Plant Kingdom

Introduction

Previously we have studied Whittaker's classification system in which he suggested the classification of organisms into five kingdoms i.e. Monera, Protista, Fungi, Animalia and Plantae. In this chapter, we will deal with further classification of Kingdom Plantae (also known as plant kingdom), in detail.

Algae

Algae are chlorophyll-bearing, photoautotrophic, simple, thalloid (plant body not differentiated into root, stem and leaves) and largely aquatic (both freshwater and marine) organisms. They also occur in a variety of other habitats: on moist stones, in moist soils and on wood. Some of them also occur in symbiotic association with fungi (lichen) and animals (e.g. on sloth bear & inside *Hydra*).

The body form and size of algae is highly variable, that ranges from microscopic unicellular forms like *Chlamydomonas*, colonial forms like *Volvox* and the filamentous forms like *Ulothrix* and *Spirogyra*. A few of the marine algal forms such as kelps have massive plant bodies. As unicellular algae are now classified in kingdom Protista, algae placed under Plantae have multicellular forms only.

Algae reproduce by vegetative, asexual and sexual methods.

Based on their photosynthetic pigments, algae are divided into three main classes: **Chlorophyceae, Phaeophyceae and Rhodophyceae.**

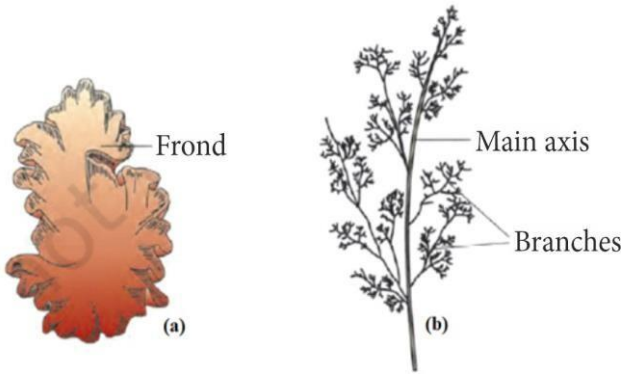

Fig* : (a) *Porphyra*, (b) *Polysiphonia

Table : Divisions of Algae and their Main Characteristics

Class	Common name	Major pig-ments	Stored Food	Cell Wall	Flagellar Number and Posi-tion of Insertions	Habitat
Chlorophyceae	Green algae	Chlorophyll a,b	Starch	Cellulose	2-8, equal, apical	Fresh water, brackish water, salt water
Phaeophyceae	Brown algae	Chlorophyll a,c, fucoxanthin	Manni-tol, lami-narin	Cellulose and algin	2, unequal lateral	Fresh water (some), brackish wa-ter, salt water (most)
Rhodophyceae	Red algae	Chlorophyll a,d, phycoerythrin	Floride-an starch	Cellulose, pectin and polysul- phate esters	Absent	Mostly salt water

BRYOPHYTES

Bryophytes, the plant group includes the various mosses and liverworts that are found usually growing in moist & shaded areas in the hills. Bryophytes are also called amphibians of the plant kingdom because these plants can live in soil but are dependent on water for sexual reproduction.

The main plant body of the bryophytes is haploid. It produces gametes, hence is called a gametophyte. It is more differentiated than the plant bodies of algae, yet it lacks true root, stem and leaves. it may possess root-like, leaf-like or stem-like structures. Hence, the plant body of bryophytes is a thallus-like structure which is either prostrate or erect, and attached to the substratum by unicellular or multicellular rhizoids.

