CHAPTER-7
PROTISTS AND FUNGI

Q1. Give the literal meaning of word Protista and define it.

Ans: Literal meaning:

Protist, is a Greek word, meaning **"the very first,"** reflects the idea that protists were the first eukaryotes to evolve.

Definition:

"Protists are defined by exclusion from other groups".

Kingdom Protista consists of a vast assortment of primarily aquatic organisms whose diverse body forms, types of reproduction, modes of nutrition, and life styles make them difficult to characterize.

Q2. Give a detailed outline on the evolutionary relationship of Protists.

Ans: Evolutionary relationship of Protists

Protists are eukaryotic cells. Many biologists interpret the protist kingdom broadly to include.

(i) Heterotrophic protists (the protozoa, slime molds, and water molds).

(ii) Autotrophic protists (the algae).

Polyphyletic origin:

The protist kingdom is a **polyphyletic group** of organisms; that is, protists do not share a single common ancestor. Any eukaryotic organism not considered a fungus, animal, or plant is classified in the kingdom Protista solely for convenience.

Variations exhibited by protists:

(i) Size:

The **size** varies considerably within the protist kingdom, from microscopic protozoa to giant kelps, which are brown algae that can reach 60 metres (almost 200 feet) in length.

(ii) Organization and structure:

Although most protists are unicellular, some have a colonial organization (a colony is a loose aggregation of cells), some are **coenocytic** (multinucleate but not multicellular), and some are multicellular. Unlike fungi, plants and animals, multicellular protists have relatively simple body forms without specialized tissues.

(iii) Mode of nutrition:

Methods of obtaining nutrients differ widely in kingdom protista. The autotrophic protists, e.g., the algae have chlorophyll and photosynthesize as plants do. Some of the heterotrophic protists, the water molds, obtain their food by absorption as fungi do. Other heterotrophs, i.e., the protozoa and slime molds resemble animals i.e., they ingest food derived from the bodies of other organisms.

(iv) Mode of life:

The **mode of life** shows that many protists are free living while others form symbiotic association with different organisms. These associations range from **mutualism,** a more or less equal partnership in which both organisms benefit, to **parasitism** in which one organism lives on or in another and is metabolically

dependent on it. Most protists are aquatic and live in oceans or freshwater. They make up a part of the **plankton.**

(v) Reproduction:

Reproduction is quite varied in the kingdom protists. All protists reproduce asexually and many also reproduce sexually with both meiosis and syngamy (the union of gametes). However most protists do not develop multicellular sex organs, nor do they form embryos.

(vi) Locomotion:

Most protists are motile at some stage of their life cycle and have various means of **locomotion.** Movement may be accomplished by **amoeboid motion,** i.e., extending cell protrusions, by waving **cilia** or by lashing **flagella.** Many protists use a combination of two or more means of locomotion, e.g., both flagellar and amoeboid motion.

Q3. Name the major groups of Protists.

Ans: Protists include four major groups

(i) Protozoa **(ii)** Algae

(iii) Myxomycota **(iv)** Oomycota

Teacher's Point

Teachers would ask the students to explain that what clues clues protists provide with respect to the evolution of the three kingdoms of eukarvotes.

Did You Know?

Naegleria fowleri, an amoeba found in rivers, lakes, springs, drinking water networks and poorly chlorinated swimming pools. It causes primary amoebic meningoencephalitis. The "brain-eating" *Amoeba* has killed 10 persons in 2012, 8 in 2015 and 3 in 2016 in Karachi. Cases have also been reported from Islamabad and other parts of Pakistan.

Science Titbits

Trichonymphas are complex specialized flagellates with many flagella. They live as symbionts in the gut of the termites. It contains a bacterium that enzymatically converts the cellulose of wood to soluble carbohydrates that are easily digested by the insect.



Trichonympha

Teacher's Point

Teachers would guide the students to find out precautionary measures against harmful protozoans.

Science Titbits

All animals are believed to have evolved from a protistan ancestor, most likely a protozoan, because protozoans are heterotrophic, ingest food and are motile.

Did You Know?

Slime molds are organisms that are fungus like in one phase of their life cycle and amoeba like in another phase of their life cycle. Slime molds are similar in some respect to fungi i.e., body is filamentous, saprotroph, formation of zygote, and having nonmotile spores. Slime molds differ from fungi due to the presence of motility in the life cycle.

Teacher's Point

Teachers would guide the students to draw charts to show differences between animal like protists and fungi like protists.

Science Titbits

The ancestry of fungi which evolved about 570 million years ago, has not been determined. It has been suggested, that fungi evolved from red algae because both fungi and red algae lack flagella in all stages of their life cycle.

Information

Rusts are called so because of numerous rusty and orange-yellow coloured disease spots on their host surface (mostly stem, leaves), later revealing brick/rust-red spores of the fungus. **Smuts** are called so because of their black, dusty spore masses that resemble soot or smut; these spore masses replace the grain kernels such as those of wheat, corn etc.

Science, Technology and Society Connections

- **Describe how helpful fungi have been for us as source of antibiotics and other useful chemicals.**

Often the first choice eukaryotic organisms for protein production is the yeast *(Saccharomyces cerevisiae)*. Yeast cells can take up foreign DNA and integrate into their genomes. Yeasts also have **plasmids** that can be used as gene **vectors** and sometime yeasts are better than bacteria at synthesizing and secreting eukaryotic protein. Yeast is currently used to produce a number of proteins. In some cases the same product, for example interferons used in cancer research can be made in either yeast or bacteria. In other cases such as hepatitis B vaccine, yeast alone is used.

Teacher's Point

Teachers would guide the students to write a brief research paper on use of fungi in biological research.

Did You Know?

Poisonous fungi: Edible and poisonous mushrooms can look very much alike and may even belong to the same genus. There is no simple way to tell them apart; they must be identified by an expert. Some of the most poisonous mushrooms belong to the genus **Amanita.** Toxic species of this genus have been appropriately called such names as "destroying angel" *(Amanita virosa)* and "death cap" *(Amanita phalloides)* Eating a single mushroom of either species can be fatal. Jack-o-lantern is a poisonous mushroom. Ingestion of certain species of mushrooms causes intoxication and hallucinations



Amanita



Jack O'Lantern

Teacher's Point

Teachers would guide the students to write about precautionary measures for human diseases caused by fungi.

Activity

1. Observation and drawing of representative members of each group of protists.
2. Observation and drawing labeled diagrams of the life cycle of black bread mold and *penicillium* from fresh culture and prepared slides.

EXERCISE

MCQs

1. Select the correct answer

(i) Which of the following is true of both fungi and some types of bacteria?

(A) they both produce gametes

(B) they both engulf microscopic animals

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(i) Which of the following is true of both fungi and some types of bacteria?

(A) they both produce gametes

(B) they both engulf microscopic animals

(C) they both absorb materials across cell wall
(D) they both fix nitrogen

(ii) The cell wall consists of two over lapping shells in

(A) euglenoids (B) diatoms
(C) dinoflagellates (D) brown algae

(iii) Which algal group is mismatched?

(A) green algae — closed relatives of land plants
(B) dinoflagellates - two part shell
(C) brown algae - include the larges seaweed
(D) diatoms - phytoplankton

(iv) The feeding stage of a slime mold is called

(A) hyphae (B) Plasmodium
(C) rhizoids (D) mycelium

(v) Which is found in slime molds but not in fungi?

(A) non-motile spores (B) amoeboid adult
(C) zygote formation (D) photosynthesis

(vi) Fungi resemble animals because they are

(A) saprotrophs (B) autotrophs
(C) heterotrophs (D) heterosporous

(vii) Fungi cell walls contain chitin, which is also found in exoskeleton of

(A) arthropods (B) molluscs
(C) echinoderms (D) chordates

(viii) In the life cycle of an alternation of generations, multicellular haploid forms alternate with

(A) multicellular diploid form (B) unicellular haploid form
(C) unicellular diploid form (D) multicellular haploid form

(ix) Which of the following is associated with asexual reproduction in fungi

(A) zygospores (B) ascospores
(C) basidiospores (D) conidia

(x) Which protists form colourful and multinucleate masses?

(A) euglenoid (B) cellular slime mold
(C) water mold (D) plasmodial slime mold

Answers

(i) C	(ii) B	(iii) B	(iv) B	(v) B
(vi) C	(vii) A	(viii) A	(ix) D	(x) D

SHORT QUESTIONS

2. What is meant by polyphyatic group?

Ans: The protist kingdom is a **polyphyletic group** of organisms, that is, protists do not share a single common ancestor. Any eukaryotic organism not considered a fungus, animal, or plant is classified in the kingdom Protista solely for convenience.

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3. How do ciliates differ from protozoans?

Ans: Ciliates is a sub group of protozoa. Ciliates has hair like extensions called cilia, e.g., Paramecium. As they are the sub group of protozoa so they don't differ.

4. How do algae differ from plants?

Ans: Algae differ from the plants in this respect that the sex organs in algae are unicellular, the zygote is not protected by the parent body and embryo is not formed.

5. What are the features that distinguish oomycotes from fungi?

Ans:

Oomycotes	Fungi
Cell wall composed of cellulose.	Cell wall composed of chitin.
It is motile.	It is immotile.
Diploid nuclei.	Haploid nuclei.
Usually un-pigmented vegetative and reproductive structures.	Pigmentation is very common in hyphae or spores. Common pigments are melanin and carotenoids.
Oomycetes produce oospores during sexual reproduction.	Oospores are absent in true fungi.
Major energy reserve is Mycolaminarin.	Major energy reserve is Glycogen

6. What is zygospore and how it is formed?

Ans: Zygospore:

It is a thick-walled sexual spore produced by a zygomycote.

Formation:

Sexual reproduction takes place by **conjugation.** When hyphae (stolon) of opposite mating types meet, hormones are produced that cause the tips of the hyphae to come together and to **form gametangia,** structures that produce gametes. These structures become separated from rest of the mycelium by the formation of **septa.** Plus and minus nuclei.then fuse to form a diploid nucleus, the **zygote.** The zygote develops into a **zygospore.**

7. How fungi resemble plants?

Ans: Fungi resemble plants because they have cell wall, lack centrioles and both are multicellular organisms.

8. How fungi get their nutrition?

Ans: The **mode of nutrition in fungi** is heterotrophic. Digestion takes place outside the body and nutrients are absorbed directly. If carbohydrate is stored, it is usually as glycogen and not starch.

9. What are the methods of asexual reproduction in fungi?

Ans: Following are three methods for asexual reproduction in fungi.

(i) Mitosis **(ii)** Budding **(iii)** Fragmentation

10. Name few fungi from which antibiotics are obtained.

Ans: Followihg are the names of the fungi from which antibiotics are obtained.

(i) *Penicillium chrysogenum.*

(ii) *Tolypocadium inflatum.*

(iii) *Penicillium nigricans.*

11. Give examples of edible fungi.

Ans: Following are the examples of edible fungi.

(i) ***Aspergilus tamari*** is used to produce soya sauce.

(ii) ***Agaricus*** is an edible mushroom usually use in pizza.

(iii) **Morels** have fruiting body i.e. ascocarp which is use as food.

12. Define/Describe/Explain briefly:

mutualism, parasitism, plankton, amoeboid motion, contractile vacuole, zooflagellates, acomplexans, thallus, euglenoid, dianoflagellates, diatoms, brown algae, red algae, kelp, green algae, gametangia, zooplankton, mycology, mycelium, zygospore, conidia, dikaryote, ascocarp, basidiocarp, cyclosporine, griseofulvin, lichens, mycorrhizae, humus, histoplasmolysis, ergotism

Ans: Mutualism:

Mutualism, a more or less equal partnership, in which both organisms are equally benefited.

Parasitism:

Parasitism is a relation between organisms, in which one organism lives on or in another and is metabolically dependent on other organism.

Plankton:

Most protists are aquatic and live in oceans or freshwater. They make up a part of the plankton.

OR

Planktons are small organisms that float or drift in great numbers of bodies in salt or fresh water. Plankton is a primary food source for many animals, and consists of bacteria, protozoans, certain algae, cnidarians, tiny crustaceans such as copepods, and many other organisms.

Amoeboid motion:

Amoeboid movement is the most common mode of locomotion in eukaryotic cells. It is a crawling-like type of movement accomplished by protrusion of cytoplasm of the cell involving the formation of pseudopodia ("false feet") and posterior uropods.

Contractile vacuole:

A membrane-enveloped cellular organelle, found in many microorganisms, that periodically expands, filling with water, and then contracts, expelling its contents to the cell exterior. Thus it is important in maintaining hydrostatic equilibrium.

Zooflagellates:

Protozoans that move by means of flagella are called **zooflagellates.**

Apicomplexans:

Apicomplexans is a large group of parasitic protozoa. Some cause diseases in man, e.g., *Plasmodium* (malarial parasite).

Thallus:

In multicellular algae, e g., sea weeds, the body is branched or leaflike called thallus.

Euglenoid: **Euglenoids** are small freshwater organisms, e g., *Euglena.*

Dianoflagellates:

A single-celled organism with two flagella, occurring in large numbers in marine plankton and also found in fresh water. Some produce toxins that can accumulate in shellfish, resulting in poisoning when eaten. Dinoflagellates vary in colour from yellow, green to brown.

Diatoms:

Diatoms are the most numerous unicellular algae in the oceans. They are also plentiful in freshwater. The cell wall has two halves, with the larger halves acting as a "lid" for the smaller half.

Brown algae:

Brown algae range from small forms with simple filaments to large multicellular forms up to 75 metre in length, live in cooler marine water.

Red algae:

Red algae are multicellular present chiefly in warmer seawater growing in both shallow and deep waters. They can be up to a metre long attached to rocks or other substances by a basal holdfast.

Kelp: The large brown algae are called **kelps.**

Green algae:

Green algae *(al-ji)* live in the ocean but are more likely found in freshwater and can even be found on land, e g , *Chlamydomonas, Spirogyra. Volvox, Chlorella, Ulva.*

Gametangia:

A gametangium (plural: gametangia) is an organ or cell in which gametes are produced that is found in many multicellular protists, algae, fungi, and the gametophytes of plants.

Zooplankton:

In oceans, freshwater lakes and ponds are **zooplanktons** that feed on phytoplanktons, and are important as primary consumers in the food chain.

Mycology:

Fungi (singular, *fungus)* can live in darkness and also in light. The study of fungi is called **mycology.**

Mycelium:

The thallus or the body of most fungi is a multicellular structure known as **mycelium.**

Zygospore:

It is a thick-walled sexual spore produced by a zygomycote.

Conidia:

Asexual reproduction involves production of spores called conidia (singular: *conidium)* or **conidiospores** (Gk: *konis,* dust, and *spora,* seed). Conidia vary in shape, size and may be multicellular. There are no sporangia in Ascomycotes. The conidia develop directly on the tips of modified aerial hyphae called **conidiophores.** The colour of conidia is what gives the characteristic brown, blue, pink or other tint to **many of** these molds.

Dikaryote:

Sexual reproduction takes place after two hyphae grow together and their cytoplasm mingles. Within this fused structure, nuclei from **the** parent hyphae pair

but do not fuse. New hyphae develop from the fused structure and the cells of these hyphae are **dikaryotic.**

Ascocarp:

The n + n hyphae form a fruiting body known as **ascocarp.** The **asci** develop in the ascocarp. The asci are usually surrounded by sterile hyphae. An ascocarp is a **fruiting body.**

Basidiocarp:

Basidiomycotes are included in the phylum **Basidiomycota.** Included in this phylum are mushrooms, bracket fungi, rust, smut and puffballs. These structures are all fruiting bodies called **basidiocarps.**

Cyclosporine:

Cyclosporins are obtained from soil fungus *(Tolypocadium inflatum)* is used in organ transplantation for preventing transplant rejection.

