Bryophytes

General Characteristics

The term ‘Bryophyte’ comes from Greek ‘bryon’ means tree-moss, oyster-green and ‘phyton’ means plant.

The term ‘Bryophyta’ was first coined by Braun (1864). However, he included algae, fungi, lichens and mosses in this group. Later, algae, fungi and lichens were placed in a separate division Thallophyta and liverworts, mosses in division Bryophyta.

The rank of division Bryophyta to this well-defined group of plants was first given by Schimper (1879).

Bryophytes are small, non-vascular plants, such as mosses, liverworts and hornworts.

The division Bryophyta includes over 25000 species. The fossil record indicates that bryophytes evolved on earth about 395-430 million years ago (i.e., during Silurian period of Paleozoic era).

The study of bryophytes is called bryology.

Hedwig is called ‘Father of Bryology’. Shiv Ram Kashyap is the ‘Father of Indian Bryology’.

Distribution: Liverworts as well as mosses are worldwide in distribution and are able to grow luxuriantly in humid climate of temperate and tropical regions. Liverworts are richly represented in humid tropics and become rare in arctic environment. Mosses can however survive in extreme conditions of arctic and alpine regions and can tolerate submergence in water to semi arid conditions.

Habitat:

They can grow in a variety of habitats due to their great adaptability, small size, minimum requirement and autotrophic mode of nutrition. On the basis of habitat bryophytes are categorised as:

1. Terrestrial: grow on soil surface e.g. *Marchantia*, *Funaria* etc.
2. Aquatic: grow in water e.g. *Riccia fluitans*, *Fontinalis antipyretica* etc.
3. Epiphyte: Grow on bark of trees (corticolous) or on the leaves of other plants (Folicolous). E.g. *Epimeropsis*, *Bryum* sp., *Tortula* sp. etc.
4. Saxicolous: grow on rocks. E.g. *Conocephalum*, *Porella* etc.
5. Xerophytic: grow in desert e.g. *Tortula princeps*, *Barbula torquala* etc.

General Characters of Bryophytes :

Bryophytes grow in damp and shady places. They are terrestrial but require external water to complete their life cycle. Hence, they are called 'Amphibians of plant kingdom'.

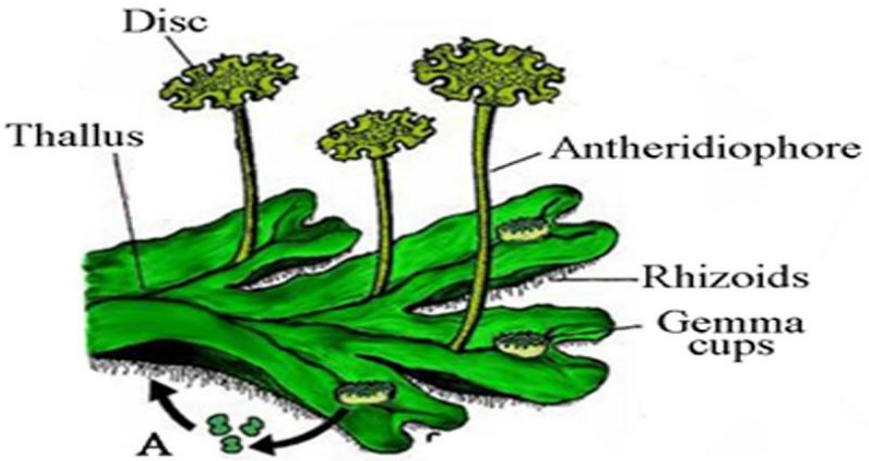
These are mostly autotrophic; a few are saprophytes, e. g., *Cryptothallus mirabilis* is a saprophyte which grows in swamps. It is completely devoid of chlorophyll and lives at the expense of its mycorrhizal fungus.

