Chapter 9
Diversity of Plants

Classification of plants

Starting with the simplest and gradually reaching the most complex. Organisms have been classified into 3 domains: Eukaryra, Archaea and Bacteria. The bacteria and Archaea belong to the prokaryotic kingdom while the eukarya are in the Eukaryotic Kingdom

The Archea include photosynthetic bacteria (cyanobacteria, green bacteria and purple bacteria). The cyanobacteria include the blue-green algae (anabaena and nostoc). The archae are the methane gas producing lower organisms. These organisms have prokaryotic cells. The means of reproduction is by binary fission (asexual reproduction).

The bacteria include gram positive (for example Streptococcus, Staphylococcus, Bacillus, and Clostridium) and gram negative (for example Pseudomonas, Escherichia, and Neisseria). They reproduce by binary fission also. Generally their reproduction is asexual.

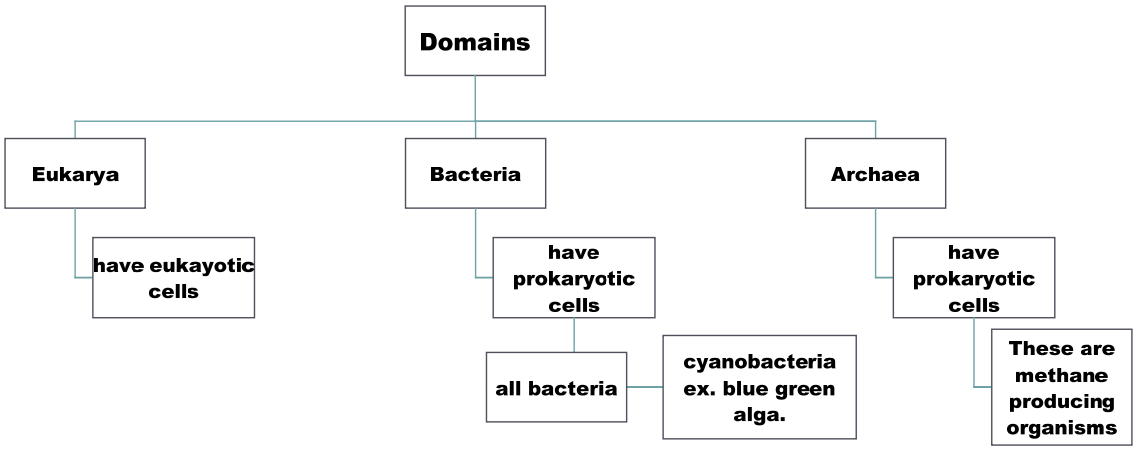


Table 9.1: An illustration of the domains of organisms.

Kingdom Protista: Unicellular and simple multicellular organisms that are plant-like or fungal-like in nature. In this kingdom are 6 divisions: dinophyta, chrysophyta, euglenophyta, chylorophyta, rhodophyta and phaeophyta. They are algae and seaweeds, some algae have flagella; they are also producers.

The Dinophyta are the dinoflagellates. The chrysophyta are the diatoms. The diatoms produce **diatomaceous earth**, which are used for **highway paint**, for **filter in wine** and in petroleum industries. The euglenophyta are the euglenas. The chlorophyta are the green algae. The rhodophyta are the red algae, they have two economically important **polysaccharides, carrageenan and agar. Carreeganan is an ingredient in ice cream, pudding, toothpaste, lotion and paint**. Agar is important for bacterial and other tissue cultures. Phaeophyta are the brown algae; this includes the rockweeds, and the kelps.

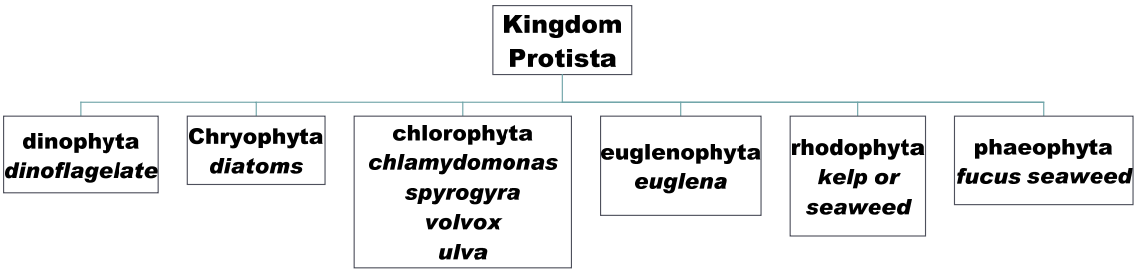


Table 9.2: An illustration of the divisions in kingdom protista

Figure 91. Red Alga (rock seaweed)

