BYJU'S Classes

BIOLOGY

PLANT KINGDOM

BRYOPHYTES

NOTES

Key Takeaways

- Introduction
- Characteristics
- Structure
- Alternation of generation
- Classification
- Reproduction
- Ecological importance
- Economic importance

Prerequisites

Algae

Rhodophyceae	Phaeophyceae	Chlorophyceae
Red algae (mainly multicellular)	Brown algae (exclusively multicellular)	Green algae (mainly unicellular)
Chlorophyll a, Chlorophyll d, Phycoerythrin	Chlorophyll a, Chlorophyll c and Fucoxanthin	Chlorophyll a, Chlorophyll b, Carotenoids
Mainly marine	Exclusively marine	Mainly freshwater
No motile gametes	Motile gametes	Motile gametes
E.g. Chondrus, Gelidium, Gracilaria	***E.g. Fucus, Kelp, Laminaria***	***E.g. Chlamydomonas, Spirogyra, Chlorella***

Origin of Land Plants

Aquatic habitat

- Insufficient sunlight
- Depletion of nutrients due to abundant growth of algae in shallow water

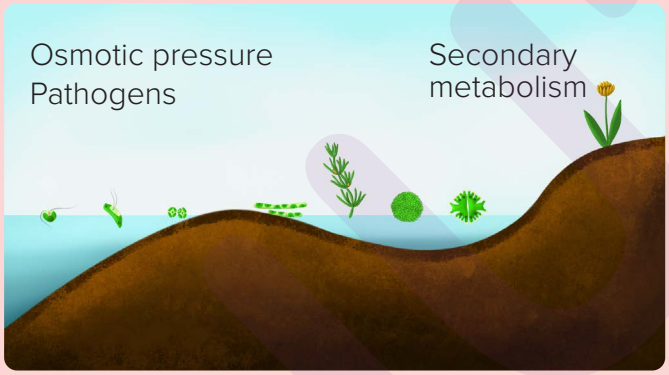
Plants transitioned from water to land

Land

- Abundance of sunlight and nutrients

Aquatic plants needed to develop some adaptations to transition from water to land.

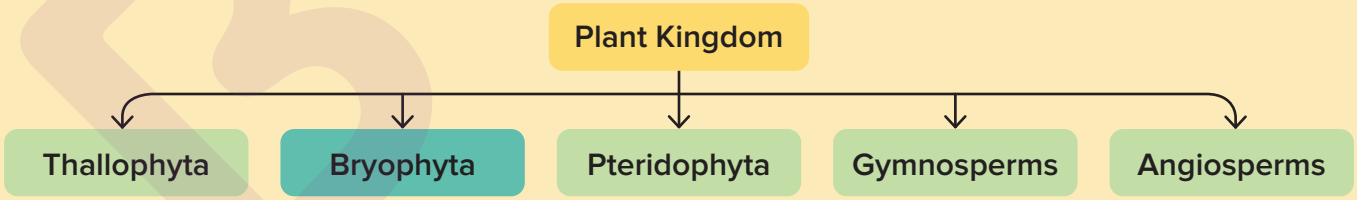
Challenges of terrestrial habitat	Adaptations to overcome the challenges
Severe dessication due to large **temperature fluctuations**	Development of the **cuticle—a waxy covering** on the exposed surfaces of the plant
Severe dessication due to intense **solar radiation**	Cuticle prevents loss of water from stems and leaves
Osmotic pressure	Development of **jacketed sex organs**
Pathogen attacks	Development of **secondary metabolism**



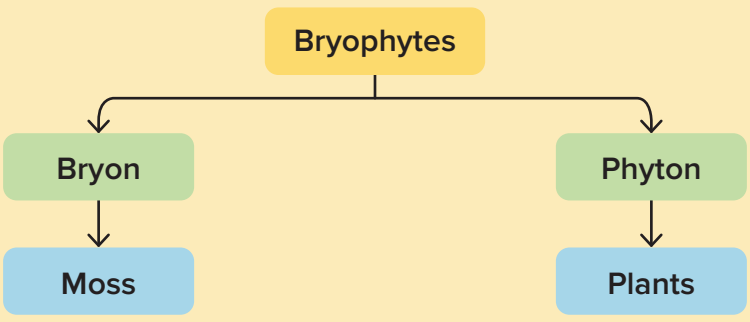
Division Bryophyta

Classification of plant kingdom

The current classification system of **Kingdom Plantae** is a combination of **Eichler's system** and the **modern classification system**.