Griseofulvin:

Griseofulvin obtained from a fungus *(Penicillium nigricans)* is used to inhibit fungal growth.

Lichens:

Mutualism is the association in which both the partners are benefitted. The two key **mutualistic symbiotic association** formed by the fungi are lichens and mycorrhizae.

Lichens are an association between a fungus (mostly Ascomycotes and a few basidiomycotes), a cyanobacterium or green alga. The body of lichen has three layers. The upper layer is thin and tough which consists of fungal hyphae. The middle layer consists of fungal hyphae interwoven with photosynthetic cell. Bottom layer consists of loosely packed fungal hyphae.

Mycorrhizae:

Mycorrhizae are mutualistic relationships between soil fungi and the roots of most plants. The hyphae help in the direct absorption of phosphorous, zinc, copper and other nutrients from the soil into the roots. Plants whose roots are invaded by mycorrhizae grow more successfully than do plants without mycorrhizae.

Humus:

Humus is an important constituent of soil and essential for the proper growth of plants. It is formed from the organic waste material through the activities of fungi and bacteria.

Histoplasmolysis:

Histoplasmolysis is a serious infection of the lungs caused by inhaling spores of a soil fungus.

Ergotism:

Ergotism is caused by purple ergot rye. It causes nervous spasm, convulsion, psychotic delusion and even gangrene.

13. Write the differences between:

(a) mutualism and parasitism
(b) zooflagellates and ciliates
(c) aseptate and septate hyphae
(d) oogonium and antheridium
(e) oospore and zygospore
(f) mycelium and conidium

(g) oospore and conidia
(h) monokarotic and dikaryotic cell
(i) fungi and plants
(j) fungi and animals
(k) zygomycota and basidiomycota
(l) sporangium and ascocarp
(m) ascus and basidium
(n) endomycorrhizae and ectomycorrhizae

Ans: (a) mutualism and parasitism:

Mutualism	Parasitism
Mutualism, a more or less equal partnership, in which both organisms are equally benefited.	Parasitism is a relation between organisms, in which one organism lives on or in another and is metabolically dependent on other organism.
In mutualism both organisms get benefits.	In parasitism, only one organism gets the benefit.
Example: Lichen and Mycorrhizae	**Example:** Human and a worm(the one in the stomach) are having the parasitism

(b) zooflagellates and ciliates:

Zooflagellates	Ciliates
Zooflagellates move with the help of flagella.	Ciliates move with the help of cilia.
They have single central nucleus.	They have two nuclei.
Example: Trypanosoma.	**Example:** Paramecium.

(c) aseptate and septate hyphae:

Septate hyphae	Aseptate hyphae
Septate hyphae have cross-walls (called septa) that divide the cytoplasm into segments.	Nonseptate hyphae have no cross walls and are just long, continuous tubes of cytoplasm.
They have openings called pores between the cells.	They lack pores.
They have slowly transport nutrients.	They allow quick transport of nutrients.

(d) oogonium and antheridium:

Oogonium	Antheridium
The female **gametangium** is called **oogonium.**	The male gametangium is called an **antheridium.**
Oogonium is female reproductive part of Algae and fungi.	They are male organs of oomycota, bryophytes and pteridophytes.
An Oogonium forms a large number of male gametes.	An antheridium forms a large number of male gametes
They are immotile.	The male gametes produced in an antheridium are usually motile.

(e) oospore and zygospore:

Oospore	Zygospore
They are thick walled cells found in water molds.	A thick walled sexual spore found in zygomycote.
They result by the fusion of male nuclei with egg in oogonium.	They result by the fusion of fungal hyphae.
It may or may not undergo meiosis	Undergoes meiosis.
They are produced in oomycota.	They are produced in zygomycota.

(f) mycelium and conidium:

Mycelium	Conidium
The thallaus of fungi is called mycelium.	The spores of ascomycota are called Conidium.
They are immotile.	They are motile.
They are not brightly coloured.	They are brightly coloured e.g blue, pink or brown.
They develop by a network of fungal hyphae.	They develop by asexual reproduction in conidiospores.

(g) oospore and conidia:

Oospore	Conidia
They are thick walled cells found in water molds.	The spores of ascomycota are called Conidium.
They are immotile.	They are motile.
They are formed as a result of sexual reproduction.	They are formed as a result of asexual reproduction.
They are produced in oomycota.	They are produced in ascomycota.

(h) monokarotic and dikaryotic cell:

Monokarotic cell	Dikaryotic cell
Monokarotic cell characterized by single nucleus	Dikaryotic cell is characterized by two nuclei.

(i) fungi and plants:

Fungi	Plants
Fungi have no chlorophyll and therefore cannot make their own food.	Plants have chlorophyll and therefore can make their own food.
Fungi cells do not differentiate and therefore Fungi have no roots, stems, leaves, bark, etc.	Plants have roots, stems, leaves and bark, etc.
Fungi cell walls are made of chitin.	Plant cell walls are made of cellulose.
Fungi generally are the decomposers of the ecosystem .	Plants are the producers in ecosystem.
Fungi may be septate or aseptate	Plants have a definite cell wall.
Fungus reproduce by spores	Plants reproduce by seeds

Examples: Yeasts, Mold and Mushrooms.	**Examples:** Trees, moss and bushes.

(j) Fungi and Animals:

Fungi	Animals
They have cell walls.	They do not have cell walls
They do not have tissue and sense organs	They have tissue and sense organs.
There method of nutrient intake is absorption.	There method of nutrient intake is ingestion.
Fungi don't move under their own power.	Animals move by cilia, flagella, or muscular structures so they are motile.

(k) zygomycota and basidiomycota:

Zygomycota	Basidiomycota
Zygomycota is the division of fungi having sexually produced zygospores	Basidiomycota comprises fungi bearing the spores on a basidium called basidiospores.
They are called conjugating fungi.	They are called club fungi.
They are non septate.	They are septate.
Example: Rhizopus nigricans	**Example:** Mushrooms, rusts and smut

(i) sporangium and ascocarp:

Sporangium	Ascocarp
It is a spore bearing structure.	It is a fruiting body of ascomycota.
They are usually spherical and rounded.	They have different shapes i.e club shaped, flask shaped.
It produces and liberates spores.	They further produce ascospore.

(m) ascus and basidium:

Ascus	Basidium
They are the fruiting bodies of ascomycota.	They are clubbed shaped structures on hyphae of basidiomycota.
Ascus produces spores inside there bodies.	They produce spores on there external surface.
They produce ascospores.	They produce basidiospores.

(n) endomycorrhizae and ectomycorrhizae:

Endomycorrhizae	Ectomycorrhizae
Endomycorrhizae have an exchange mechanism on the inside of the root.	**Ectomycorrhizae** live only outside of the root.
Endomycorrhizae penetrate only into the outer cells of plant root forming coils, swellings and minute branches and also extend out into surrounding soil.	Ectomycorrhizae form a mantle that is exterior to the root, and they grow between cell walls.

Examples:	Examples:
Most Vegetables, Grasses, Flowers, Shrubs, Fruit Trees, and Ornamentals.	These are mostly formed with pines, firs etc.

EXTENSIVE QUESTIONS

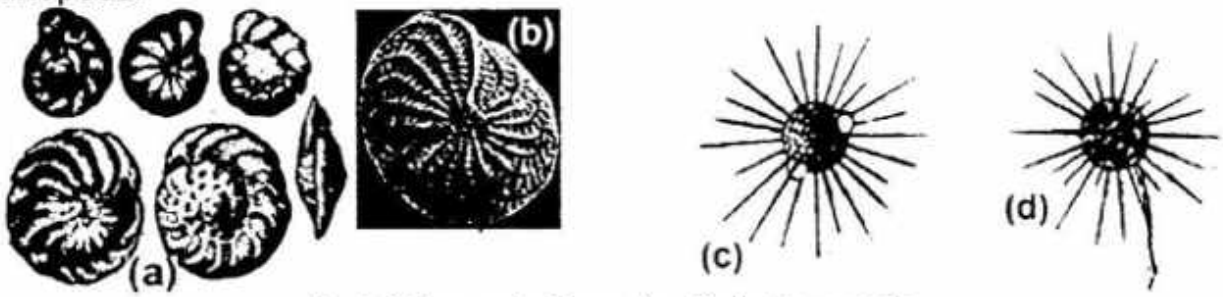
14. Explain protists as a diverse group of eukaryotes.

Ans: Protozoa: The Animal like Protists:

The name protozoa comes from the Latin word meaning **"first animals"** (sing: *protozoon)*. The term protozoa is used today to designate an informal group of protists that ingest food. Protozoa are polyphyletic group.

Mode of life:

Protozoans are mostly aquatic, **freshwater,** e.g., *Amoeba, Paramecium,* **parasitic** e.g., *Plasmodium. Entamoeba histolytica.* Some are **marine,** e.g., Actinopods.



(a, b) **Foraminifera** (c, d) **Actinopods**

Cell morphology:

Body of the protozoan is a single mass of cytoplasm and consists of one cell containing all the structures of a typical cell.

Protozoans have organelles called **vacuoles** to perform special function. Their food is digested inside **food vacuoles.** Freshwater protozoans have **contractile vacuoles** for the elimination of water. Some protozoans have **shell,** e.g., Foraminifera.

Reproduction:

Reproduction takes place by asexual and sexual method.

Locomotion:

The organs of locomotion are pseudopodia, e.g., *Amoeba,* cilia, e.g., *Paramecium,* flagella, e.g., *Trypanosoma,* the parasitic protozoans do not have any specific means of locomotion, e.g., *Plasmodium* (malarial parasite).

Regeneration:

Regeneration is common in protozoans. Protozoans form resistant cyst to overcome unfavourable conditions. *Amoebas* move and feed with the help of pseudopodia, e.g., *Amoeba proteus, Entamoeba histolytica.*

Examples:	Examples:
Most Vegetables, Grasses, Flowers, Shrubs, Fruit Trees, and Ornamentals.	These are mostly formed with pines, firs etc.

EXTENSIVE QUESTIONS

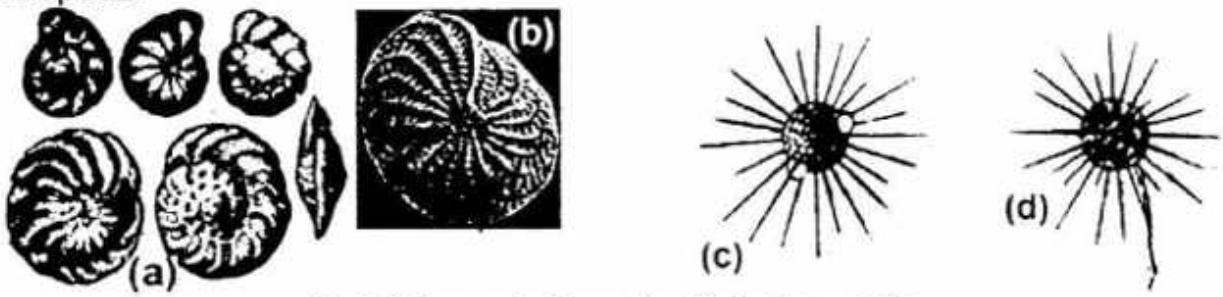
14. Explain protists as a diverse group of eukaryotes.

Ans: Protozoa: The Animal like Protists:

The name protozoa comes from the Latin word meaning **"first animals"** (sing: *protozoon)*. The term protozoa is used today to designate an informal group of protists that ingest food. Protozoa are polyphyletic group.

Mode of life:

Protozoans are mostly aquatic, **freshwater,** e.g., *Amoeba, Paramecium,* **parasitic** e.g., *Plasmodium. Entamoeba histolytica.* Some are **marine,** e.g., Actinopods.



(a, b) **Foraminifera** (c, d) **Actinopods**

Cell morphology:

Body of the protozoan is a single mass of cytoplasm and consists of one cell containing all the structures of a typical cell.

Protozoans have organelles called **vacuoles** to perform special function. Their food is digested inside **food vacuoles.** Freshwater protozoans have **contractile vacuoles** for the elimination of water. Some protozoans have **shell,** e.g., Foraminifera.

Reproduction:

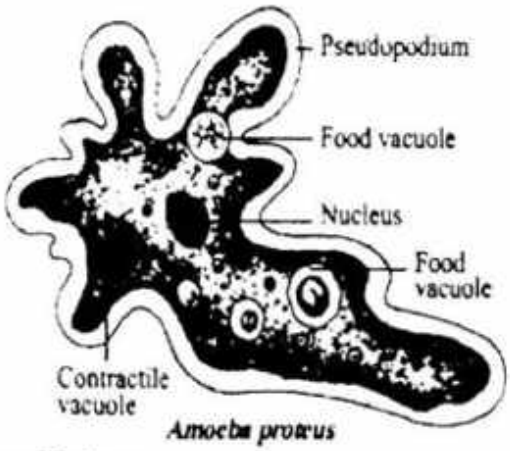
Reproduction takes place by asexual and sexual method.

Locomotion:

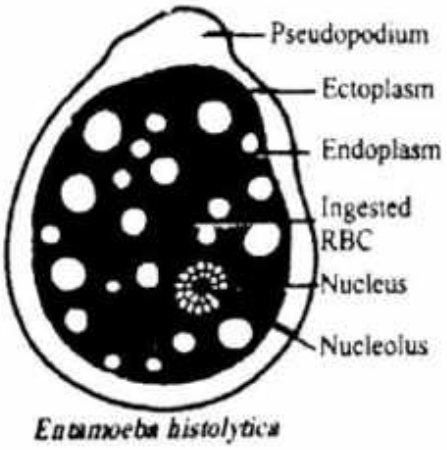
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Regeneration:

Regeneration is common in protozoans. Protozoans form resistant cyst to overcome unfavourable conditions. *Amoebas* move and feed with the help of pseudopodia, e.g., *Amoeba proteus, Entamoeba histolytica.*



Amoeba proteus

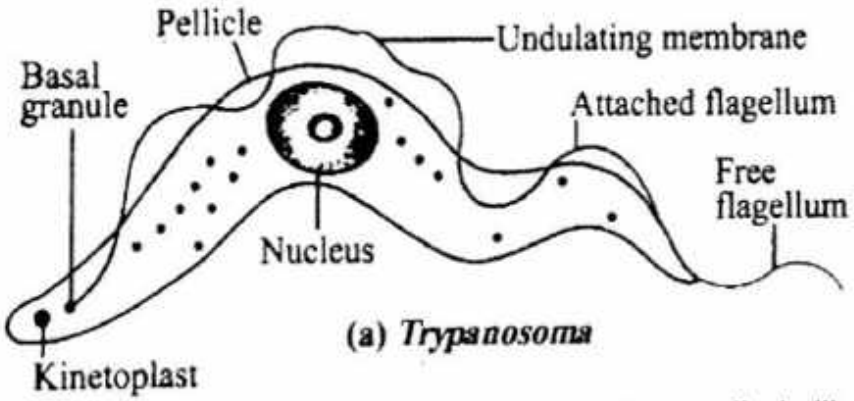


Entamoeba histolytica

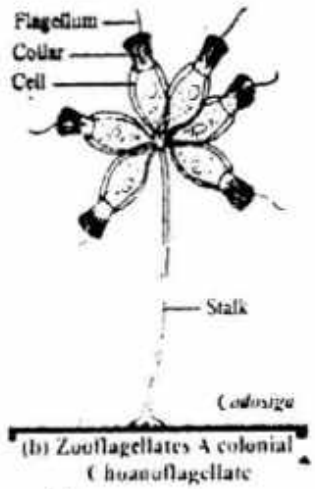
Zooflagellates:

Protozoans that move by means of flagella are called **zooflagellates.** *Trypanosoma* is a human parasitic flagellate.