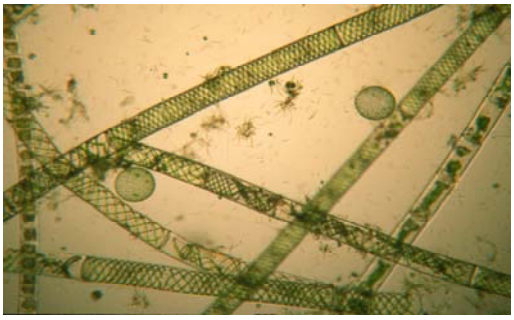


Figure 9.2: A Filamentous green alga

Figure 9.3 Sea Lettuce (ulva) a green alga

Figure 9.4 Brown alga

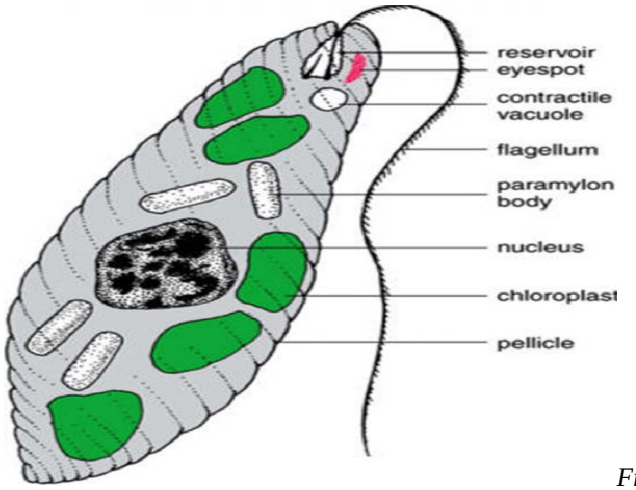


Figure 9.5: an illustration of a green alga

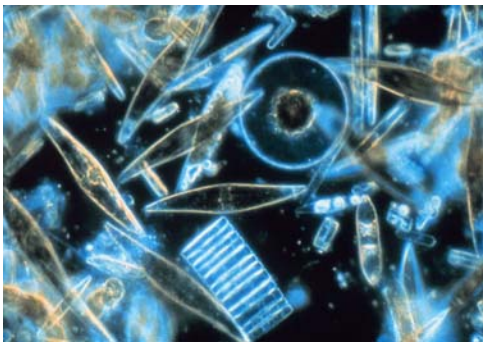


Figure 9.6: Diatoms

Figure 9.7. Golden Alga

Life Cycle of a typical protista

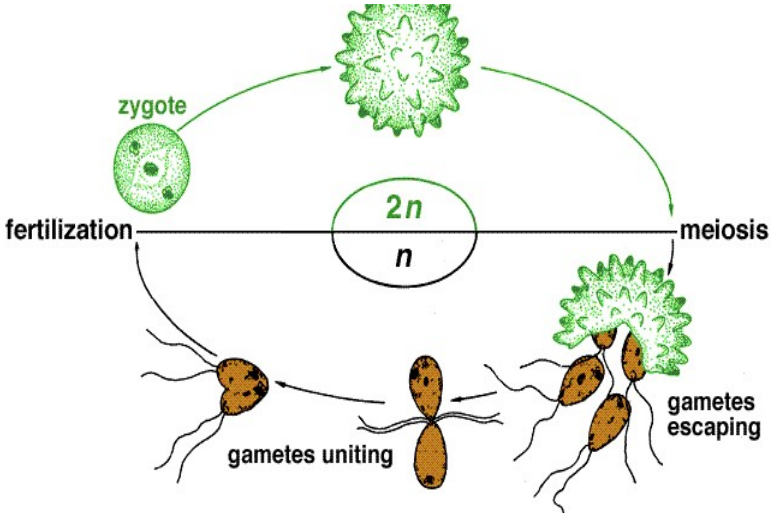


Figure 9.8a. Life Cycle of a protista, Chlamydomonas, a green alga showing fusion of gametes (a sexual reproduction)

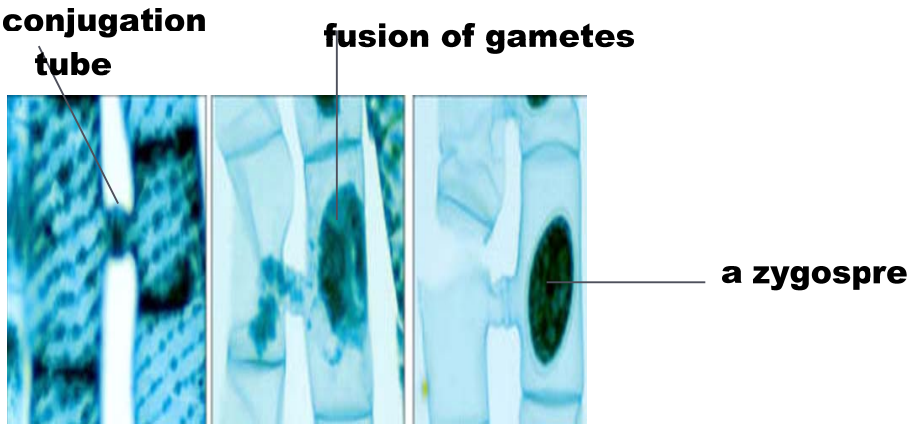


Figure 9.8b Life cycle of a protista, spirogyra showing conjugation (a sexual reproduction)

Kingdom Plantae

This is the kingdom in which the familiar organisms known as plants belong to. In this kingdom are the mosses through flowering and non-flowering plants. The kindom planta is divided into two major groups: **Nonvascular plants** which the Byrophytes (mosses and their allies); the other group consists of the **Vascular plants**.

The vascular plants can be divided into **seedless** and **seed bearing plants**. Seedless plants that reproduce by pores only, these are the ferns in the **Division Pterophyta** and their allies. Seed bearing plants are the dominant vegetation in the world can be divided into two **Gymnosperms (non-flowering) and Angiosperms (flowering).**

Gymnosperms

Division Coniferophyta: Conifers are the pines, spruce, cedars, redwoods, and larches plants that bear seed cones. The woods are used for building houses.

Division Cycadophyta: Cycads look like palm trees, they bear seed cones. Cycads are rich in starch but they contain some toxins, examples include BMAA (betamethylamino-alanine) and cycasin. Cycasin is carcinogenic and BMAA is a neurotoxic glycoside.

Division Ginkgophyta: Ginkgo biloba is cultivated in the Orients, and used for medication for cough, asthma and other respiratory complaints.

Division Gnetophyta: Ephedra plants used to extract ephedrine used in the treatment of bronchial asthma, and common cold.

