

MORPHOLOGY OF NON-VASCULAR PLANTS

**COURSE TITLE: INTRODUCTORY BOTANY
COURSE CODE: BOT 102
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NON-VASCULAR PLANTS?

- **VASCULAR:** comes from the Latin word “**vascularis**”, meaning a vessel or duct that has some fluid flowing through it.
- So, vascular plants have vessels running through them, and non-vascular plants do not.
- **Non-vascular plants lack specialized vascular (transport) tissues (xylem and phloem)**
- **Non-vascular plants are dependent on diffusion and osmosis for the movement of water and minerals, consequently restricting their ecological distribution to moist environments.**

WHAT ARE NON-VASCULAR PLANTS?

- A group of plants that **lack a vascular system** (that is, they lack xylem and phloem)
- They are **seedless plants** (that is, they do not produce seeds); instead, they **produce spores**
- They **lack true roots, stems, or leaves**.
- They can be divided into **two main groups**: the **algae** and **bryophytes**

ALGAE

- Algae (singular: alga) are **chlorophyllous thallophytes** (plants lacking true roots, stems, and leaves)
- Inhabit a wide range of environments, although they are mainly found in aquatic habitats
- They are the **first group of plants to possess chlorophyll**; hence, the first group of photosynthetic plants
- They are the **primary producers in all aquatic habitats**
- They are **responsible for a significant portion of the Earth's oxygen production**, which is a by-product of their photosynthetic process

MORPHOLOGY OF ALGAE

- The plant body is a **THALLUS** (plural; thalli) – that is, their body is **undifferentiated** into true roots, stems, and leaves.
- Algae show diverse morphologies, ranging from simple single-celled microscopic forms (**MICROALGAE**) to complex multicellular macroscopic forms (**MACROALGAE**).
 - Wide range of sizes and shapes
 - Unicellular (motile or non-motile), colonial, filamentous, or multicellular
 - The cell wall can be thin or rigid
 - Pigments include chlorophyll *a* (primary photosynthetic pigment), other chlorophylls, carotenoids, and phycobilins

Unicellular algae

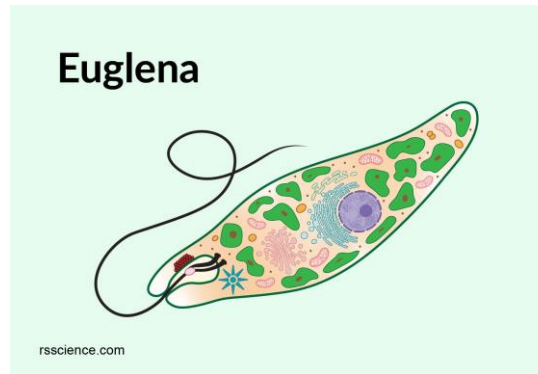
- Exist as single cells
- They can be motile (*Chlamydomonas*) or non-motile (*Chlorella*)
- Shape: spherical, oval, or other shapes



Chlorella



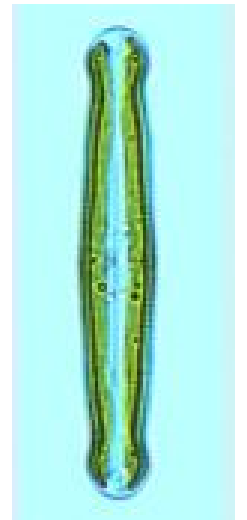
Chlamydomonas



Euglena



Navicula



Pinnularia

Colonial algae

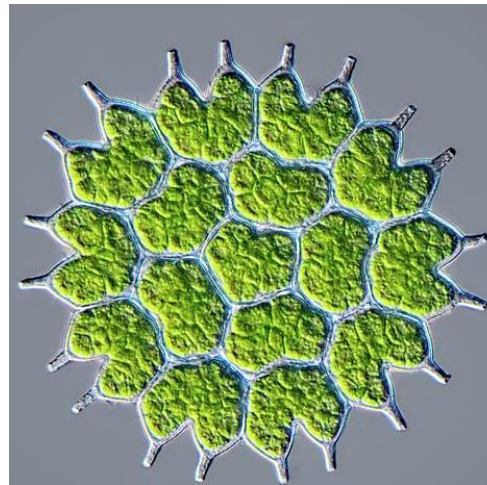
- Consist of individuals or single cells that exist together to form colonies.
- These groups can also be called **coenobia** (singular: coenobium).
- Colonies can be simple or complex, with varying degrees of cell specialization.



