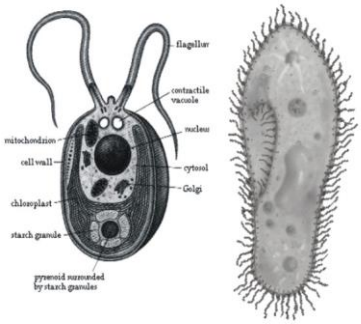


Chapter 7

The Kingdom Protista (or Protoctista)

7.1 INTRODUCTION

Reasons for Creation of Kingdom Protista

i) This kingdom consists of organisms whose diverse body forms, types of reproduction, modes of nutrition and lifestyles make them difficult to characterize.

ii) Basically, this kingdom system is defined by exclusion i.e. all members have characteristics that exclude them from the other four kingdoms.

iii) Scientists found it difficult to place certain eukaryotes in appropriate kingdom.

iv) This difficulty is a consequence of the fact that the other eukaryotic kingdoms have their origin in kingdom protista.

v) The other eukaryotic kingdoms i.e, Plantae, Animalia and Fungi arose from protests in various ways.

All the above-mentioned reasons laid down the foundation of Kingdom Protista.

Characteristics of Protists

- Most of the organisms present in this kingdom are ***aquatic***.
- All protists are ***eukaryotes*** and have evolved from prokaryotes.
- These are ***unicellular, colonial or simple multicellular organisms***.
- Their eukaryotic feature is ***similar to plants and animals but*** unlike them they ***do not develop from a blastula or embryo.***

Divisions of Kingdom Protista

The kingdom protista consists of ***four major groups*** of eukaryotic organisms, which are;

1. Protozoans: Animal like Protists.
2. Unicellular Algae: Plant like Protists.
3. Multicellular Algae: Plant like Protists.
4. Slime Molds and Water Molds: Fungus like Protists.

QUESTION RELATED TO ABOVE ARTICLE

Discuss important features of protists. Why are protists so difficult to classify? (Exercise Question i)

What are three major groups of protists? (Exercise Question iv)

What are the reasons for grouping simple eukaryotic organisms into a separate kingdom protista? (Exercise Question ii)

7.2 HISTORICAL PERSPECTIVE

Work of some scientists related to formation of kingdom protista is give below.

Work of John Hogg

In *1861,* John Hogg proposed the ***kingdom Protoctista*** for microscopic organisms.

Work of Ernst Haeckel

In *1866,* Ernst Haeckel suggested creating the ***Kingdom Protista.***

- Kingdom protista include bacteria and other microorganisms (such as *Euglena*) that did not fit into plant or animal kingdom.
- He separated blue green algae and bacteria (prokaryotes) from nucleated protists and placed them in a separate group called Monera within Kingdom Protista.

Work of Herbert Copeland

In *1938*, Herbert Copeland elevated the prokaryotes to kingdom status ***(kingdom Monera),*** thus separating them from protista.

Work of Robert Whittaker

In *1969*, Robert Whittaker placed unicellular eukaryotes in kingdom Protista according to five-kingdom classification.

Work of Margulis and Schwartz

In *1982*, Margulis and Schwartz modified five-kingdom system. Protista or Protoctista is one of the five kingdoms

- Recently colonial and simple multicellular eukaryotes have also been included in kingdom Protista.

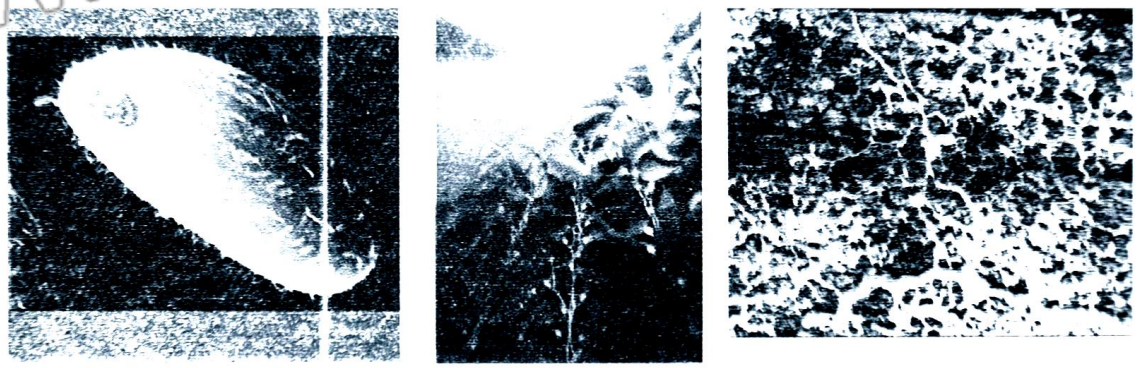


Fig. 7.1 The kingdom protista includes such diverse species as (a) single celled ciliated protozoan, (b) giant brown algae (kelps) and (c) slime molds.

7.3 DIVERSITY AMONG PROTISTS

During course of evolutionary history, organisms in the kingdom Protista have evolved diversity in their different features e.g. in;

- Size
- Habitat
- Structure
- Means of locomotion
- Modes of reproduction
- Ways of obtaining nutrients
- Interaction with other organisms

Diversity is exhibited by all of the major protist groups.

Based on diversity, most biologist regard kingdom Protista as ***polyphyletic group of organisms***. Protists do not share a single common ancestor. Margulis and Schwartz have listed ***27 phyla*** to accommodate this diverse assembling of organisms.