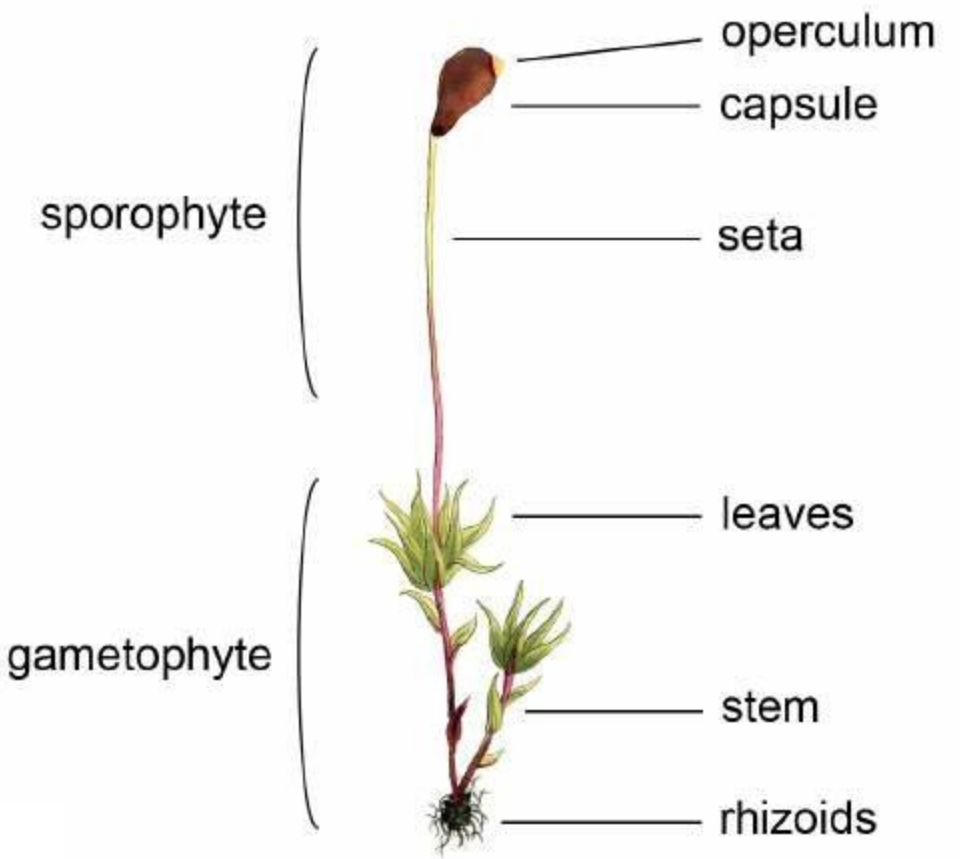
The main plant body of bryophytes is gametophyte. It is more conspicuous, long- lived, independent, green and freely branched. On the other hand, the sporophyte is short-lived and completely dependent on the gametophyte.

Plant body is very small and ranges from a few mm. to many cm. *Zoopsis* is the smallest bryophyte (5 mm) while the tallest bryophyte is *Dawsonia* (50-70 cm).

Gametophytic and sporophytic phases are present in the life cycle of bryophytes. Both these phases are morphologically distinct (i.e., heteromorphic).

Cryptothallus mirabilis- sporophyte





Moss gametophyte and sporophyte

In the liverworts such as *Riccia* and *Marchantia*, the gametophyte is prostrate and thalloid, but in the mosses, the gametophytic plant body is erect and differentiated into stem and lateral appendages.

The true roots are absent in bryophytes and the function of anchorage and absorption is performed by filamentous structures known as rhizoids. The rhizoids may be unicellular and unbranched (liverworts and hornworts), or multicellular and branched (mosses). Rhizoids are analogous to the roots of higher plants.

The plant body is composed of parenchymatous cells and lacks differentiated xylem and phloem - characteristic of true vascular plants.

Being embryophytes, they have multicellular sporangia and gametangia: reproductive cells are always surrounded by one or several layers of sterile cells.

The bryophytes reproduce by vegetative and sexual methods.

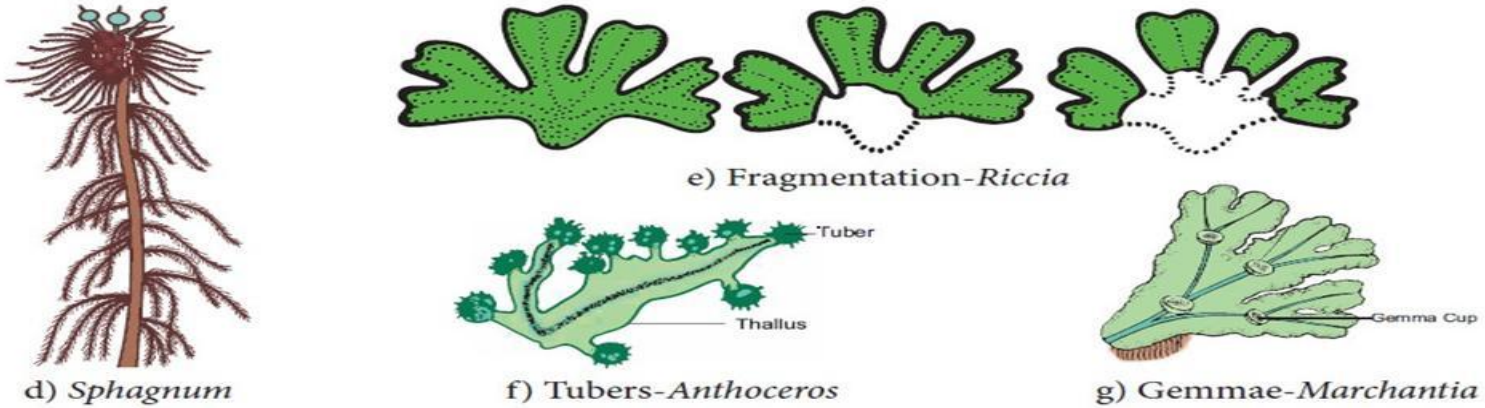
Vegetative multiplication in bryophytes takes place by:

a. Fragmentation: Progressive death and decay of older portions of thallus at the posterior end reaching a dichotomy, and younger branches at anterior end by apical growth separating into new individuals. In this way, an increasing number of plants are produced.

b. Adventitious branches: In thallose liverworts and hornworts, often there is formation of adventitious branches from the underside midrib which on breaking form new plants.

c. Innovations: These are few axillary branches which grow vigorously and after separation from mother plant grow into new individuals, e.g. *Sphagnum*.

d. Gemmae: These are special vegetative organs, and in a more restricted sense refer to a propagative organ of definite form. The gemmae characteristically originate from single cell, but may be unicellular, bicellular or multicellular at the time of its release.

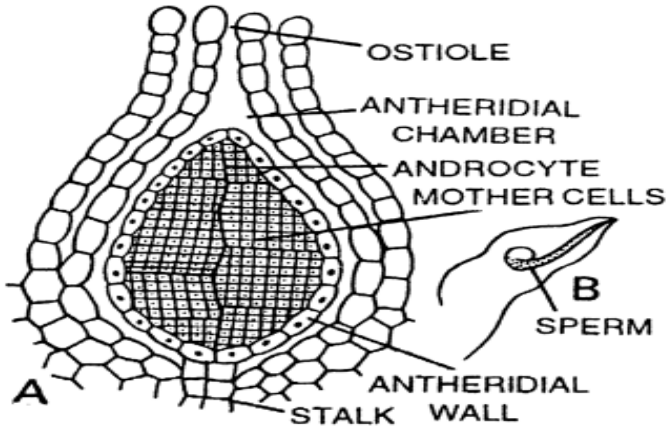


d) *Sphagnum* e) Fragmentation-*Riccia* f) Tubers-*Anthoceros* g) Gemmae-*Marchantia*

Figure 2.11: Structure and reproduction in Bryophytes

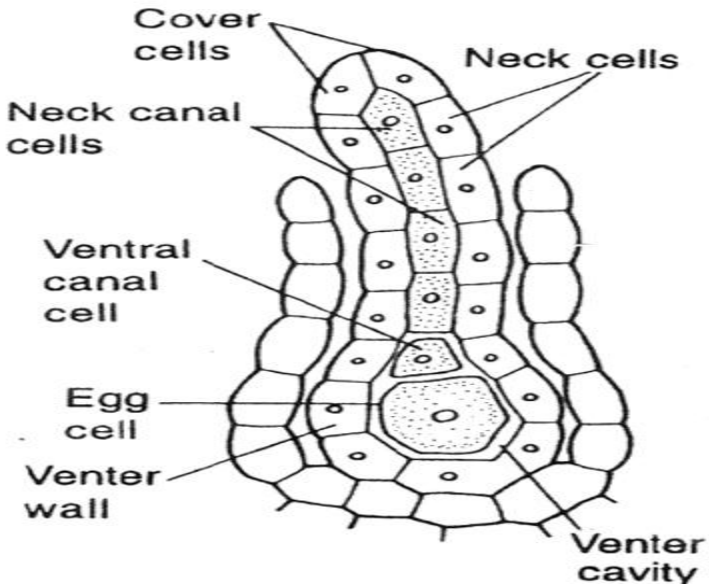
Typical spore formation in bryophytes is lacking. But they show the formation of gametophyte directly from the cells of sporophyte, other than a spore, a phenomenon called as apospory. The mosses have great power of regeneration and the wounding of unspecialized cells of various parts of sporophyte induces the production of green filament, the latter bears a new crop of leafy gametophores.

