

Morphology, Anatomy &
Reproduction: *Marchantia*



Systematic Position

- Kingdom-Plantae
- Division-Bryophyta
- Class-Hepaticopsida
- Order-Marchantiales
- Family-Marchantiaceae
- Genus-*Marchantia*

Habitat and Distribution

- Genus has about 65 species
- Grows best in cool, moist and shady places
- *Marchantia polymorpha* grows as a pioneer in burnt forest soil

Distribution in India:

- 11 species occur in India mainly in western Himalayas
- *M. polymorpha* occurs at high altitudes in Himalayas on moist river banks and rocks
- *M. palmate* occurs in Kashmir, Kumaon, South India, Bengal and Assam
- *M. simlana* occurs in Himachal Pradesh
- *M. nepalensis* in Punjab and in Garhwal & Kumaon hills



Gametophyte

Morphology

- Plant body is prostrate, dorsiventral and dichotomously branched



Dorsal Surface:

- A shallow groove marked by the presence of a distinct midrib in each branch
- Many polygonal areas which demarcate the outline of underlying air chambers
- Each polygonal area has a pore in its centre called air pore
- Gemma cups are present along the midrib
- Each branch has a growing point situated at the apex in a groove called apical notch



- **Ventral Surface—**

- ✓ Bears rhizoids and scales along midrib



Rhizoids

- Unicellular and colourless
- Two types
 - i. Smooth walled- Inner walls are smooth
 - ii. Tuberculate- Inner walls show papilla like outgrowths
- Function– Anchorage and absorption of water and minerals

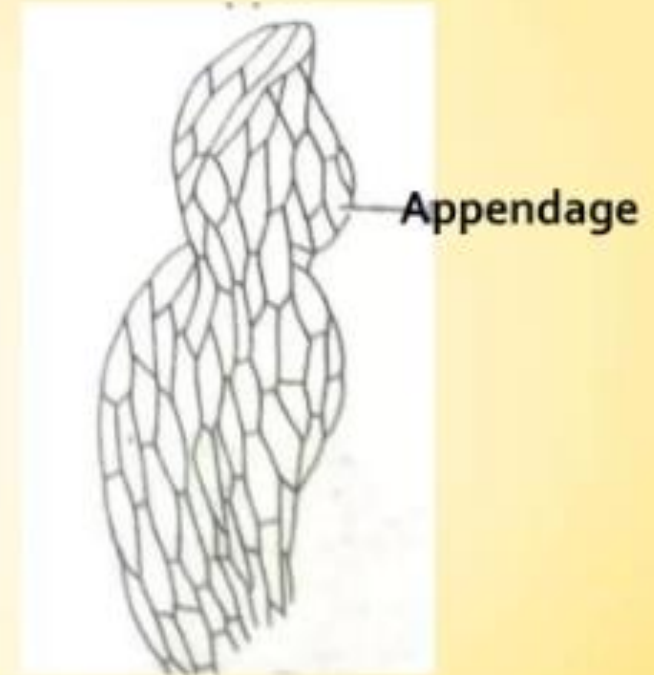


Optical Section



Scales

- Multicellular(one cell in thickness) and violet coloured due to presence of anthocyanin pigments
- Arranged in 2 rows on either side of mid-rib
- Two types
 - i. Appendiculate– these have an apical sub-rotund appendage and form inner row of scales
 - ii. Ligulate– these are small, without appendage and form outer row of scales
- Function—Protection of growing point and retention of water by capillary action



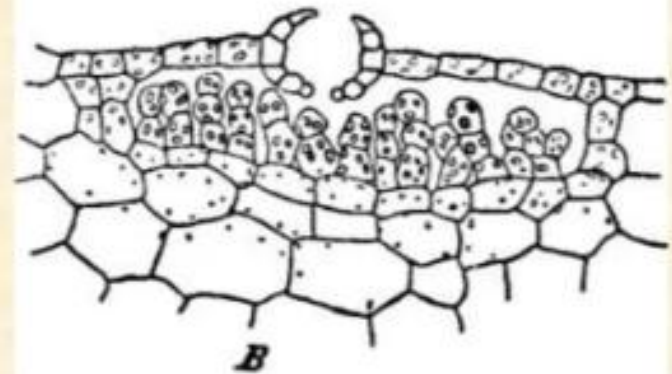
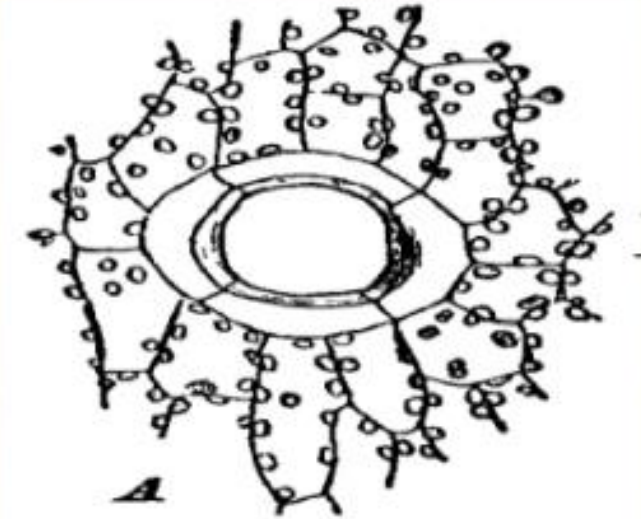
Appendiculate Scale



