Division: Rhodophyta (Red Algae)

- **General Characters:**

1- The red algae, or Rhodophyta from Ancient Greek (rhodon), meaning 'rose' and (phyton), meaning 'plant'), are one of the oldest groups of eukaryotic algae. The Rhodophyta also comprises one of the largest phyla of algae, containing over 7,000 currently recognized species with taxonomic revisions ongoing.

2- The red color of these algae results from the pigments phycoerythrin and phycocyanin; this masks the other pigments, Chlorophyll *a* (no Chlorophyll b), beta-carotene and a number of unique xanthophylls.

3- The main reserves are typically floridean starch and floridoside; true starch like that of higher plants and green algae is absent.

4-Rhodophyta are aquatic organisms that exist in both freshwater and marine habitats, although mostly marine.

5- They are found in tropical, temperate and cold-water environments. Rhodophyta tend to live at greater depths of water than Charophyta and Chlorophyta. This is because Rhodophyta pigments absorb blue light, which penetrates water to a greater depth than other wavelengths.

6-Red algae have double cell walls. The outer layers contain the polysaccharides agarose and agaropectin that can be extracted from the cell walls by boiling as agar. The internal walls are mostly cellulose.

- An unusual feature of red algae compared to other algae is the occurrence of protein plugs (pit connections) in cell walls between the cells.

Economic Importance:

1- Rhodophyta are primary producers. They provide habitats for other aquatic organisms.

2- In addition, Rhodophyta play an important part in the establishment and maintenance of coral reefs. Those species found in coral reefs are called coralline algae; they secrete a shell of carbonite around themselves.

➢A very important group of red algae is the coralline algae, which secrete calcium carbonate onto the surface of their cells. Some of these corallines are articulated. These corallines have been used in bone-replacement therapies. Coralline algae were used in ancient times as vermifuges, thus the binomial *Corallina officinalis*.

3- The red algae *Kappaphycus* and *Betaphycus* are now the most important sources of carrageenan, a commonly used ingredient in food, particularly yoghurts, chocolate milk and repaired puddings.

4-Gracilaria, *Gelidium*, *Pterocladia* and other red algae are used in the manufacture of the all-important agar, used widely as a growth medium for microorganisms and for food and biotechnological applications.

REPRODUCTION

1- Asexual Reproduction:

- By discharging spores and fragmentation of the algal bodies.

2- Sexual Reproduction:

- as well as alteration of generations, is widespread among the Rhodophyta, but two classes of red algae (floridean and bangean) have particular variations.

- most species of red floridean algae have three phases: free-living, haploid gametophytes, diploid carposporophytes and diploid tetrasporophytes. Male and female gametophytes are often separate.

