to produce haploid organisms
4. Zygote divides mitotically	4. Zygote divides meiotically

PHOTOSYNTHETIC PROTIST

Photosynthetic protists or protistan algae are the dinoflagellates, diatoms and the *Euglena* like flagellates. The term algae is used for many types of aquatic photosynthetic organisms. These range form microscopic forms to giant weeds. This is a diverse group and is placed in

(i) Kingdom Monera for blue green algae or cyanobacteria.

(ii) Kingdom Protista for phytoplanktonic organisms.

(iii) Kingdom Plantae for red, green or brown algae.

1. Phylum Pyrrophyta (Dinoflagellates)

It includes dinoflagellates. These are next to diatoms as producers in ocean. The blooms of *Gonyaulax* cause red tide since the cells are present in such a large quantity that they colour the water. Unfortunately this species produces a poison that is deadly to fish, smaller organisms and man (**saxitoxin** produce by *Gonyaulax catenella* accumulates in shell fishes but its consumption by man causes paralytic shell fish poisoning). Some dinoflagellates are bioluminescent ex. *Noctiluca*.

Dinoflagellates exhibit a number of traits that appear intermediate between prokaryotes and eukaryotes. Like prokaryotes they have no histones in their chromosomes and their mitosis is quite simple than that of higher eukaryotes, this condition is called **mesokaryotic**.

Important features

(i) Unicellular, motile, photosynthetic organisms.

(ii) Body is enclosed in a cellulose wall divided into plates which give an armoured appearance.

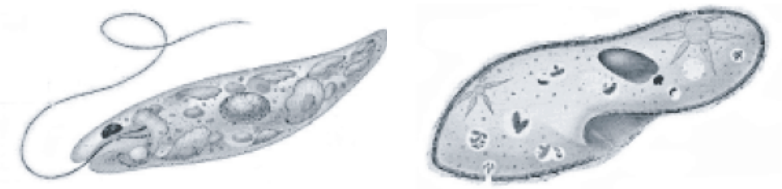
(iii) Cellulose cell wall divided into plates. It is called **theca** or **lorica**. The theca contains two grooves longitudinal **sulcus** and transverse **girdle** or **annulus**.
(iv) Have two unequal flagella ; one lies in a longitudinal direction and the other lies transversly in a furrow between the wall plates.
(v) Organisms reproduce asexually only. Sexual reproduction is almost unknown.
(vi) About 1,000 species are known most of these are marine.

2. Chrysophyta (Diatoms)

They are termed golden brown algae. They are the most important producers in marine ecosystems though they are also common in fresh water. A large percentage of marine animal life is dependent on them. A 60 ton blue whale may have 2 tons of plankton (mostly diatoms) in the gut. Of the 6,000 species known, mostly are marine.

Important features

(i) Mostly occur as individual cells, but some may get attached and form a colony.
(ii) They are unique as they have deposits of silicon dioxide in their cell wall. When the organism dies everything degenerates except silicon dioxide.
(iii) The glassy cell walls are arranged in pairs like a small dish with a cover or soap box. The glassy walls are decorated with grooves and holes.
(iv) They donot have flagella and float due to light storage lipids.
(v) During asexual reproduction each daughter cell retains one half of the old wall and synthesises a new half.
(vi) During sexual reproduction, they reproduce by forming gametes.
(vii) Their asexual spores are known as **auxospores**.
(viii) They are diploids and undergo meiosis during sexual reproduction.
(ix) Their cells have at soap box like structure.
(x) When these cells divide into two parts the missing part is replaced.



(a) *Euglena* (b) *Paramoecium*

3. Phylum Euglenophyta

It includes Euglena-like flagellates which have plant like characteristics (chlorophyll) in addition to some animal characteristics. They ingest food particles and carry on photosynthesis.

Important features

(i) Mostly unicellular and free living, found in fresh water ponds, ditches or in damp soil.

(ii) Have a pellicle instead of a cellulose cell wall. Pellicle is flexible and allows a change in shape.

(iii) Have a long, whip like flagella inserted at the front end in a cavity. It helps *Euglena* pull through the water.

(iv) Have a light sensitive red spot called eye spot near the flagellum base that enables it to move towards or away from light.

(v) The dominant photosynthetic pigment is chlorophyll, therefore they are green in appearance.