Ligulate scale

Air Pores

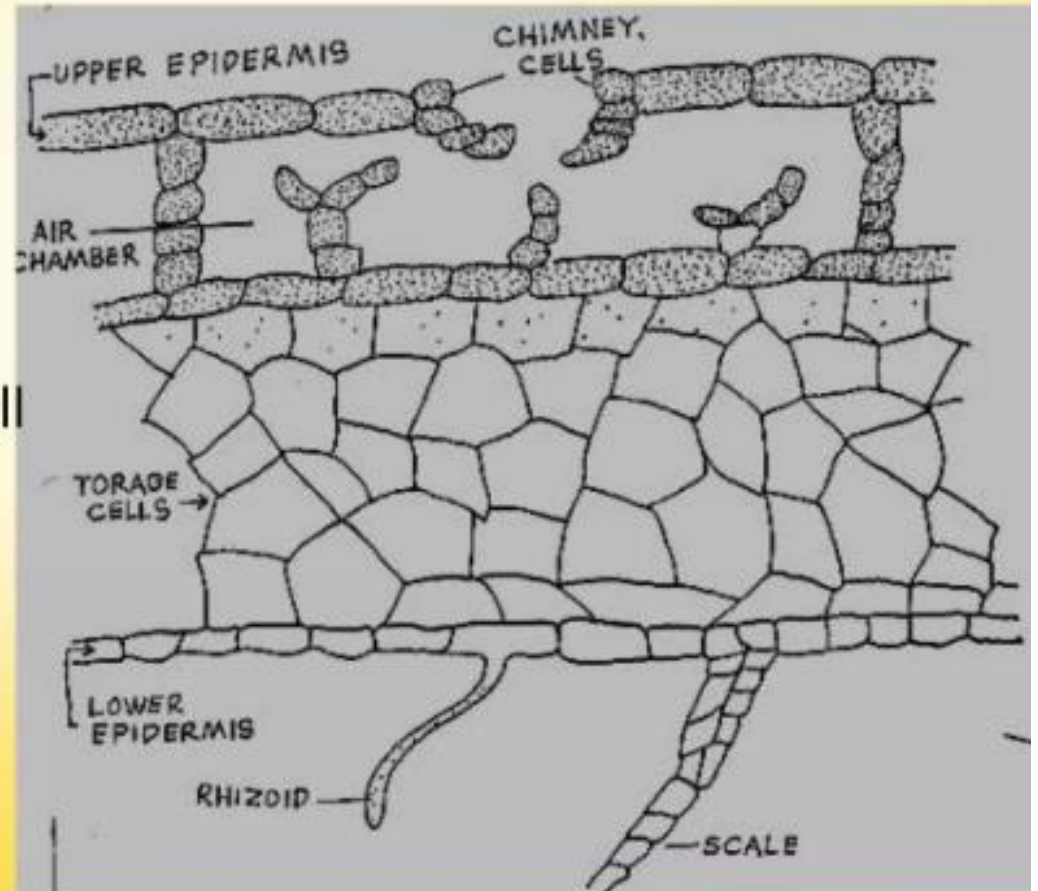
- Barrel shaped
- Each pore has 4-8 superimposed tiers of cells
- Each tier consist of a ring of 4-5 cells
- The cells of lowermost tier project inward giving the pore a star-shaped appearance
- Half of tiers project outward and half project inward
- The pores have comparatively wide pore passage in the middle than on margins
- These are analogous to stomata but they cannot control the pore size like stomata