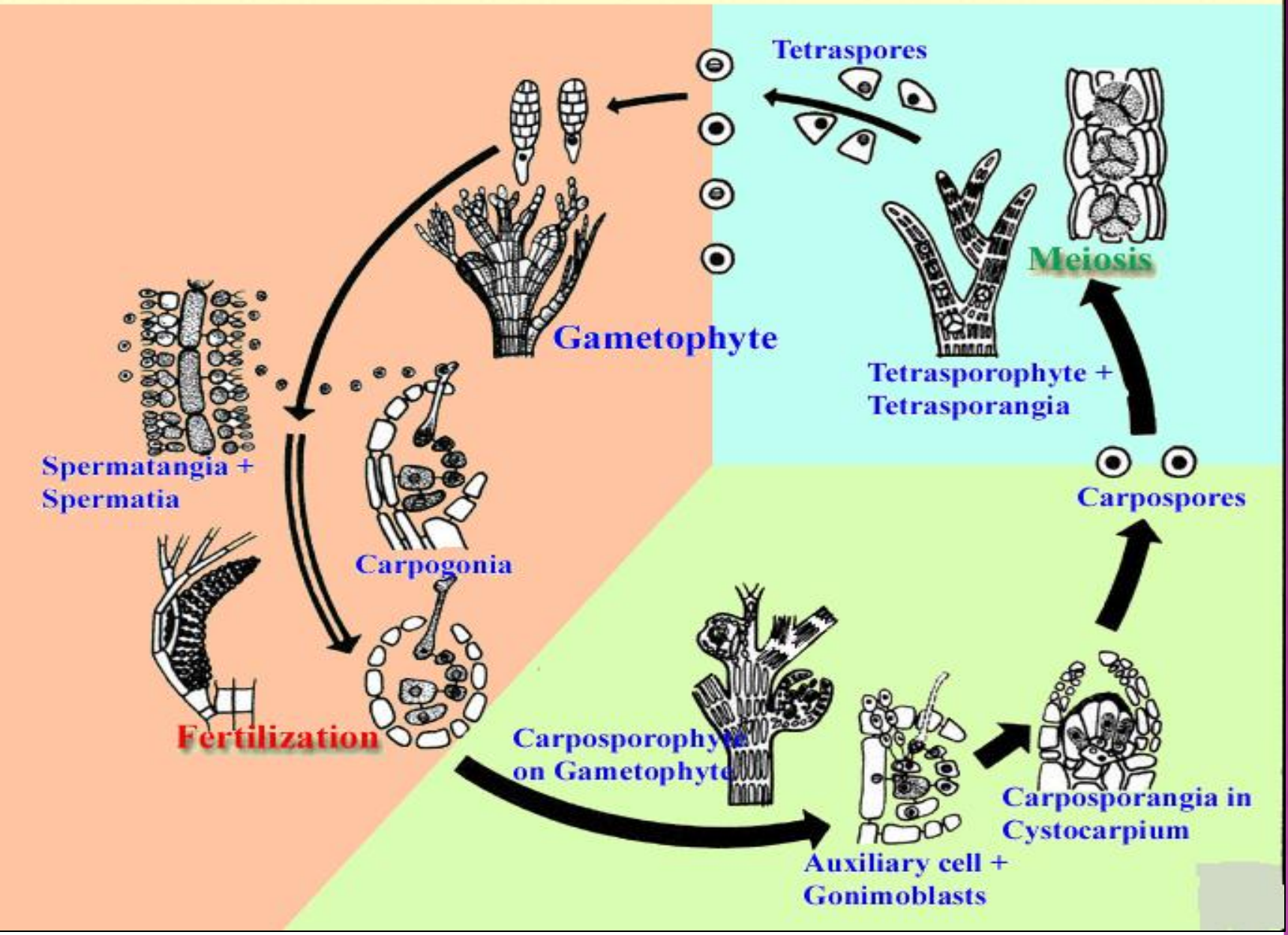
- The male gametophytes produce male non flagellated gametes called spermatia. Female gamethophytes produce a carpogonial branch that produces a terminal carpogonium (oogonium, an egg-bearing structure).

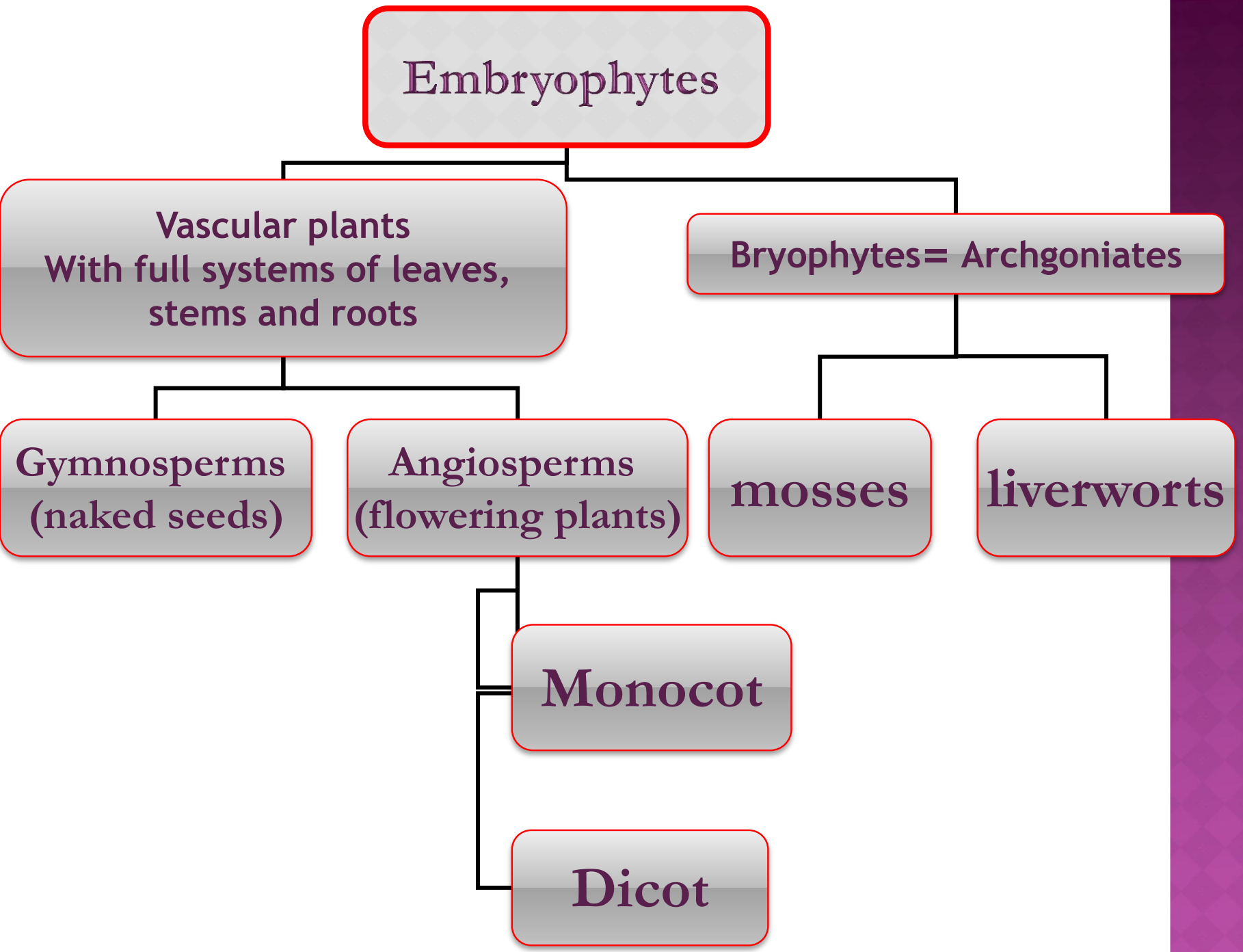
- Contact between spermatia and carpogonia is facilitated by water movements. The carposporophyte is a diploid stage that develops from the zygot (fertilized carpogonium) and produces carpospores.