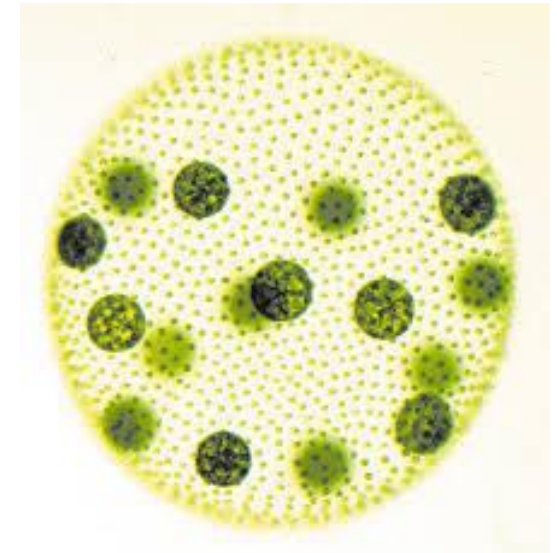
Pandorina



Eudorina



Pediatrum



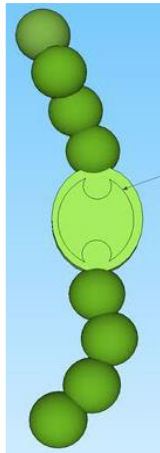
Volvox

Filamentous algae

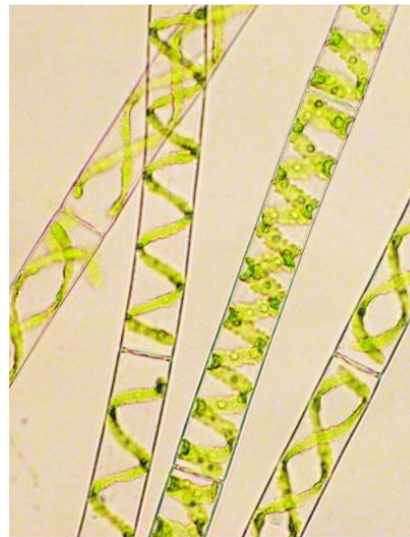
- Their cells are arranged end to end, forming thread-like structures called **filaments**
- Filaments can be **unbranched** (*Oscillatoria*, *Spirogyra*) or **branched** (*Stigeoclonium*, *Bulbochaete*)