Anatomy

Photosynthetic region

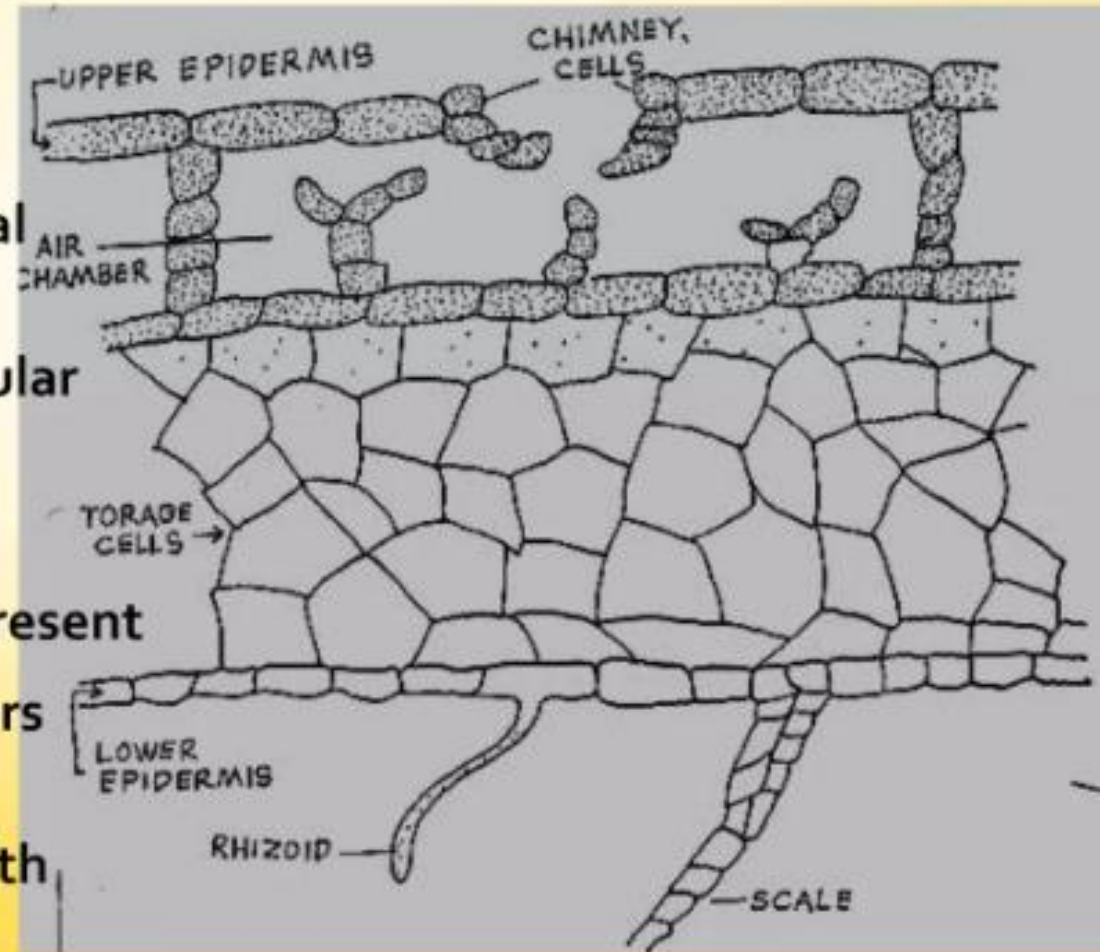
- Lies below upper epidermis
- It consists of large air chambers separated by single layered partition wall
- Uniform in shape and are arranged in a horizontal row
- Many photosynthetic filaments arise from foot of each chamber
- The filaments are made of chloroplast containing cells



Anatomy

Storage region

- Lies below photosynthetic region
- Compact zone of several layers of polygonal parenchymatous cells
- Cells devoid of chloroplast and no intercellular spaces in between
- Cells contain starch and protein granules
- Mucilage and oil containing cells are also present
- Storage region thick in the centre and tapers towards the margins
- Cells of midrib region are elongated and with reticulate thickenings

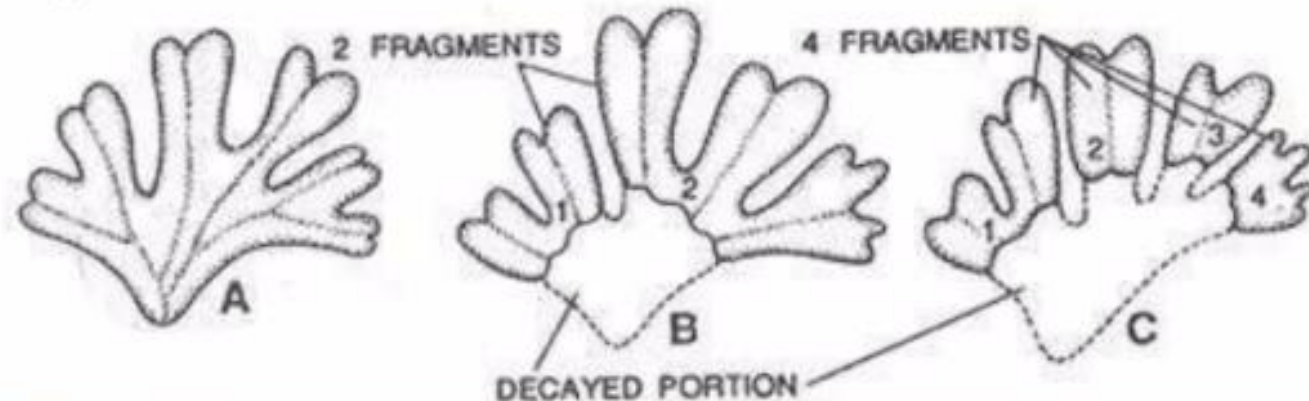


Reproduction

Vegetative reproduction:

By progressive death and decay

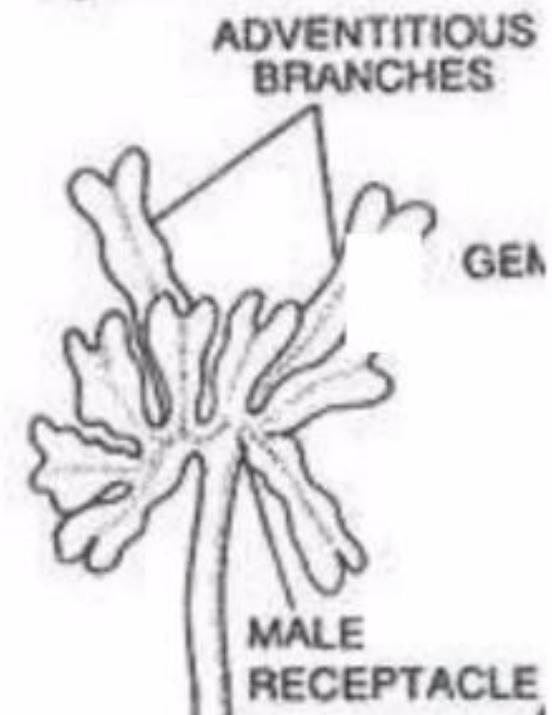
- Mature cells are present at posterior end and are short-lived
- New cells are regularly formed by apical cell
- Death and decay therefore naturally starts from the posterior end
- As the process of decay reaches the point of dichotomy, two apical parts of thallus separate
- Each grows into a new plant