- Diploid tetrasporophytes develop from carpospores. Tetrasporophytes form tetrasporangia, which produce four haploid tetraspores. When released, tetraspores develop into new gametophytes.

- The gametophyte and tetrasporophyte may appear nearly identical, and therefore can be said to be isomorphic, as in the *Polysiphonia*. Alternatively, the tetrasporophyte and gametophyte may be very different in size and appearance (heteromorphic), as in *Phyllophora*.

LIFE CYCLE OF *POLYSIPHONIA FLEXICAULIS* (RED ALGA)




Embryophytes
Vascular plants
With full systems of leaves, stems and roots
Bryophytes= Archgoniates
Gymnosperms (naked seeds)
Angiosperms (flowering plants)
mosses
liverworts
Monocot
Dicot

Embryophytes

- **General Characters:-**

1- These plants have eukaryotic cells with cell walls composed of cellulose.

2- They obtain their energy through photosynthesis.

3- Nevertheless, there are about three hundred plant species which do not photosynthesize but are parasites on other species of photosynthetic plants.

4- Embryophytes are distinguished from green algae by having specialized reproductive organs protected by non-reproductive tissues.

5- Bryophytes can only survive where moisture is available for long periods, although some species are desiccation-tolerant.

6- Most species of bryophytes remain are of small size.

7- Life-cycle involves alternation between two generations: a haploid stage called the gametophyte and a diploid stage called the sporophyte. The sporophyte is short-lived and remains dependent on its parent gametophyte.

VASCULAR PLANTS

- **General Characters:-**

1- Vascular plants have a number of adaptations that allowed them to overcome the limitations of the bryophytes.

2- These include a cuticle resistant to desiccation and vascular tissues which transport water throughout the plant body.

3- The sporophyte is the dominant phase, while the gametophyte remains small.

Primitive Seed Plants (Pteridosperms)

- **General Characters:-**

1- In the primitive seed plants (Pteridosperms, seed ferns) the gametophyte is extremely reduced.

2- The sporophyte begins its life inside an enclosure called a seed and with fertilization by means of pollen grains.

3- some seed plants can survive and reproduce in extremely arid conditions

Lower Vascular Plants (Ferns)

1- They reproduce by means of spores and so need moisture to develop.

Early Seed Plants (Gymnosperms)

- **General Characters:-**

1- Early seed plants are referred to as gymnosperms (naked seeds), as the seed embryo is not enclosed in a protective structure at pollination, with the pollen landing directly on the embryo sac.

2- Four surviving groups remain widespread now; particularly the conifers, which are dominant trees in several biomes.

Flowering Plants (Angiosperms)

The angiosperms (flowering plants) were the last major group of plants to appear. These differ form gymnosperms in that the seed embryo is enclosed within the carpel; so the pollen has to produce a tube to penetrate the protective seed coat. They are the predominant group of flora in most biomes today.

Archegoniata

- **Archegoniata** is a group of plants including both Bryophytes and Pteridophytes. The term Archegoniata is derived from the **archegonium** which is the female sexual organ of this group.