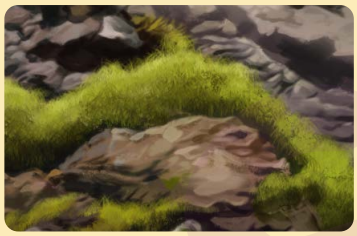
Bryophytes - The first land plants



Characteristics of bryophytes

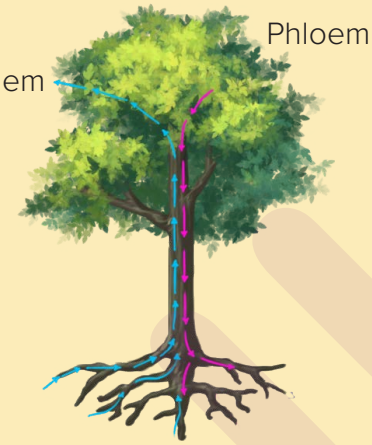
- Bryophytes are moss-like plants that grow in moist, shaded areas.

- They are **short** and grow as **dense mats** on the soil.



- Why are bryophytes **short**?

Tall trees have **xylem** for the transport of water and **phloem** for the transport of nutrients, like **glucose**



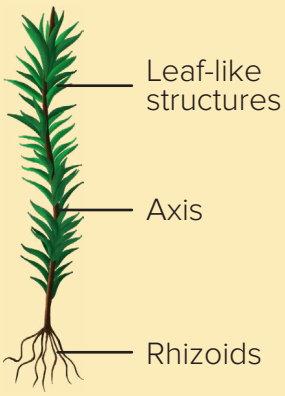
Tall trees

Short bryophytes

Do not have xylem and phloem

Structure of bryophytes

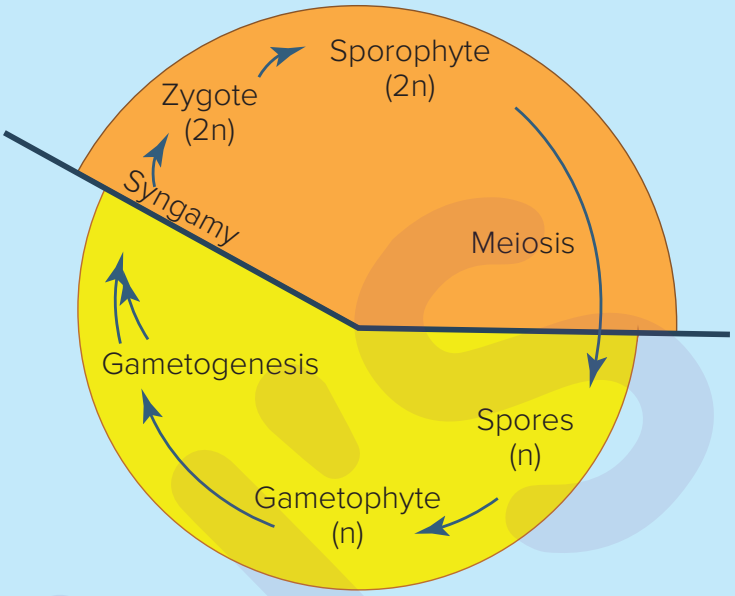
- The plant body is **undifferentiated** and **thallus-like**.
- They do not have true roots, stem, or leaves but may bear **root-like**, **stem-like,** and **leaf-like** structures.
- The undifferentiated thallus can be **prostrate** or **erect**.

Prostrate thallus		The thallus is flat and is stretched on the ground.
Erect thallus		• The plant body is **erect.** • Plant body is differentiated into **rhizoids**, **axis,** and **leaf-like** structures. • The primary function of rhizoids is to **anchor** the plant to the substratum but unlike **roots**, they **cannot absorb** water and minerals.