7.4 MAJOR GROUPS OF PROTISTA

The kingdom protista consists of four groups of eukaryotic organisms, which are

1. Protozoans: Animal like Protists.
2. Unicellular Algae: Plant like Protists.
3. Multicellular Algae: Plant like Protists.
4. Slime Molds and Water Molds: Fungus like Protists.

7.4.1 Protozoa: Animal like Protists

- All protozoans are ***unicellular***.
- Most ***ingest*** their food by endocytosis.

A summary of protozoan diversity is given below.

Common Name	Form	Locomotion	Examples
Amoebas	Unicellular, no definite shape	Pseudopods	*Amoeba, Entamoeba*
Zooflagellates	Unicellular, some colonial	One or more flagella	*Trypanosoma, Euglena*
Actinopods	Unicellular	Pseudopods	*Radiolarians*
Foraminifera	Unicellular	Pseudopods	*Forams*
Apicomplexans	Unicellular	None	*Plasmodium*
Ciliates	Unicellular	Cilia	*Paramecium, Vorticella, Stentor*

7.4.1.a) Amoebae

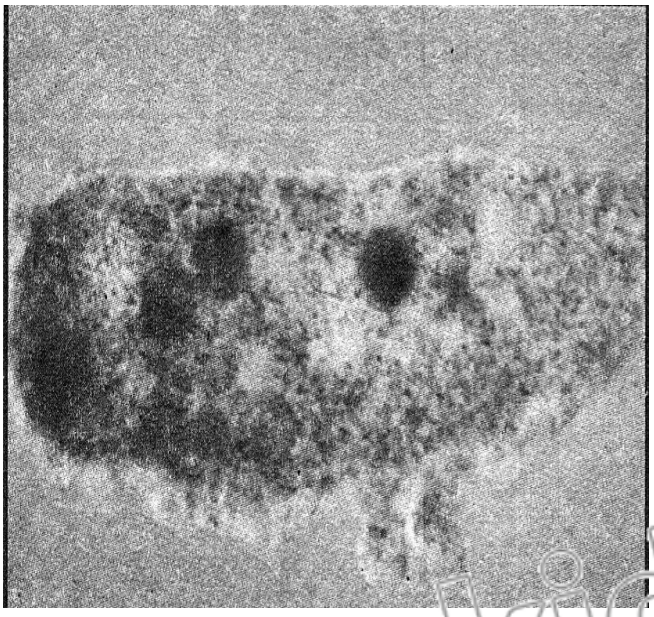
Introduction

This group includes all free-living freshwater, marine and soil amoebae, as well as those that are parasite of animals.

Characteristics

i) Amoebae ***lack flagella***.

ii) They **move by** forming specialized cytoplasmic projections called ***pseudopodia*** (false feet).



Pelomyxa palustris

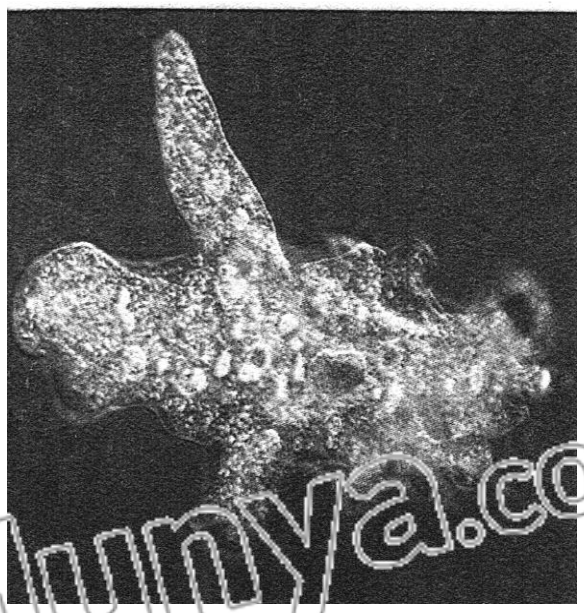


Fig. 7.2 The flowing Pseudopods of Amoeba constantly change shape as the organism moves and feeds.

Example

The intestinal parasite, *Entamoeba histolytica*, causes amoebic dysentery in humans.

The Giant Amoeba

The giant amoeba ***Pelomyxa palustris*** may be the most primitive of all eukaryotic life forms.

Features

- This species ***has multiple membrane bounded nuclei*** but none of the other organelles found in all other eukaryotes.
- The giant amoebas ***obtain energy from methanogenic bacteria,*** which reside inside them.
- Giant amoebas inhibit mud at the bottom of freshwater ponds, where they ***contribute to the degradation of organic molecules.***

7.4.1. b) Zooflagellates

Introduction

This group includes ***mostly unicellular*** and a ***few are colonial*** organisms. They may be free living and as well as those, that are human parasites.

Characteristics

i) They have spherical or elongated bodies with a ***single central nucleus.***

ii) They possess from ***one to many*** long, whip like ***flagella*** that enable them to move.

iii) They ***move rapidly,*** pulling themselves forward by lashing flexible flagella that are usually located at the anterior end.

iv) They obtain their food either by ingesting living or dead organisms or by absorbing nutrients from dead or decomposing organic matter.