Life Cycle of a Bryophyte

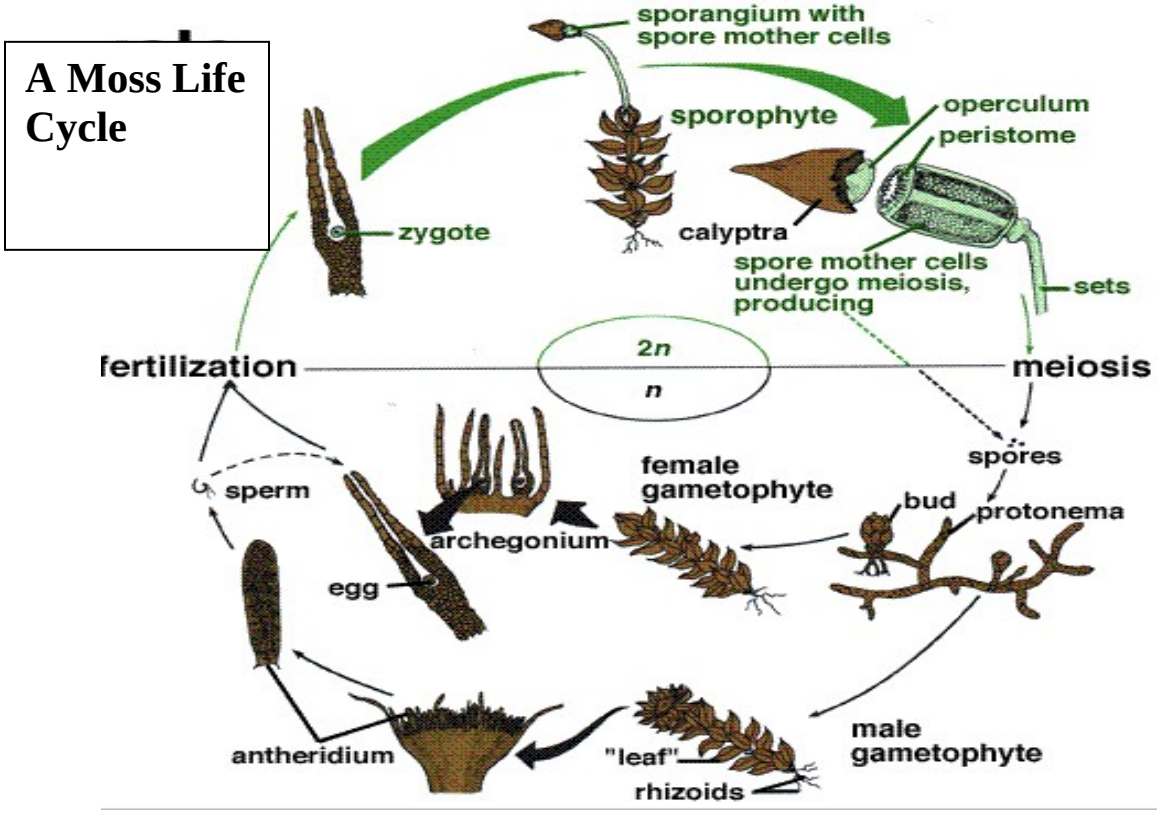


Figure 9.9. Life Cycle of a Moss plant – non-vascular seedless plant

Life Cycle of a Pterophyte

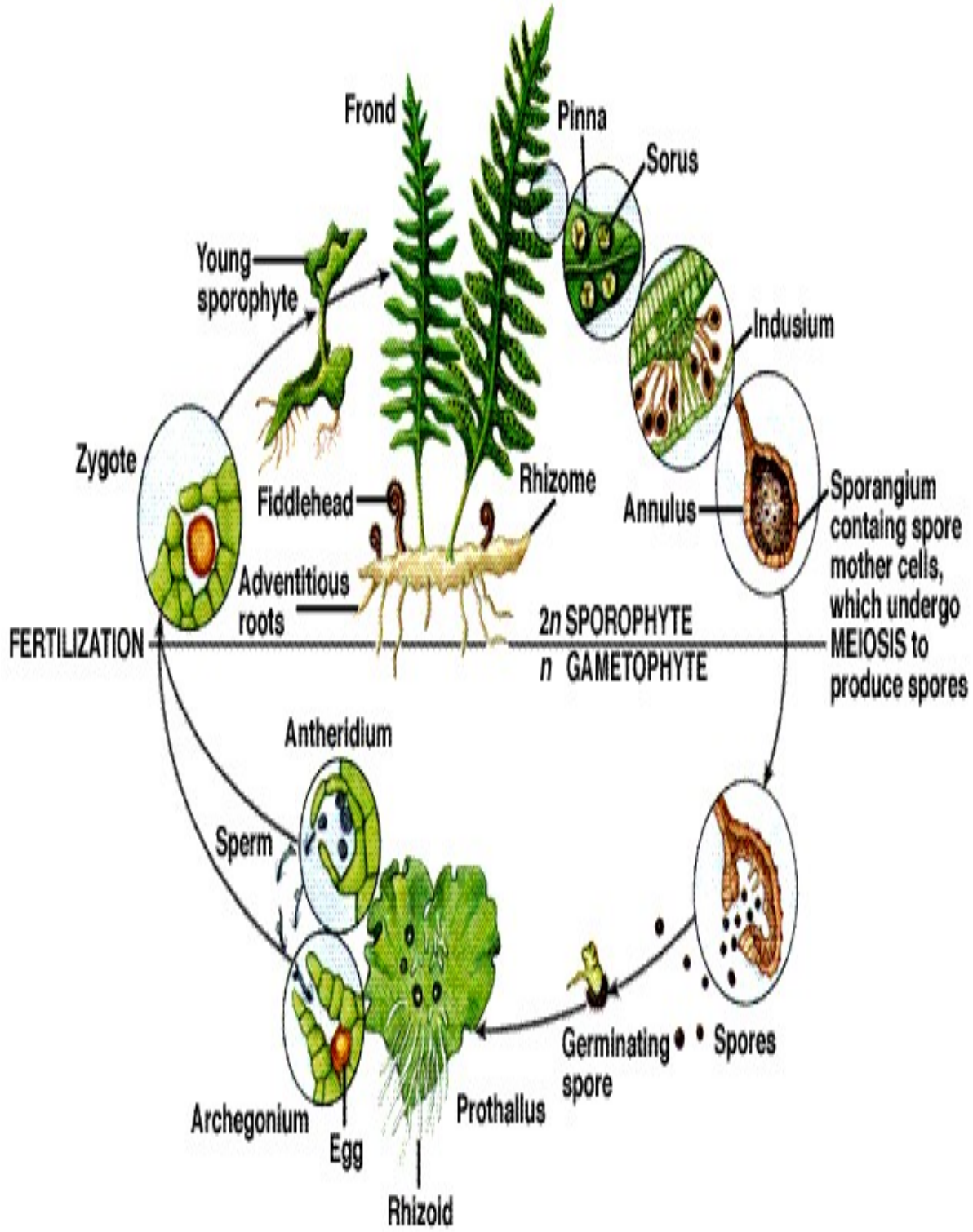


Figure 9.10. Life cycle of a fern- vascular non-seed bearing plant (copyright McGraw Hills)