Alternation of generation

Bryophytes exhibit two phases in their life cycle:

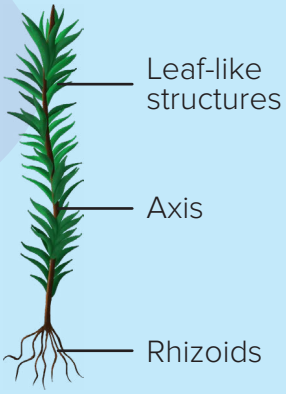
- The **sporophytic** phase (**2n**)
- The **gametophytic** phase (**n**)



Alternation of generations

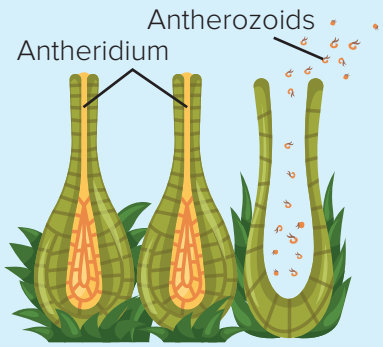
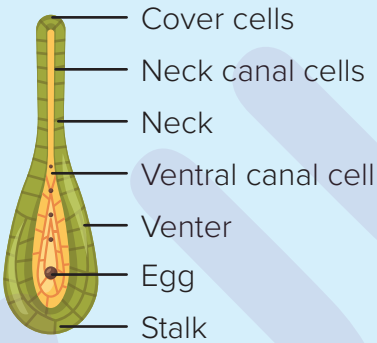
The gametophytic phase

- 'Gameto' = Gamete producing; 'Phyte' = Plant



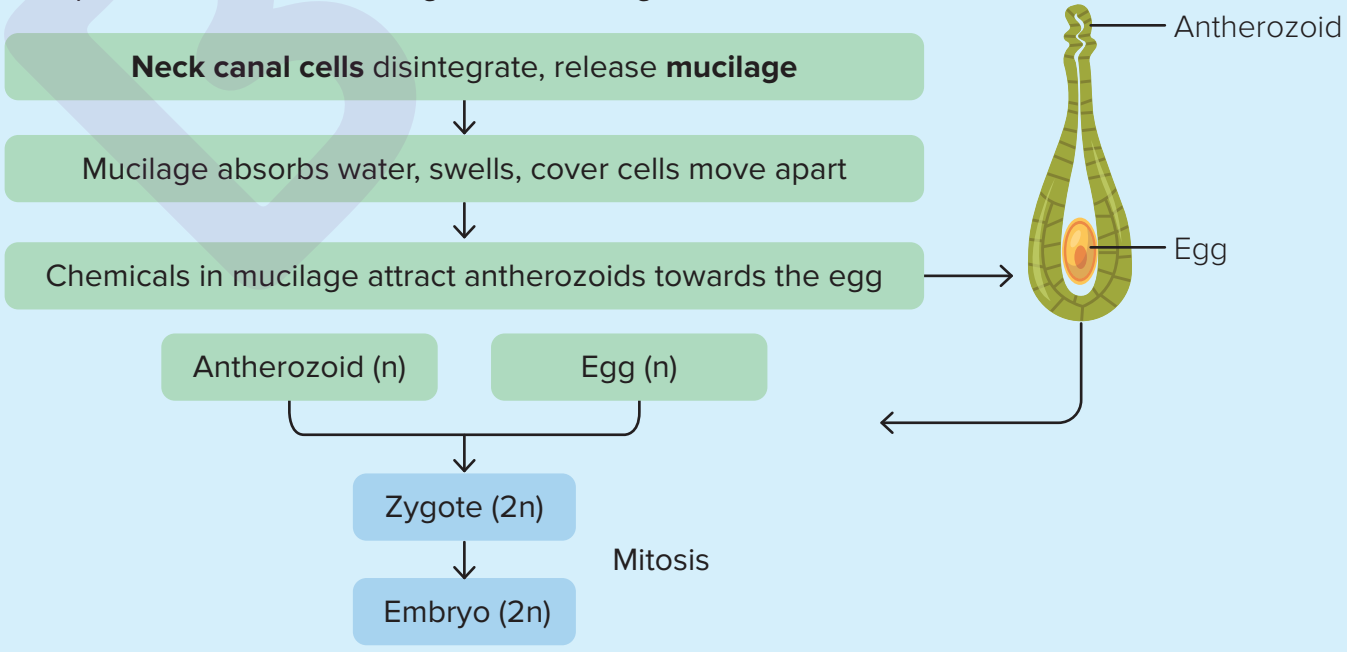
Gametophytic stage

- The gametophyte exists **independently**.
- It is **haploid** (n).
- Features of sex organs in the gametophyte:
  - **Multicellular**
  - Arise on **stalks**
  - Covered by a layer of sterile cells known as the **jacket**