Reproduction

By adventitious branches

- Some species possess adventitious branches on ventral surface
- On separation these grow into new thalli



Reproduction

By Gemma

- Gemma cups(2mm X 3mm) are cupules present on dorsal surface along midrib region
- Margins are hyaline, lobed, spiny or entire
- From floor of gemma cup many small, stalked, discoid & biconvex gemma arise
- Gemma is constricted in middle and 2 notches possess a row of apical cells
- Gemma contains chloroplast containing cells and rhizoidal cells
- Some mucilage hairs also arise from gemma cup's floor which imbibe water and help in deispersal of gemmae
- Gemmae on coming in contact with ground start germinating immediately

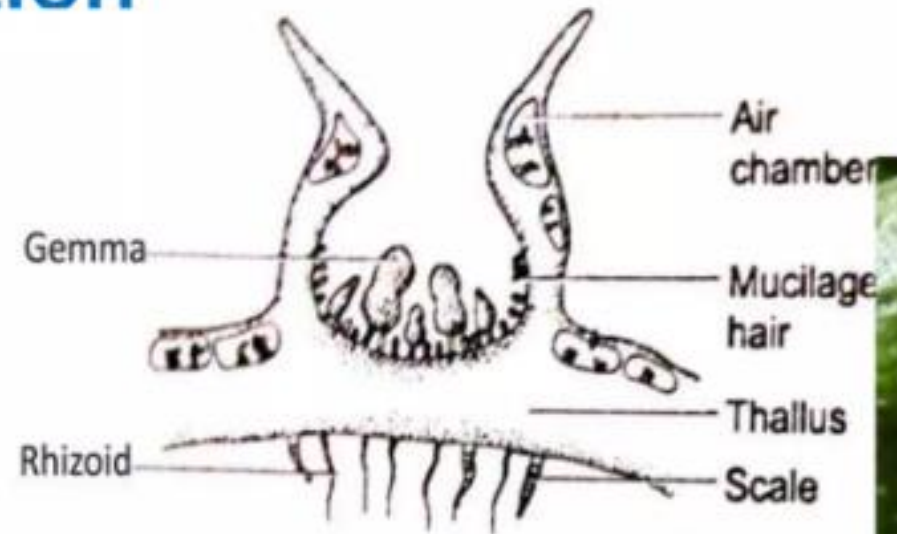


Fig: V.S. of thallus through gemma cup

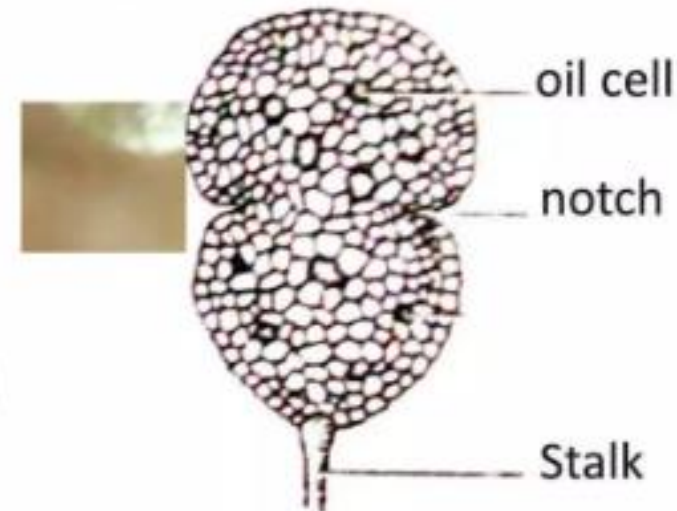


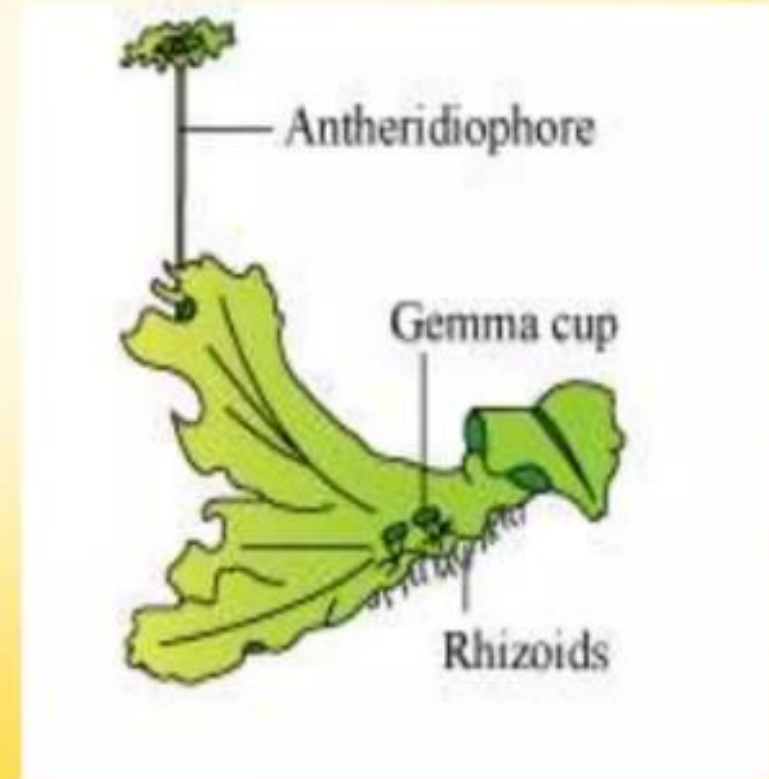
Fig: Gemma

Sexual Reproduction

- Marchantia is a heterothallic or dioecious plant
- Male thallus bears antheridiophores and female thallus bears archegoniophores
- They arise from distal end of thallus from growing point and after their formation growth of thallus ceases

Antheridiophore

- It has 1-3cm long stalk that bears 8 lobed peltate disc