The bryophytes are divided into two groups- liverworts and mosses:

Liverworts

The liverworts grow usually in moist, shady habitats such as banks of streams, marshy ground, damp soil, bark of trees and deep in the woods. The plant body of a liverwort is thalloid, e.g.,

Marchantia

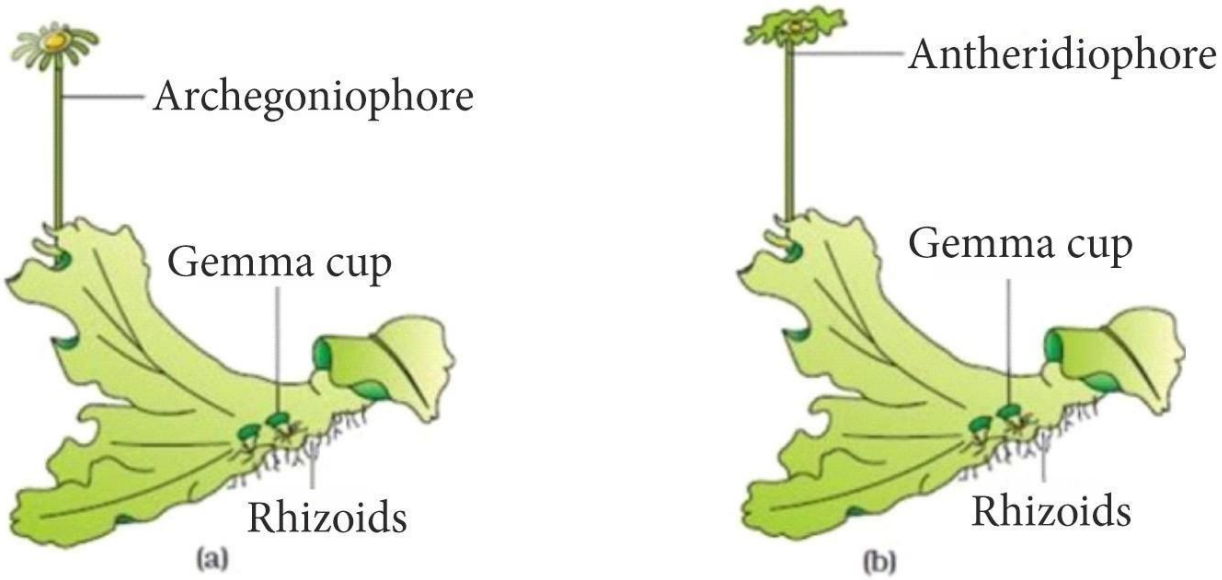

***Fig* : Bryophytes : A liverwort-*Marchantia* (a) Female thallus (b) Male thallus**

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Mosses

The predominant stage of the life cycle of a moss is the gametophyte which consists of two stages.

The first stage is the protonema stage, which develops directly from a spore.

It is creeping, green and filamentous stage that undergoes frequent branching.

The second stage is the leafy stage, which develops from the secondary protonema as a lateral bud.

It consists of upright, slender axis bearing spirally arranged leaves.

It is attached to the soil through multicellular and branched rhizoids and bears sex organs i.e. antheridia and archegonia.

Sex organs are produced at the apex of the leafy shoots.

Vegetative reproduction in mosses is by fragmentation and budding in the secondary protonema.