Life Cycle of a Gymnosperm

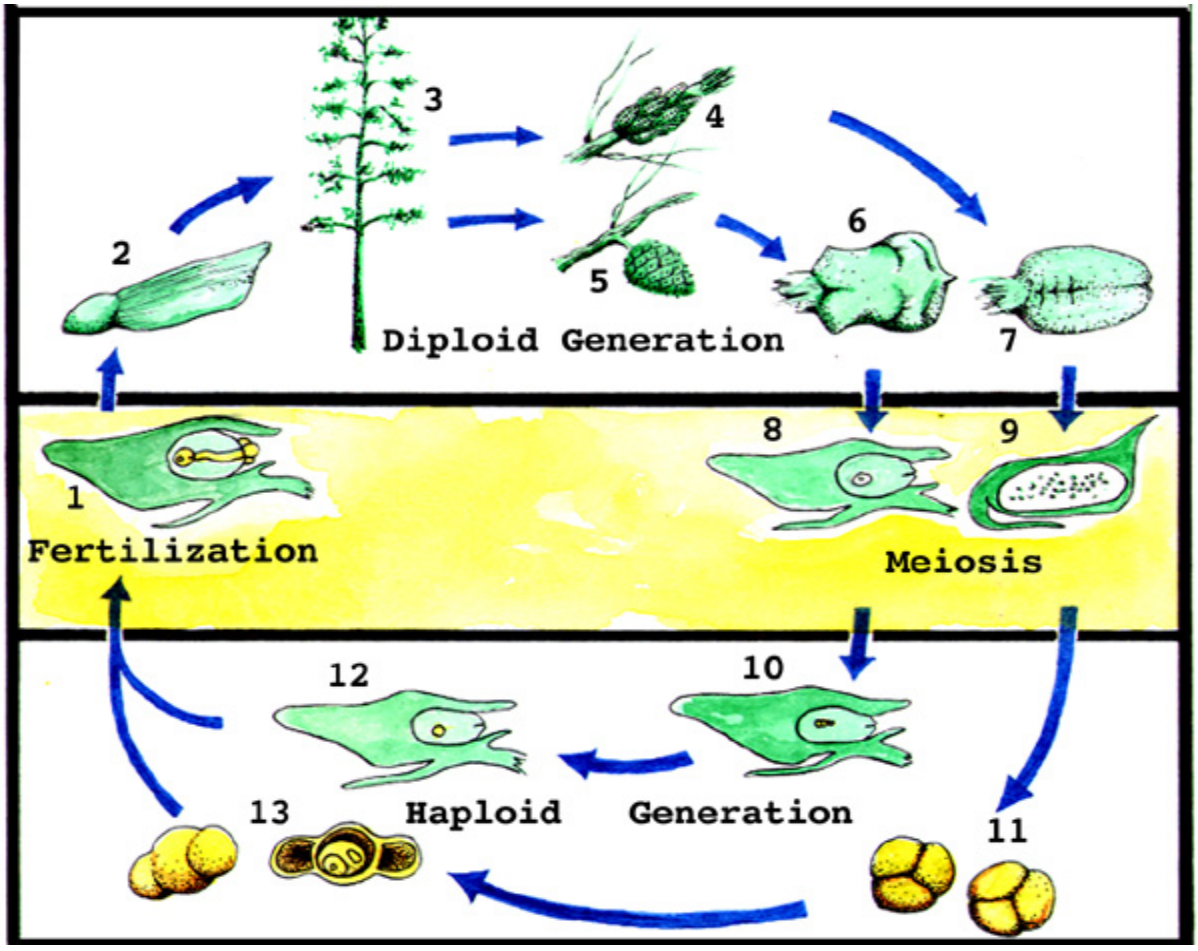


Figure 9.11. Life Cycle of a Pine Tree- a naked seed bearing

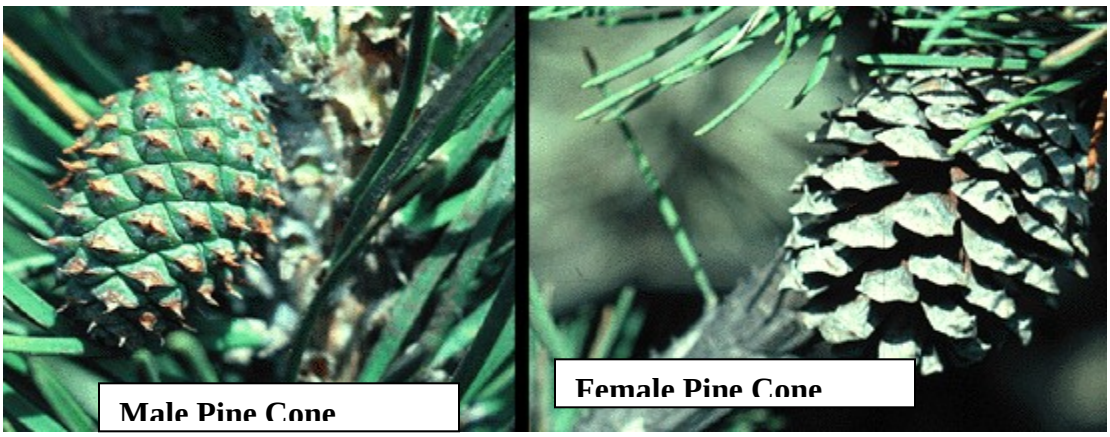
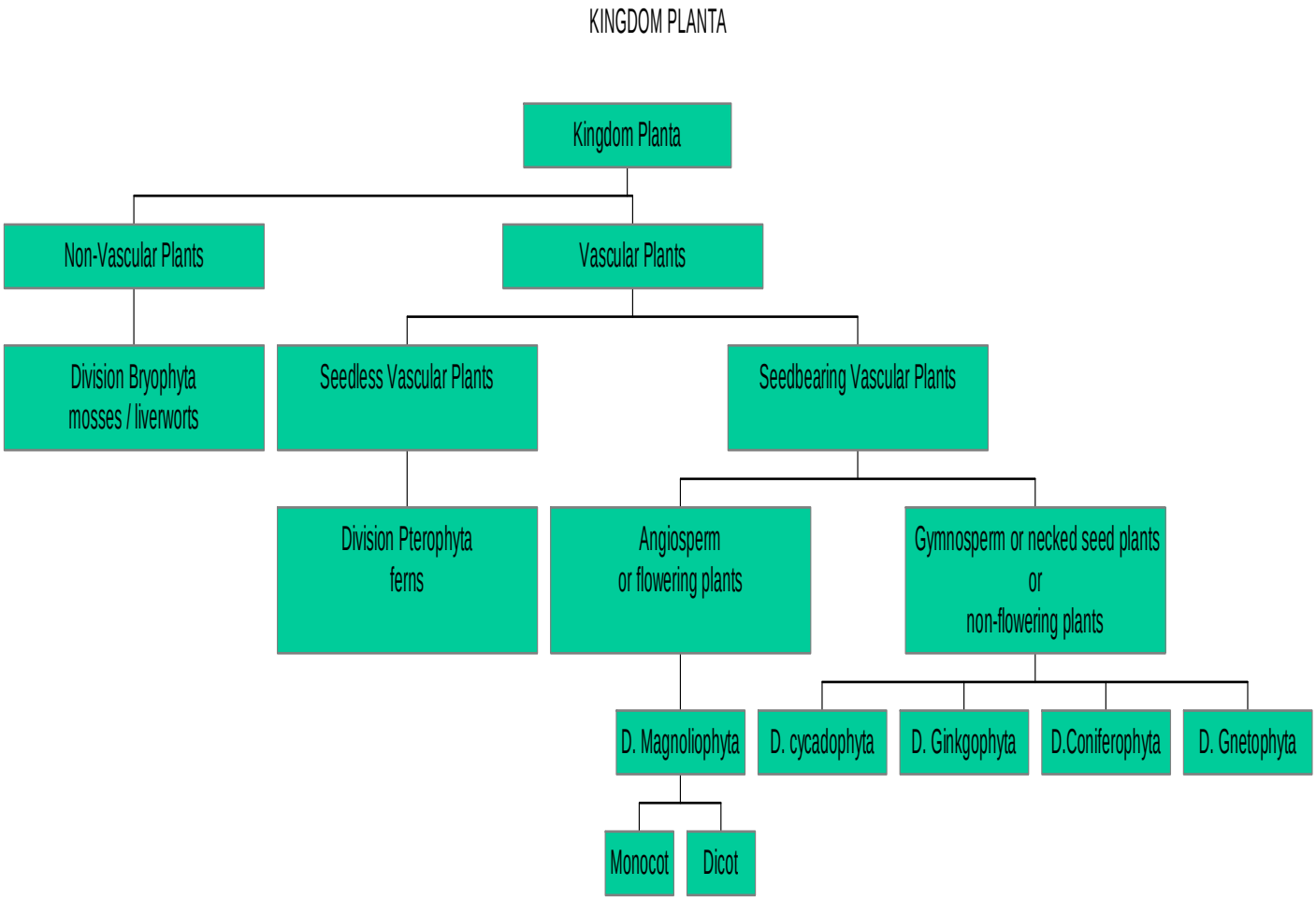


Figure 9.12. Male and Female Pine Cones

Angiosperms
Division Magnoliophyta--oak, elms, maples, vegetables, weeds, houseplants, grass, and corn plants. They are divided into two: monocot and dicot.

CHART SUMMARY OF KINGDOM PLANTA



<u>Kingdom Fungi</u>
In this kingdom are the fungi. This includes **mushrooms, molds, yeast, rust and mildews and lichens**. **The fungi are thread-like in structure**. These threadlike structures are called **hyphae**; collectively, they are called **mycelium.