- Inner structure similar to that of thallus with upper epidermis(having air pores), air chambers(having photosynthetic filaments)
- Antheridial chambers alternate with air chambers
- Each antheridial chamber contains a single antheridium and opens externally by a pore called ostiole.
- On each lobe antheridia arise acropetally
- Antheridiophore has 2 longitudinal grooves which contain rhizoids and scales

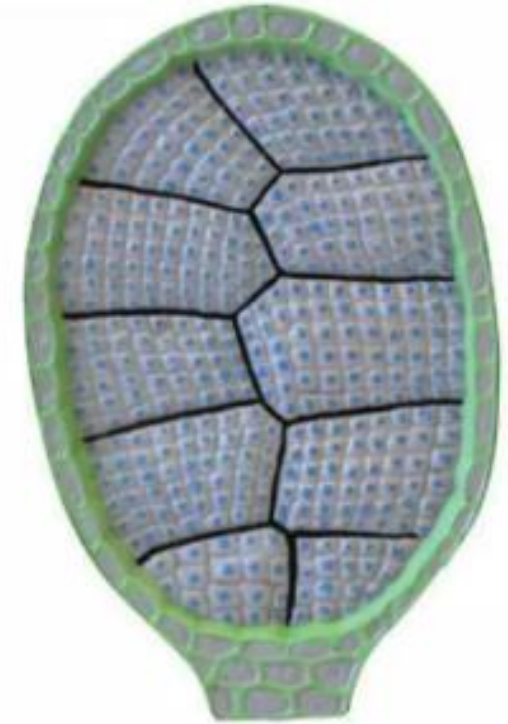


Antheridium

- A mature antheridium is globular or oval with multicellular stalk
- Body of antheridium has a single layered sterile jacket enclosing androcytes which eventually metamorphose into antherozoids
- The antherozoid is a minute biflagellate structure

Dehiscence of antheridium:

- Water enters the antheridial chamber through ostiole
- Some cells at the distal end disintegrate when they come in contact with water and hence antheridium ruptures
- Antherozoids come out of ostiole like smoke column and spread on surface of antheridial disc



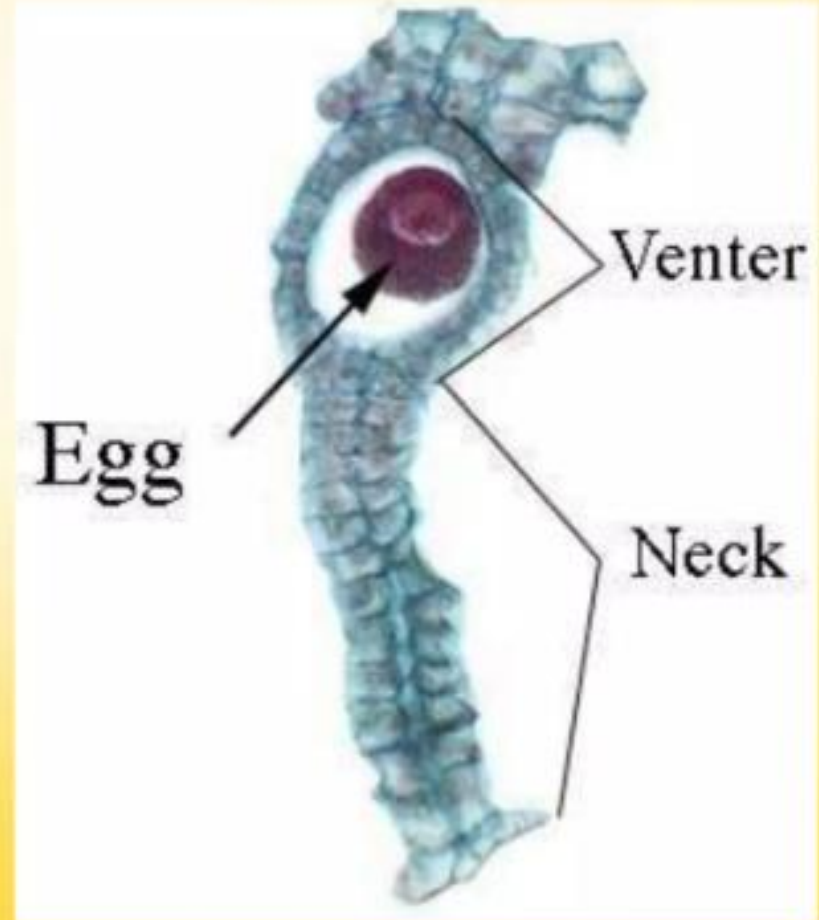
Archegoniophore

- It has slightly longer stalk(2-5cm) and a terminal disc which is 8 lobed
- Archegonia are borne on dorsal surface in acropetal succession
- Internal structure is similar to thallus with upper epidermis having air pores and underlying air chambers