(vi) Store carbohydrate as paramylum (similar to starch) bodies.

(vii) Asexual reproduction is by longitudinal fission starting at the flagellar end. The flagellum duplicates before the cell divides.

(viii) During unfavourable conditions (drying of pool) they form cysts

	Phylum Pyrrophyta	**Phylum Chrysophyta**	**Phylum Euglenophyta**
(i)	Cellulose cell wall divided into plates. It is called theca or lorica. The theca contains two grooves longitudinal sulcus and transverse girdle or annulus.	They have wall of cellulose impregnated with glass like silica, the cell wall consists of two overlapping halves, the upper half is called epitheca and lower is called hypotheca.	They are without cellulosic cell wall but possess a elastic pellicle.
(ii)	They have 2 unequal flagella	Lack flagella	They have 1-3 flagella
(iii)	They possess pigment, chl *a* and *c*	They possess pigment, chl *a* and *c*	They possess pigment, chl a and *b*
(iv)	They store food in the form of oil and starch	They store food in the form of oil and leucosin	They store food in the form of paramylum granules
(v)	Reproduce asexually only	Reproduce both asexually and sexually	Reproduce asexually by binary fission and form cysts during unfavourable conditions.
(vi)	Include dinoflagellates	Include diatoms and golden brown algae	*Euglena* like flagellates

SLIME MOULDS (CONSUMER, DECOMPOSER PROTISTS)

They constitute a group of consumer-decomposer organisms which live on decaying organic matter in both terrestrial and aquatic habitats. Slime moulds consists of a spreading slimy mass of protoplasm and share the characters of both animals and fungi. Due to this peculiarity they are commonly called **fungus animals**. Slime moulds are of two types – **acellular slime moulds** and **cellular slime moulds**.

1. Acellular Slime Moulds

It is unicellular without cell wall and is multinucleate. It looks like one large mass of protoplasm in which there may be thousands of nuclei, lacking cell walls. It often appears as a slimy, fan shaped network of living matter. It is called as **plasmodium**. This mass flows along in an amoeboid manner on the soil of a forest, surface of dead leaves or on a rotting log. As it moves along it engulfs food particles and digests them in food vacuoles.

Life cycle

During unfavourable condition (dry) the plasmodium of acellular slime mould change itself into spore-bearing structure called **sporangia**. The haploi spores are formed as a result c **meiotic** division. The spores hav cell walls. They behave a gametes and are calle myxamoebae.

During favourable conditions th spores germinate to forr **flagellated** haploid gamete which are termed **swarm spore** that fuse to form the zygote. Th diploid zygote then divide mitotically to form nev multinucleated plasmodiur.. (Fig. 3.2). Example - *Physarum*.