Choanoflagellate is marine or freshwater flagellate. It is sessile and remains attached by a stalk. Flagellum is surrounded by a delicate collar which resembles the collar cell of sponges.



(a) *Trypanosoma*



(b) Zooflagellates A colonial Choanoflagellate

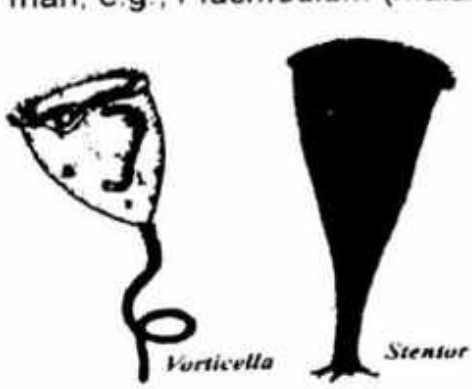
Ciliates: Ciliates have hair like extensions called cilia, e.g., *Paramecium.*

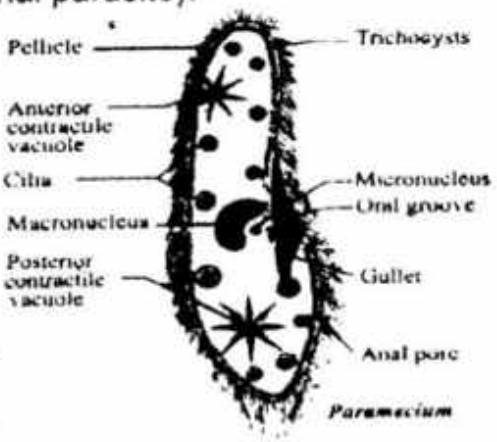
Protozoans with shells:

Foraminifera and Actinopods are marine protozoans. They produce tests or shells. In actinopods shells are made up of silica.

Apicomplexans:

Apicomplexans is a large group of parasitic protozoa. Some cause diseases in man, e.g., *Plasmodium* (malarial parasite).





Ciliates

Algae: The Plant like Protists:

Occurrence:

Algae (singular: *alga)* are found in ocean, freshwater ponds, lakes, streams, hot springs, polar ice, moist soil, trees and rocks.

Cell morphology and organization:

Algae may be unicellular, filamentous or multicellular. Filaments are composed of multicellular structures, with distinct cells or lack cross-walls (coenocytes). In multicellular algae, **e.g., sea weeds**, the body is branched or leaflike called thallus.

Pigment composition:

The photosynthetic pigments found in algae are chlorophyll "a", yellow and orange carotenoids, xanthophyll and phycoerytnrin.

Variation in Algal life cycle:

Algal life cycle shows extreme variations. All algae except the red algae (Phylum Rhodophyta) have forms with flagellated motile cells in at least one stage of their life cycle.

Peculiar nature:

Algae differ from the plants in this respect that the sex organs in algae are unicellular, the zygote is not protected by the parent body and embryo is not formed.

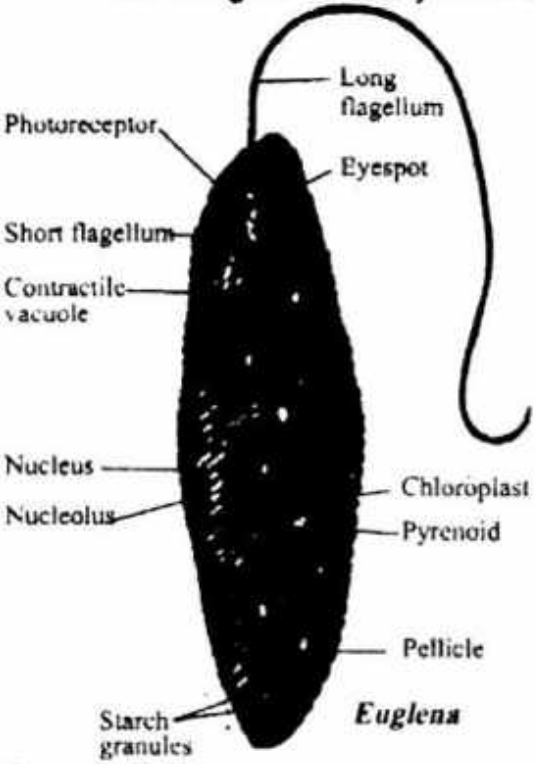
Classification:

Euglenoids:

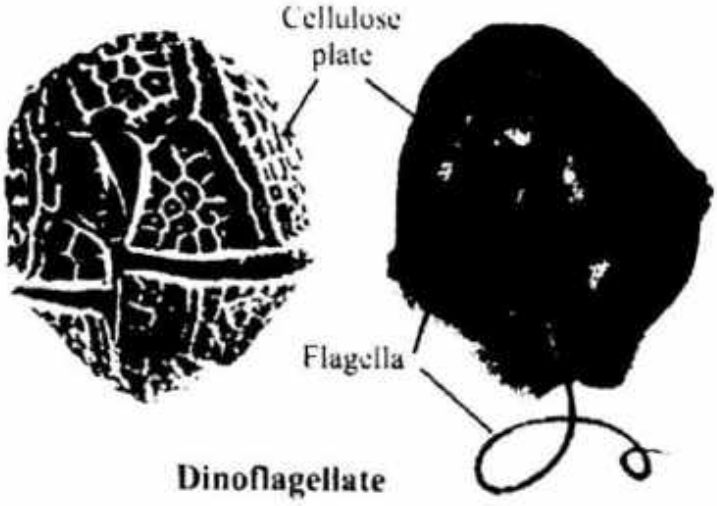
Euglenoids are small freshwater organisms, e.g., *Euglena.*

Dinoflagellates:

Dinoflagellates vary in colour from yellow, green to brown.



Euglena



Dinoflagellate

Diatoms:

Diatoms are the most numerous unicellular algae in the oceans. They are also plentiful in freshwater. The cell wall has two halves, with the larger halves acting as a "lid" for the smaller half.

Brown algae:

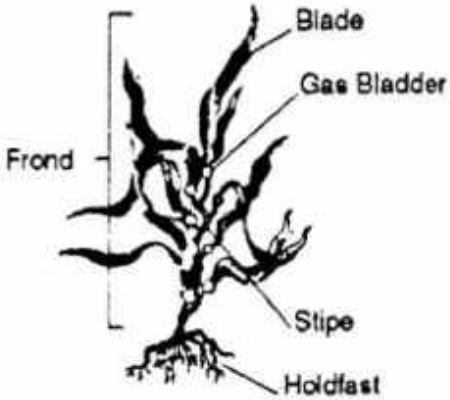
Brown algae range from small forms with simple filaments to large multicellular forms up to 75 metre in length, live in cooler marine water. The large brown algae are called **kelps.**

Red algae:

Red algae are multicellular present chiefly in warmer seawater growing in both shallow and deep waters. They can be up to a metre long attached to rocks or other substances by a basal holdfast.



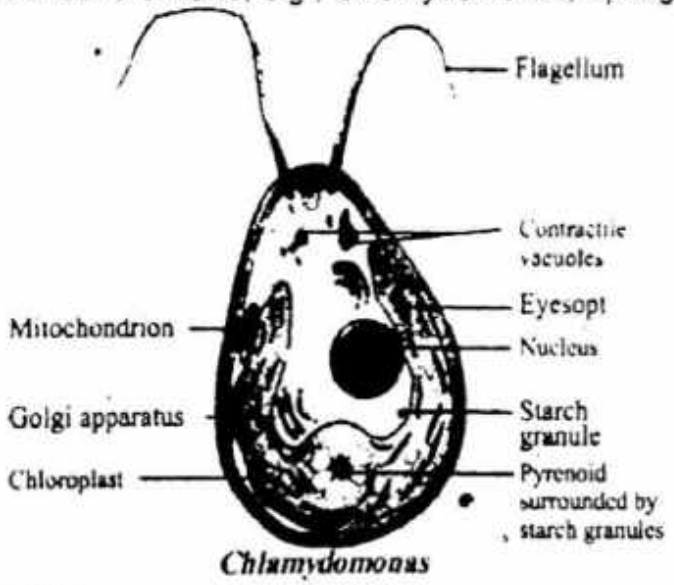

Diatoms



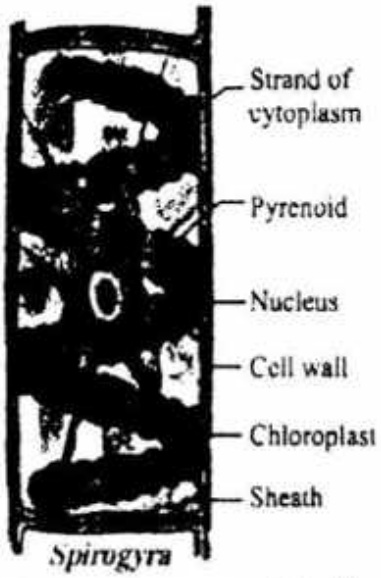
Brown algae *Laminaria*

Green Algae:

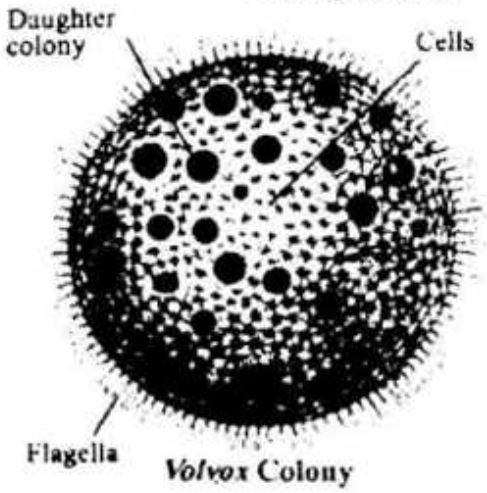
Green algae *(al-ji)* live in the ocean but are more likely found in freshwater and can even be found on land, e.g., *Chlamydomonas, Spirogyra, Volvox, Chlorella, Ulva.*



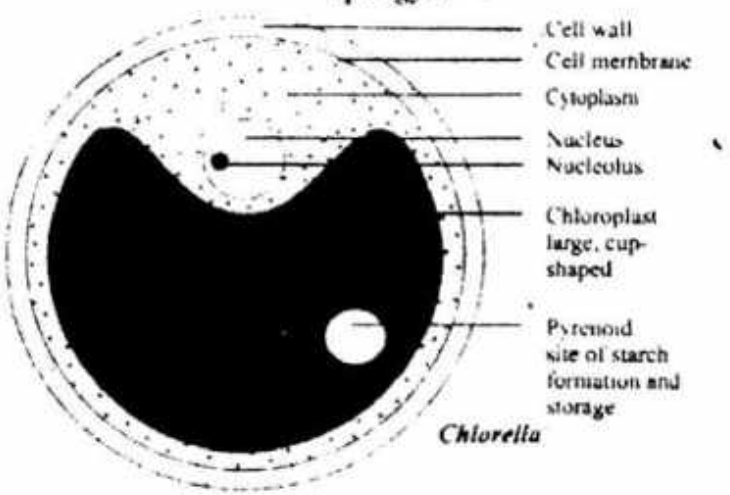
Chlamydomonas



Spirogyra



Volvox Colony



Chlorella

Fungi like Protists: Myxomycota and Oomycota:

Myxomycota: Slime Molds:

Usually **plasmodial slime molds** exist as a **Plasmodium.** It is a diploid multinucleated cytoplasmic mass enveloped by slime sheath.

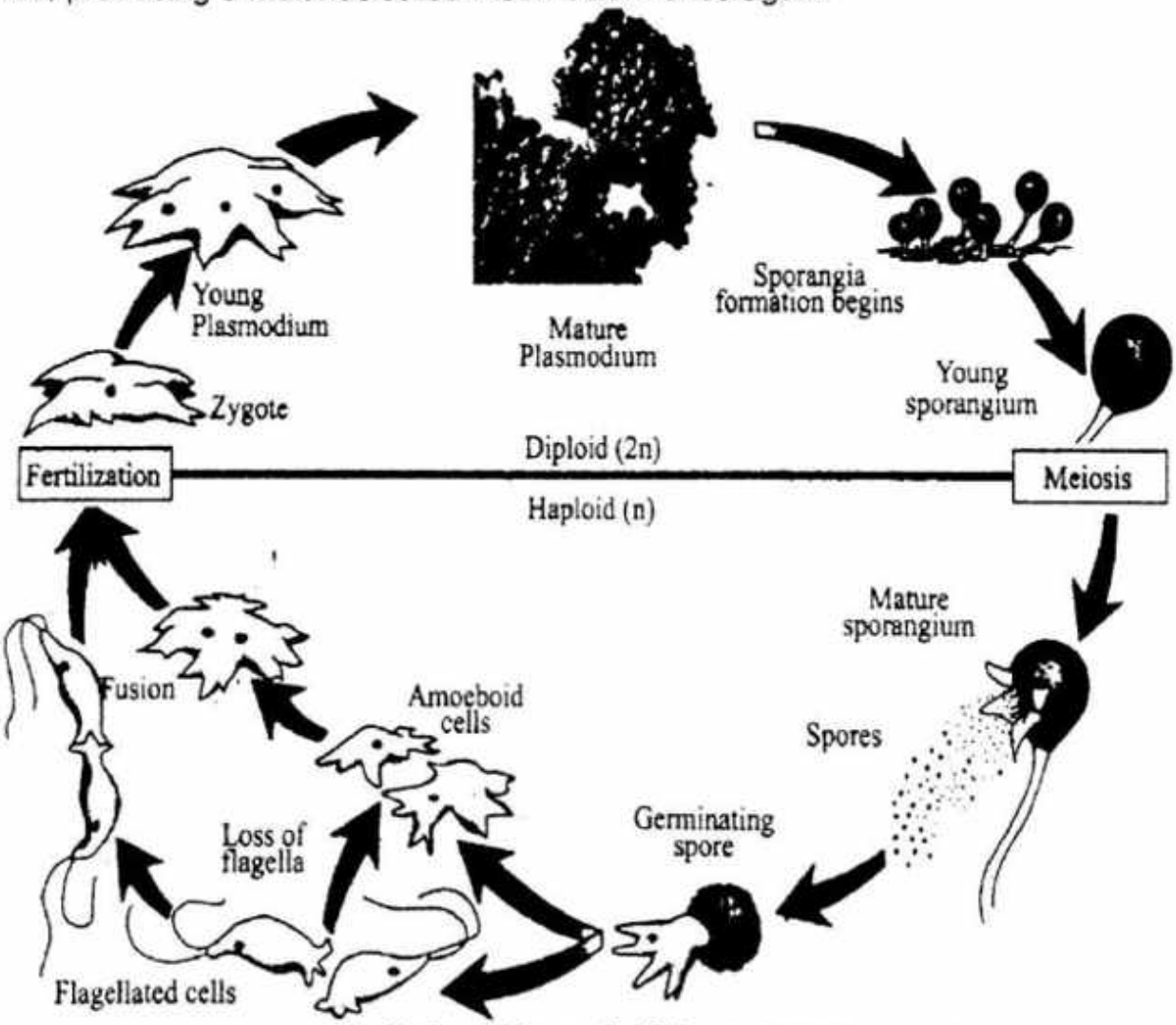
Characteristics:

Characteristics of slime molds are interesting to biologists because the life cycle involves many changes in form. These different forms resemble other types of protists.