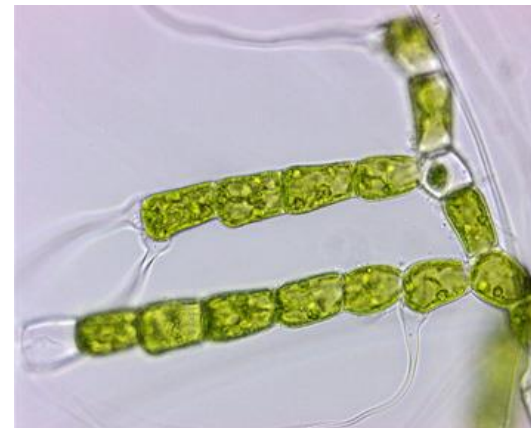
Oscillatoria



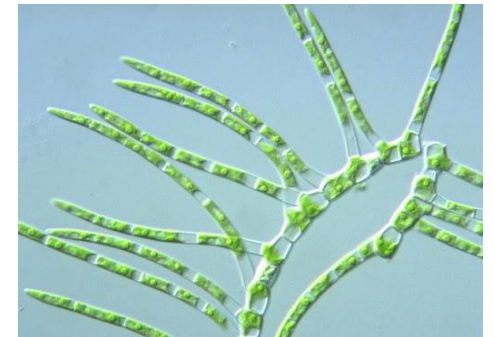
Nostoc



Spirogyra



Bulbochaete



Stigeoclonium

Multicellular algae

- Large (may grow up to over 80 meters in length) **macroscopic** algae composed of many cells organized into specialized tissues and organs
- Thallus **NOT DIFFERENTIATED** into true roots, stems, or leaves, but has structures that can perform similar functions. For example,
 - Holdfasts anchor the algae
 - Stipes provide support
 - Fronds are leaf-like structures for photosynthesis
- They are commonly called seaweeds. Examples include *Laminaria*, *Fucus*, *Macrocystis pyrifera* (giant kelp or giant bladder kelp)



Laminaria



Fucus



Macrocystis



A MAN HOLDING MACROALGAE.

BRYOPHYTES

- **Seedless, non-vascular land** plants found in moist and shady environments. They grow on rotting logs, tree bark, and in the spray of waterfalls.
- Possess a simple body structure called a **thallus**. They have **rhizoids** (instead of roots) which are thread-like structures that anchor them to the substrate.
- Some bryophytes have **a waxy cuticle**, which helps to **retain water and prevent desiccation** on land
- **Believed to have evolved from the green algae.**
- They were **pioneers in establishing themselves on land**, but they **still depend on water for reproduction**. This is because **the male gametes need to swim through a film of water to the female for fertilization to take place**. Hence, they are called the “**amphibians**” of the plant kingdom.

BRYOPHYTES

- They **exhibit an alternation of generation** between the **haploid gametophyte** and the **diploid sporophyte**.
- The gametophyte generation is the more **conspicuous, long-lived and dominant phase**, bears the antheridium (male) and archegonium (female), which produce sperm and eggs, respectively.
- The sporophyte generation is **short-lived, produce spores**, and it is **dependent on or attached to the gametophyte** for **nutrition**.
- They are classified into three groups: the **liverworts**, **hornworts** and **mosses**

CLASSIFICATION OF BRYOPHYTES

1. **DIVISION: HEPATICOPHYTA**

CLASS: HEPATICOPSIDA (HEPATICAE)

They are commonly called the LIVERWORTS.

2. **DIVISION: ANTHOCEROPHYTA**

CLASS: ANTHOCEROTOPSIDA (ANTHOCEROTAE)

They are commonly called the HORNWORTS.

3. **DIVISION: BRYOPHYTA**

CLASS: BRYOPSIDA (MUSCI)

They are commonly called MOSSES.

THE LIVERWORTS

- Liverworts are tiny nonvascular plants that have leaf-like, lobed, or ribbon-like photosynthetic tissues rather than leaves.
- Their rhizoids are very fine, they lack stems, and they are generally less than 10 centimeters (4 inches) tall.
- They often grow in clusters that carpet the ground.
- Examples are *Marchantia* and *Riccia*

MARCHANTIA

- *Marchantia* gametophyte is a **prostrate thallus** (flattened body) that generally spreads across the ground surface.
- The thallus is **green**, characterized by repeated branching into two parts (dichotomous branching) as it grows, with a dorsal (top) and ventral (bottom) surface.
- The dorsal surface bears, **open pores** (allows for carbon dioxide diffusion), **chlorophyll-containing cells**, and **gemma cups** which contain gemmae for **vegetative reproduction**
- The ventral surface has **scale-like structures** and **rhizoids** that help **attach** the liverwort to a substrate.