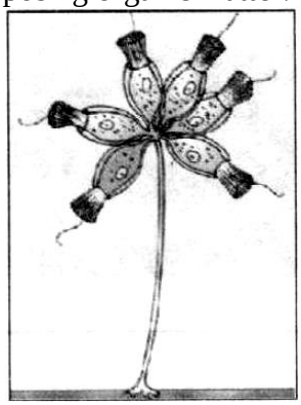


Fig. 7.4 A Colonial Choanoflagellate

Examples Unicellular Zooflagellates

- ***Trichonymphas*** are complex, specialized flagellates with many flagella, which live as symbionts in the gut of termites and help in the digestion of dry wood.

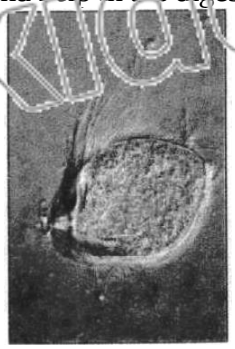


Fig. 7.3 Zooflagellates (a) Trichonympha has hundreds of flagella

- ***Trypanosoma*** is a human parasite causing African sleeping sickness. It is transmitted by the bite of infected tsetse fly.

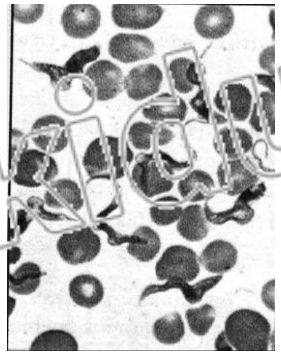


Fig. 7.3 Trypanosoma (b) Causes sleeping sickness

Example of Colonial Zooflagellates

Choanoflagellates are sessile, marine or freshwater flagellates, which are attached by a stalk and their single flagellum is surrounded by a delicate collar.

They are of special interest because to their striking resemblance to collar cells in sponges.

7.4.0.) Ciliates

Introduction

These are unicellular organisms with short, hair like and large number of structures called ***cilia*** which act as locomotary organs. The cilia beat in such a way that the organism not only goes forward but can also move back and turn around.

Characteristics

i) Ciliates possess a flexible outer covering called a ***pellicle*** that gives them a definite but change able shape.

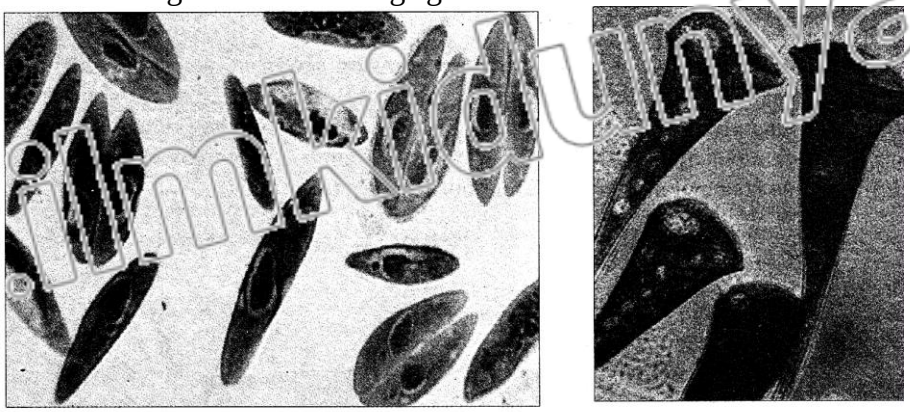
ii) Most ciliates ***ingest*** bacteria or other tiny protists.

iii) Water regulation in freshwater ciliates is controlled by special organelles called ***contractile vacuoles***.

iv) They differ from other protozoans in having **two kinds of nuclei.**

- ***Micronuclei;*** which are small, one or more in number and function in sexual process.
- ***Macronucleus;*** which is single, large, polyploid nucleus that controls cell metabolism and growth.

v) Most ciliates are capable of sexual process called ***conjugation***. During conjugation, two individuals come together and exchange genetic material.



(a) (b)

Fig. 7.5 (a) Paramecium, conjugating individuals **(b)** Stentor, a sessile ciliate.

Types of Ciliates

There are two types of ciliates i.e,

i) Motile Ciliates; *Paramecium*, *Vortticella* etc are common examples.

ii) Sessile Ciliates; *Stentor* is a common example.

7.4.1.d) Foraminiferans and Actinopods

Introduction

These organisms have shell, so also called as shelled organisms.

Characteristics

i) These marine protozoans produce ***shell*** (also called as ***tests***).

ii) Tests of foraminifera are made of ***calcium*** whereas those of actinopods are made of ***silica***.

iii) The shells contain ***pores*** through which cytoplasmic projections can be extended. These ***cytoplasmic projections*** form a sticky, interconnected net that ***entangles prey***.

iv) ***Dead foraminiferans*** sink to the bottom of the ocean where their shells form a grey mud that is gradually **transformed into chalk.** For aminiferans of the past have created vast limestone deposits.