Life cycle:

At times unfavourable to growth, such as during drought the Plasmodium develops many sporangia. A sporangium (Gk. *spora*, seed, and *angeion*, vessel) is a reproductive structure that produces spores by meiosis.

In **plasmodial slime molds,** spores release a haploid flagellated cell or an **amoeboid cell.** Eventually two of them fuse to form a diploid zygote that feeds and grows, producing a multinucleated Plasmodium once again.



Life Cycle of Plasmodial Slime Mold (*Physarum*)

Oomycota: The Water Molds:

Oomycotes include water molds, white rusts and downy mildews.

Characteristics:

(i) All of the members of the group are either parasites or saprotrophs.

(ii) The cell wall contains cellulose, not chitin like fungi.

(iii) Their life cycles are characterized by gametic meiosis resulting in a diploid phase.

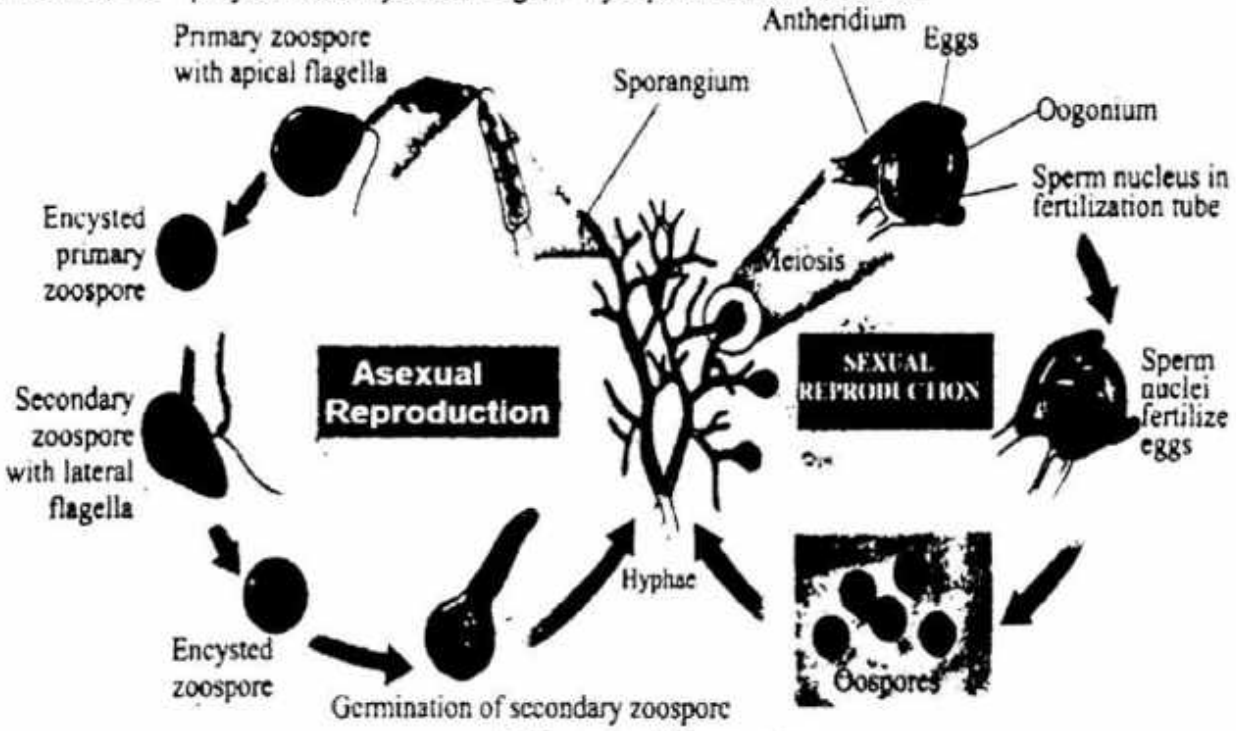
(iv) The filamentous structures are called **hyphae** as in fungi. The hyphae are **aseptate,** i.e., without intercellular cell wall.

(v) Most oomycotes live in freshwater or saltwater or in soil. Some are plant parasites. A few aquatic oomycotes are animal parasites.

Life cycle:

Zoospores are motile and have two flagella. Zoospores are produced asexually in sporangium. For sexual reproduction there are two types of **gametangia.** The female **gametangium** is called **oogonium** and the male gametangium is called an **antheridium.**

The flowing of the contents of an antheridium into an oogonium leads to the individual fusion of one or more pairs of male nuclei with eggs. This produces a special kind of thick walled cell called an **oospore.** This structure gives the phylum its name, i.e phylum oomycota, e.g., *Phytophthora infestans.*



Life cycle of Oomycotes

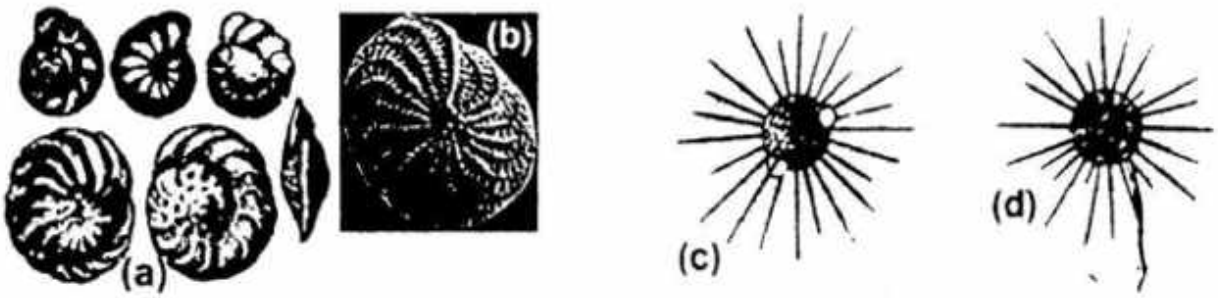
15. Explain the salient features of the protists Protozoa and give examples.

Ans: Protozoa: The Animal like Protists:

The name protozoa comes from the Latin word meaning **"first animals"** (sing: *protozoon).* The term protozoa is used today to designate an informal group of protists that ingest food. Protozoa are polyphyletic group.

Mode of life:

Protozoans are mostly aquatic, **freshwater,** e.g., *Amoeba, Paramecium,* **parasitic** e.g., *Plasmodium, Entamoeba histolytica.* Some are **marine,** e.g., Actinopods.



(a, b) **Foraminifera** (c, d) **Actinopods**

Cell morphology:

Body of the protozoan is a single mass of cytoplasm and consists of one cell containing all the structures of a typical cell.

Protozoans have organelles called **vacuoles** to perform special function. Their food is digested inside **food vacuoles.** Freshwater protozoans have **contractile vacuoles** for the elimination of water. Some protozoans have **shell,** e.g., Foraminifera.

Reproduction:

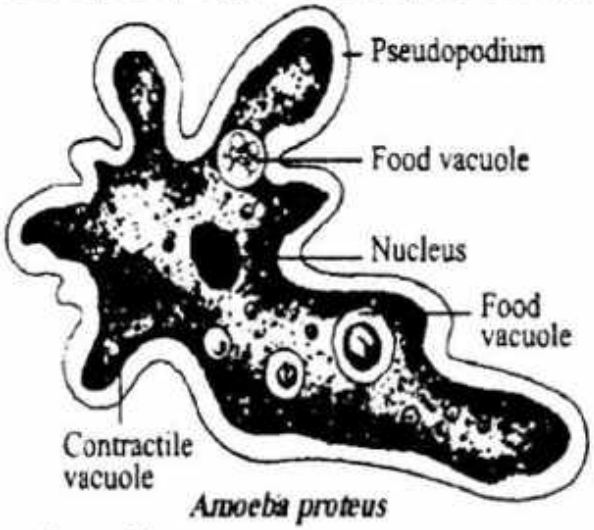
Reproduction takes place by asexual and sexual method.

Locomotion:

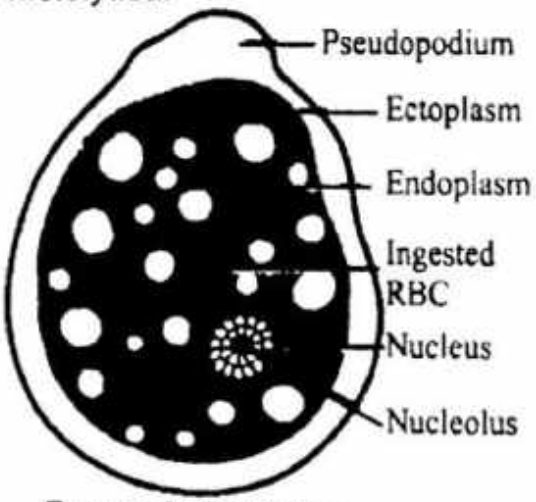
The organs of locomotion are pseudopodia, e.g., *Amoeba*, cilia, e.g., *Paramecium*, flagella, e.g., *Trypanosoma*, the parasitic protozoans do not have any specific means of locomotion, e.g., *Plasmodium* (malarial parasite).

Regeneration:

Regeneration is common in protozoans. Protozoans form resistant cyst to overcome unfavourable conditions. *Amoebas* move and feed with the help of pseudopodia, e.g., *Amoeba proteus, Entamoeba histolytica.*



Amoeba proteus

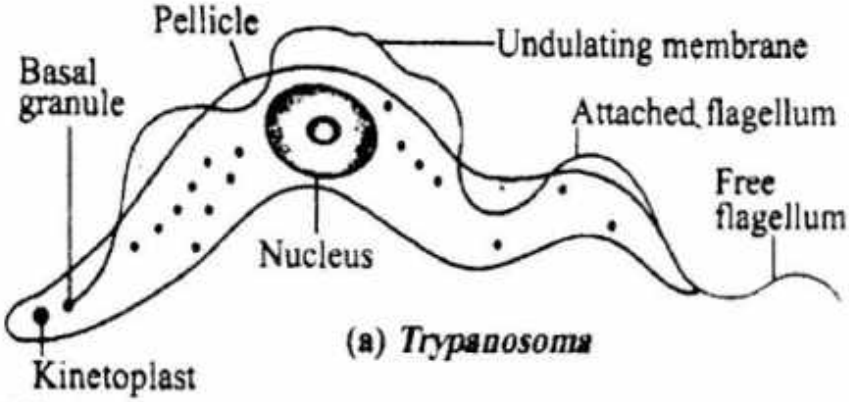


Entamoeba histolytica

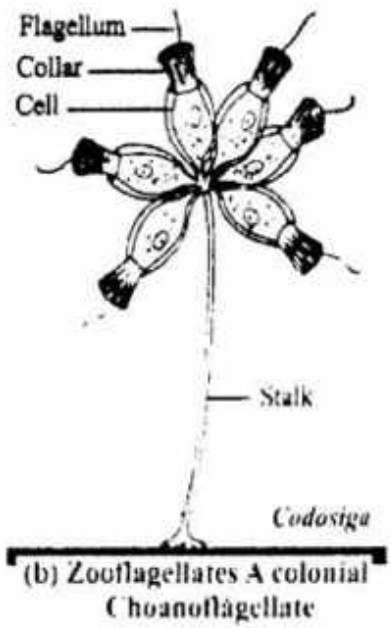
Zooflagellates:

Protozoans that move by means of flagella are called **zooflagellates.** *Trypanosoma* is a human parasitic flagellate.

Choanoflagellate is marine or freshwater flagellate. It is sessile and remains attached by a stalk. Flagellum is surrounded by a delicate collar which resembles the collar cell of sponges.



(a) *Trypanosoma*



(b) Zooflagellates A colonial Choanoflagellate

Ciliates:

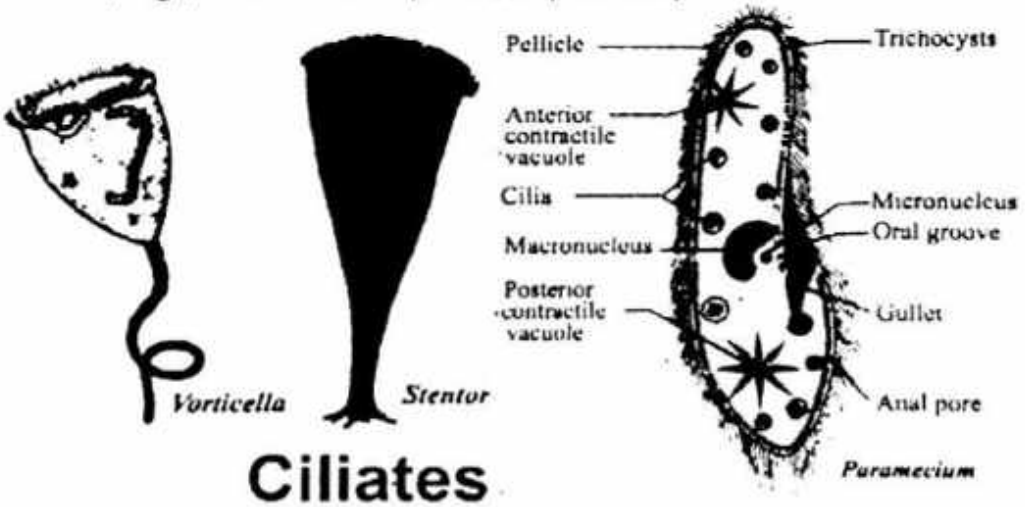
Ciliates have hair like extensions called cilia, e.g., *Paramecium*.

Protozoans with shells:

Foraminifera and Actinopods are marine protozoans. They produce tests or shells. In actinopods shells are made up of silica.

Apicomplexans:

Apicomplexans is a large group of parasitic protozoa. Some cause diseases in man, e.g., *Plasmodium* (malarial parasite).



Ciliates

16. Explain the salient features of the protists Algae and give examples.

Ans: Algae: The Plant like Protists:

Occurrence:

Algae (singular: *alga)* are found in ocean, freshwater ponds, lakes, streams, hot springs, polar ice, moist soil, trees and rocks.

Cell morphology and organization:

Algae may be unicellular, filamentous or multicellular. Filaments are composed of multicellular structures, with distinct cells or lack cross-walls (coenocytes). In multicellular algae, **e.g., sea weeds**, the body is branched or leaflike called thallus.

Pigment composition:

The photosynthetic pigments found in algae are chlorophyll "a", yellow and orange carotenoids, xanthophyll and phycoerytnrin.

Variation in Algal life cycle:

Algal life cycle shows extreme variations. All algae except the red algae (Phylum Rhodophyta) have forms with flagellated motile cells in at least one stage of their life cycle.

Peculiar nature:

Algae differ from the plants in this respect that the sex organs in algae are unicellular, the zygote is not protected by the parent body and embryo is not formed.