** The mycelia of fungi grow into substrates for extraction of nutrients for the fungi. They reproduce by spores. They can reproduce **sexually and asexually**. Under good conditions, they produce spore-forming structures called sporangiophores; examples include mushrooms, puffballs, and bracket fungi.

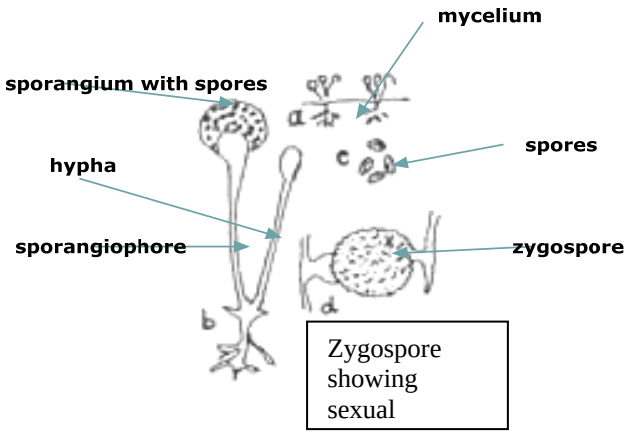


Figure 9.13: A diagram of a fungus

Economic Applications

Some fungi are edible, some for making of **bread, alcohol beverages, cheese and antibiotics**. There are also pathogenic fungi that cause fungal diseases in humans, animals and plants.