The Archegonium

1- The **archegonium** is usually made up of two parts:
- a swollen base known as the **Venter.**
- a cylindrical **Neck.**

2- Archegonium is flask-shaped and is usually inserted on a short stalk.

3- Inside the Venter there are two cells: a large cell (the egg or ovum) and a smaller cell (the ventral canal cell).

4- The Venter is surrounded by a sterile wall made up of one or two layers.

- This wall has the ability to stretch to protect the embryo during the early stages.

5- The neck is provided with a wall made up of one layer of cells.

- Inside the neck there is a row of cells separated by mucilaginous material known as neck canal cells.
- The aperture of the neck is covered by a number of lid cells.

6- As the archegonium matures, the lid cells separate and the neck canal cells disintegrate into mucilaginous substance, part of which exudes outside the neck aperture to attract the antherozoids.

Antheridium

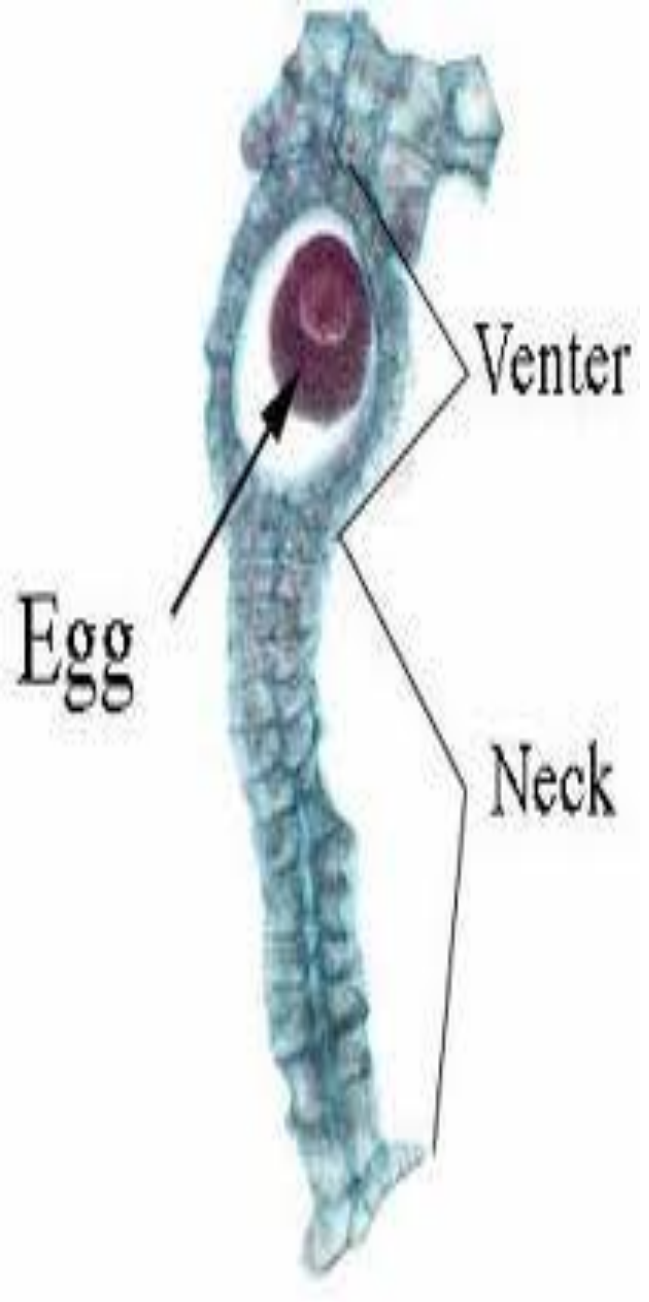
1- The male sexual organ of this group is the antheridium; the same term is applied to male gametangium of thallophytes.