The **sexual reproduction** in bryophytes is of oogamous type. The sex organs are multicellular. The male sex organs are known as antheridia; the latter are stalked, globose or somewhat elliptic. They have an outer sterile one-cell thick jacket, which surrounds a solid mass of fertile cells, the androcytes. Each androcyte eventually metamorphosis into a motile, biflaggelate antherozoid.



Riccia sp. A, antheridium (male sex organ)

The female sex organ known as archegonium is a flask-shaped structure having basal swollen venter and somewhat more slender and elongated upper part, the neck. The venter and neck are surrounded by a jacket of sterile cells. Four cover cells are located at the top of the neck. Each archegonium contains a single egg cell which is located in the venter. A short stalk attaches the archegonium to gametophyte.



Water is necessary for fertilization. Shortly before egg cell is mature, the cover cells separate. At the same time, the cells in the centre of neck dissolve so that an open canal connects the venter with moisture outside the archegonium. Free swimming sperms move towards chemical substances

formed by the archegonium. This response to chemical stimuli is known as chemotactic response. Several sperms may enter the archegonium but only one fertilizes the egg to form diploid zygote within venter. The zygote does not have any resting period and it divides immediately after fertilization. The first division of zygote is always transverse and outer cell gives rise to embryo. Thus, they show exoscopic mode of embryo development.

The embryo develops within the venter of the archegonium and gives rise to sporophyte or sporogonium. The sporophyte is a simple structure without rhizoids, stem or leaves. It is completely dependent on gametophyte.

The sporophyte is a projecting structure differentiating into foot, seta and capsule. The sporogenous cells present in capsule form haploid spores (meiospores) after reduction division. All spores are similar in shape and size (Homosporous). The spores are non-motile and disseminate exclusively by wind.

Under favourable conditions, spores either form filamentous germ tube which divides to give rise to young gametophyte (*Riccia*, *Marchantia*) or form a protonema, as in mosses. The protonema bears many buds which develop into erect gametophyte.

In bryophytes, growth of gametophyte is by means of a single apical cell rather than by a meristematic tissue. Regardless of where bryophyte grows, all bryophytes require water for fertilization and dispersal.

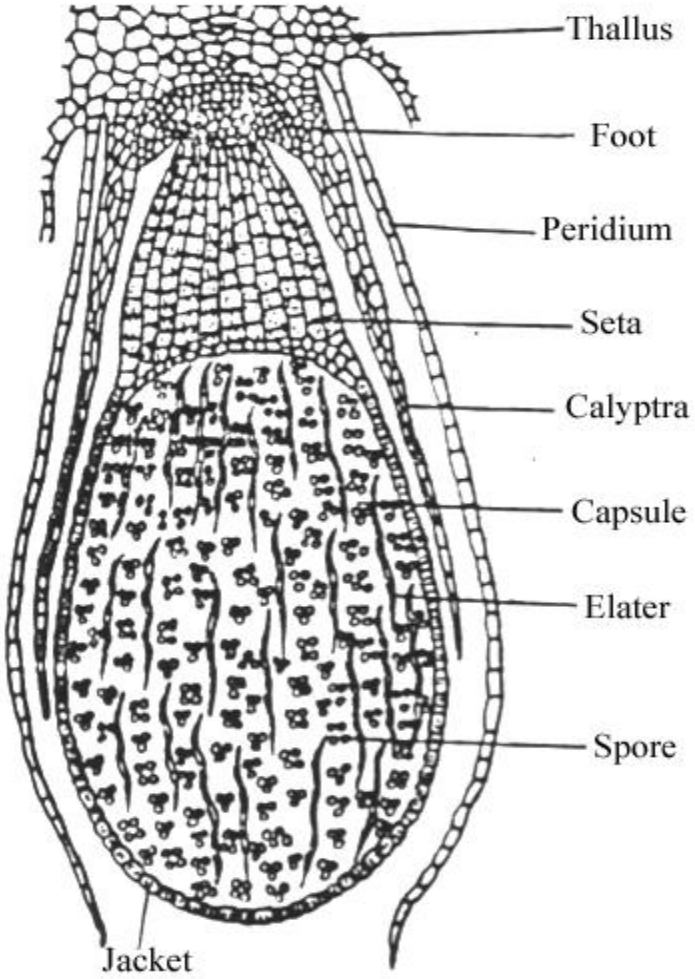


Fig: *Marchantia spp.* Structure of mature sporophyte.

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