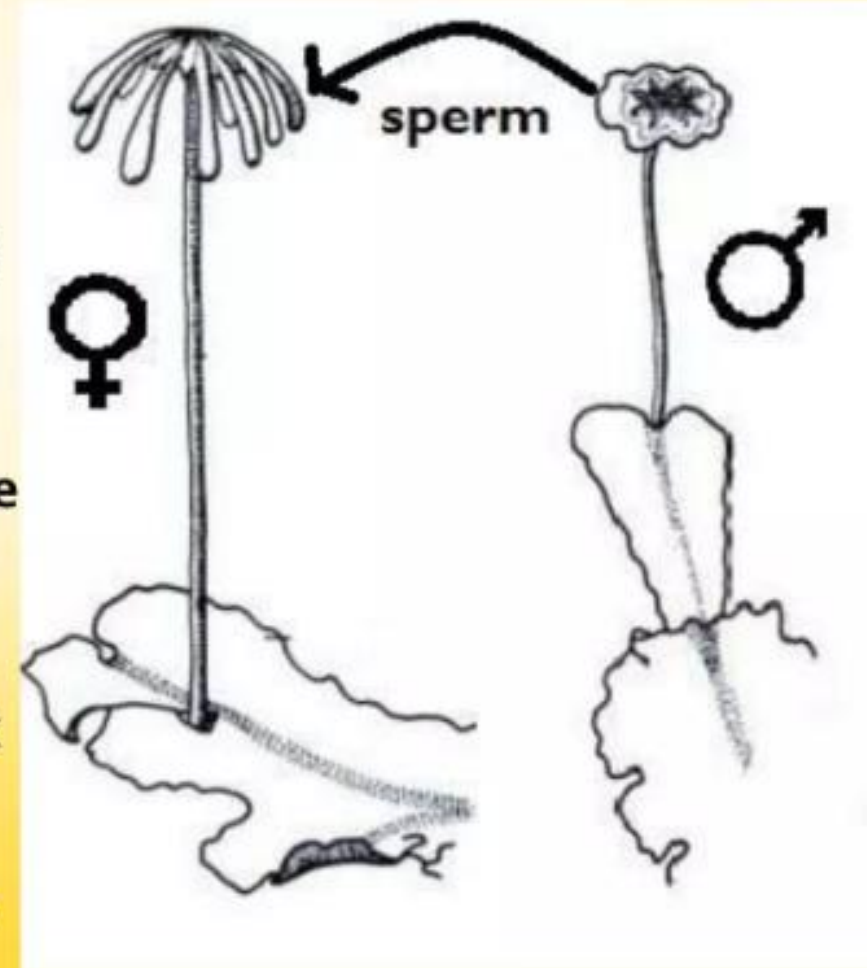
Archegonium

- The archegonium is a stalked flask shaped structure with a basal swollen venter and an elongated neck
- Venter is surrounded by 1 celled thick sterile jacket and contains a large egg cell and relatively small venter canal cell
- The neck consist of 6 vertical rows of cells called neck cells which enclose 4-8 neck canal cells
- Tip of neck has a rosette of 4 cover cells



