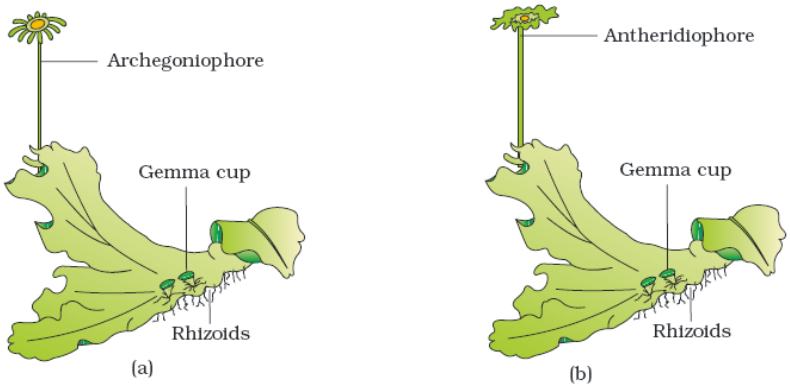
PLANT KINGDOM

PTERIDOPHYTES

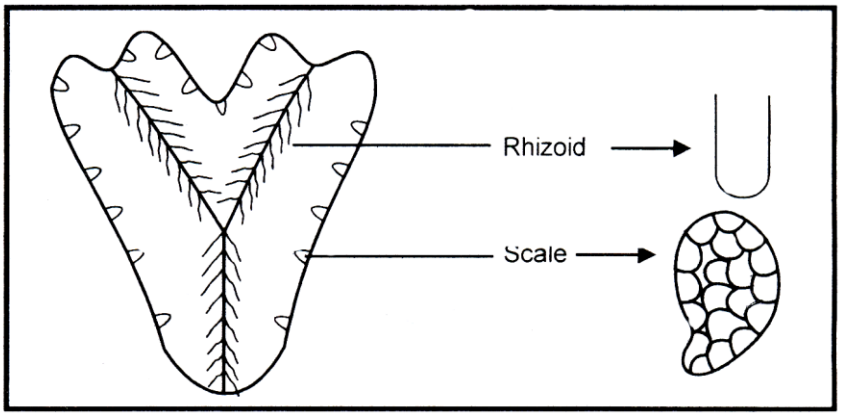
LIVERWORTS

HEPATICOPSIDA – LIVER WORTS



A liverwort – *Marchantia* (a) Female thallus (b) Male thallus

- All the bryophytes includes in this class have shape like **liver**, so they are know as liverworts.
- Plant body of this group is **thallus like**.
- **Rhizoids** and **scales** are present on thallus.
- **Rhizoids** are **unicellular, unbranched**. **Scales** are **multicellular**.
- **Rhizoids** mostly on **ventral** surface while **scales** on **margin** and **apical notch**
- Thallus has two distinct zones i.e. **photosynthetic** and **storage zone**.
- **Asexual reproduction** occur by means of fragmentation, or by specialized structure called **gemmae** (e.g. **Marchantia**).
- Gemmae are '8' shaped, **stalked**, **green** and multicellular asexual **buds** developing in small receptacles (**gemma cups**) on **dorsal surface** of thallus.
- In marchantia specific structure found on which **sex organs** found in **groups** called **Archegoniophore** (archegonia) and **Antheridiophore** (Antheridium).
- The sporophyte of liverworts is **completely depend** on **gametophyte** i.e it is depend on gametophyte for food, water and habitat.



The sporophyte of liverworts made up of **foot**, **seta** and **capsule**. [Except **Riccia sporophyte is made up of only capsule**).

- In this class formation of **spores** and **nurse** cells takes place by the **cells of endothecium**.
- Cells of **amphithecium** form only **wall of sporophyte**.

  Amphithecium = Wall of sporophyte

  Endothecium = sporogenous cells = spore mother cells + nurse cells

- **Elaters** are present in **sporophyte** of some members of liverworts. (e.g. **Marchantia** - In **Marchantia** nurse cells are modified in to elaters).
- **Elaters** are **diploid**, **hygroscopic** structures with **spiral thickenings** bands which help in **spore dispersal**.

  Eg. Riccia, Marchantia, Cryptothallus, Riella, Pellia

  Porella (Leafy thallus have two rows of leafy appandages on stem like structure)

  Note : In Bryophytes, sporophyte of Riccia is the simplest.