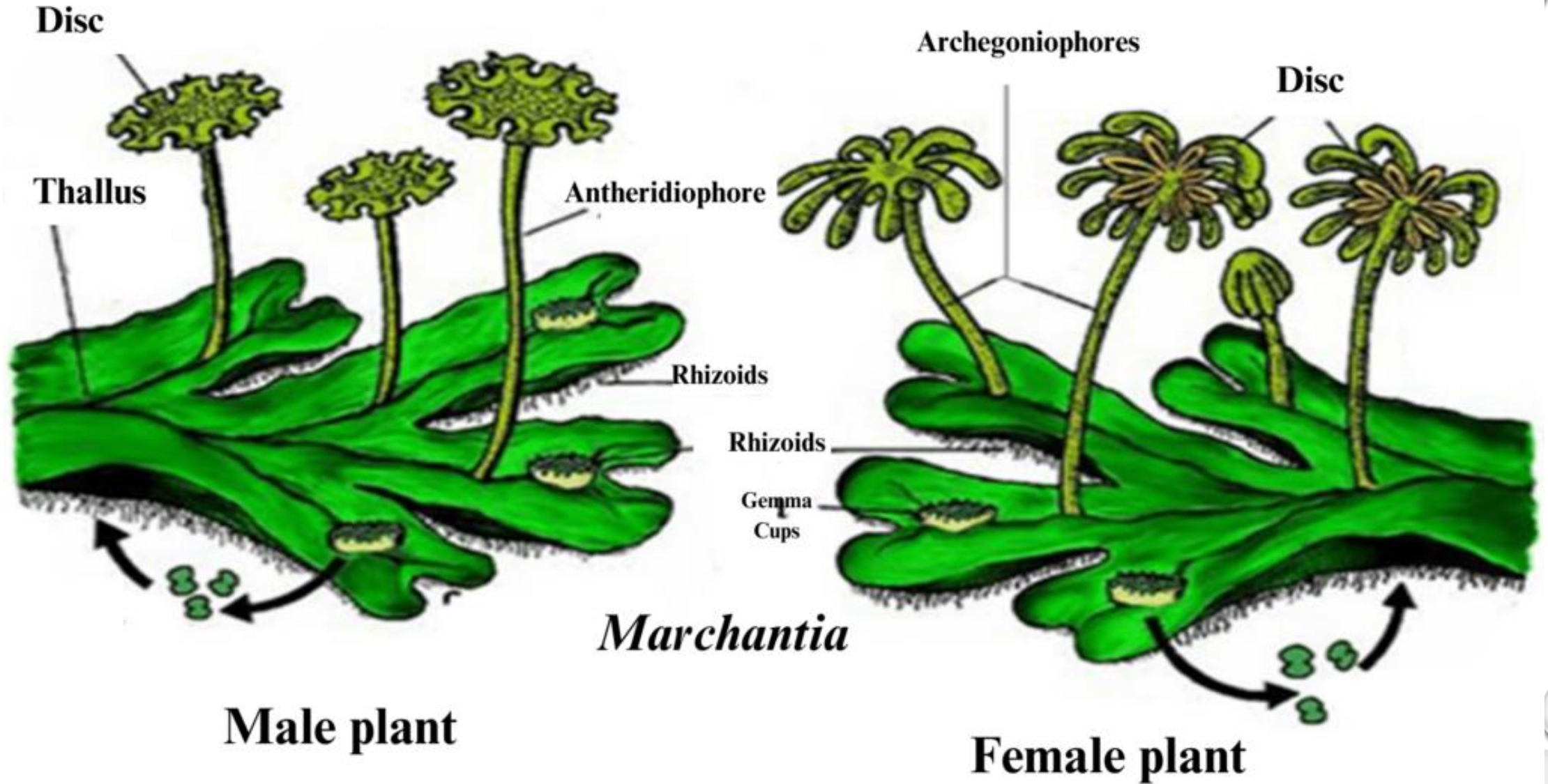
MARCHANTIA

- Under appropriate conditions, the gametophyte of *Marchantia* produce two types of vertically oriented structures on the **dorsal surface** called:
 - **antheridiophores** (male structures that produce the sperm)
 - **archegoniophores** (female structures that produce the egg)
- The **sporophyte is hard to find**, being small and imbedded on the underside of the archegoniophores