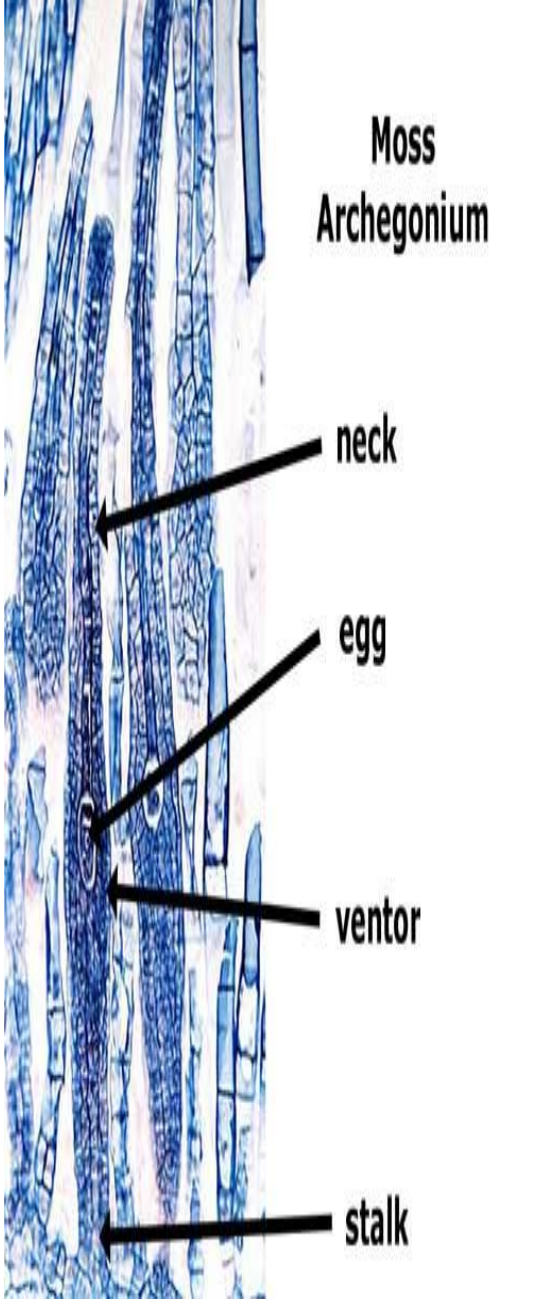
2- It is usually oval, spherical or club-shaped and is also inserted on a stalk.

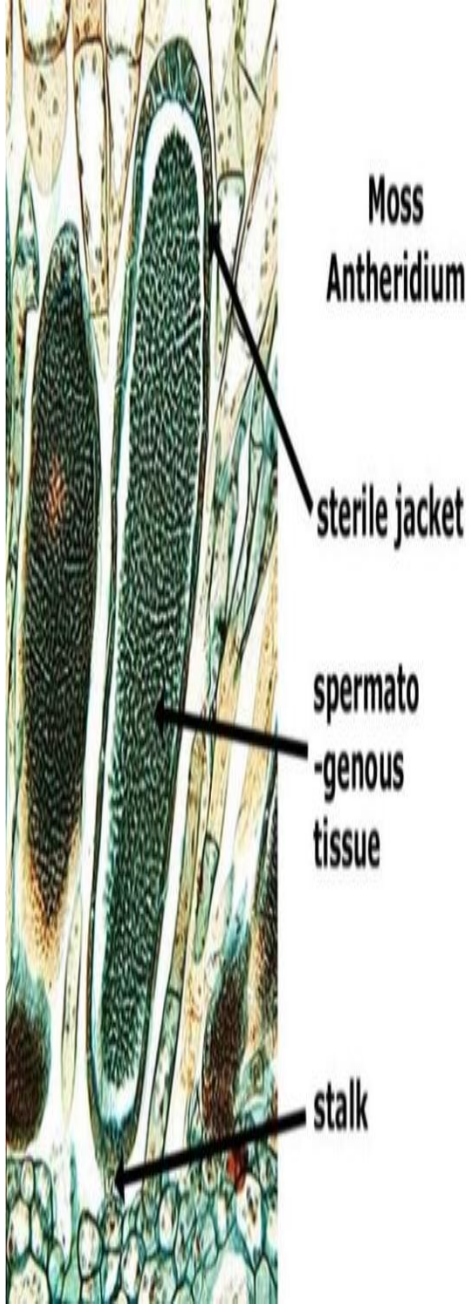
3- It is covered with a sterile multicellular wall.

- The wall encloses a fertile tissue called spermatogenous tissue.
- This tissue is transformed into antherozoid mother cells, which give rise to antherozoids.

4- Antherozoids are motile, provided by two or more flagella, by which they swim in water.







Archegonium and Antheridium

Fertilization Process

1- Antherozoids are attracted to the archegonia, enter through the aperture of the neck and swim in the mucilaginous material remaining after disintegration of neck canal cells, until they reach the egg or ovum where fusion takes place.

2- The ventral canal cell also disintegrates upon maturity of archegonium.

3- The fertilized egg (zygote) develops into sporophyte which is the diploid phase in the life cycle. The sporophyte produces at maturity:

- a fertile tissue known as sporogenous tissue or archesporium. This tissue (2n) differentiates into spore mother cells (2n) which by meiosis give rise each to four haploid spores.
- The resulting spores are thus grouped in fours called tetrads. Haploid spore germinates and gives rise to the haploid phase known as the gametophyte; which, in turn, produces archegonia and antheridia.