Antheridium (male sex organ)	L.S. of the antheridium	Antherozoids (motile male gamete)
		• Formed by the antheridium • Biflagellate Androcyte mother cell (n) → Mitosis → Biflagellate antherozoids 
Archegonium (female sex organ)	**L.S of the archegonium**	**Egg cell**
		Produced by the archegonium

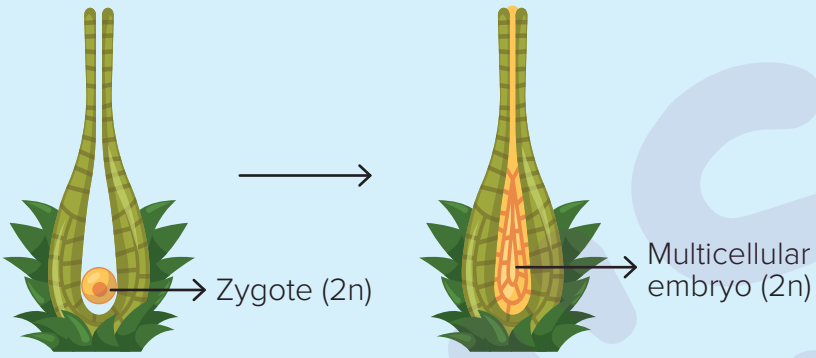
Fertilisation

- **Water** is required for the fertilisation as the male and female gametes are brought together through the medium of water.
- Since they live on land but need water for fertilisation, they are known as the **amphibians of the plant kingdom**.
- The process of fertilisation is given in the diagram shown.



Characteristics of the embryo

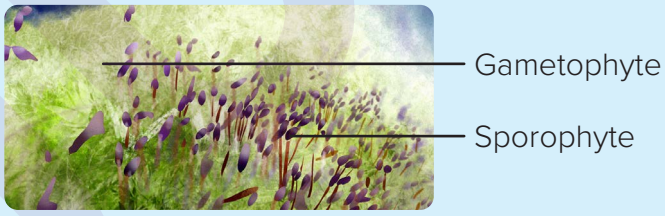
- The embryo is **multicellular**.
- Bryophytes are the **first embryophytes**—organisms that form the embryo stage.



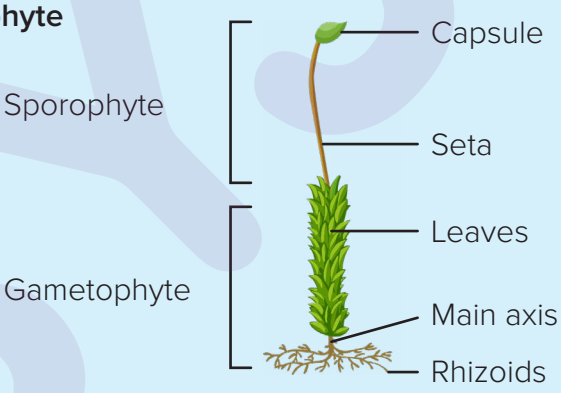
Development of the zygote into the multicellular embryo