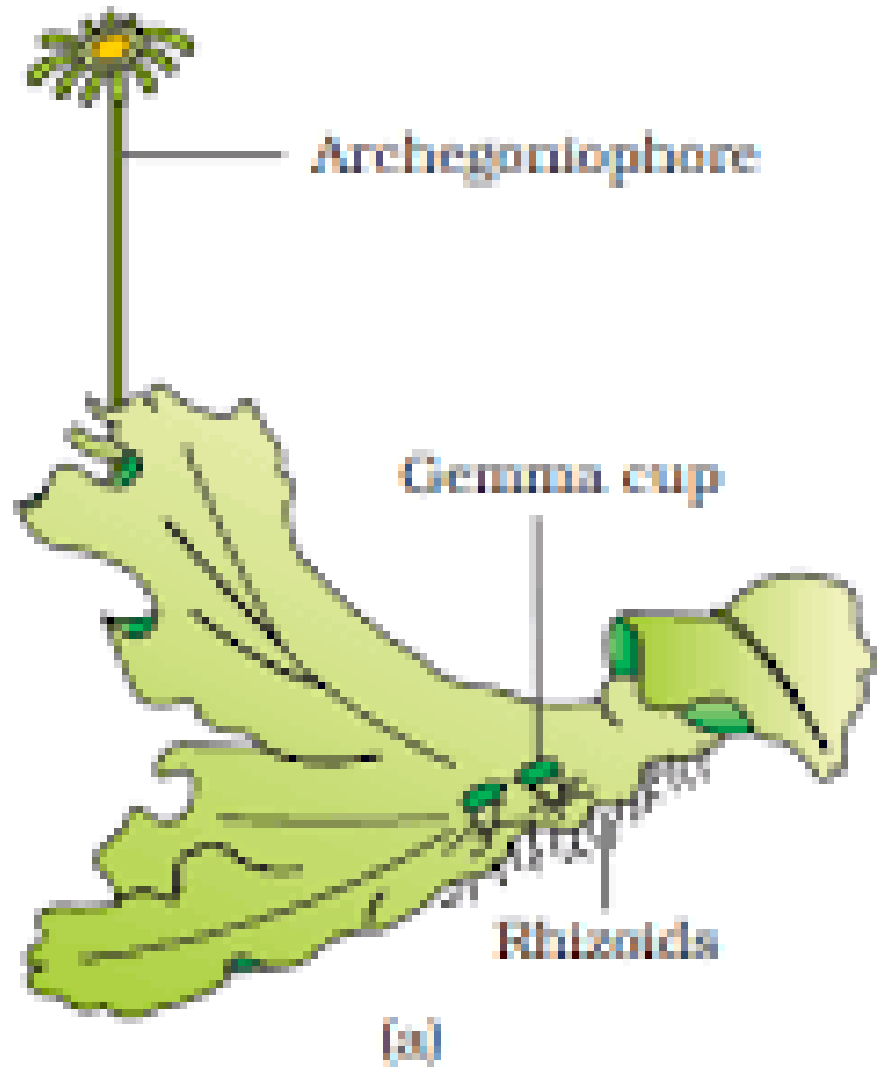
MARCHANTIA

- *Marchantia* plant is **dioecious**; that is, reproductive organs are borne on separate plants.
 - **Male *Marchantia* plant:** bears **male reproductive branches** called **ANTHERIDIOPHORES** which bear the **antheridia (lobed-disc shaped)** on top.
 - **Female *Marchantia* plant:** bears **female reproductive branches** called **ARCHEGONIOPHORES** which bear the **archegonia (disc projected into distinct rays)** on top.

GENUS: MARCHANTIA



GENUS: MARCHANTIA





A



B



THE HORNWORTS

- The common name HORNWORT refers to the characteristic horn-shaped sporophytes
- Gametophytes are exclusively thalloid, often with mucilage-filled cavities, which are invaded by free-living cyanobacteria (especially *Nostoc*). The presence of cyanobacteria growing inside the thallus give the hornwort a distinctive blue-green color.
- Some species are monoecious while others are dioecious
- Antheridia and archegonia are sunken on the dorsal surface of the gametophyte