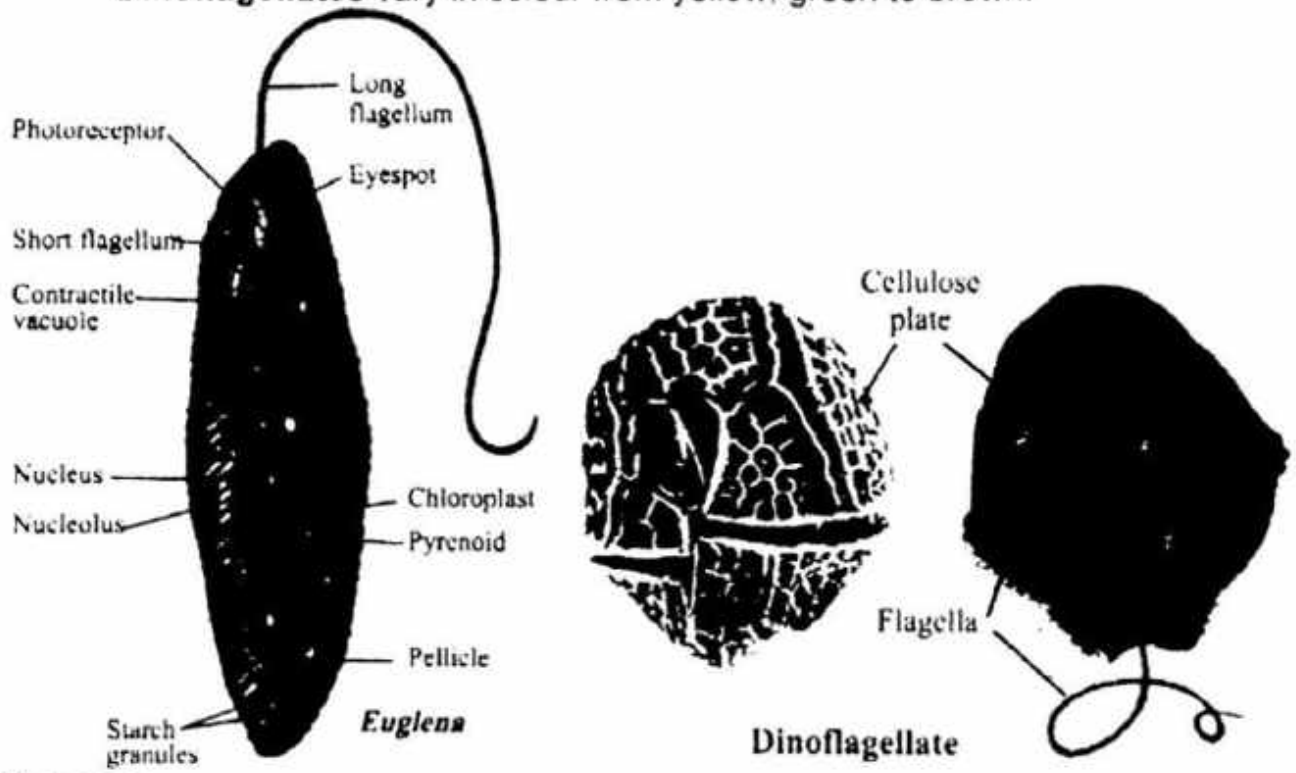
Classification:

Euglenoids:

Euglenoids are small freshwater organisms, e.g., *Euglena*.

Dinoflagellates:

Dinoflagellates vary in colour from yellow, green to brown.



Diatoms:

Diatoms are the most numerous unicellular algae in the oceans. They are also plentiful in freshwater. The cell wall has two halves, with the larger halves acting as a "lid" for the smaller half.

Brown algae:

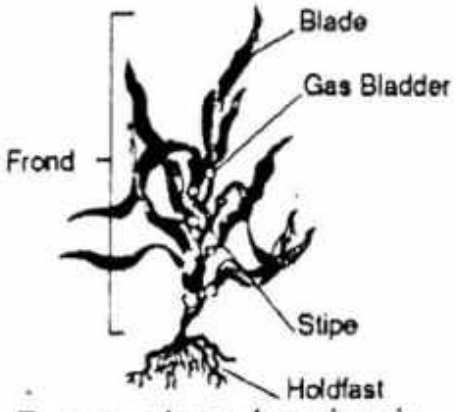
Brown algae range from small forms with simple filaments to large multicellular forms up to 75 metre in length, live in cooler marine water. The large brown algae are called **kelps.**

Red algae:

Red algae are multicellular present chiefly in warmer seawater growing in both shallow and deep waters. They can be up to a metre long attached to rocks or other substances by a basal holdfast.



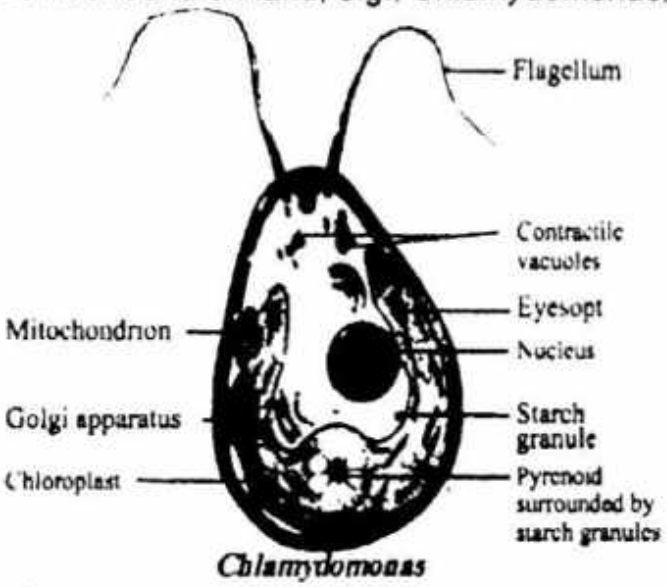




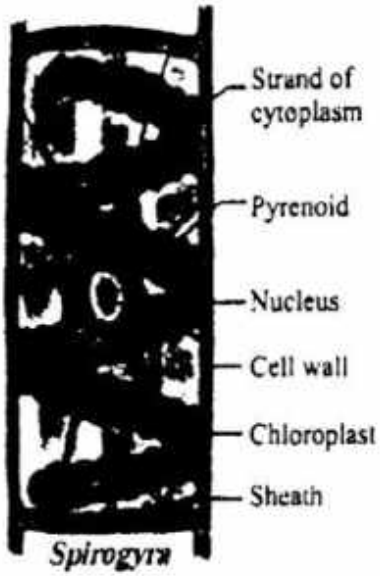
Brown algae *Laminaria*

Green Algae:

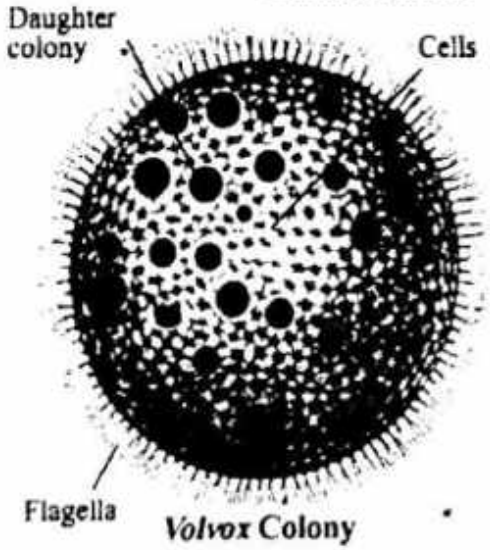
Green algae *(al-ji)* live in the ocean but are more likely found in freshwater and can even be found on land, e.g., *Chlamydomonas, Spirogyra, Volvox, Chlorella, Ulva.*



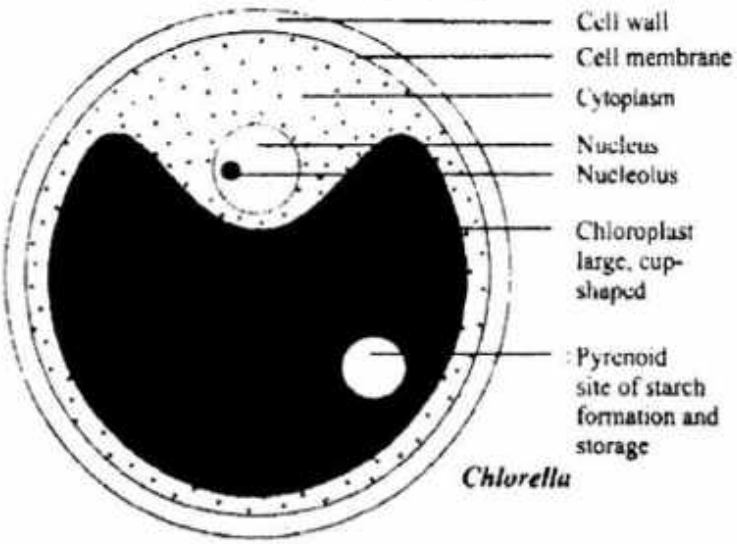
Chlamydomonas



Spirogyra



Volvox Colony



Chlorella

17. Explain the salient features of the protists Myxomycota and give examples.

Ans: Fungi like Protists: Myxomycota and Oomycota:

Myxomycota: Slime Molds:

Usually **plasmodial slime molds** exist as a **Plasmodium.** It is a diploid multinucleated cytoplasmic mass enveloped by slime sheath.

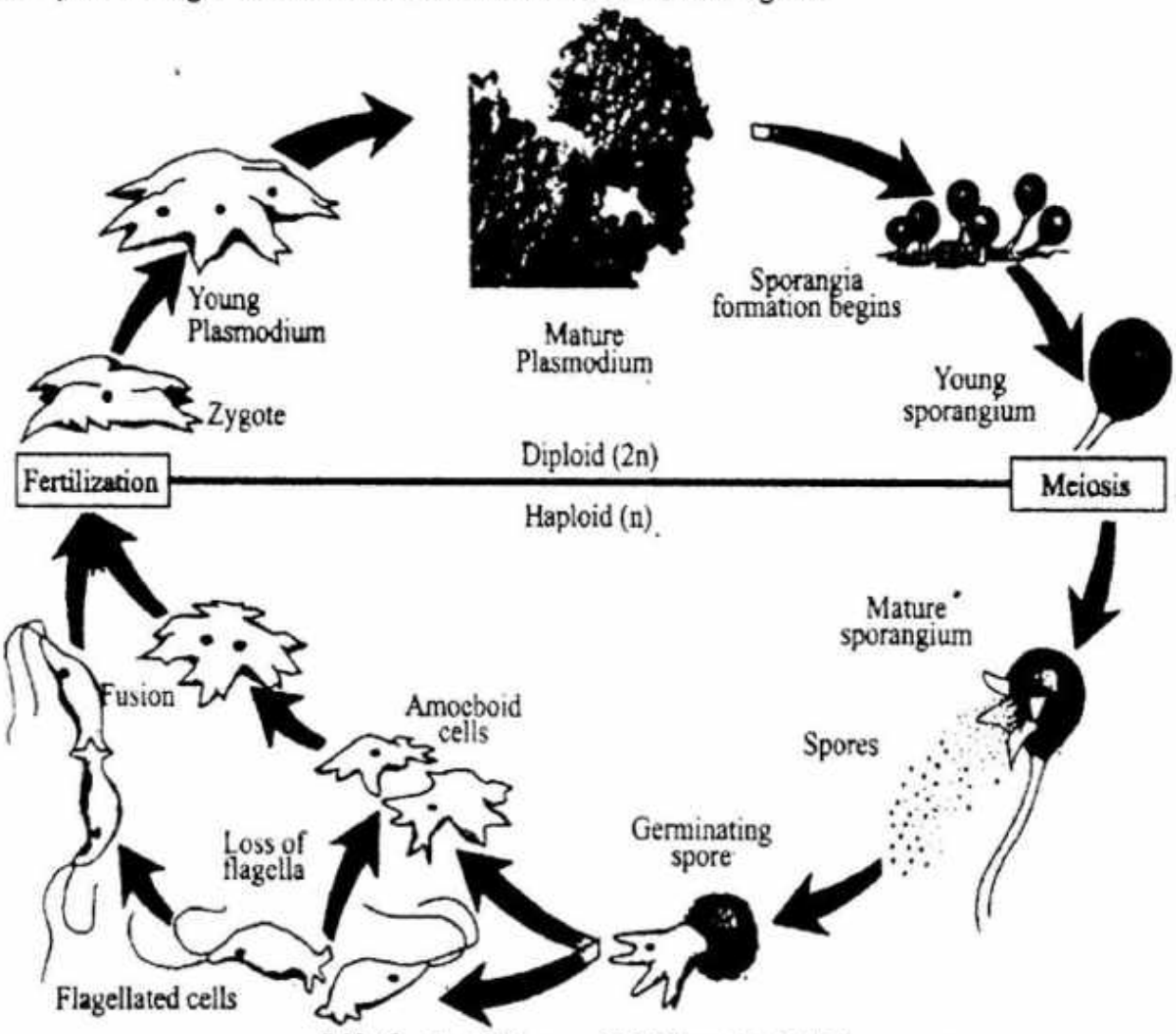
Characteristics:

Characteristics of slime molds are interesting to biologists because the life cycle involves many changes in form. These different forms resemble other types of protists.

Life cycle:

At times unfavourable to growth, such as during drought the Plasmodium develops many sporangia. A sporangium (Gk. *spora*, seed, and *angeion*, vessel) is a reproductive structure that produces spores by meiosis.

In **plasmodial slime molds,** spores release a haploid flagellated cell or an **amoeboid cell.** Eventually two of them fuse to form a diploid zygote that feeds and grows, producing a multinucleated Plasmodium once again.



Life Cycle of Plasmodial Slime Mold (*Physarum*)

18. Explain the salient features of the protists Oomycota and give examples.

Ans: Oomycota: The Water Molds:

Oomycotes include water molds, white rusts and downy mildews.

Characteristics:

(i) All of the members of the group are either parasites or saprotrophs.

(ii) The cell wall contains cellulose, not chitin like fungi.

(iii) Their life cycles are characterized by gametic meiosis resulting in a diploid phase.

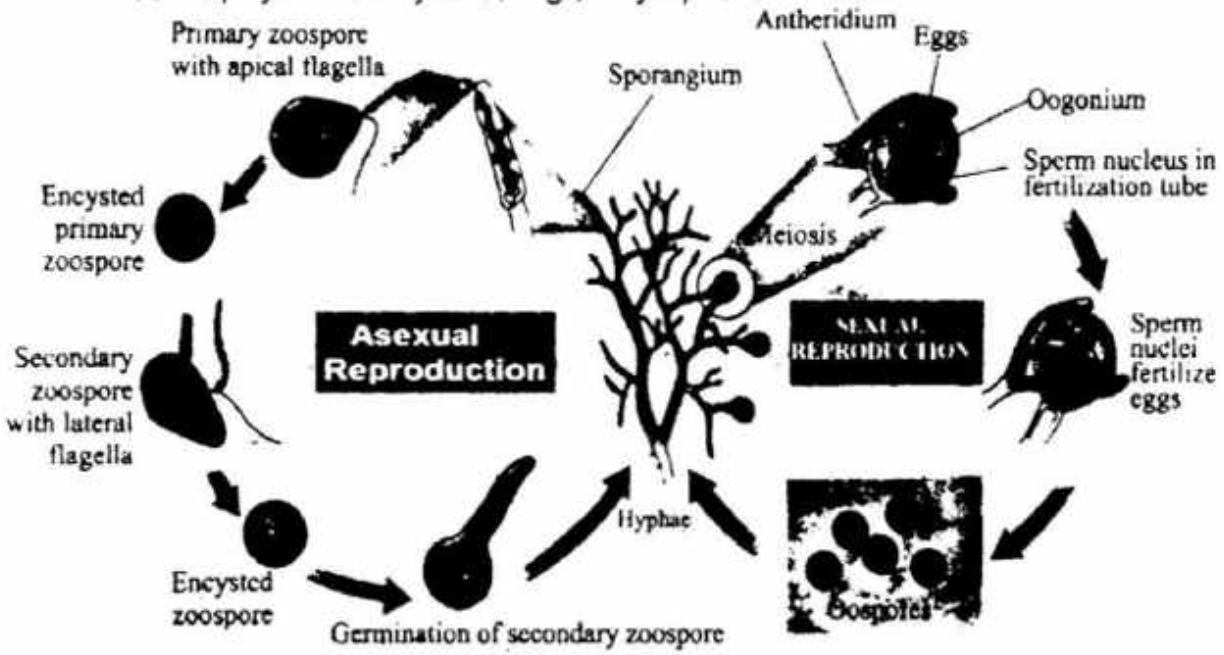
(iv) The filamentous structures are called **hyphae** as in fungi. The hyphae are **aseptate,** i.e., without intercellular cell wall.