The sporophytic phase

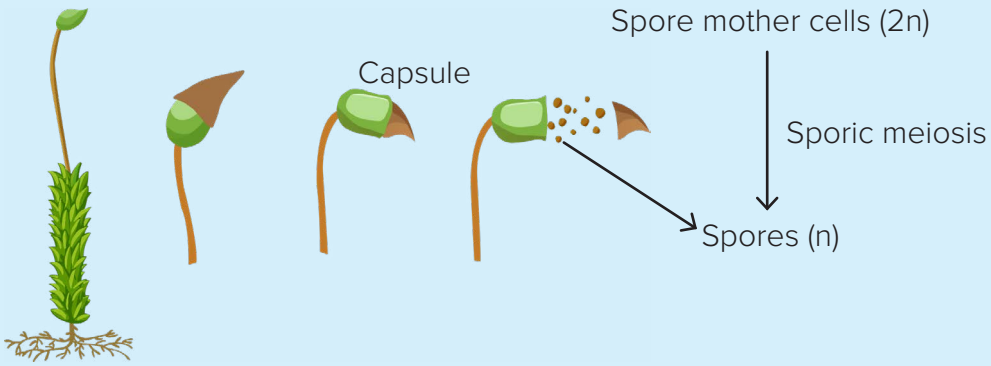
- 'Sporo' = Spore producing; 'Phyte' = Plant
- It is **dependent** on the gametophyte. Hence, the two phases exist together.
- It is diploid (2n).



- **Structure of the sporophyte**



- **Formation of haploid spores in the sporophyte**
- Some cells of the sporophyte, known as the **spore mother cells** (2n), undergo meiosis (reduction division) to give rise to **haploid spores** (n).