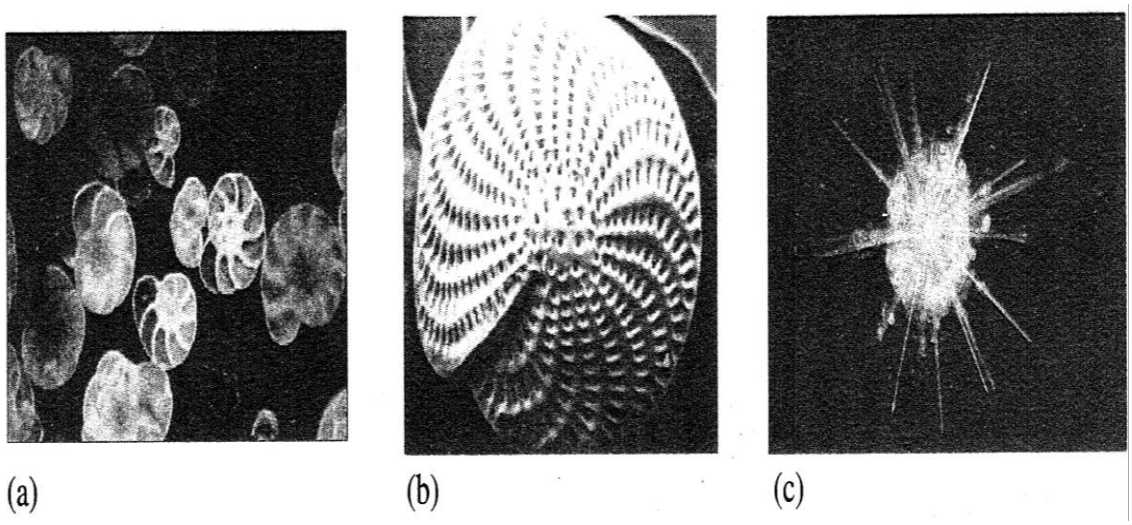


Fig. 7.6 (a) Foraminiferan tests have **(b)** Beautiful geometric patterns and **(b)** pores through which cytolasmic projections are extended **(c)** Radiolarians are actinopods with glassy shells

Example

Forams (foraminiferans) and *Radiolarians* (actinopods) are common examples.

7.4.1.e) Apicomplexans

Introduction

Apicomplexans are a large group of parasitic protozoa, some of which cause serious diseases such as malaria in humans.

Characteristics

i) They lack specific structures for locomotion but ***move by flexing***.

ii) At some stage in their lives, they develop a spore (small infective agent) transmitted to the next host.

iii) Many of them spend part of their life in one host and part in a different host species.

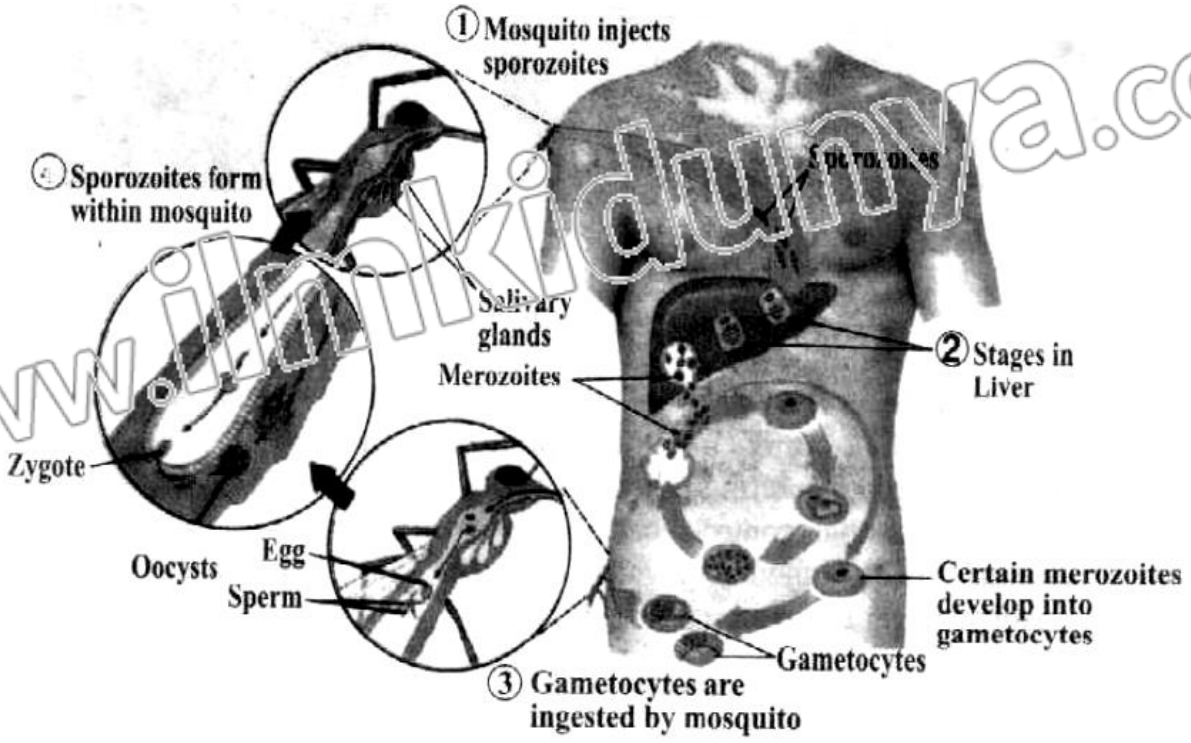


Fig 7.7 The life cycle of the malarial parasite (*Plasmodium*)

Life Cycle of *Plasmodium*

Plasmodium, the apicomplexan, causes malaria. Different steps involved in its life cycle are;

i) It enters human blood through the bite of an infected female *Anopheles* mosquito.

ii) Plasmodium first enters liver cells and then red blood cells where it multiples.

iii) After liver, it attacks on red blood cells. When each infected red blood cell bursts, many new parasites are released.

iv) The released parasites infect new red blood cells and the process is repeated.

v) The simultaneous bursting of millions of red cells causes the symptoms of malaria; a chill, followed by high fever caused by toxic substances that are released and affect other organs of the body.