(v) Most oomycotes live in freshwater or saltwater or in soil. Some are plant parasites. A few aquatic oomycotes are animal parasites.

Life cycle:

Zoospores are motile and have two flagella. Zoospores are produced asexually in sporangium. For sexual reproduction there are two types of **gametangia.** The female **gametangium** is called **oogonium** and the male gametangium is called an **antheridium.**

The flowing of the contents of an antheridium into an oogonium leads to the individual fusion of one or more pairs of male nuclei with eggs. This produces a special kind of thick walled cell called an **oospore.** This structure gives the phylum its name, i.e., phylum oomycota, e.g., *Phytophthora infestans.*



Life cycle of Oomycotes

19. How are protists important to humans?

Ans: Importance of protists to humans:

Diatoms are an important source of food and oxygen for heterotroph in both freshwater and marine ecosystem. **Brown algae** not only provides food to organisms, but is also harvested for human food and for fertilizer in several parts of the world.

Red algae:

Red algae are economically important. The mucilaginous material in the cell walls of certain genera of red algae is a source of agar used commercially to make capsules for vitamins and drugs, as a material for making dental impression and a base for cosmetics. In laboratory agar is a culture medium for bacteria.

Green algae:

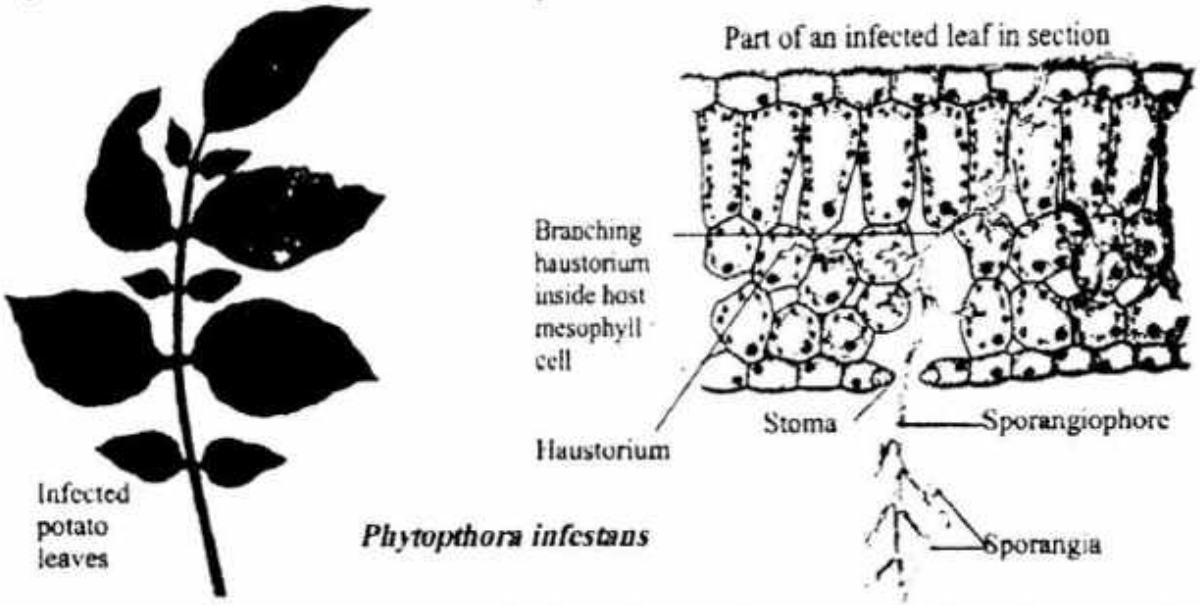
Green algae are important producers. *Chlorella* has been used as an experimental organism in research in photosynthesis. A relatively new food source is single cell protein (SCP).

Disease causing protists:

Malaria caused by ***Plasmodium*** (malarial parasite) is one of the world's most common serious infectious diseases. According to world health organization about one to two million people die each year from malaria.

Other important protozoans are ***Entamoeba histolytica*** causes amoebic dysentery. *Trypanosoma* causes sleeping sickness.

In oceans, freshwater lakes and ponds are **zooplanktons** that feed on phytoplanktons, and are important as primary consumers in the food chain. *Phytophthora infestans* causes late blight disease in potatoes.



20. What are the characteristics that distinguish fungi from other groups?

Ans: General Characteristics of Fungi:

(i) Fungi (singular, *fungus)* can live in darkness and also in light. The study of fungi is called **mycology.** The person who studies fungi is called **mycologist.**

(ii) Fungi occupy a wide range of **habitats,** aquatic, terrestrial and as parasites on plants and animals.

(iii) The **mode of life** shows that fungi can be parasites, saprotrophs or mutualists.

(iv) Fungi range in **size** from the unicellular yeasts to the large toadstool.

(v) Fungi lack chlorophyll, so they are nonphotosynthetic. Thus **mode of nutrition** is heterotrophic. Digestion takes place outside the body and nutrients are absorbed directly.

(vi) **Cell walls** are rigid containing chitin as fibrillar material. If carbohydrate is stored, it is usually as glycogen and not starch.

(vii) Fungi do not have root stem or leaves. The thallus or the body of most fungi is a multicellular structure known as **mycelium.** A mycelium (Gk: *mycelium,* fungus filaments) (pi. mycelia) is a network of filaments called **hyphae** (Gk: *hyphae,* web).

(viii) The hyphae may be nonseptate (aseptate) or septate. Nonseptate (L. *septum,* wall) hyphae have no cross walls, are multinucleated, e.g., *Rhizopus.* Septate fungi have cross wall, e.g., *Penicillium.*

(ix) Fungi are non-motile, lack basal bodies and do not have flagella at any stage of their life cycle. They move towards a food source by growing towards it.

(x) A fungus reproduces both asexually and sexually.

Fungi as separate kingdom:

According to five kingdom system of classification, 'Fungi' is now a separate kingdom.

Fungi are different from plants:

(i) Fungi have no chlorophyll

(ii) Fungi never have flagella

(iii) Fungi are saprotrophs.

Fungi are different from animals:

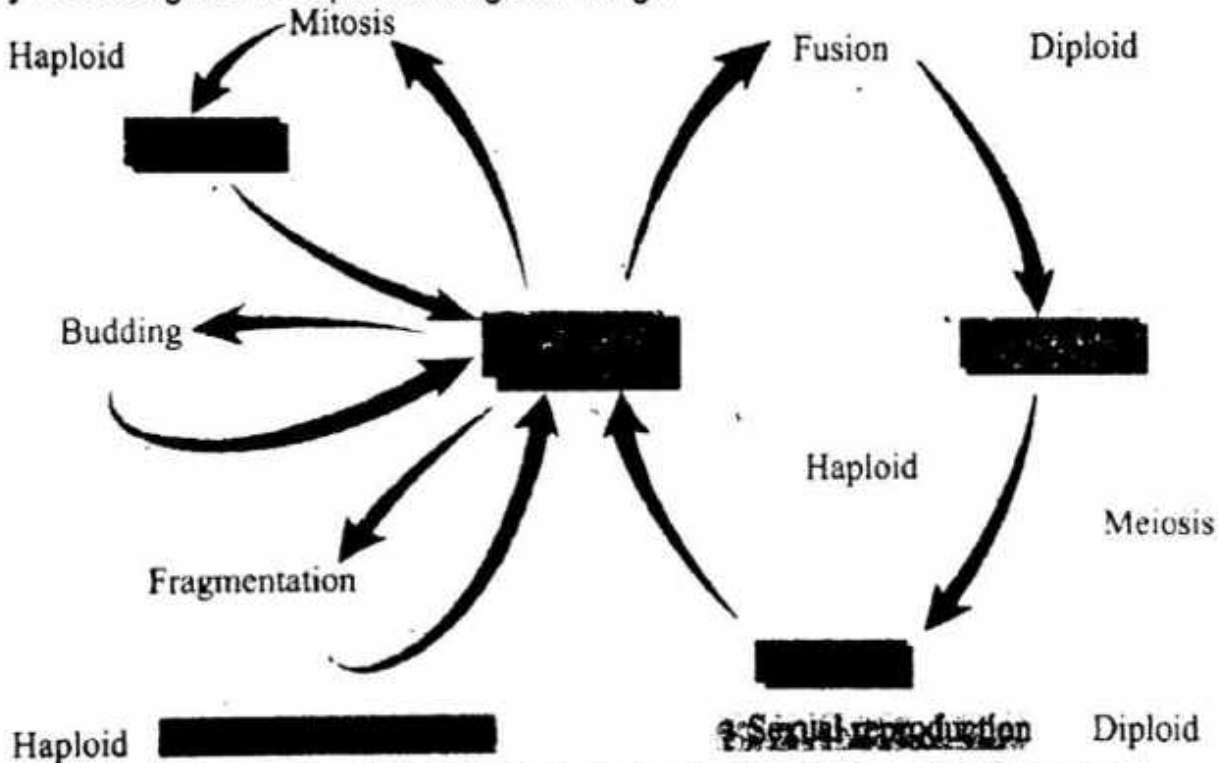
(i) Fungi have cell wall.

(ii) Fungi are absorptive heterotrophs.

(iii) Fungi are non-motile.

Conclusion:

So fungi are neither plants nor animals. They show "nuclear mitosis" Because fungi are distinct from plants, animals and other eukaryotes in many ways, **they are** assigned to separate kingdom-fungi.



A Generalised life cycle for Fungi. Fungi alternate between sexual and asexual reproductive stages

21. Give reasons why fungi are classified in a separate kingdom.

Ans: Fungi as separate kingdom:

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So fungi are neither plants nor animals. They show "nuclear mitosis". Because fungi are distinct from plants, animals and other eukaryotes in many ways, they are assigned to separate kingdom-fungi.

22. Give the diagnostic features and examples of the fungi Zygomycota.

Ans: Zygomycota (Conjugating Fungi):

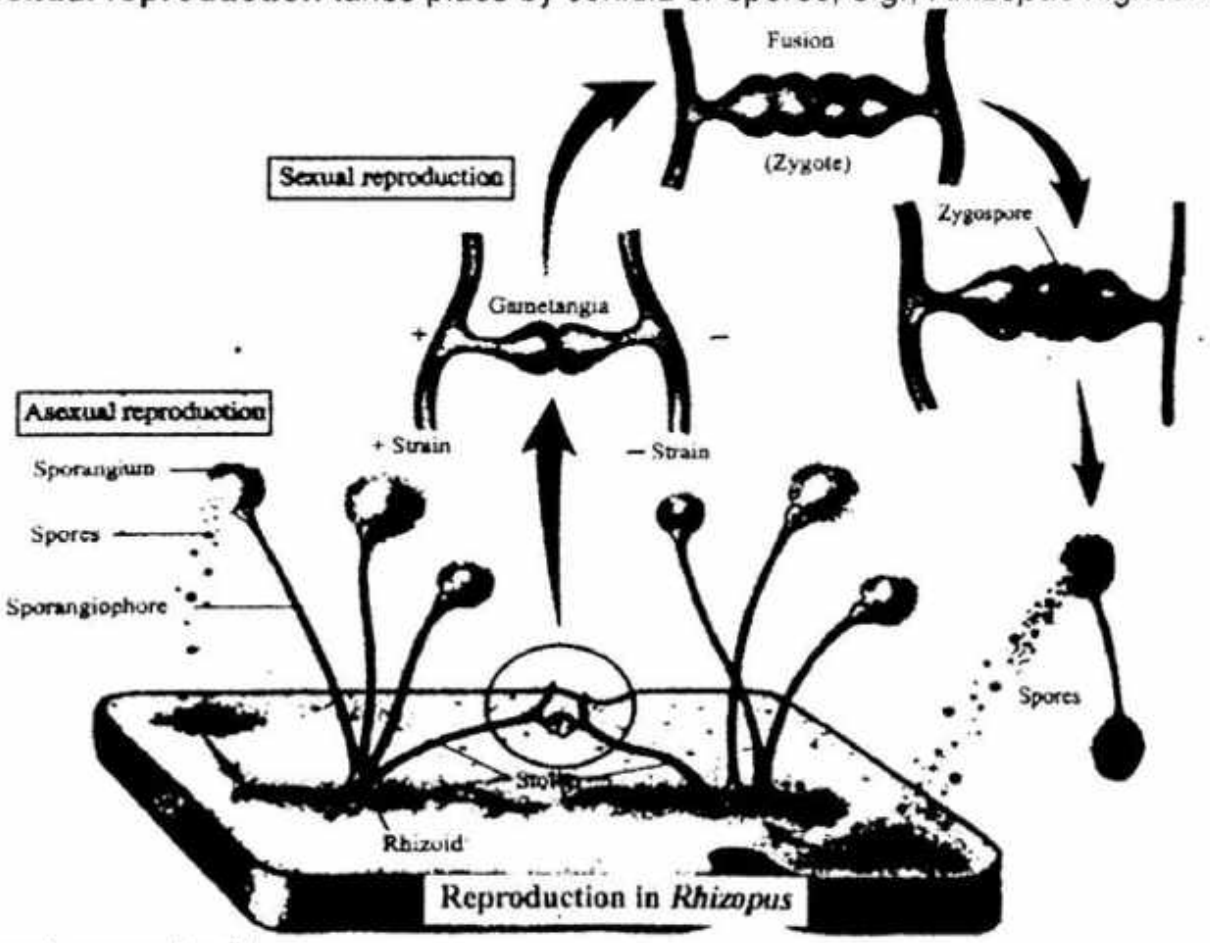
The phylum zygomycota is called conjugating fungi.

Characteristics:

They are mainly saprotrophs living on plant remains, on bakery goods, on vegetables and fruits Some are parasites of small soil protists. Hyphae are nonseptate, mycelium well developed and branching.

Asexual reproduction:

Asexual reproduction takes place by conidia or spores, e.g., *Rhizopus nigricans*.



Sexual reproduction:

Sexual reproduction takes place by **conjugation.** When hyphae (stolon) of opposite mating types meet, hormones are produced that cause the tips of the hyphae to come together and to **form gametangia,** structures that produce gametes. These structures become separated from rest of the mycelium by the formation of **septa.** Plus and minus nuclei then fuse to form a diploid nucleus, the **zygote.**

The zygote develops into a **zygospore.** The division or phylum name refers to the **zygospore.** Zygospores **germinate** under favourable conditions and divide by **meiosis.** The wall of the zygospore shifts and hypha grows upward. The tip of the hypha develops into a **sporangium.** The sporangium contains many nuclei. The wall of the sporangium ruptures and the spores are liberated. Each spore grows into a new plus or minus strain of mycelium.