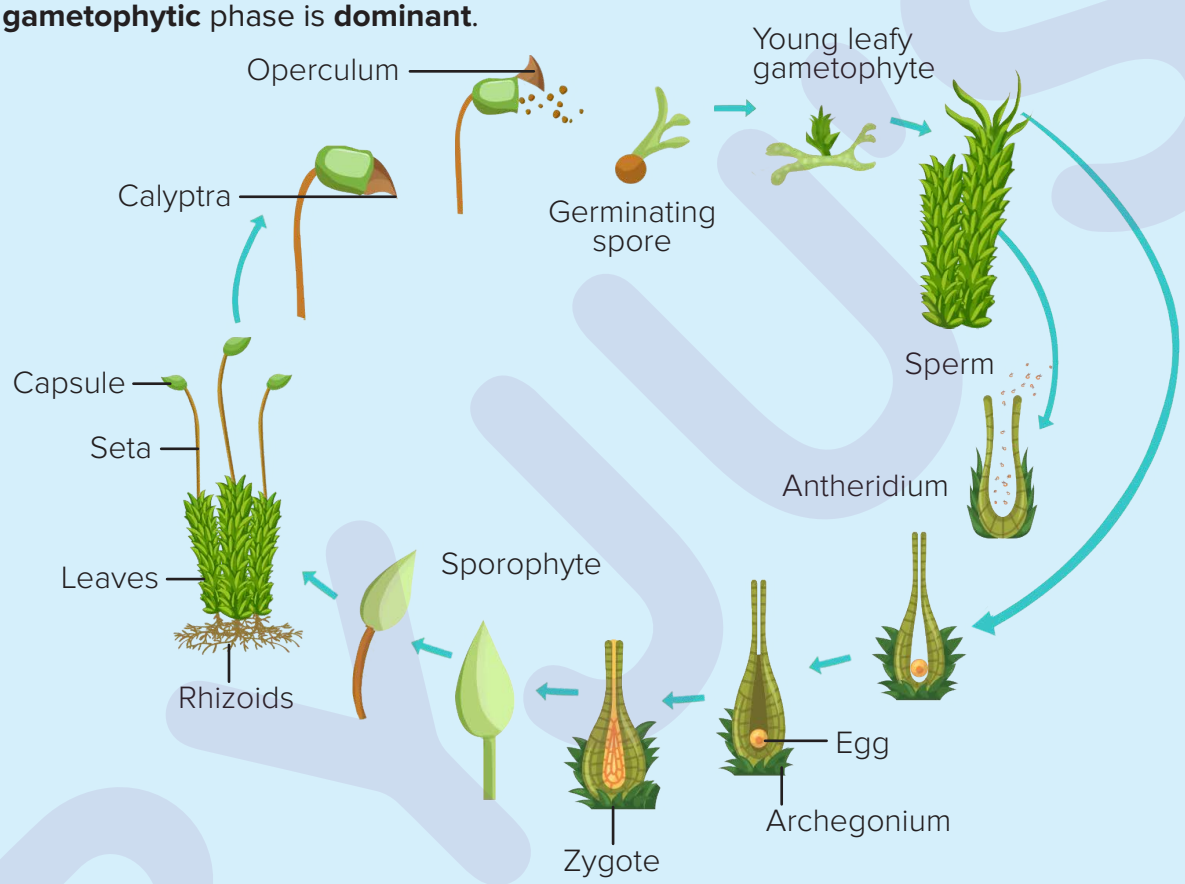


- **Formation of gametophyte from the sporophyte**

Spore germination (n) → Protonema (n) → Gametophyte (n)

Life cycle of bryophytes

- The life cycle is known as '**haplodiplontic**' as bryophytes alternate between the haploid gametophyte phase and the diploid sporophyte phase. Both the phases are multicellular and can be seen very clearly.
- The **gametophytic** phase is **dominant**.



Life cycle of bryophytes

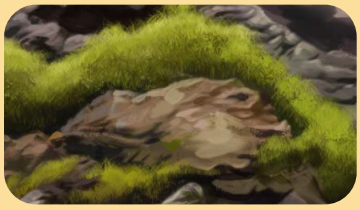
Classification of bryophytes

Bryophytes

Liverworts

Hornworts

Mosses

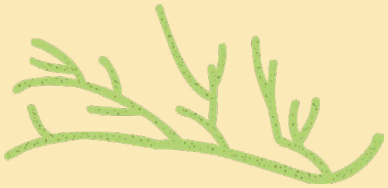


Known so because of its horn-like sporophyte

Mosses

- In mosses, the spores germinate to form juvenile gametophyte known as **protonema**.
- Further stages of development are given in the image shown.

Protonema
(Juvenile gametophyte)



- Protonema is **creeping, branched** and **filamentous**.
- Buds on protonema develop into **foliose** (leafy) stage.

Foliose stage
(Adult stage)

- The foliose stage is differentiated into **rhizoids**, **axis,** and **leaf-like** structures.
- Plant body is attached to substratum by rhizoids.

Stages of development of mosses

Liverworts

- There are two types of liverworts—**thalloid liverworts** and **foliose liverworts**.

Thalloid liverworts	Foliose liverworts
Thallus is **undifferentiated** and is **dorsiventral** and **dichotomously branched.**	Thallus is **differentiated** and has **stem-like** and **leaf-like structures.**
Rhizoids are unicellular.	Rhizoids are unicellular.
	
Most liverworts are thalloid liverworts.	

The leaves of the liverworts and mosses are slightly different

Leaves in mosses	Leaves in liverworts
In mossess, the leaves are arranged spirally.	In liverworts, the leaves are arranged in two rows.
	

Reproduction in liverworts and mosses

Reproduction

Vegetative

Fragmentation in both liverworts and mosses

Asexual

- Liverworts: **Gemmae**
- Mosses: **Budding**

Sexual

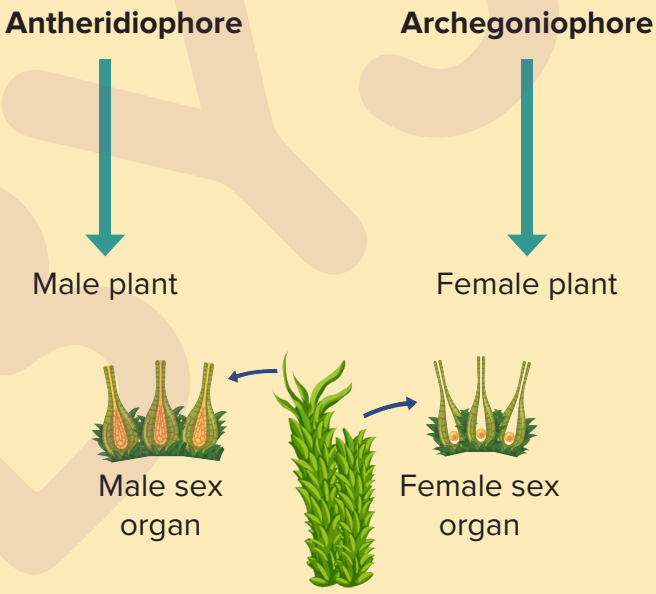
Oogamy in both liverworts and mosses

- **Asexual reproduction in liverworts and mosses**
- The table shown highlights the characteristics and differences between asexual reproduction in liverworts and mosses.

