9. The gametophyte has a stem like axis with spirally arranged leaves, which are known as phyllids. Sex organs borne apically in groups on main 'stem' or on branch.
10. They attach to their substrate with multicellular rhizoids. The sporophyte has a foot, seta and a capsule. The capsule bears the haloid spores.
11. Columella is usually present and endothecial in origin. Peristome helps in the dispersal of spores.
12. Spores on germination produce the protonema.
13. Leaves usually consist of a single cell layer. *Polytrichum* has a pad of cells and filamentous strands of photosynthetic cells. The margins of the leaves are often toothed, the teeth pointed or rounded.
14. They lack xylem and phloem. The plant body may have primitive xylem-like conducting tissue called hydroid. The phloem-like conducting tissue is called leptoid.
15. Sexual reproduction is oogamous. Male reproductive organs –antheridia are produced by gametophytic plant. A mature antheridium consists of a slender stalk and a club-shaped or pouch-like body. The club-shaped body has a single-layered jacket which encloses a number of biflagellate antherozoids. They may be dioecious or monoecious. Archegonia are produced on the gametophytic thallus. Archegonia are flask-shaped structure with neck and venter. The venter bears an egg. Fertilization takes place when antherozoids enter through the dissolved neck canal cells and meet the egg in the venter.
16. Fertilization leads to the development of diploid zygote. Zygote develops into an embryo. The embryo gives rise to sporophyte. The sporophyte produces haploid spores.

This class has been divided into the following orders:

Order 1. Sphagnales

Order 2. Andreaeales

Order 3. Bryales

Examples*: *Sphagnum*, *Polytrichum Funaria

19.3. ADAPTATIONS OF BRYOPHYTES TO LAND HABIT:

Life originated in ocean and continued there for millions of year before an attempt was made by some green algae to conquer land habitat. The establishment of plant life on land therefore is one of the most significant evolutionary episodes in Earth history. Terrestrial colonization was possible due to a series of major innovations in body plans, anatomy, and biochemistry of the plant during the Paleozoic period. Change over to land was decided by various factors including an increase accumulation of biomass over the land surface, firstly by cryptogamic ground covers, enhanced rates of silicate weathering and carbon burial that drove major disturbance in the long-term carbon cycle, resulting in substantial drops in atmospheric CO_2 levels and increased oxygenesion. It also led to major changes in soil types for animals and fungi to colonize.

Cladistic analysis of land plants suggests that the bryophytes are paraphyletic in origin. Molecular phylogenies have not yet able to prove that liverworts, mosses or hornworts were the sister group of the vascular plants. Moreover, some recent studies suggested that embryophytes were present on land from the middle Cambrian and by the early Silurian, the four major lineages of land plants had already diverged and were constituents of early cryptogamic ground covers. Plants had then already evolved key adaptations like development of an embryo, alternation of generations, aerial sporophytes, sporophyte branching, cuticle, stomata, vascular tissue, sporopollenin-coated spores for survival and proliferation on dry land in the early Silurian. They started interactions with early soils and nutrient using rhizoids, rhizomes, and symbiosis with the help of mycorrhizal fungal partners. Unless molecular evidences are not forthcoming to shed further light on the evolution of land plants it remains-inconclusive. However, conventional methods and fossil evidences suggest algal origin of bryophytes. The amphibian nature of bryophytes has strengthen this view. Similarly, majority of the bryophytes are terrestrial but they are incompletely adapted to the land conditions. They are unable to grow during dry season and require sufficient amount of water for their vegetative growth. Water is absolutely essential for the maturity of sex organs. Without water they are unable to complete their life cycle.

The point of suspect that bryophytes arisen from algal ancestors became stronger by the facts that many of the characteristics of bryophytes are common to their algal ancestors. They retained autotrophic and complex nature of the gametophyte; the photosynthetic pigments - chlorophyll a and b, carotenoids, and xanthophylls; sperm that swim by means of two asymmetrically attached flagella; starch as food reserve; and cell walls composed primarily of cellulose and pectin. Bryophytes also engage in a particular type of cell division that is present in charophytes but absent in other green algae. In an attempt to ward off some of the problems faced with the terrestrial life, bryophytes also evolved many new adaptations like preventing death by drying out, using little water to facilitate sexual reproduction and dispersing spores through the air.

Some of the important adaptations made by bryophytes for adopting land habitat are:

A. Evolution of Sporophyte

1. Development of multicellul[a]porophyte. One of t important development among early bryophytes was ev[e] of a multicellular te. Two simple steps helped in this matter. First, meio[sis] be delayed in the second, the zygote must undergo mitotic cell divisio[n] ate a multicellular ere possible by embedding the young sporophyte [on] es of the gametop[hyte] ing nutrient water, and hormones for develop[ment] embryo phase o[f] has retained in all extant land plants. In [these] groups, the spor[ophyte] on the gametophyte for its entire life.