Alternation Of Generations

1- In addition to the presence of archegonia and antheridia, archegoniates are characterized by the phenomenon of alternation of generations.

- This means that there are two phases alternating in the life cycle of the plant.

A- A haploid phase known as the gametophyte

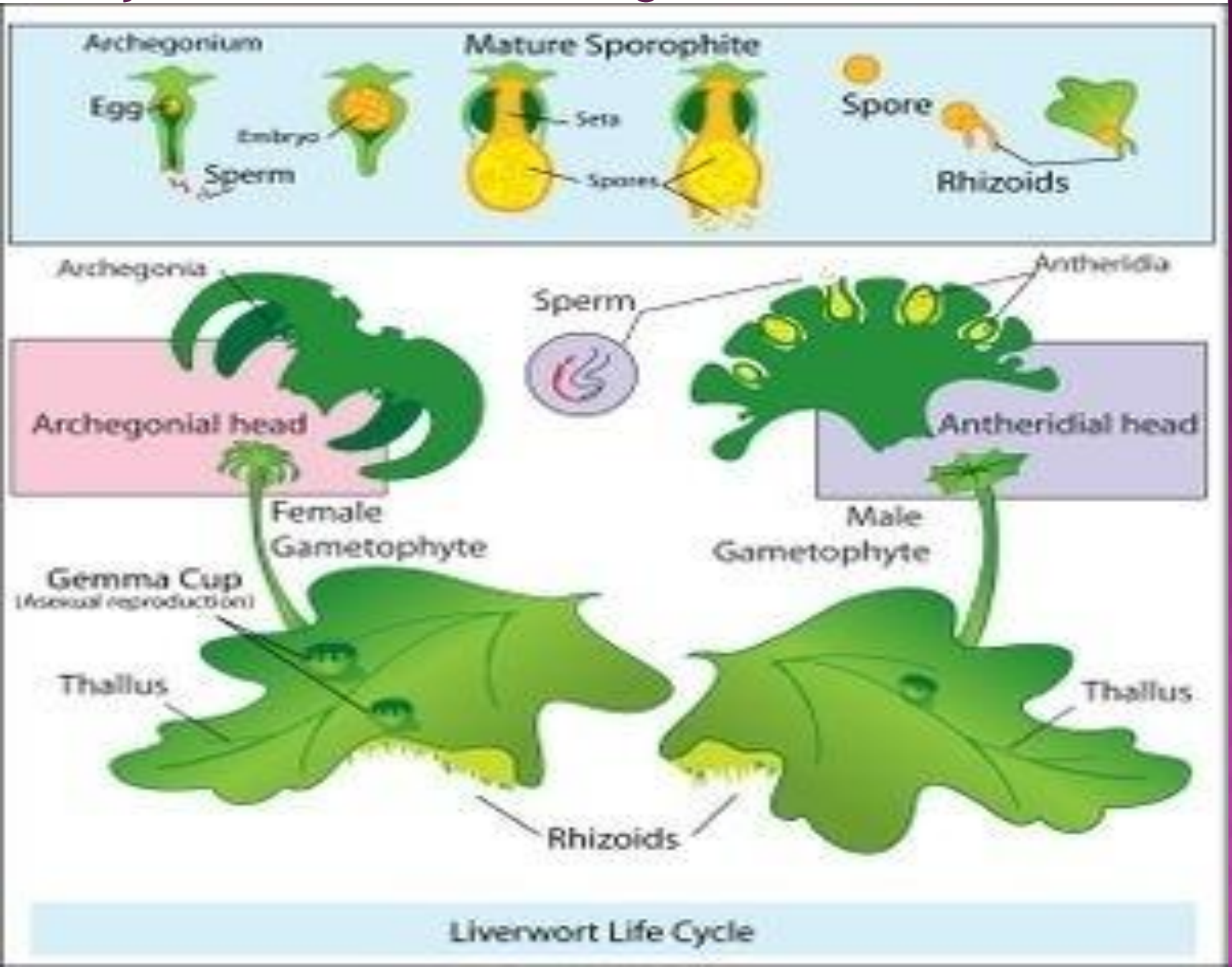
B- A diploid phase known as the sporophyte.

2- The gametophyte (N) produces gametes within the sex organs (archegonia and antheridia). Upon fusion of gametes the zygote (2N) is formed which develops into the sporophyte (2N).

3- The sporophyte via meiosis produces haploid spores which on germination give the gametophyte again.

- In Bryophytes the dominant phase in the life cycle is the gametophyte while in Pteridophytes the dominant phase is the sporophyte.

Life Cycle Of Liverworts Showing Alternation Of Generations.