7.4.2 The Algae: Plant like Protists

Introduction

Algae are photosynthetic protists, carrying out probably ***50 to 60% of all the photosynthesis*** on earth (plants account for most of the rest).

Characteristics

i) Differences from Plants

- Algae differ from plants in their ***sex organs*** which are unicellular while the sex organs of plants are multicellular.
- ***Zygote*** of Algae is not protected by the parent body. A plant zygote, on the other hand, grows into a multicellular embryo that is protected by parental tissue.

ii) Habitat

Almost all are ***aquatic***. When actively growing, algae are restricted to damp or wet environment, such as the ocean, freshwater ponds, lakes and streams, hot springs, polar ice, moist soil, trees and rocks.

iii) Body Structure

Algae exhibit a remarkable range of growth forms i.e,

- Some are ***unicellular.***
- Others are ***filamentous***.
- Filaments are composed either of ***distinct cells*** or ***coenocytes*** (multinucleate structures that lack cross-walls).
- Still others (e.g. sea weeds) are ***multicellular*** and intricately branched or arranged in leaf-like extensions.
- A body, which is not differentiated into true roots, stems and leaves and lacks xylem and phloem is called a ***thallus***.

iv) Photosynthetic Pigments

In addition to ***chlorophyll a***. yellow and orange ***carotenoids*** (photosynthetic pigments) are found in all algae and other pigment (such as ***xanthophyllus*** and ***phycoerythrine***) that are also important in photosynthesis.

➢ Classification of algae into phyla is largely based on their pigment composition.

v) Life Cycle

Algal life cycles show extreme variations, but all algae except members of the phylum Rhodophyta (red algae) have forms with flagellated motile cells in at least one stage of their life cycle.

QUESTION RELATED TO ABOVE ARTICLE

Discuss general characteristics of algae. **(Exercise Question v)**

Table 7.2 CLASSIFICATION OF THE PHOTOSYNTHETIC PROTOCTISTS

Phylum	Common Name	Form	Locomotion	Pigments	Examples
Euglenophyta	Euglenoids	Unicellular	Two flagella one long one short	Chl.a, Chl.b, Carotenoids	*Euglena*
Phyrrophyta	Dinoflagellates	Unicellular	Two flagella	Chl.a, Chl.c, Carotenes including Fucoxanthin	*Gonyaulax, Ceratium*
Chrysophyta	Diatoms	Usually multicellular	Usually none	Chl.a, Chl.c, Carotenes including Fucoxanthin	*Diatoma, Frequilaria, Pinnularia*
Phaeophyta	Brown algae	Multicellular	Two flagella on reproductive cells	Chl.a, Chl.c, Carotenes including Fucoxanthin	*Focus, Macrocystis*
Rhodophyta	Red algae	Multicellular or unicellular	None	Chl.a, Carotenes, Phycoerythrin	*Chondrus, Polysiphonia*
Chlorophyta	Green algae	Unicellular, colonial, multicellular	Most have flagella	Chl.a, Ch.b, carotenes	*Chlorella, Ulva, Acetabularia, Spirogyra*

UNICELLULER ALGAE; PLANT LIKE PROTISTS

7.4.2. a) The *Euglenoids*

On the basis of molecular data, *euglenoids* are thought to be closely related to zooflagellates. *Euglenoids* have at various time been classified in the plant kingdom (with algae) been classified in various groups with time. They have been placed in;

- ***Plant kingdom*** (with algae) because they have pigments for process of photosynthesis.
- ***Animal kingdom*** (in protozoans) because they are closely related to zooflagellates. Some photosynthetic euglenoids lose their chlorophyll when grown in dark and obtain their nutrients heterotrophically by ingesting organic matter.

➢ Other species of euglenoids are always colourless and heterotrophic.

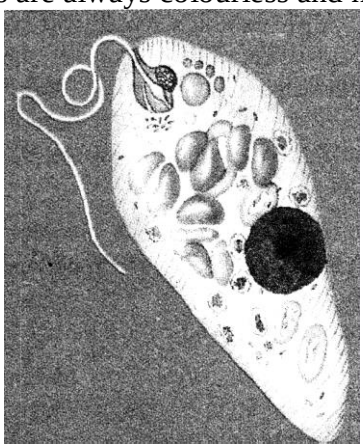


Fig 7.8 Euglenoids have special evolntionary significance as they resemble with plants and green algae in having similar pigments and, on the other hand, are also related to Zooflagellates.

7.4.2. b) Dinoflagellates

Introduction

One of the most unusual protist phyla is that of dinoflagellates.

Characteristics

i) Most dinoflagellates are ***unicellular***.

ii) Their cells are often covered with shells of ***interlocking cellulose plates*** impregnated with silicates.

iii) Ecologically, dinoflagellates are one of the most important groups of ***producers*** (second only to diatoms) in marine ecosystem.

iv) Dinoflagellates are known to have occasional population explosions or ***blooms.*** These blooms frequently colour the water orange, red or brown and are known as ***red tides***.