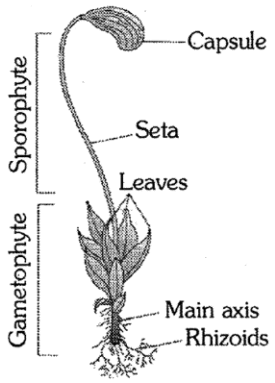
HORNWORTS AND MOSSES

ANTHOCEROTOPAIDA - HORNWORTS

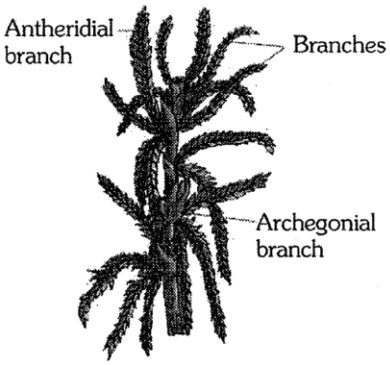
1. The plant body of this group is also thallus like. Scales are absent but rhizoids are present on thallus. Rhizoids are unicellular and unbranched.
2. The sporophyte of Hornworts is divided into foot and capsule.
3. The sporophyte of Hornworts is not completely dependent on its gametophyte i.e. it is partially depend because its sporophyte is photosynthetic therefore it can manufacture Its own food. So it does not depend on gametophyte for food, it depends only for water and habitat.
4. In hornworts at the basal part of capsule, a special, type of meristem is present. Due to the activeness of this, meristem, the capsule grows rapidly. It grows like the horn of animals.
   eg. Notothylus, Anthoceros
   Note : Pseudoelaters are present in hornworts, which help in spores dispersal.

BRYOPSIDA OR MUSCI - MOSSES

1. All the Mosses are included in this class. The plant body of mosses is made up of stem like, leaf like and rhizoids (roots like). The Rhizoids present in the plants of this class are multicellular, branched and obliquely septet.
   Note - The presence of leaf like structure in gametophyte is the unique character of Moss because in plant kingdom any gametophyte do not have leaf like structure. They consist of upright slender axis bearing spirally arranged leaves.
2. Vegetative reproduction in mosses is by fragmentation and budding in the secondary protonema.
3. During sexual reproduction, sex organs are produced at the apex of the leafy shoots.
4. The saprophyte in mosses is more elaborated (developed) than that in liverworts. The saprophyte of moss is divided into foot, seta, capsule.
5. The saprophyte of mosses is also partially depend like, that of Hornworts, i.e. it is photosynthetic. The moses have an elaborate mechanism of spore dispersal.
   Note : Peristomial teeth are present in moss saprophyte which help in spores dispersal.



***Funaria*, gametophyte and sporophyte**



***Sphagnum* gametophyte**

E.g. of Mosses :

- Fun aria - Rope moss
- Polytrichum - Hair cap moss
- Buxbaumia - Saprophytic moss
- Sphagnum

- **Peat moss** – It is a fossil fuel that obtained from bog. The formation of peat takes place by the fossilization of sphagnum. Sphagnum grows in acidic bog. The number of bacteria are less in bog due to which the degradation of dead cell could not takes place. Hence it is present in the form of fossil.
- **Absorbent cotton -** Sphagnum can absorb water in very high amount, therefore it is used in the form of absorbent cotton in Europe.
- Bryophytes in general are of little economic importance but some mosses provide food for herbaceous mammals, birds and other animals. Species of sphagnum, a moss, provide peat that have long been used as fuel, and because of their capacity to hold water as packing material for trans-shipment of living material. Mosses along with lichens are the first organisms to colonies rocks and hence, are of great ecological importance. They decompose rocks making the substrate suitable for the growth of higher plants. Since mosses form dense mats on the soil, they reduce the impact of falling rain and prevent soil erosion.

PTERIDOPHYTES (PTERIS = FEATHER, PHYTON = PLANT):

Introduction

- The term **pteridophyta** coined by **Haeckel (1866)**.
- The study of pteridophytes is called pteridology**.**
- These are **seedless**, spore producing land plants which are popularly known as **botanical snakes** or **vascular cryptogams (vascular tissues xylem and phloem present)**.