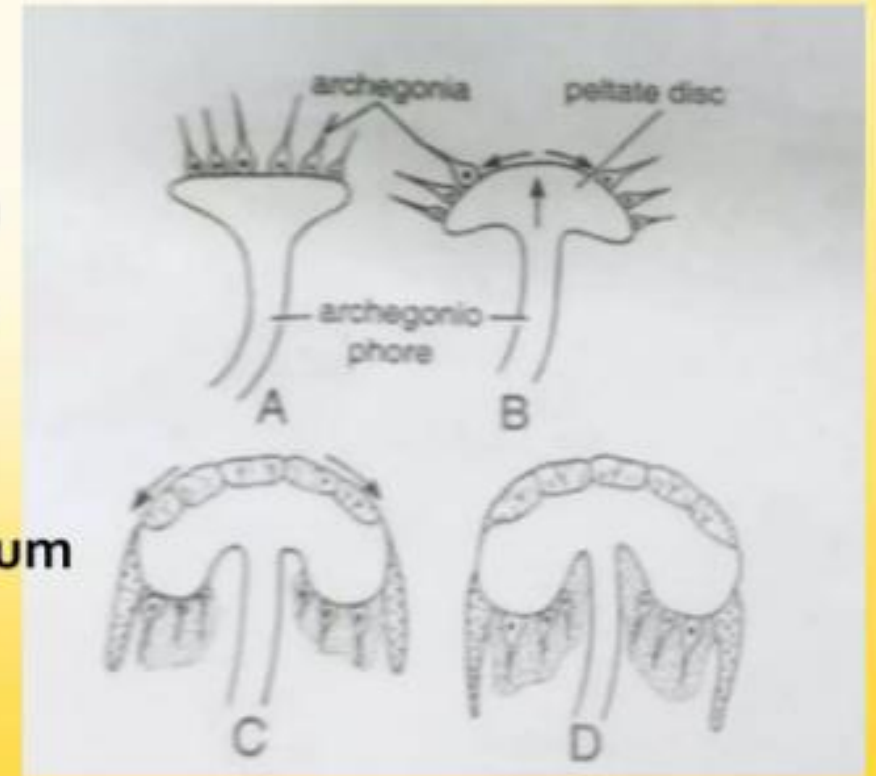
Fertilization

- Water is essential for fertilization
- Archegonia are placed upright on archegonial disc
- Venter canal and neck canal cells degenerate to form a mucilaginous substance which imbibes water and results in separation of cover cells by pressure
- Antherozoid present on surface of antheridial disc are splashed by rain drops on to the surface of archegonial disc
- They are attracted chemotactically towards the neck of archegonium
- Antherozoids enter archegonium and only one fuses with egg leading to formation of zygote



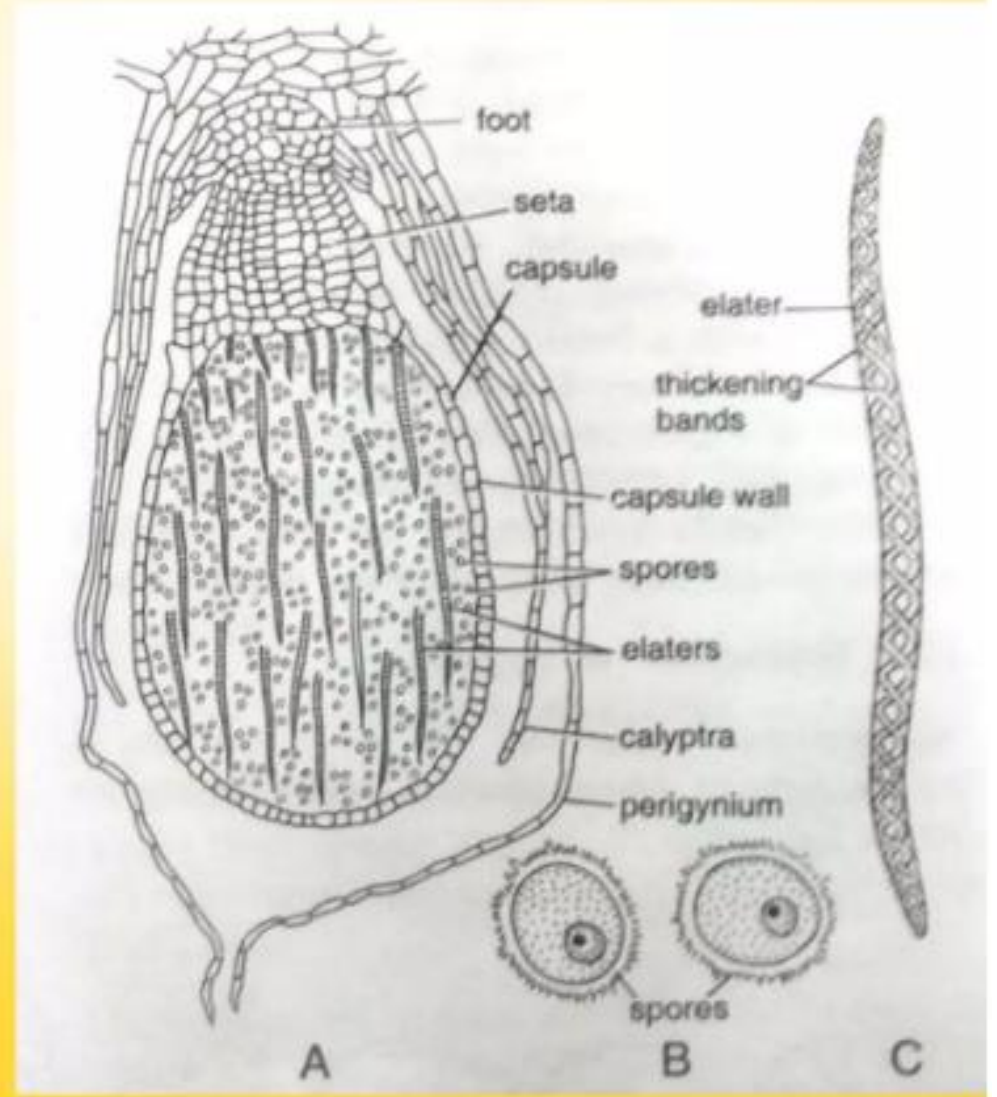
Post fertilization events (Inversion of Archegonia)

- After fertilization, archegoniophore elongates accompanied by rapid growth of central part of archegonial disc that leads to inversion of archegonia
- The arrangement of archegonia is also reversed from acropetal to basipetal
- This process of inversion is accompanied by development of one cell thick tissue called perichaetium or involucre on both sides of each archegonial row
- Also long, green, finger-like projections arise from margins of disc known as Rays