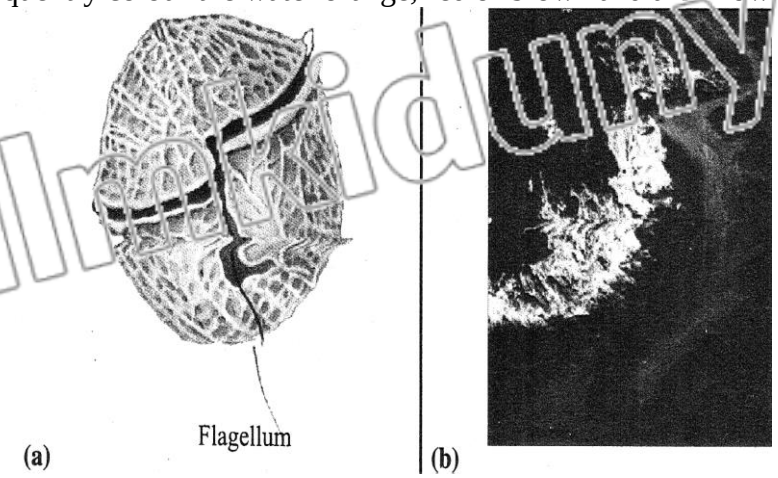


Fig. 7.9 (a) A dinoflagellate showing cellulose plates in the shell and flagella located in the grooves. **(b)** A red tide.

7.4.2. c) Diatoms

Introduction

They are called diatoms because the cell wall of each diatom consists of ***two shells*** that overlap where they ***fit together like a petri dish.***

Characteristics

i) Silica is deposited in the shell, and this glass like material is laid down in intricate pattern

ii) They are very ***important in food chains***

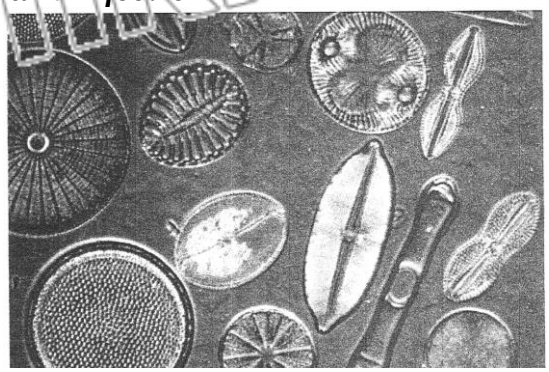


Fig. 7.10 Diatoms have silica shells with extremely beautiful symmetrical patterns

MULTICELLULER ALGAE; PLANT LIKE PROTISTS

7.4.2.d) Brown Algae

Introduction

Brown algae include the ***giants of kingdom protista.***

Characteristics

i) All brown algae are ***multicellular***.

ii) They range in size from a ***few centimeters to*** approximately ***75 meters*** in length.

iii) They are ***common in cooler marine waters***, especially along rocky coastlines in the intertidal zone.

Example

Laminaria The largest brown algae, called the *kelp*, are tough and leathery in appearance. They possess;

- Leaf-like; blades
- Stem-like; stipes
- Root-like; anchoring holdfast.

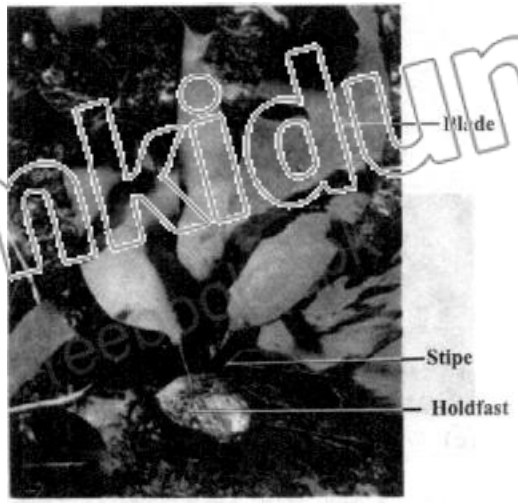


Fig. 7.11 Laminaria, a brown alga showing blades, stipes and holdfast

7.4.2. e) Red Algae

Characteristics

i) They are ***multicellular***.

ii) Body is commonly composed of complex interwoven filaments that are ***delicate*** and ***feathery***.

iii) A few algae are ***flattened sheets*** of cells.

iv) Most are ***attached to rocks*** or other substances by a basal holdfast.

v) Some red algae incorporate calcium carbonate in their cell walls from the ocean and ***take part in building coral reefs*** alongwith coral animals.

Fig. 7.12 Polysiphonia is a representative red alga with world wide distribution

Example

Polysiphonia is representative red algae with worldwide distribution.

7.4.2.f) Green Algae

Introduction

Green algae are considered to be the ***ancestors of plants.***

Characteristics

i) Green algae have ***pigments***, energy reserve products and cell walls that are identical to those of plants.

ii) They are photosynthetic with ***chlorophyll 'a'*** and ***chlorophyll 'b'*** and ***carotenoids*** present in the chloroplast.

iii) Their main energy reserves are stored as ***starch***.

➢ Because of these and other similarities it is generally accepted that plants arose from ancestral green algae.

Relation with plants

Evidence from RNA sequencing also indicates that green algae and the plants form a monophyletic lineage.