23. Draw and explain a diagram of the life cycle of *Rhizopus nigricans.*

Ans: Zygomycota (Conjugating Fungi):

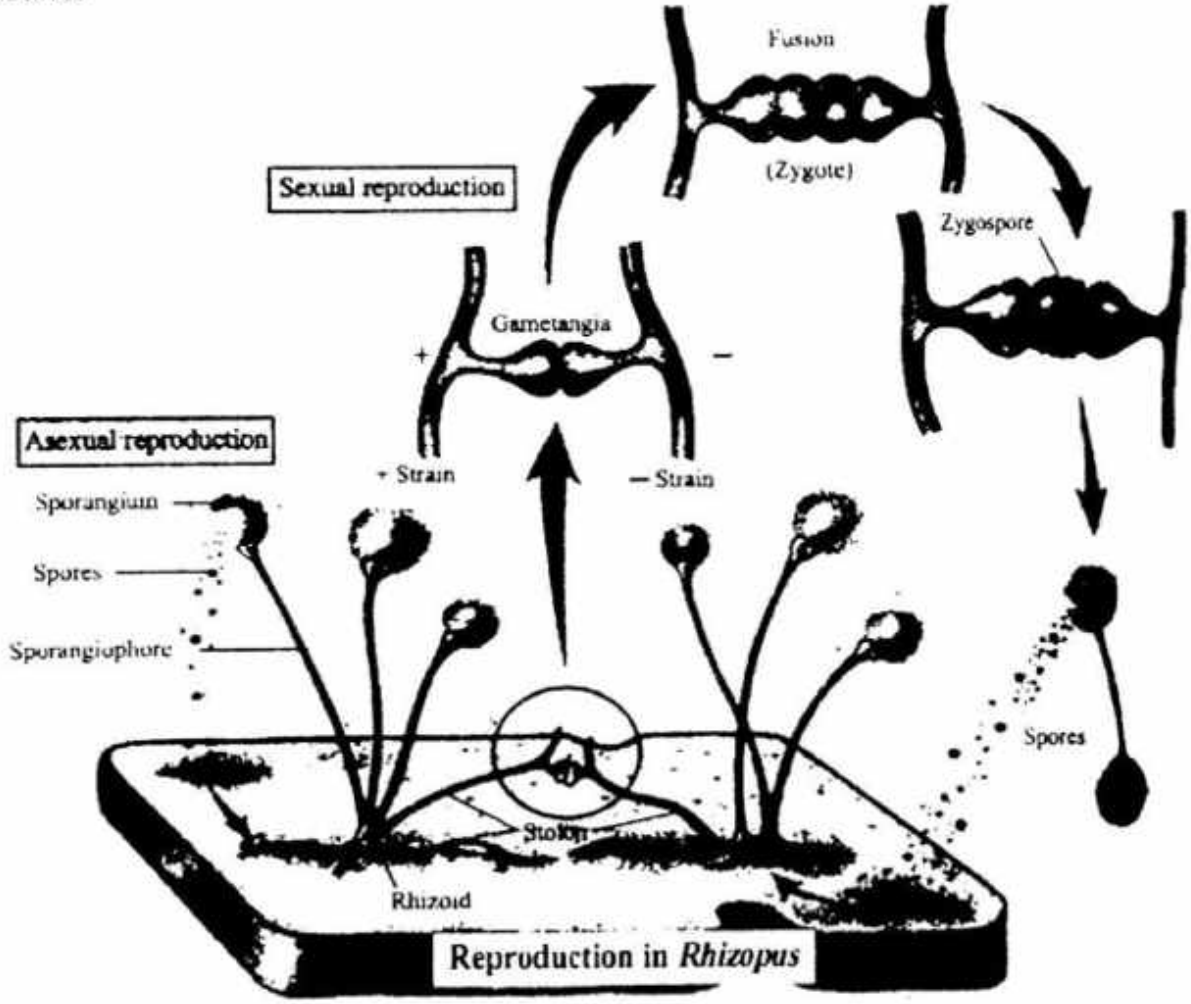
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24. Give the diagnostic features and examples of fungi Ascomycota

Ans: Ascomycota (Sac Fungi):

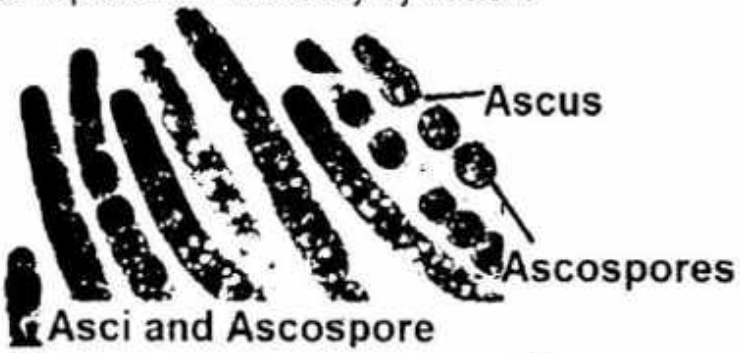
Asconiycotes are the members of phylum ascomycota. It is a large group. Ascomycotes are also known as **sac fungi** because their sexual spores are produced in little sacs called asci (sing. *ascus).*

Hyphae of Sac Fungi:

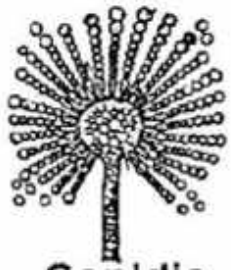
Their hyphae usually have septa but the cross walls are perforated so that cytoplasm can move from one compartment to other.

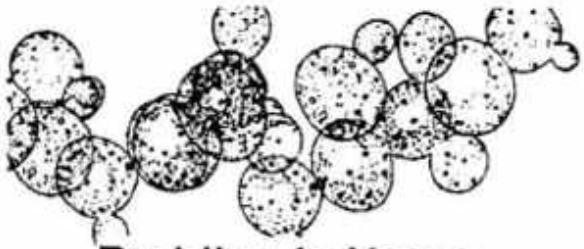
Asexual reproduction:

Asexual reproduction involves production of spores called conidia (singular: *conidium)* or **conidiospores** (Gk: *konis,* dust, and *spora,* seed). Conidia vary in shape, size and may be multicellular. There are no sporangia in Ascomycotes. The conidia develop directly on the tips of modified aerial hyphae called **conidiophores.** The colour of conidia is what gives the characteristic brown, blue, pink or other tint to **many of** these molds. In unicellular **yeasts,** asexual reproduction takes place by **budding.** Yeast also reproduces asexually by fission.



Asci and Ascospore


Conidia


Budding in Yeast

Sexual reproduction:

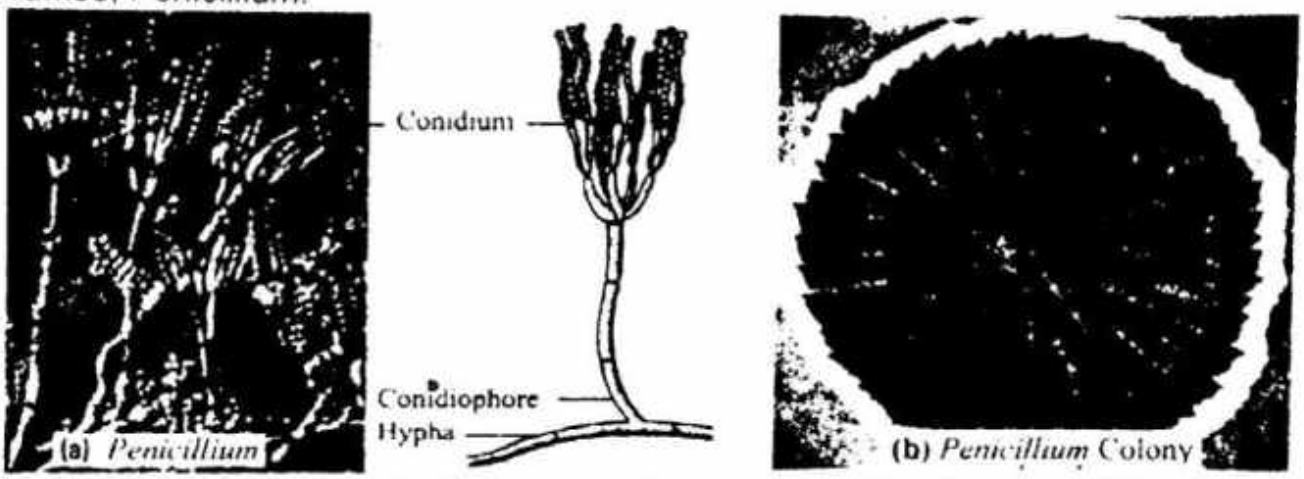
Sexual reproduction takes place after two hyphae grow together and their cytoplasm mingles. Within this fused structure, nuclei from **the** parent hyphae pair but do not fuse. New hyphae develop from the fused structure and the cells of these hyphae are **dikaryotic.** The n + n hyphae form a fruiting body known as **ascocarp.** The **asci** develop in the ascocarp. The asci are usually surrounded by sterile hyphae. An ascocarp is a **fruiting body.** It is a reproductive structure where spores are produced and released. Ascocarps can have different shapes. In cup fungi they

are cup shaped, in molds they are flask shaped and in the **morels** they are stalked and crowned by bell shaped structure.

Within an ascus the two nuclei fuse and form a **diploid** nucleus the **zygote** which undergoes **meiosis** to form four haploid nuclei. This process is usually followed by one mitotic division of each of the four nuclei, resulting in eight haploid nuclei. Each haploid nucleus develops into an **ascospore.**

The ascospores, are then windblown if they land on a suitable location and germinate to form a new mycelium, e.g., in Yeasts.

During sexual reproduction, asci within a fruiting body produce ascospores. The examples of sac fungi are Yeasts *(Saccharomyces), Neurospora,* Morels, Truffles, *Penicillium.*



25. Give the diagnostic features and examples of the fungi Basidiomycota.

Ans: Basidiomycota (Club-Fungi):

Basidiomycotes are included in the phylum **Basidiomycota.**

Example:

Included in this phylum are mushrooms, bracket fungi, rust, smut and puffballs. These structures are all fruiting bodies called **basidiocarps.**

Characteristics:

Basidiocarp contains the basidia. Each **basidium** is a club shaped structure. It is a hyphal cell on the tip of which develops four **basidiospores,** from which this phylum takes its name.

Each individual fungus produces millions of basidiospores and each basidiospore has the potential to give rise to a new primary mycelium. Hyphae of primary mycelium are composed of monokaryotic (n) cells.

The mycelium of a basidiomycote, e.g., *Agaricus* (Mushroom), consists of mass of white, branched, thread like hyphae that occur mostly below ground. The hyphae are divided into cells by septa. The septa are perforated and allow cytoplasmic streaming between cells.

Reproduction:

Although club fungi occasionally do produce conidiospores asexually, they usually **reproduce** sexually. A hyphae of a primary mycelium encounters another monokaryotic (n) hyphae of a different mating type and the two hyphae fuse. However the two haploid nuclei remain separated from each other.

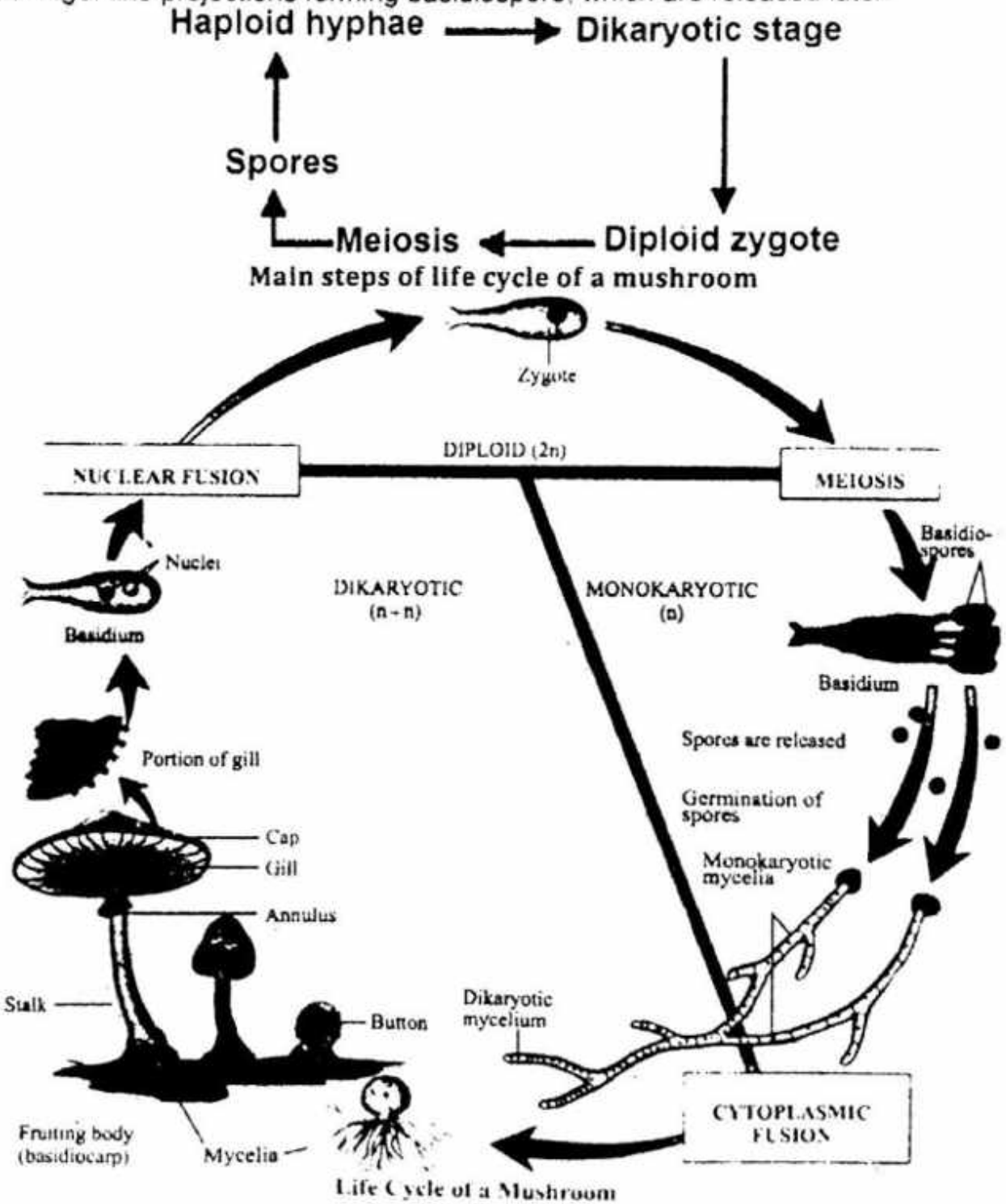
In this way a secondary mycelium with a **dikaryotic** (n + n) hyphae is produced, in which each cell contains two haploid nuclei. The n + n hyphae of the

secondary mycelium grow and form compact mass, called **buttons,** along the mycelium. Each button grows into a **fruiting body** known as **mushroom.**

A mushroom, which consists of a stalk and a cap, is more formally referred to as basidiocarp. Each basidiocarp actually consists of interwined hyphae that are matted together. The walled off ends of the tightly packed hyphae become the club shaped basidia.

The lower surface of the cap usually consists of many thin perpendicular plates called gills that radiate from the stalk to the edge of the cap.

On the gills of the mushroom haploid nuclei of the dikaryotic cells fuse to form diploid zygotes. Meiosis then takes place forming four haploid nuclei that move into finger like projections forming basidiospore, which are released later.