Asexual reproduction in liverworts	Asexual reproduction in mosses
• With the help of **gemma cups.** • Gemma cups have green, multicellular **asexual buds** known as **gemmae.** • Gemmae germinate to form new organisms.	• **Buds** on protonema develop into foliose stage.
  Gemmae	Protonema (Juvenile gametophyte)   Foliose stage (Adult stage)

- **Sexual reproduction in liverworts and mosses**
- The table shown highlights the characteristics and differences between sexual reproduction in liverworts and mosses.

Sexual reproduction in liverworts	Sexual reproduction in mosses
Most liverworts are **dioecious.**	Most mosses are **monoecious.**
Male and female sex organs are found on different thalli.	Male and female sex organs are found on the same plant at the tip of leafy shoots.
• Gametes produced by sex organs fuse and form into zygote that develops into sporophyte. • Sporophyte produces spores by meiosis that germinate to form gametophyte.	• Gametes produced by sex organs fuse and form the zygote that develops into sporophyte. Sporophyte produces spores by meiosis. • In mosses, spores germinate into a filamentous green structure known as protonema. • Protonema develops buds that germinate to form gametophyte.



Liverworts: Male and female sex organs are borne on separate thalli.

Mosses: Male and female sex organs are on the same plant at tips of leafy shoots.

Sex organs in liverworts and mosses

Did you know?

***Sphagnum*, peat moss,** due to its high absorbing capacity and antiseptic property, was used in World War I as bandages to treat injured people.

Did you know?

Mosses could have caused the ice age

- Mosses altered the bedrock composition, causing the Earth's surface to absorb the carbon dioxide from air.
- Carbon dioxide is a greenhouse gas that traps heat from the Sun and keeps the Earth warm. But here, due to the low level of carbon dioxide, the Earth's temperature became low and eventually lead to the ice age.