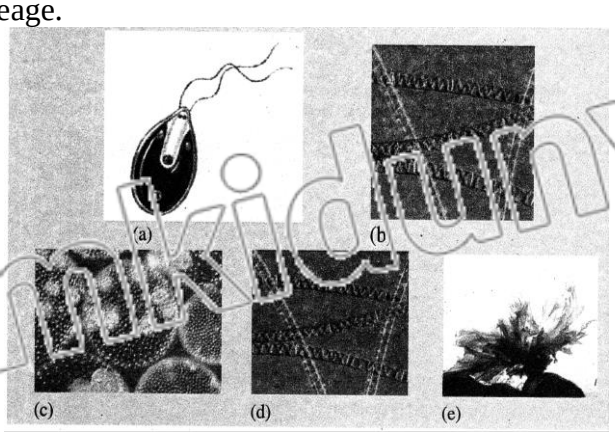


Fig. 7.13 Green algae exhibit diverse forms.
(a) Unicellular Chlamydomonas
(b) Desmids have cells with two halves.
(c) Colonial Volvox
(d) Filamentous Spirogyra
(e) Ulva, having sheet like body

Example

- *Chlamydomonas* and *Chlorella* are (unicellular).
- *Desmids* (cells with two halves).
- *Volvox* (colonial).
- *Spirogyra* (filamentous).
- *Ulva* (sheet-like body) are some examples.

Chlorella

- It is a **unicellular** non-motile green alga.
- Its habitat is fresh water, ponds and ditches.
- It is easily cultured and has been used as an **experimental organism** in research on photosynthesis and investigated as an alternate source of food.

7.4.2.1) Importance of Algae

Algae have great economic and environmental importance for us.

i) Some algae such as ***kelps*** are ***edible*** and may be used to overcome shortage of food in the world.

ii) Marine algae are also ***source of many useful substances*** like algin, agar, carrageenan and antiseptics.

iii) Algae are major ***producers*** of the aquatic ecosystem; thus, they play a basic ***role in food chains***, providing food and oxygen to other organisms.

QUESTION RELATED TO ABOVE ARTICLE

Green algae are considered ancestral organisms of green land plants. Discuss.
(Exercise Question vi)

7.4.3 Fungus-like Protists

Some protists superficially resemble with fungi in some way and differ in other way.

Similarities

Some of their similarities are;

i) They are ***not photosynthetic***.

ii) They have bodies formed of threadlike structures called ***hyphae***.

Differences

Some of their differences are;

i) Many of these protists have ***centrioles***, which are absent in fungi.

ii) Many of them have ***cellulose*** major component of their cell walls where fungi lack cellulose and have cell wall of chitin.

Types

Two major groups of fungus-like protists are;

a) Slime Molds (Myxomycotes).

b) Water Molds (Oomycotes).

7.4.3. a) Slime Molds or Myxomycota

They pass through two important stages.

i) Feeding Stage

The feeding stage of a slime mold is a ***plasmodium***.

Features

Different features of plasmodium are;

- It is a ***multinucleate*** mass of cytoplasm that can grow to ***30 cm*** (1 ft) in diameter.
- It is ***slimy in appearance,*** streams over damp, decaying logs and leaf litter.
- It often forms a ***network of channels*** that cover a large surface area.
- It creeps along and ***ingests*** bacteria, yeasts, spores and decaying organic matter.

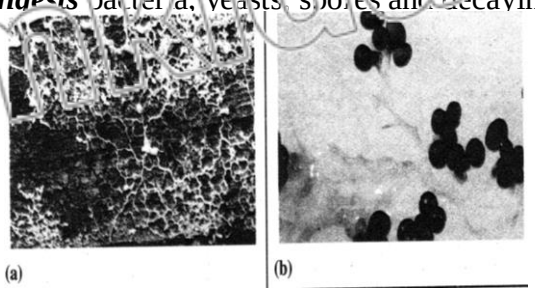


Fig. 7.14 Slime mold ***Physarum***
(a) The Plasmodium is a naked mass of cytoplasm having many nuclei
(b) Reproductive structures are stalked sporangia

ii) Reproductive Stage

Different features of reproductive stage are;

- ***During unfavourable condition,*** slime mold forms resistant haploid spore by meiosis within stalked structures called sporangia.
- ***When conditions become favourable,*** spores germinate into biflagellated or amoeboid reproductive or swarm cells, which unite to form diploid zygote. Zygote produces multinucleate plasmodium, each nucleus being diploid.

Importance

The plasmodial slime mold *Physarum polycephalum* is a model organism that has been used to study many fundamental biological processes, such as;

- Growth and differentiation
- Cytoplasmic streaming
- Function of cytoskeleton

7.4.3.b) Water Molds or Oomycotes

Introduction

Oomycotes show close relations with the fungi and have a similar structure but are now regarded as more ancient group.

Characteristics

i) Their ***cell walls*** contain cellulose, not chitin.

ii) Their ***hyphae*** are aseptate (without cross walls).

Example

Oomycotes include a number of pathogenic organisms, including powdery mildew *Phytophthora infestans*, which have played infamous role in human history.

Irish Potato Famine of the 19th Century

Phytophthora infestans was the cause of Irish potato famine of the 19th century. It causes a disease commonly known as late blight of potatoes. Because of several rainy, cool summers in Ireland in the 1840's, the water mold multiplied unchecked, causing potato tubers to rot in the fields.

Since potatoes were the staple of Irish peasants' diet, many people (250,000 to more than 1 million) starved to death. The famine prompted a mass migration out of Ireland to such countries as the United States.