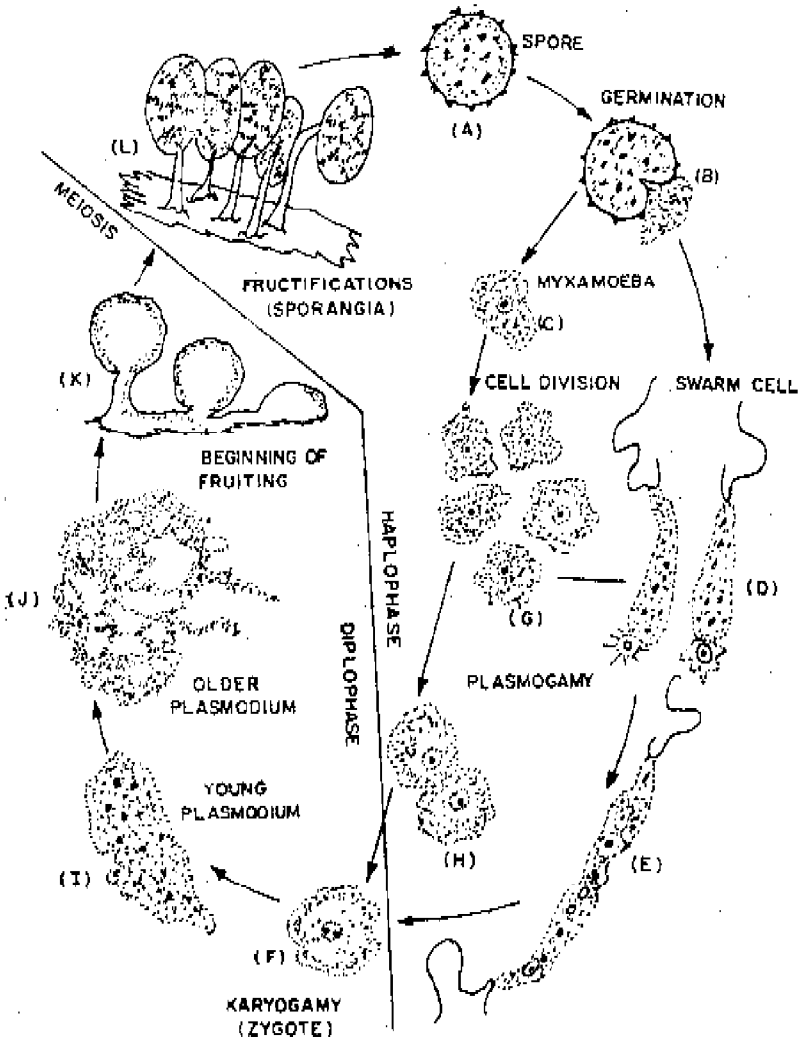


Fig. 3.2. Life cycle of acellular slime mould.

2. Cellular Slime Mould

In this numerous individuals, amoeboid cells aggregate and move together like a mass of protoplasm. This is called as a **pseudoplasmodium.** Example - *Dictyostelium.*

Life-Cycle

During unfavourable conditions, some of the amoeboid cells form the fruiting body while others form the spores. Because of this division of labour, they are considered to be advanced protists or primitive fungi.

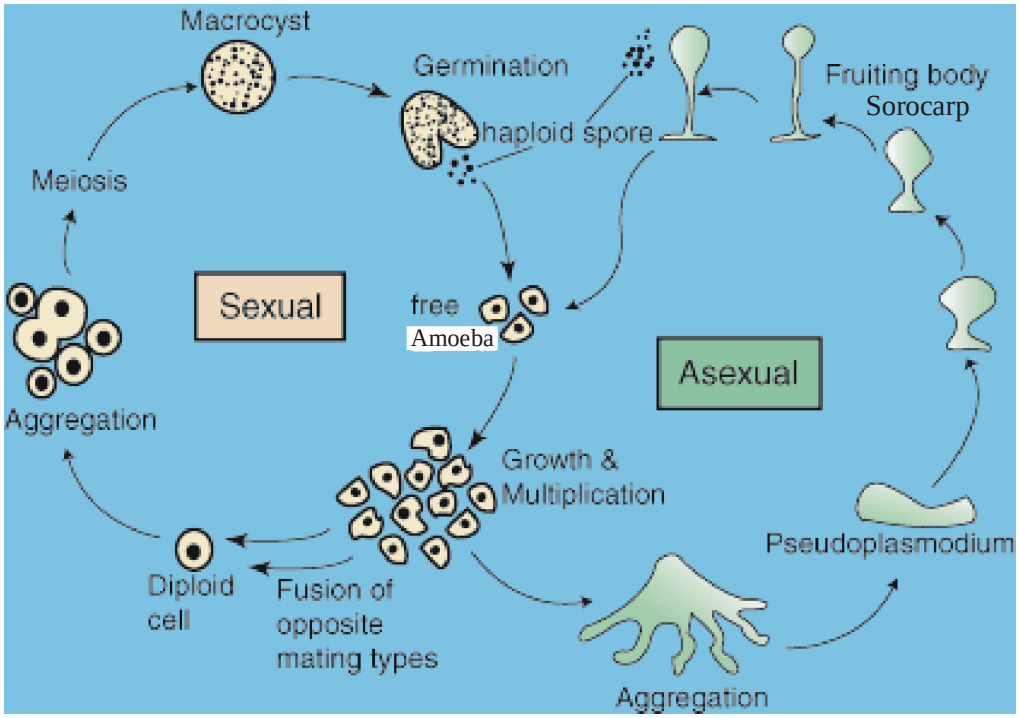


Fig. 3.3. Life cycle of cellular slime mould.

During favourable conditions the spores germinate into amoeboid cells which aggregate again to form a pseudoplasmodium. e.g., *Dictyostelium* (Fig. 3.3).