THE HORNWORTS

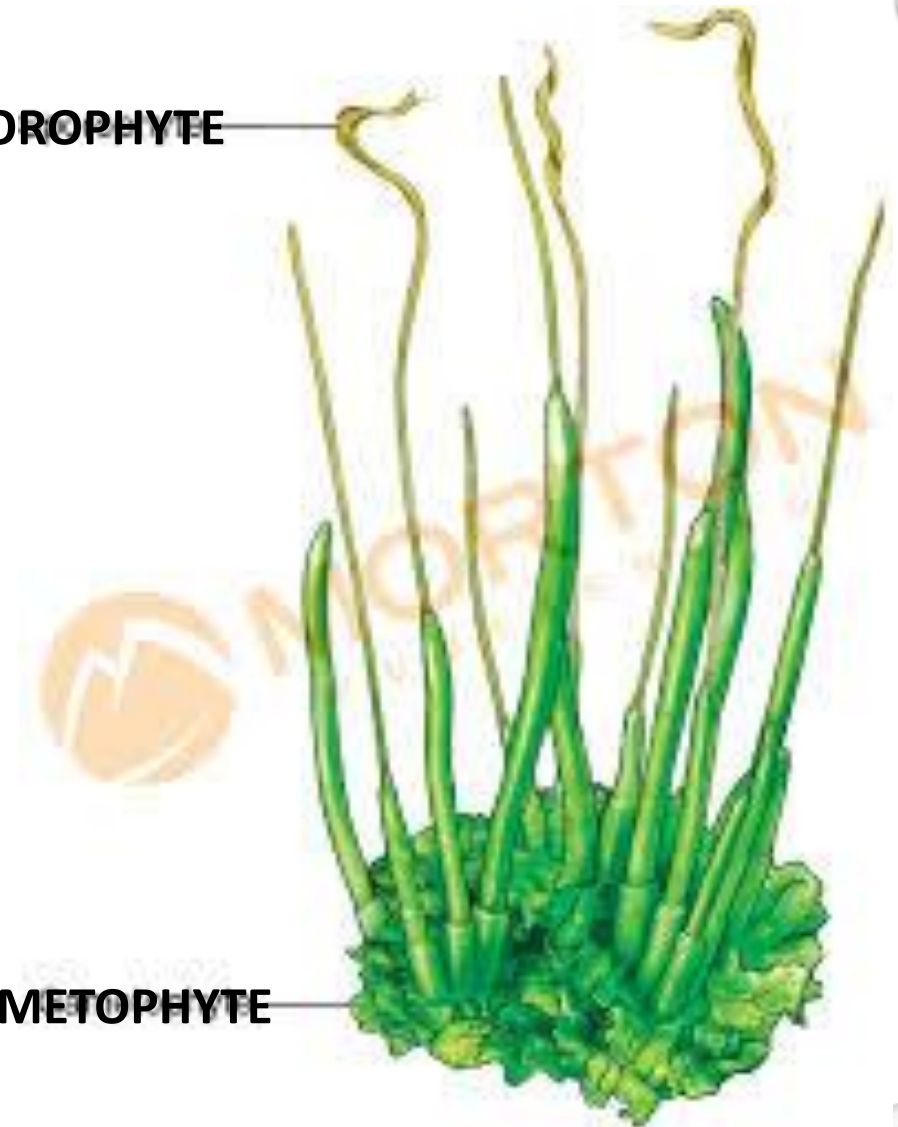
- Their sporophytes are **long and pointed, like tiny horns**. They rise several centimeters above the gametophytes of the plant.
- A mature sporophyte has a multicellular outer layer, **a central rod-like** structure called **columella** running up the center, and a layer of tissue in between that produce **spores** and **pseudo-elaters**.
- Ventral surface of gametophyte bears many rhizoids which helps in attachment.
- Examples are *Anthoceros*, *Megaceros*, *Notothylas*, *Dendroceros*