Fungi are **heterothrophic** because they can obtain food from any source in the environment. They can be **parasitic** if they obtain food from a living organism or **saprophytic** if their food is from dead organisms from the environment. Saprophytic fungi are **decomposers**.

Fungal diseases include the late **blight of potatoes** caused by ***Phytoptera infectans***. **Corn smut** is another disease caused by rust and smut fungi. There are other fungal diseases that cause elimination of some plants like Dutch Elm disease.

Fungi are important in the wine industries for making wine. Yeast for example is important in **fermentation**, making of white and red wine, also for brewing of beer and in the making of bread.

Fungi are widely used as food. Among these fungi include the edible mushrooms of **basidiomycota family** or club fungi.

Mycotoxins and their diseases

Fungi have **toxins**; the most common ones are **mycotoxins and mushroom toxins**. **Mycotoxins** are secreted by fungi into contaminated foods. These toxins are carcinogenic. Among them include **Aflatoxins** from *Aspergillus flavus;* **Ergot** from *Clavicep purpurea* that causes **ergot** disease known as **Ergotism. Ergot** infects plants also.

Symptoms of ergotism in humans include burning sensation in the fingers, toes, feet, legs and hands. The limbs become swollen, the burning sensation alternates with icy-cold symptoms. This is followed by numbness of the affected parts. The part of the body becomes darkened and may lead to gangrene and amputation of the limbs. In pregnant women, abortion can set in. Other symptoms include itching, muscle cramp or spasm, hallucination and convulsion. Ergot has been used to induce abortion or aid in childbirth.

Extracts of Ergot used in pharmacology

Ergometrine is an alkaloid extracted from the ergot infected plant, used to reduce postpartum bleeding.

Ergotamine
Another ergot extract is ergotamine that is used for migraine headache. Pharmaceutical industries inoculate the fungus ***Claviceps purpurea*** in rice plants to obtain ergot for medicinal purposes.

LSD (Lysergic acid diethylamide) is another ergot extract that consists of a group of alkaloids that can produce hallucinations. LSD is a psychoactive drug that infects the midbrain and alters the release of serotonin. Other symptoms include elevated blood pressure, respiration, perspiration and palpitation. LSD has a long - term mind - altering effect plus other side effects, however it has been employed in the treatment of schizophrenia. LSD is an illegal drug and its use on the streets has increased.

Penicillin from Ascomycetes is known to inhibit the growth of gram-positive bacteria by blocking the bacterial cell wall synthesis.

Divisions of Kingdom Fungus
There are 3 divisions: zygomycota, ascomycota, and basidiomycota, however there are some protista that reproduce like fungi and are usually discussed along with fungi. Among them include the slime molds in the Division Myxomycota, and water molds, white rust and mildews in the Division Oomycota.

Division Zygomycota: Bread Mold
These fungi have thick walled sexual spores called zygosporangia. There are no distinct male and female gametophytes, but the mating types are – and + strains. The two strains come together, their nuclei fuse and a zygosporangium is formed. This can be seen in figure 9.15. They can undergo both sexual and asexual reproductions. In the case of asexual reproduction, the hyphae form sporangiophores carrying sporangia. Each sporangium contains spores that when released germinate into other fungi.

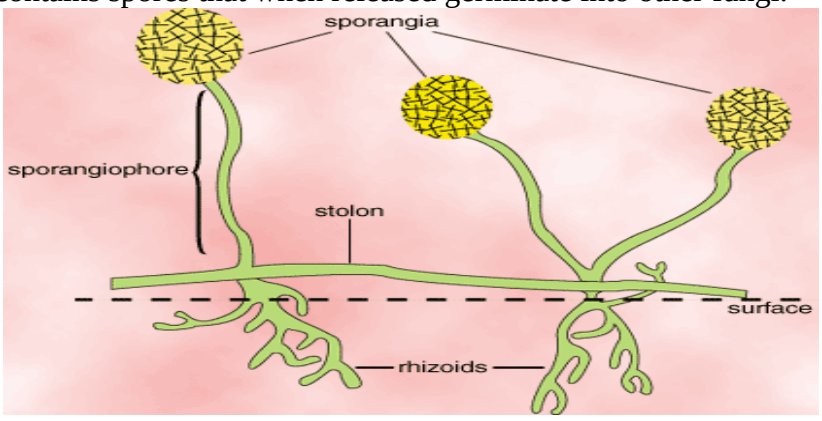


Figure 9.14: Zygomycota: Rhizopus stonolifer, Bread mold

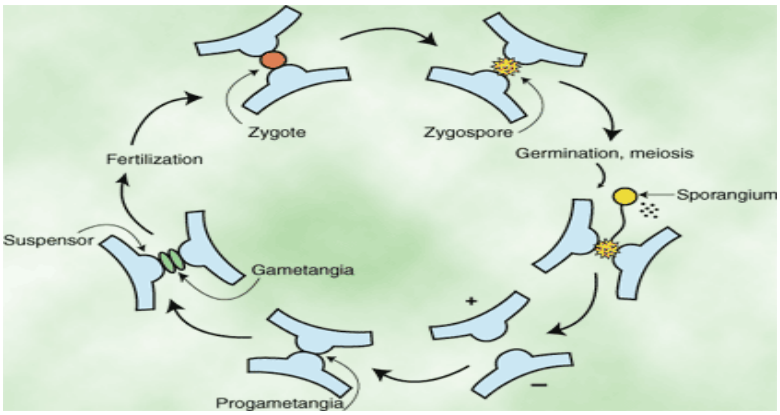


Figure 9.15: A Sexual reproduction life cycle of a bread mold (Rhizopus stonolifer)

Division Ascomycota

The ascomycetes produce **ascospores** in sacs called Asci. The mycelium is branched and septate. During sexual reproduction, hyphae of different mating types intertwine to form male antheridia and female ascogonia.