26. Explain the term club fungi. Draw and explain a diagram of the life cycle of a typical mushroom.

Ans: Basidiomycota (Club-Fungi):

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Example:

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Reproduction:

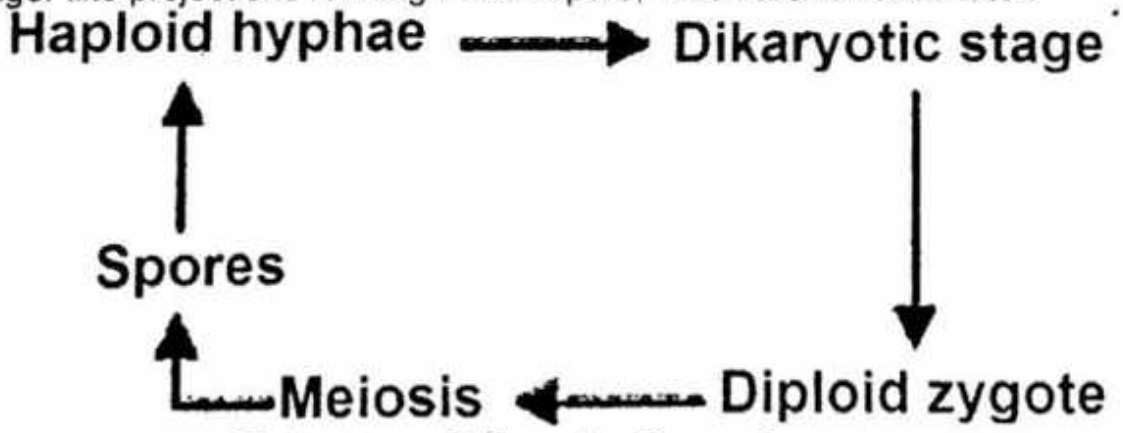
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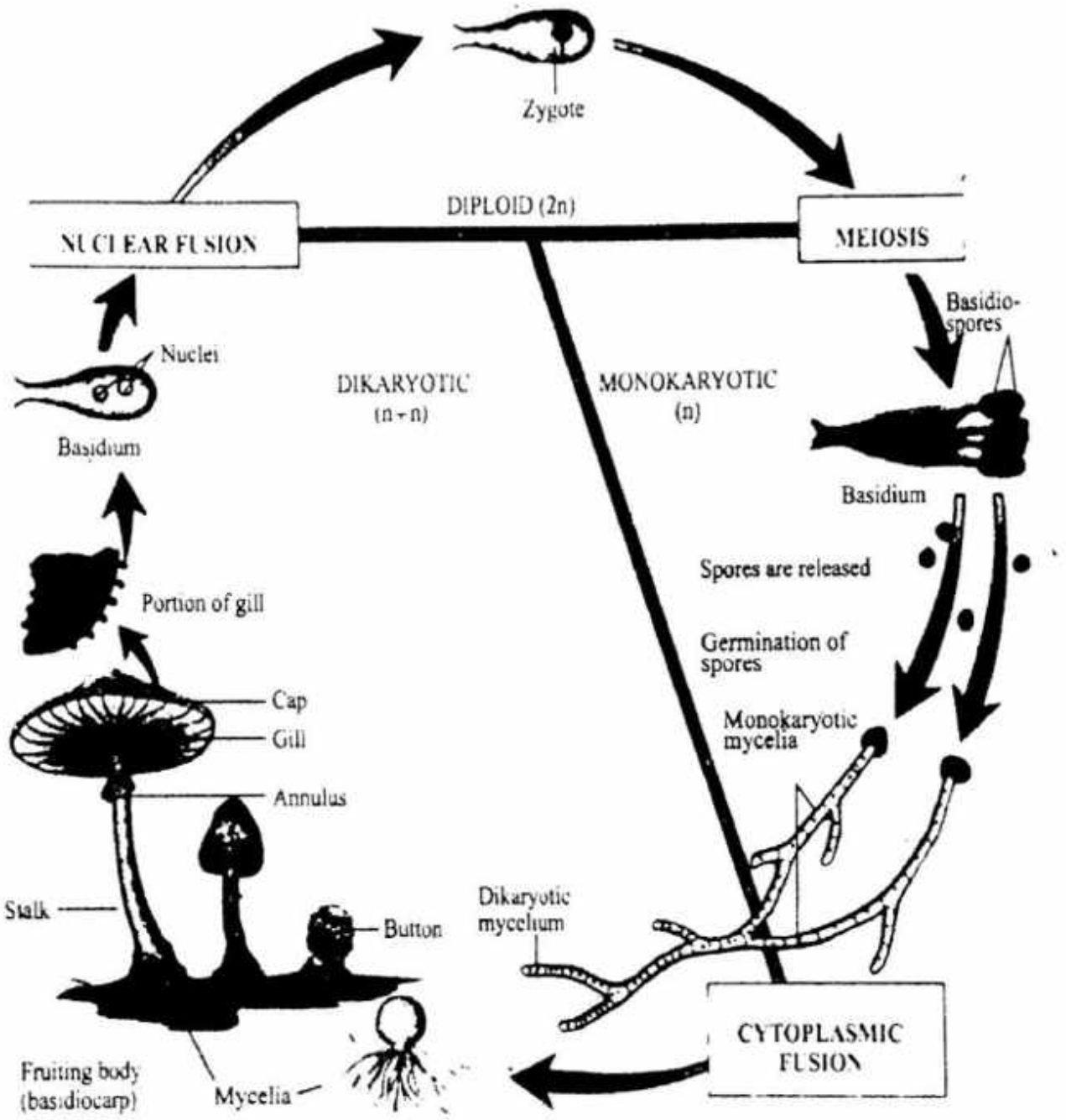
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Main steps of life cycle of a mushroom



Life Cycle of a Mushroom

27. Write the importance of the unicellular fungi yeast.

Ans: Importance of Fungi:

Fungi are useful and also harmful to human beings. Fungi cause economic gains as well as losses.

People eat fungi and grow them to make various chemicals. Fungi cause diseases in humans, other animals and plants.

Here we will discuss use of fungi, antibiotics obtained from fungi, mutualism, edible fungi, ecological role of fungi and pathological role of fungi.

Uses of Fungi:

Fungi are used in baking, brewing and genetic research

(a) Use of fungi in baking:

In making bread Amylase from fungi, which digest starch, can be added to increase the sugar contents. **Yeast** uses sugars as a source of energy in respiration. Both aerobic and anaerobic respiration result in production of

carbon dioxide gas. When making bread, bubbles of the gas are trapped inside the warm dough causing it to rise

Strains of the yeast *Saccharomyces cerevisiae* are selected for their high production of carbon dioxide gas.

(b) Use of fungi in brewing:

Wine production is called brewing. Two commonly species *Saccharomyces cerevisiae and Saccharomyces carsbergensis* are used in brewing.

(c) Use of fungi in genetic research:

Yeasts are used in the biological research especially in genetic research. Researchers use Saccharomyces to study molecular genetics of eukaryotes, because its cells are easy to culture and manipulate. Scientists are gaining insight into the genes involved in human diseases such as Parkinson's disease and Huntington's disease by examining in *Saccharomyces*.

Antibiotics are obtained from fungi:

Penicillin:

The first antibiotic discovered was **penicillin,** made by the mold *Penicillium chrysogenum.*

Cyclosporins:

Cyclosporins are obtained from soil fungus *(Tolypocadium inflatum)* is used in organ transplantation for preventing transplant rejection.

Griseofulvin:

Griseofulvin obtained from a fungus *(Penicillium nigricans)* **is used** to inhibit fungal growth.

Neurospora:

Pink mold *Neurospora* has also been used for genetic research.

Saccharomyces cerevisiae:

Yeast was the first eukaryotes to be used in genetic engineering. In 1983, a functional artificial chromosome was made in *Saccharomyces cerevisiae.* It was also the first eukaryotes whose genomic sequence was completely studied in 1996.

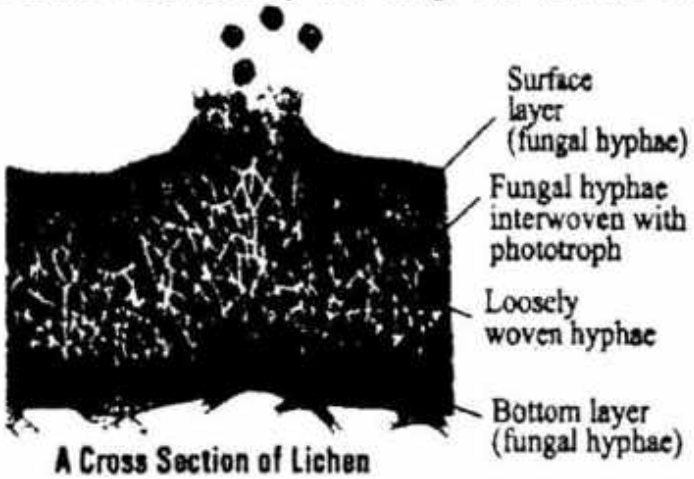
28. Explain the mutualism established in mycorrhizae and lichen associations.

Ans: Mutualism: Lichen and Mycorrhizae

Mutualism is the association in which both the partners are benefitted. The two key **mutualistic symbiotic association** formed by the fungi are lichens and mycorrhizae.

Lichens:

Lichens are an association between a fungus (mostly Ascomycotes and a few basidiomycotes), a cyanobacterium or green alga. The body of lichen has three layers. The upper layer is thin and tough which consists of fungal hyphae. The middle layer consists of fungal hyphae interwoven with photosynthetic cell. Bottom layer consists of loosely packed fungal hyphae. Specialized fungal hyphae

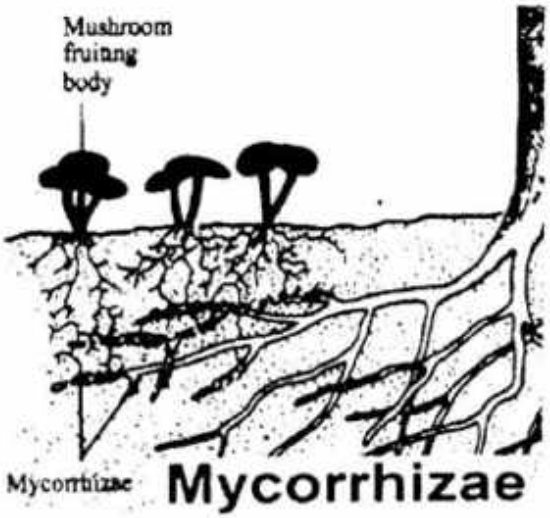


A Cross Section of Lichen

which penetrate or envelope the photosynthetic cells, transfer nutrients directly to the rest of the fungus.

Mycorrhizae:

Mycorrhizae are mutualistic relationships between soil fungi and the roots of most plants. The hyphae help in the direct absorption of phosphorous, zinc, copper and other nutrients from the soil into the roots. Plants whose roots are invaded by mycorrhizae grow more successfully than do plants without mycorrhizae. There are two main types of mycorrhizae in which mycilia extend far out into the soil.



Endomycorrhizae:

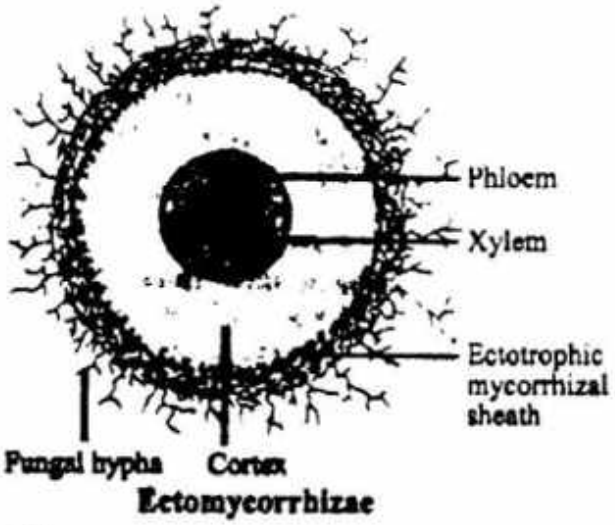
Endomycorrhizae penetrate only into the outer cells of plant root forming coils, swellings and minute branches and also extend out into surrounding soil.

Ectomycorrhizae:

Ectomycorrhizae form a mantle that is exterior to the root, and they grow between cell walls. These are mostly formed with pines, firs etc.



Endomycorrhizae



Ectomycorrhizae

29. Write a brief note on edible fungi.

Ans: Edible fungi:

Aspergilus tamari is used to produce soya sauce. There are some 200 kinds of edible mushrooms e.g., *Agaricus*. Some edible mushrooms are cultivated commercially. Morels, which superficially resemble mushrooms and truffles, produce underground fruiting bodies are ascomycetes. The edible part of yellow morels *(Morchella esculenta)* is an ascocarp.


Morchella esculenta

30. Describe the ecological impact of fungi.

Ans: Ecological impacts of fungi:

Saprotrophs:

Fungi make important contributions to the ecological balance of our world Like bacteria, most fungi are saprotrophs, decompose and absorb nutrients from

organic wastes and dead organisms. In this way fungi help in maintaining the nutrient balance in nature. The organic waste is removed from the environment by the activity of saprotrophic fungi and bacteria.

Humus:

The fungi and bacteria liberate huge amounts of CO_2 in the air by decomposing dead bodies of animals and plants. The green plants for the synthesis of organic food use this carbon dioxide. Thus fungi help in recycling of materials.

Humus is an important constituent of soil and essential for the prope growth of plants. It is formed from the organic waste material through the activities of fungi and bacteria.

31. Explain the pathogenic role of fungi.

Ans: Pathogenic Role of fungi:

Fungi cause many important diseases in plants and also in animals including human beings.

Plant diseases:

Fungi are responsible for many serious **plant diseases,** including epidemic diseases that spread rapidly and often result in complete crop failure. All plants are apparently susceptible to some fungal infection.

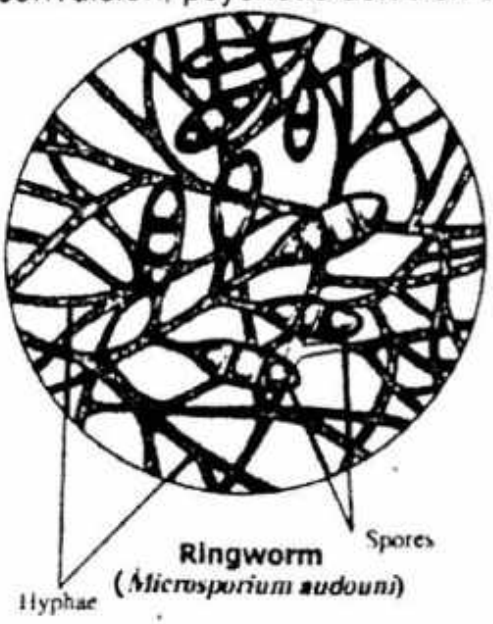
Some important plant diseases caused by **ascomycotes** are powdery mildews, chestnut blight, Dutch elm disease, apple scab, and brown rot;* which attack cherries, peaches, plums, and apricots. Diseases casued by basidiomycotes include smuts and rusts that attack various plants - for example the cereal crops of corn, wheat, oats etc.

Animal diseases:

Some fungi cause superficial infections in which only the skin, hair, or nails are infected. Ringworm *(Microsporium audouni)* and athlete's foot *(Tinea pedis)* are examples of fungal infection of the skin. Candidiasis is a yeast infection of mucous membrane of the mouth or vagina.

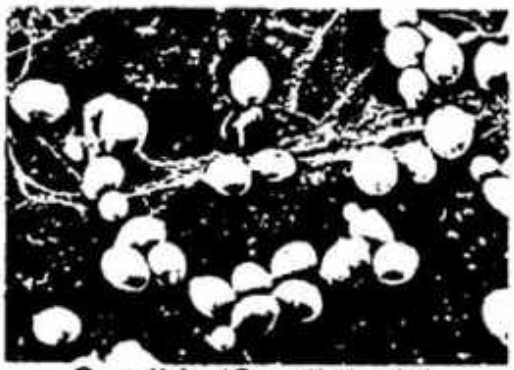
Histoplasmosis is a serious infection of the lungs caused by inhaling spores of a soil fungus.

Ergotism is caused by purple ergot rye. It causes nervous spasm, convulsion, psychotic delusion and even gangrene.



Ringworm
(*Microsporium audouni*)


Athlete's foot


Candida (Candidiasis)