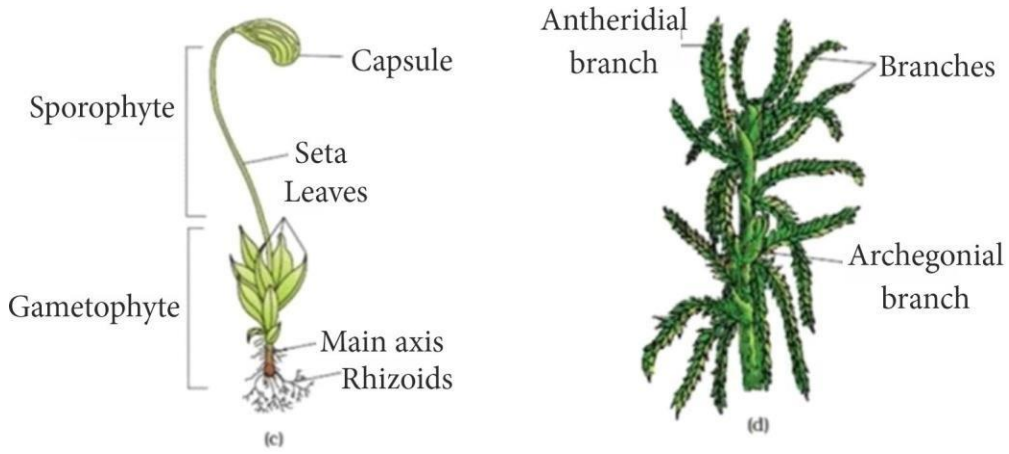


Fig **: Mosses-(c)** ***Funaria*****, gametophyte and sporophyte; (d)** ***Sphagnum*** **gametophyte**

PTERIDOPHYtes

The Pteridophytes include plants like horsetails (*Equisetum*) and ferns.

In pteridophytes, the main plant body is a sporophyte which is differentiated into true root, stem and leaves.

The leaves in pteridophyta are small (microphylls) as in *Selaginella* or large (macrophylls or megaphylls) as in ferns.

Evolutionarily, they are the first terrestrial plants to possess well-differentiated vascular tissues i.e. xylem and phloem.

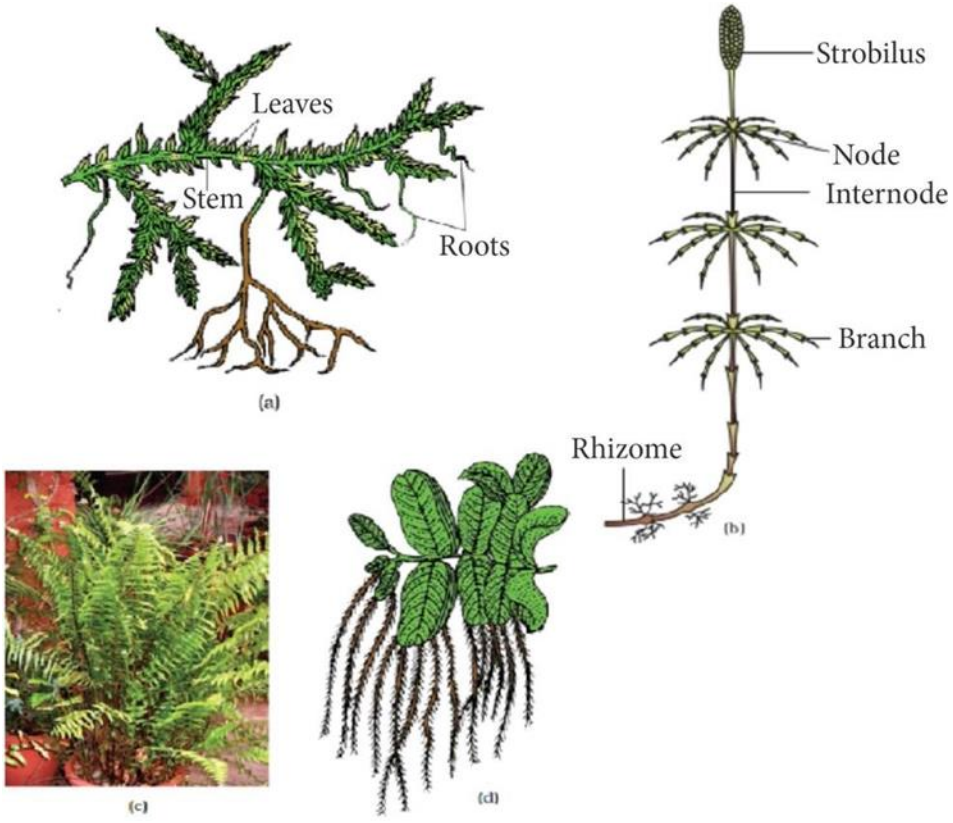


Fig. **Pteridophytes : (a) *Selaginella* (b) *Equisetum* (c) Fern (d) *Salvinia***

The sporophytes of pteridophytes bear spore producing structures called sporangium (pl: sporangia) which are present on leaf-like appendages called sporophylls.