Bryophytes

- The **bryophytes** includes three divisions:

1- The **Marchantiophyta** (liverworts).
2- **Anthocerotophyta** (hornworts)
3- **Bryophyta** (mosses).

Division: Marchantiophyta
Class: Marchantiopsida
Order: Marchantiales
Family: Ricciaceae

General Characters:

1- The Marchantiophyta are commonly referred to as hepatics or liverworts.
2- They have a gametophyte-dominant life cycle.
3- The plant is always dorsiventral and is frequently prostrate.
4- In the simple forms the vegetative body is thalloid while the more advanced members develop an axis (stem) on which leaves are produced.

Riccia

- **General Characters:-**

1- *Riccia* species grow extensively along the Nile banks in autumn.

2- The gametophyte is typically thalloid, dichotomously branched having the rosette shape.

3- The thallus has a conspicuous median longitudinal furrow on the dorsal side.

- The thallus shows internal differentiations where the upper zone is occupied by assimilatory tissue made up of numerous assimilatory filaments.
- Each filament consists of a row of chlorenchyma, rich in chloroplasts and ends at the top by an epidermal cell devoid of chlorophyll.

4- The filaments are separated by air canals; thus:

- The upper epidermis is an interrupted layer.
- The lower zone of the thallus is made up of parenchyma, poor in chlorophyll and its function is to store up reserve food.
- The lower layer of the thallus is the lower epidermis which is a continuous layer.

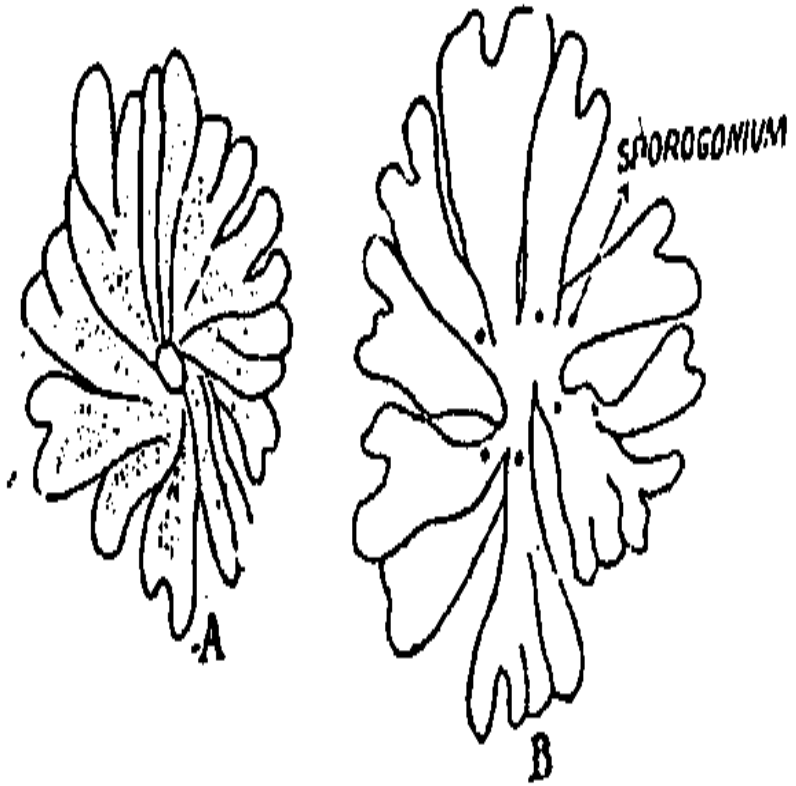
5- From the lower epidermis comes out unicellular rhizoids which help in:

A- Anchorage of the thallus.

B- Absorption of water and minerals.

6- In addition to rhizoids, there are multicellular scales arranged in two rows parallel to the long axis of each dichotomous segment.

Gametophyte Of *Riccia*



(A—C). Riccia sanguinea (R. frostii)

A. Male plant.

B. Female plant.

Reproduction

1- Most species of *Riccia* are homothallic or monoecious i.e. sexual fusion takes place between gametes from the same thallus. Few species are heterothallic or dioecious; i.e. there are male and female thalli.

2- The sexual organs are produced singly in chambers towards the upper surface of the thallus. These chambers open to the exterior by means of narrow pores.

3- The antheridium is usually oval and is inserted on a short stalk. Antherozoids are curved and biflagellate, with two anterior flagella.

4- Water is essential for fertilization as antherozoids will swim to reach the archegonium.