Importance of bryophytes

Ecological importance

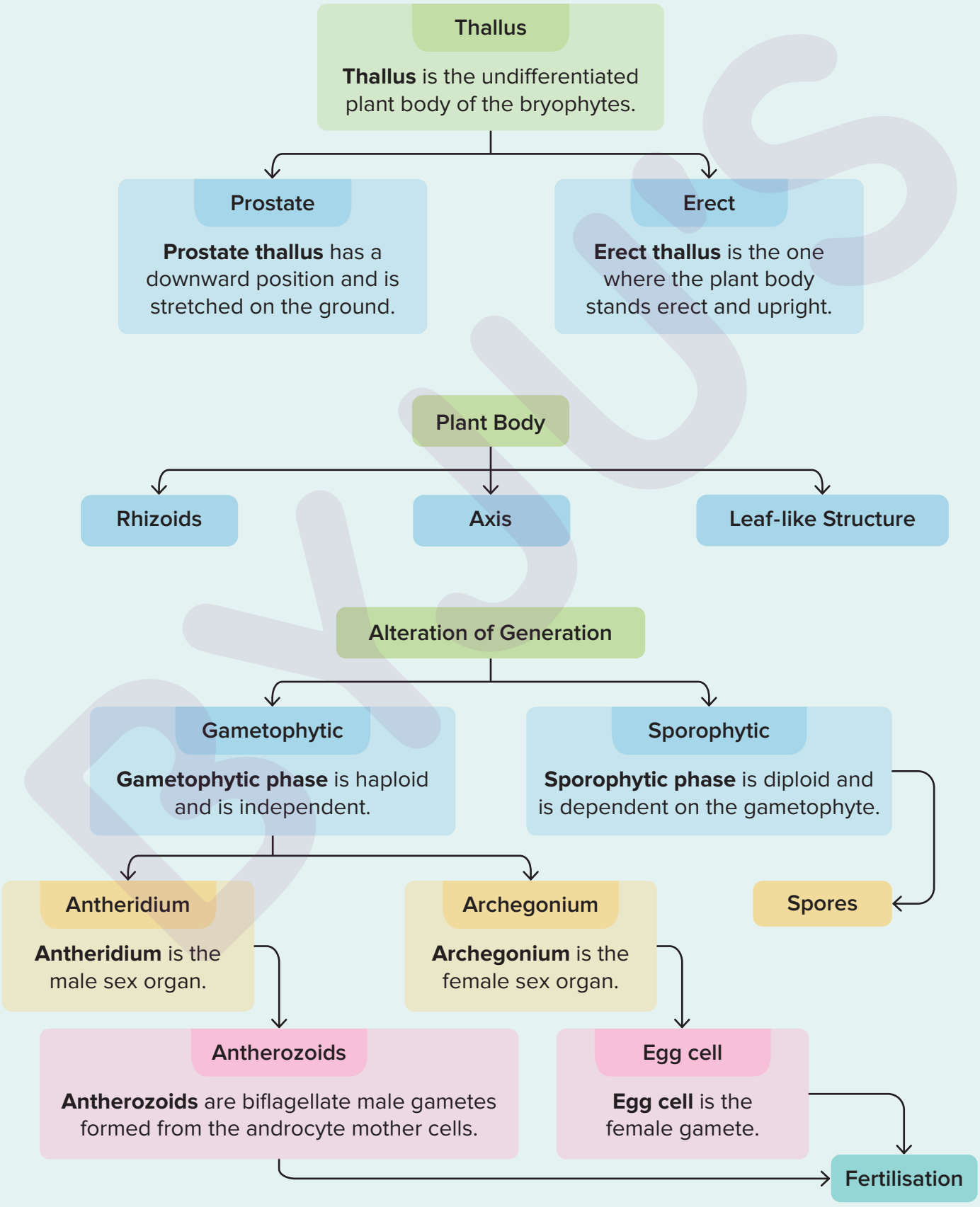
- Death and decay of mosses leads to **soil formation**.
- **Prevents soil erosion** by reducing the impact of rain.
- **Food** for herbaceous animals.
- Packing material (**peat moss**).

Economic importance

- **Peat** is obtained from ***Sphagnum***.
- Peat is formed in soil due to **partial decomposition** of vegetative matter.
- Uses of peat:
  - Peat is used as a **fuel** and also in **gardening**.
  - Due to **high water holding capacity**, it is used as **packing material** for trans-shipment of living material.

Summary Sheet

- **Bryophytes** are moss-like plants that grow in moist, shaded areas.
- **Vascular tissues absent in bryophytes**



- **Haplodiplontic life cycle** is seen in the bryophytes as they alternate between the haploid gametophyte phase, and the diploid sporophyte phase, and the gametophyte is dominant.

<table>
<tr><td rowspan="4">Classification of Bryophytes</td><td>Hornworts</td><td colspan="4">Have a horn-like sporophyte</td></tr>
<tr><td rowspan="2">Mosses</td><td>Structure</td><td colspan="3">Reproduction</td></tr>
<tr><td></td><td>Vegetative</td><td>Asexual reproduction</td><td>Sexual reproduction</td></tr>
<tr><td>• Protonema is the juvenile gametophyte phase.
• Foliose stage is the adult stage.</td><td>• Fragmentation is a type of a reproduction wherein the parent cell splits into fragments and each fragment develops into new organisms.</td><td>• Budding is the process by which the buds on the protonema develop into foliose stage.</td><td>• Oogamy is a form of gametic fusion in which the female is non-motile and is significantly larger than the male gamete.
• Monoecious organisms are those in which the male and female sex organs are found on the same plant at tips of leafy shoots.</td></tr>
<tr><td>Liverworts</td><td>• Thalloid liverworts have an undifferentiated thallus.
• Foliose liverworts have a differentiated thallus.</td><td>• Fragmentation is a type of a reproduction wherein the parent cell splits into fragments and each fragment develops into new organisms.</td><td>• Gemmae are multicellular asexual buds that germinate to form new organisms.</td><td>• Oogamy is a form of gametic fusion in which the female is non-motile and is significantly larger than the male gamete.
• Dioecious organisms are those in which the male and the female sex organs are found on different thalli.</td></tr>
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