In some pteridophytes like *Selaginella*, *Equisetum* etc., sporophylls may form distinct compact structures called strobili or cones. The sporangia have spore mother cells which undergo meiosis to produce spores.

Gymnosperms

The gymnosperms are spermatophytes (seed-producing plants) but their seeds which are developed post-fertilisation from ovules, are not covered by any fruit wall, i.e. are called naked seeds. (gymnos: naked, sperma: seeds).

In other words, it can be concluded that the ovules of gymnosperms are not enclosed by any ovary wall and remain exposed, both before and after fertilisation.

Gymnosperms include medium-sized trees or tall trees and shrubs.

The giant redwood tree *Sequoia*, a gymnosperm, is one of the tallest among all tree species.

The gymnosperms are heterosporous plants i.e. they produce haploid microspores and megaspores.

ANGIOSPERMS

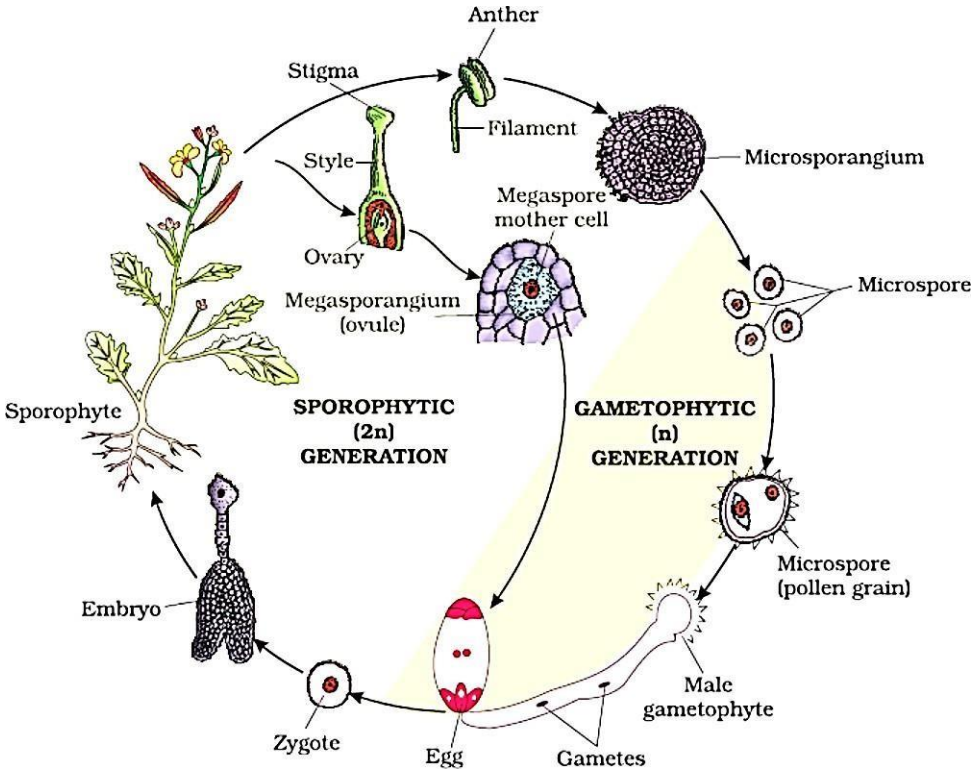
Unlike the gymnosperms where the ovules or seeds are naked, in the angiosperms or flowering plants, the pollen grains and ovules are developed in specialised structures called flowers and the seeds are enclosed within fruits. The angiosperms are the largest group of plants, occurring in wide range of habitats. They range in size from the smallest *Wolffia* to tall trees of *Eucalyptus* (over 100 metres). Angiosperms are divided into two classes

1. Dicotyledons or dicots: They are characterised by seeds having two cotyledons, reticulate venations in leaves, and tetramerous (as in mustard) or pentamerous (as in brinjal) flowers, i.e., having four or five members in each of their floral whorls.
2. Monocotyledons or monocots: They are characterised by single cotyledonous seeds, parallel venation in leaves and trimerous flowers i.e. three members in each of their floral whorls.