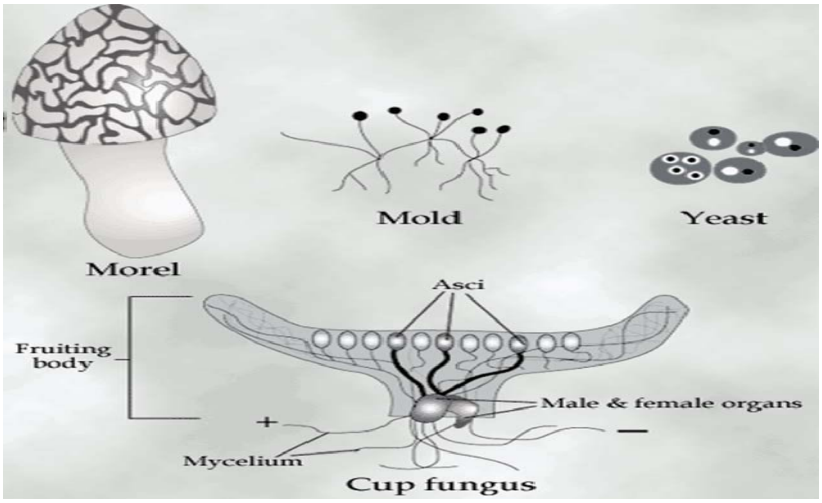


Figure 9.16: An illustration of the cup fungus

They can reproduce asexually or sexually. Asexual reproduction occurs through the formation of conidiophores. The conidiophores release spores called conidia which later germinate to form young ascomycetes.

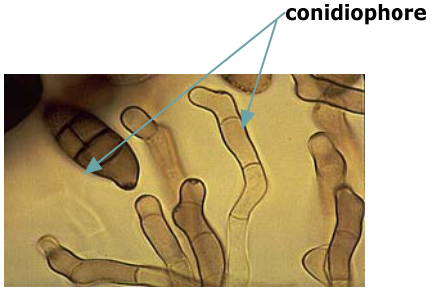


Figure 9.17: conidiophores of ascomycota in asexual reproduction.

In sexual reproduction the hyphae of different mating types become intertwined, male antheridia may form on one, and the female ascogonia may form on the other, plasmogamy occurs, followed by karyogamy. The fused cell undergoes meiosis to form ascopores. The ascopores undergo mitosis to form numerous spores that are later released to germinate.

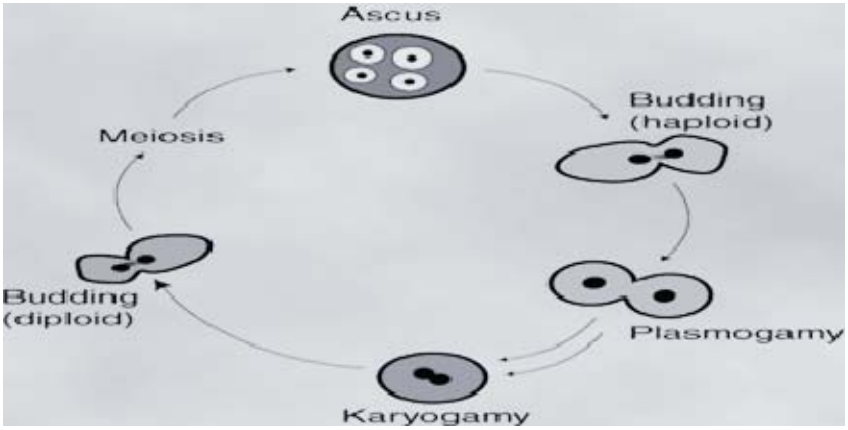


Figure 9.18: The sexual rteproduction life cycle of another ascomycete, yeast.

Ascomycetes are used to produce antibiotics, which include **erythromycin, tetracycline, chloramphenicol and nystatin.** ***Cephalosporium acremonium*** is used to produced cephalosporin for the treatment of Gram-positive and Gram-negative bacterial infections. The cephalosporin antibiotics are broad-spectrum drugs, they can be used to treat penicillin-resistant bacteria, and they are very expensive. *Neurospora crassa* is a common ascomycete commonly known as red bread mold. It is commonly used for research studies.

Division Basidiomycota

These are mushrooms, puffballs, bracket fungi, rusts, and smuts. The rusts and smuts lack fruiting bodies. The basidiocarps are the fruiting bodies which are the visible portions of an extensive mycelia within the substrate (or soil). The basidiospores form externally on the basidia. Each basidium bears 4 spores. Some spores have +, while others have – strains of nuclei. Gills of mushrooms are lined with basidia. When the spores are ready to be released, they are shot out of the basidia. The spores germinate into young basidiomycetes.

For sexual reproduction to occur, the haploid germinated hypha fuses with another one of a different strain to form a dykaryon. This develops into an extensive mycelium with fruiting bodies. See figure 9.20.