- **Several antherozoids may enter the neck and Venter of an archegonium but only one of them fuses with the egg.**

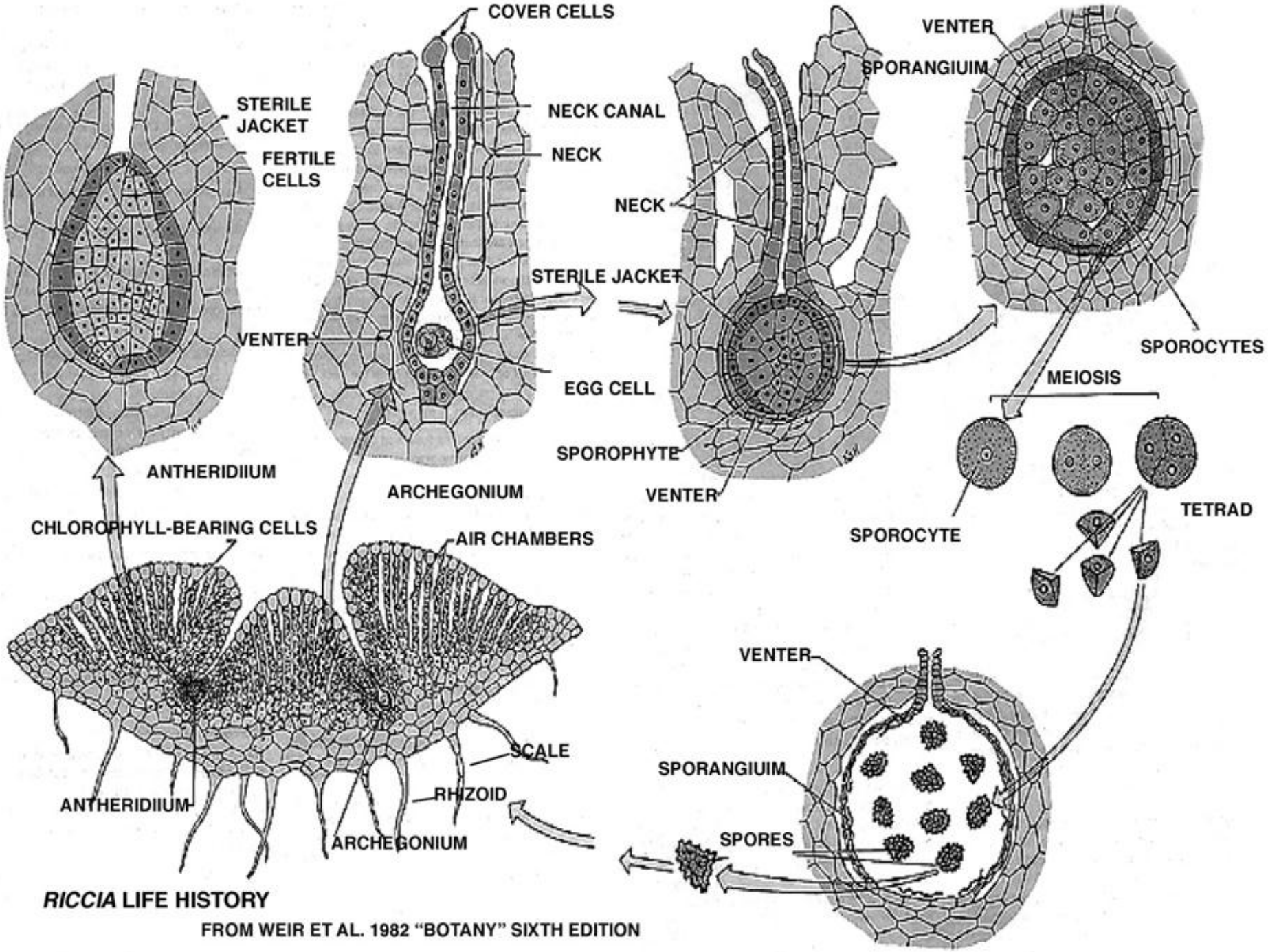
5- Shortly after gametic union, the zygote secretes a wall and undergoes division to form sporogenous tissue which fill the cavity of the Venter.

6- The Venter wall is stimulated after fertilization to divide and becomes two-layered.

7- Each cell of the sporogenous tissue (2 N) undergoes meiosis to yield four haploid spores in a tetrad.

8- Spores are released after lysis of the walls and germinate to give the haploid gametophytes.

9- The sporophyte of *Riccia* is the most primitive amongst Archegoniates. It is very simple (all the sporogenous tissue is fertile) and small (remains enclosed within the archegonial Venter) and there is no definite mechanism of spore dispersal.



***RICCIA* LIFE HISTORY**

FROM WEIR ET AL. 1982 "BOTANY" SIXTH EDITION

Thanks