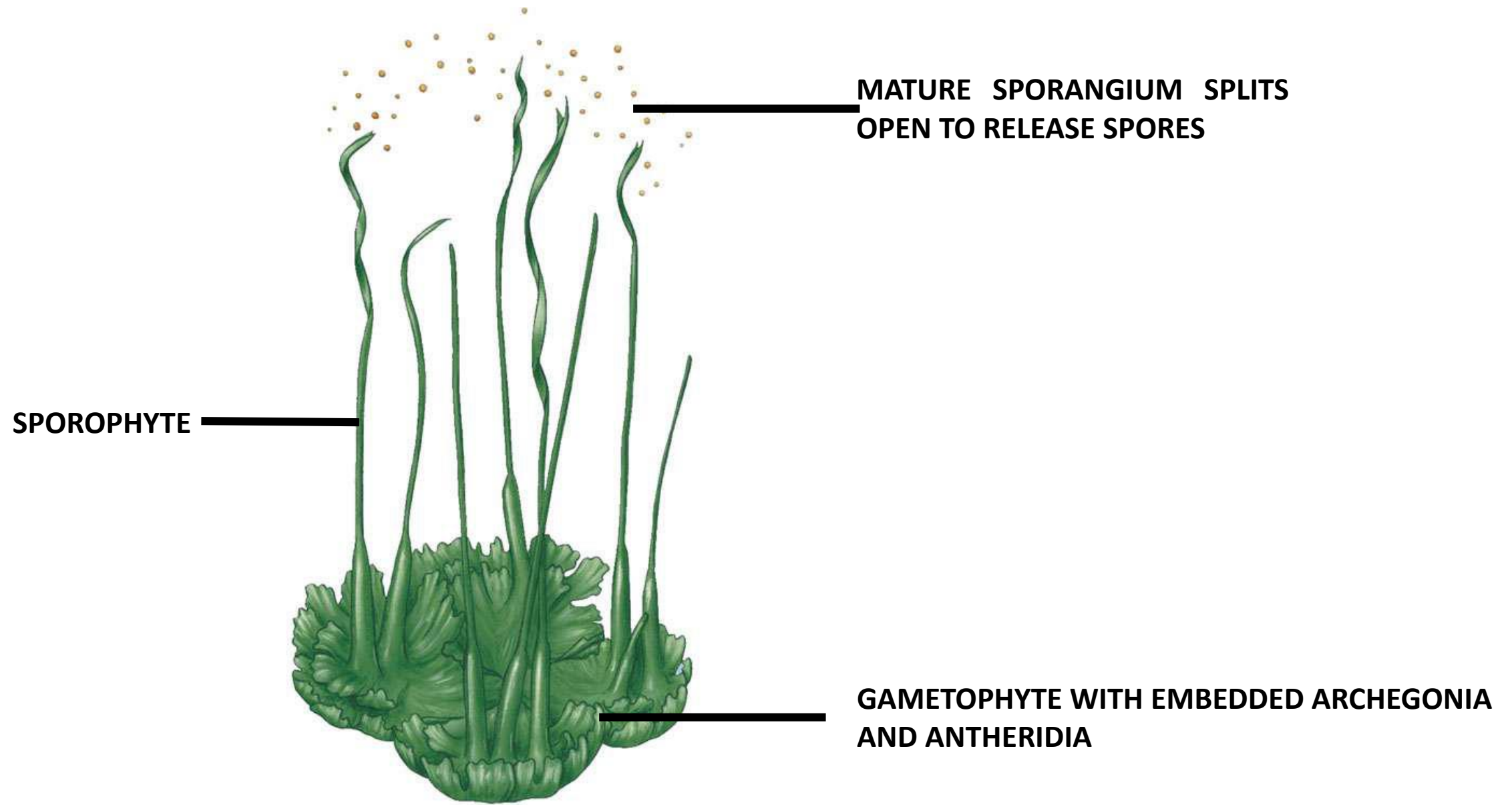
HORNWORT



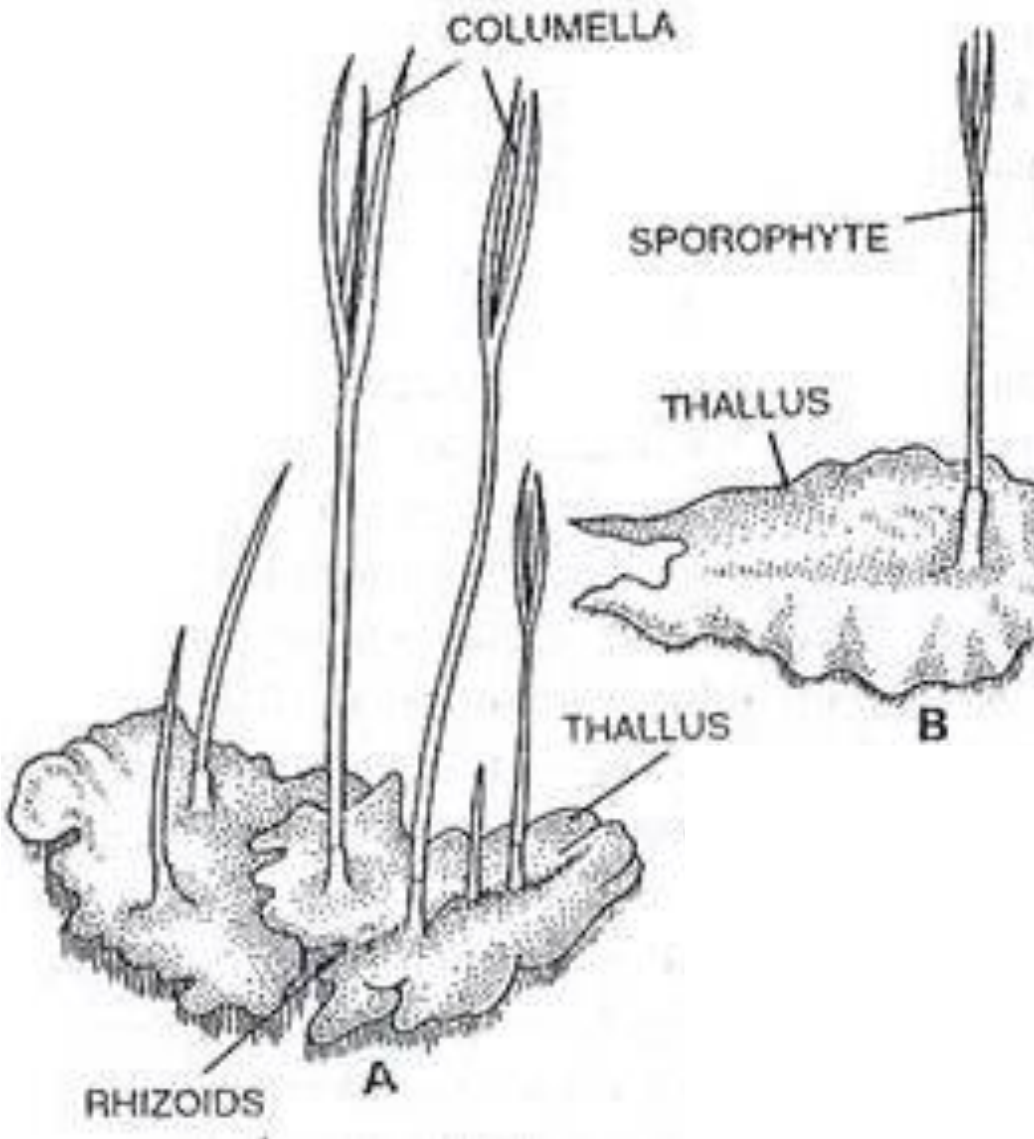
SPOROPHYTE

GAMETOPHYTE





***Anthoceros* sp.**



A. Gametophyte (thallus) bearing rhizoids with mature and immature sporophytes

B. Part of the thallus with opened sporophyte

THE MOSSES

- Larger non-vascular plants that have multicellular rhizoids that help in anchoring to surfaces.
- They have tiny, photosynthetic structures similar to leaves that encircle a central stem-like structure.
- They do not produce flowers or seeds; they reproduce through spores
- Mosses grow in dense clumps or mats (which help to retain moisture), forming green carpets or cushions.
- Examples include *Sphagnum*, *Polytrichum*, *Barbula*



Clumps of moss on the ground and base of trees



MOSS PLANT

Structure of Moss