Fig. **Angiosperms : (a) A dicotyledon (b) A monocotyledon**

The flower is the reproductive structure of angiosperms, usually having both male and female reproductive structures. Male sex organ in a flower is the stamen (homologous to microsporophyll of gymnosperms). Each stamen consists of a slender filament with an anther (microsporangia) at the tip.

Double fertilization



Plant Life Cycles And Alternation Of Generations

In plants, both haploid and diploid cells can divide by mitosis and because of this ability, there is the formation of haploid and diploid plant bodies. The haploid plant body called gametophyte, produces gametes by mitosis. Following fertilisation, the zygote also divides by mitosis to produce a diploid sporophytic plant body. Specific cells of sporophyte divide meiotically to produce haploid spores (meiospores or sexual spores). Spores in turn, divide by mitosis to form a gametophytic (haploid) plant body once again. Thus, during the life cycle of any sexually reproducing plant, there is an alternation of generations between gamete producing haploid gametophyte and spore producing diploid sporophyte. Different plant groups or individuals, in their life cycle, represent this alternation of generation in three possiblemanners:

1. **Haplontic life cycle :** In this type of life cycle, the sporophytic generation is represented only by the one-celled zygote. Thus, there are no free-living sporophytes. Meiosis in the zygote (zygotic meiosis), results in the formation of haploid spores. The haploid spores divide mitotically and form the gametophyte. The dominant phase of life cycle or main plant body, in such plants is the photosynthetic & free-living gametophyte. e.g. many algae such as *Volvox*, *Spirogyra* and some species of *Chlamydomonas* represent thispattern.

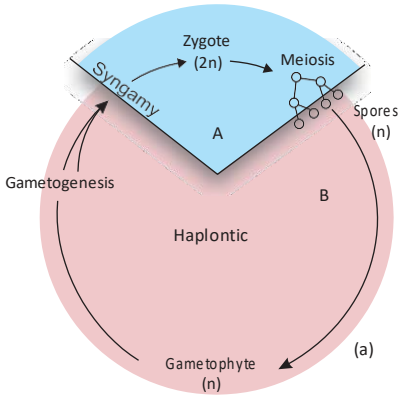


***Fig*. Life cycle patterns : (a) Haplontic**

2. **Diplonticlifecycle:** In thistypeoflifecycle, thediploidsporophyteisdominant, photosynthetic, independent phase of the plant and the gametophytic phase is represented by the single to few-celled haploid structures, usually are the gametes which are produced by meiosis in specific cells of the main plant body (gametic meiosis). e.g. A brown alga, *Fucus* sp. In addition, all seed-bearing plants i.e., gymnosperms and angiosperms, follow this pattern with some variations.

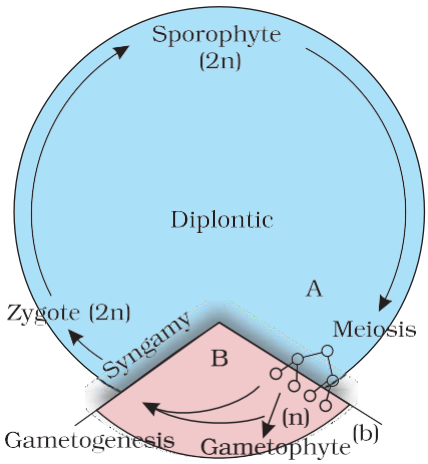


***Fig*. Life cycle patterns : (b) Diplontic**