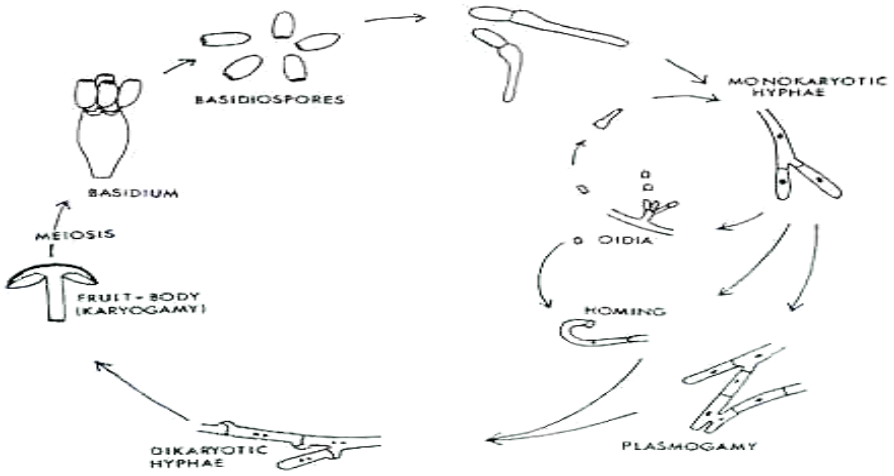
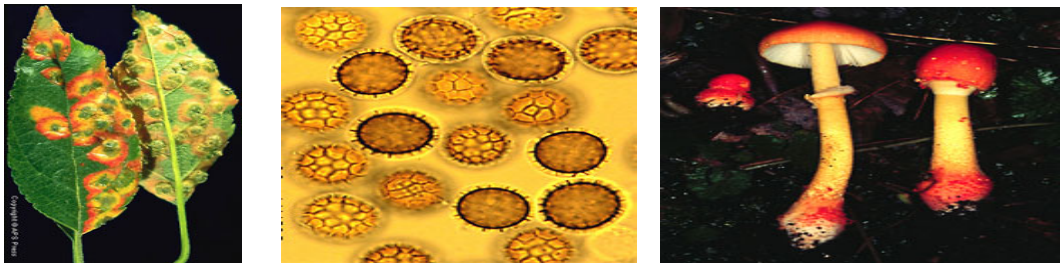


Figure 9.19: The Life cycle of a Basidiomycota (Mushroom)

Parasitic and poisonous basidiomycetes include gymnosporangium, tilletia and amanita.



A B C

Figure 9.20: Parasictic Basidiomycota: A. Gymnosporangium parasitic infection on leaves, B. Tilletia, C. Amanita

Poisonous Mushroom

Among the **poisonous mushrooms** includes the **toadstool**. Mushroom toxins are classified into three: **protoplasmic poisons** that destroy the liver and the kidneys; **neurotoxins** that affect the central nervous system and the autonomic nervous system to cause hallucinations; and the **gastrointestinal irritants** causing nausea, vomiting, stomach cramps and diarrhea. The **mushroom toxins** include **Amatoxin** found in **Amanita mushrooms**. *Amanita muscaria* produces **ibotenic acid** that can be converted into **muscimol inside the body.** The effect of this toxin is psychoactive. **Psylocybe mushrooms** are known to produce **psilocybin** and **psilocin toxins**. These toxins act like the **neurotransmitter serotonin** and interfere with the function of serotonin in the brain. They cause hallucination, vomiting, depression and irritability. Excessive doses may cause paralysis, insanity or suicide. These mushrooms are small and brown in appearance.

Fungal Allergy and Pathogens

Infectious fungal diseases include superficial mycoses of the skin, hair and nails and deep systemic diseases that affect the organs.

Superficial Mycoses include dermatophytes – ring worms of nails, scalp and the skin.

Fungal allergies are caused by fungal spores. Among the allergies include **hay fever and asthma**. Fungal spores can be found in toxic molds in carpets, clothes, shoes, showers, bathroom fixtures, and furniture, these can cause sick building syndrome. **Toxic molds can cause breathing difficulties, dizziness, and memory loss.**

Key Points

1. Fungi have no chlorophyll pigments. They function in decomposition, fermentation, food, and drugs.
2. Fungi are heterotrophic, their characteristic features are mycelia. A mycelium is a mass of hyphae (hyphae are threadlike tissues). They reproduce by spores.
3. Fungi are classified into 4 divisions: Myxomycete s (slime molds) zygomycetes (bread mold), Basidiomycetes (club fungi, examples are mushroom and puffballs) and Ascomycetes (sac fungi, an example is yeast).
4. Fungi are used to make beverages, examples are wine and beer.
5. Fungi are used to produce cheese, yogurt, sausage, and make bread.
6. Penicillin is the antibiotic from Ascomycetes or sac fungi. The antibiotic is used to suppress bacterial growth. From Ascomycetes are produced erythromycin, tetracycline, nystatin and chloramphenicol. Cephalosporin is another antibiotic from celphalosporium, another fungus.
7. Fungus are plant pathogens, an example is Ergot which contaminates Rye grains. It causes the disease ergotism (numbness of the limbs and abortion in pregnant women).
8. From Ergot, the following can be extracted: ergometrine (drug to reduce postpartum bleeding), ergotamine (drug for migraine headache), and LSD (lysergic acid diethylamide)
9. Mushrooms are edible, but some are poisonous. Amatoxin is found in the mushroom amanita. It is a toxin that can be deadly. Muscimal is another toxin in another amanita mushroom. It produces psychoactive affects, dizziness, nausea, and seizure Psilocybe mushrooms contains Psilocybin which is easily converted into psilocin which causes hallucination, nausea, vomiting, and possibly paralysis, and insanity.
10. Fungi are pathogenic to man. They can be divided into 2 groups: dermatophytes (superficial skin diseases) and mycosis (systemic diseases). Dermatophytes attack skin, hair, and nails. They cause ringworms on the skin, head, and feet (athlete foot). They can cause yeast infection. Systemic mycosis are not very common, it can cause lung deterioration.

Study Questions

1. State 3 general characteristics of organisms in the kingdom monera.

2. Give an example of any plant in each of the following divisions of the Kingdom Protista: pyrrophyta, chrysophyta, euglenophyta, chlorophyta, rhodophyta and phaeophyta

3. State one general characteristic of plants in the Kingdom Plantae.

4. Name an example of plant in each of these divisions: Bryophyta, Psilophyta, lycophyta, Sphenophyta, Pterophyta, Coniferophyta, Cycadophyta, Ginkophyta, and Gnetophyta.

5. Name any 10 plants, (using common names) that are in the division magnilophyta.

6. State the 3 general characteristics of Kingdom fungi.

7. Give one example of a fungus in this division: zygomycota, ascomycota, and basidiomycota.

8. List names of fungi that you know, and classify them by placing them in each of the above mentioned division

9. State any 3 common fungal diseases of plants.

10. State any 5 common fungal diseases of man

11. Explain briefly the economic importance of algae and of fungi.