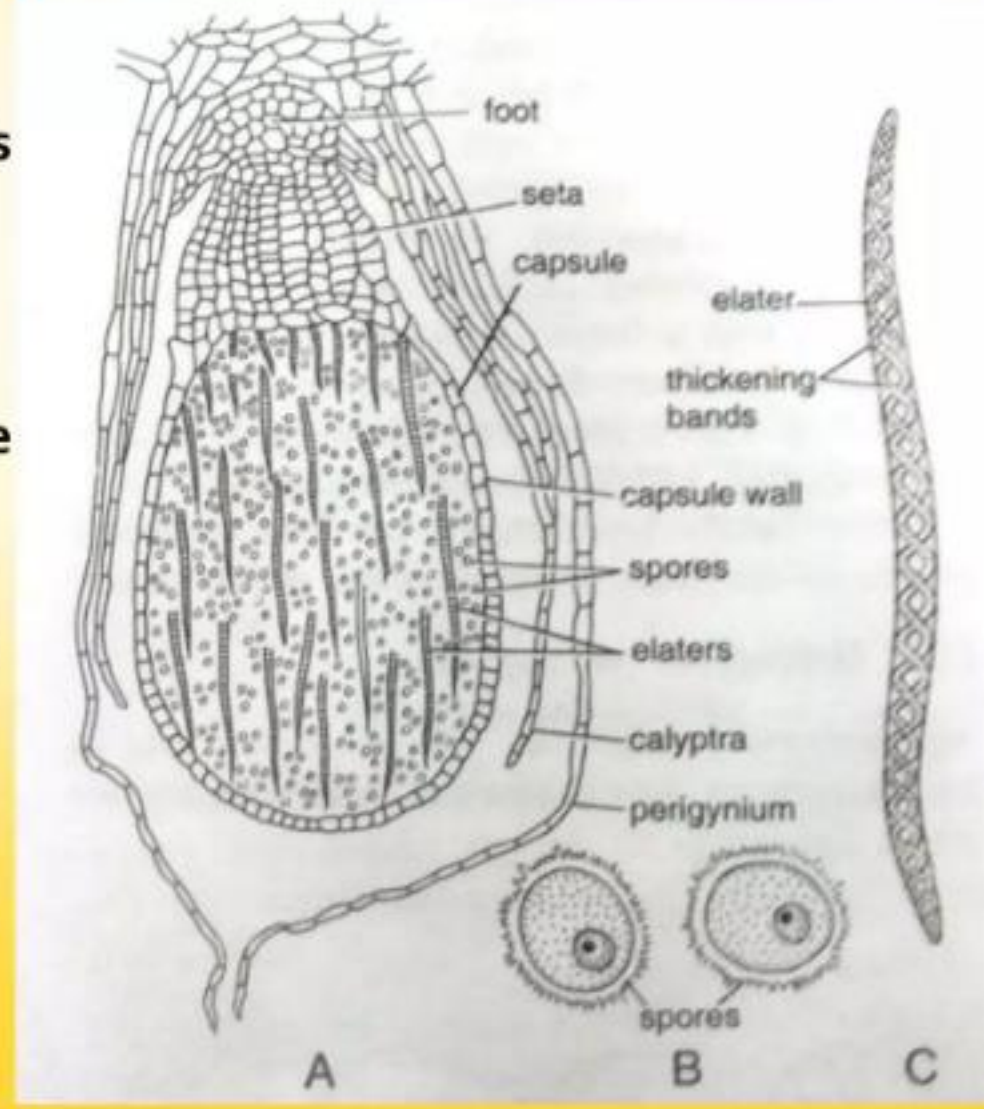
Sporophyte

- Zygote develops to form sporophyte
- It is differentiated into foot, seta and capsule
- Foot-It is basal bulbous part which anchors and provides nutrition to sporophyte
- Seta-It is short stalk that connects foot to capsule
- Capsule-It is yellow coloured oval structure and has a single layered jacket
- In young sporophyte, capsule encloses sporogenous mass which differentiate into spore mother cells and elater mother cells



Sporophyte

- Spore mother cells give rise to spore tetrad by meiosis and elater mother cells give rise to elaters which are diploid and sterile
- During the development of sporophyte from zygote, the venter wall cells give rise to 2-3 layered protective covering of sporophyte called calyptra
- The basal cells of archegonium give rise to one celled thick collar like outgrowth outside the calyptra called Perigynium or Pseudoperianth
- Towards maturity of sporophyte, the seta elongates and pushes the mature capsule out through calyptra, perigynium and perichaetium



Dehiscence of sporophyte

- Single layered capsule wall splits into a no. of longitudinal valves which extend from apex towards the middle of capsule
- The valves are rolled back due to annular thickenings in jacket cells
- Jerky movement of elaters due to their hygroscopic nature leads to loosening up of spore mass and scattering of spores in air



Germination of Spores

- Spores are viable for about a year
- Under favourable conditions they absorb moisture from substratum and increase in size
- Chloroplasts reappear at this stage
- Spore undergoes repeated divisions to form 6-8 celled filamentous structure with a rhizoid at one end
- The apical cell cuts off derivatives on lateral sides and finally give rise to gametophyte