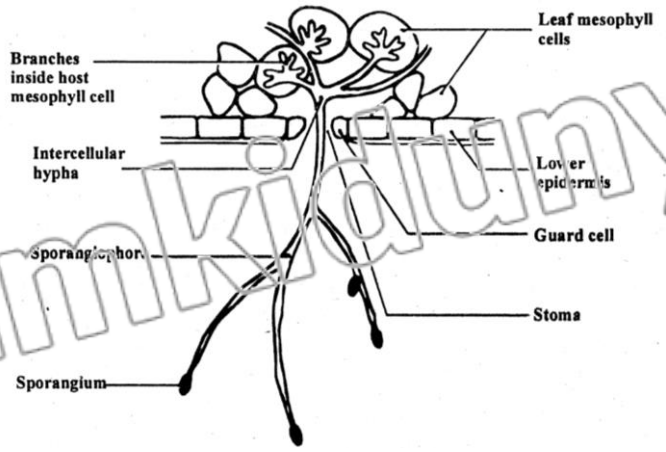


Fig. 7.15 *Phytophthora infestans* growing in a diseased potato leaf, with sporangiophores emerging from the underside of the leaf.

QUESTION RELATED TO ABOVE ARTICLE

Describe structure and reproduction of slime molds. (Exercise Question viii)

KEY POINTS

Polyphyletic and monophyletic evolution:

The evolution from single ancestor is called monophyletic evolution. The evolution of a group of organisms from different ancestors is called polyphyletic evolution.

Pellicle:

The bodies of certain protozoans like paramecium are covered by pellicle. Pellicle is composed of double membranous structure. It is made up of a substance gelatin. It is a firm structure but it is elastic and allows the organisms to contract. It maintains the shape of the organism.

Euglena:

Euglena shows the characters of plants and animals. So it is believed to be the ancestor of both animal and plants.

It shows following characters of animals.

- It is motile.
- It lack cell wall and its outer covering is pellicle.
- It ingests organisms like animals when it lives in darkness.

It shows following characters of plants.

- It has chlorophyll, so it can synthesize its own food.

Food Chain:

The relationship of organisms in which one organism eats and is being eaten by the other. For example, Goat eats grass. Goat itself is eaten by lion and so on.

Difference between Cutin, chitin and cellulose:

- **Cutin:** It is a wax (a lipid). It forms waxy layer on leaves and reduce the loss of water by evaporation.
- **Chitin:** It is aminopolysaccharide. In this case amide group combine with polysaccharide (carbohydrates).

Cellulose:

It is polysaccharide and composed of many molecules of glucose.

EXERCISE

Q.1. Each Question Has Four Options. Encircle Correct Answer.

i) Amoebas move and obtain food by means of:
(a) Plasmodium
(b) Flagella
(c) Cilia
(d) Pseudopodia

ii) The sexual process exhibited by most ciliates is called:
(a) Oogamy
(b) Binary fission
(c) Conjugation
(d) Fertilization

iii) Parasitic protozoans that form spores at some stage in their life belong to which group:
(a) Ciliates
(b) Actinopods
(c) Diatoms
(d) Apicomplexans

iv) Algae which have shells composed of two halves that fit together like petri dish belong to:
(a) Brown algae
(b) Diatoms
(c) Euglenoids
(d) Green algae

v) Algae in which body is differentiated into blades, stipes and holdfast belong to:
(a) Golden algae
(b) Diatoms
(c) Kelps
(d) Euglenoids

vi) Chl.a, Chl.b and carotenoids are found in:
(a) Brown algae, golden algae and diatoms
(b) Green algae, golden algae and euglenoids
(c) Green algae, euglenoids and plants
(d) Red algae, euglenoids and brown algae

vii) The feeding stage of a slime mold is called:
(a) Mycelium
(b) Pseudopodium
(c) Hyphae
(d) Plasmodium

viii) Cell wall in Oomycetes is chemically composed of:
(a) Cellulose
(b) Chitin
(c) Proteins
(d) Lignine

Answers Key:

i	**d**	**vi**	**c**
ii	**c**	**vii**	**d**
Iii	**d**	**viii**	**a**
iv	**B**		
v	**c**		

Q.2. Short Questions

i) Write two characteristics of each of the following groups.

Ans: Protozoa

- All are unicellular.
- Mostly ingest their food by endocytosis.

Dinoflagellates

- Mostly are unicellular.
- They are often covered with cells of interlocking cellulose plates impregnated with silicates.

Diatoms

- Cell wall consists of two shells that overlap where they fit together.
- They are major producers in aquatic ecosystem.

Slime molds

- Feeding stage is plasmodium.
- It can grow to a diameter of 30 cm.

Oomycotes

- Their cell wall contains chitin.
- Their hyphae are aseptate.

Q.3. Extensive Questions.

i) Discuss important features of protists. Why are protists so difficult to classify?

Ans: (See article 7.1)

ii) What are the reasons for grouping simple eukaryotic organisms into a separate kingdom protista?

Ans: (See article 7.2)

iii) How are protists important to humans? What is their ecological importance?

Ans: Animal-like protists (amoeba) use bacteria as food, which otherwise cause diseases in man. Some of them cause diseases in man e.g. antamoeba, plasmodium etc.

Plant-like protists are major source of food and oxygen in aquatic habitat. Some of them are used as food by man e.g. kelp. Some produce chalk e.g. foramineferans.

iv) What are three major groups of protists?

Ans: (See article 7.1)

v) Discuss general characteristics of algae.

Ans: (See article 7.4.2)

vi) Green algae are considered ancestral organisms of green land plants. Discuss.

Ans: (See article 7.4.2f)

vii) What features distinguish Oomycotes from fungi?

Ans: (See article 7.4.3b)

viii) Describe structure and reproduction of slime molds.

Ans: (See article 7.4.3a)