General characters:

In pteridophyta main plant body is **sporophytic**.

- The plant body is completely differentiated in to true **root**, **stem** and **leaves**
- The **primary root** remains alive for **short period**. After some time it is replaced by **advantitious** roots.
- Stem is erect or prostrate. In some pteridophytes stem is **underground**, which is known as **rhizome**.

On the basis of leaves, pteridophytes are of two types -

- **First**, In which stem is larger and **leaves are smaller**. They are called as **microphyllous** Pteridophytes.
  eg. **Equisetum, Lycopodium, Selaginella**
- **Second**, in which stem is smaller while **leaves are larger**. They are known as **macrophyllous** Pteridophytes.
- Eg. **Pteridium, Pteris, Marsilea** (most of **ferns**)
  Note : Differentiation in plant body starts from bryophytes.

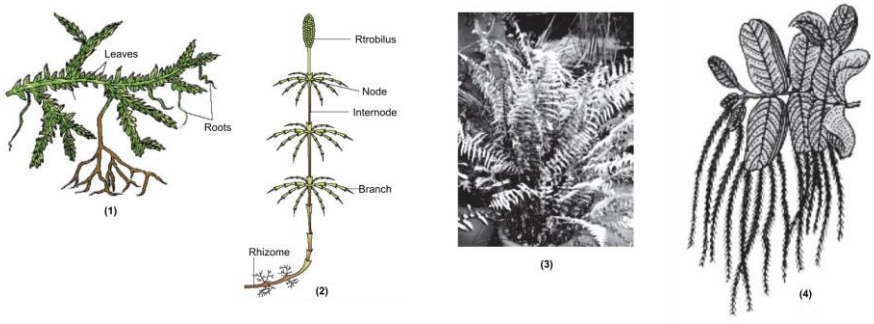


Fig. Pteridophytes : (a) Selaginella (b) Equisetum (c) Fern (d) Salvinia

Habitat of some important pteridophytes –

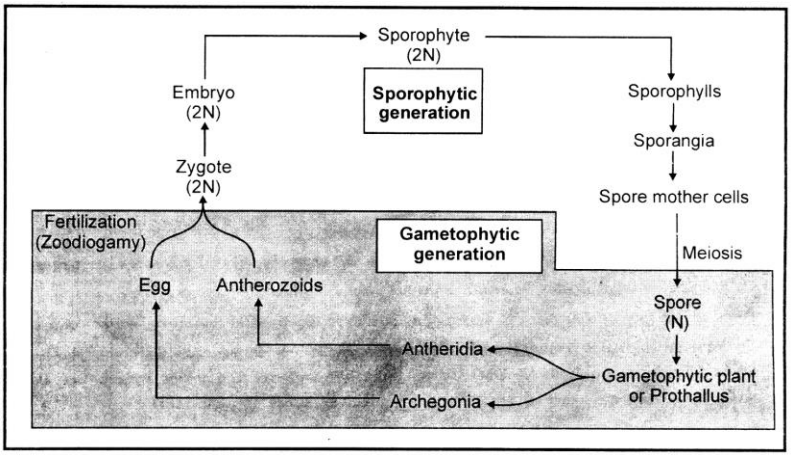
Most of the pteridophytes are found in **moist soil** and **shady places**.

- **Aquatic** - Some pteridophytes are found in water.
  eg. Marsilea, Salvinia, **Azolla**, Isoetes
- **Epiphytes** – Some pteridophytes grow on other plants.
  eg. Lycopodium phlegmeria, Ophioglossum pendulum, Pleopeltis

Life cycle of Pteridophytes:

Homosporus pteridophytes

1. Main plant body is sporophyte (2N).
2. **Sporophyll posses spore forming structure (Sporangia) on abaxial surface (Ventral / lower surface) of leaf. The leaves in pteridophyta are small (microphylls) as in Selaginella or large (macrophylls) as in ferns. The sporophytes bear sporangia that are subtended by leaf-like appendages called sporophylls.**
3. **In some cases sporophylls may form distinct compact structures called strobili or cones (Selaginella, Equisetum)**
4. Spores (N) released from sporangia and reach the soil and germinate to develop into gametophyte (Prothallus).
5. **Prothallus is small, inconspicuous, multicellular, independent, free living, monoceious, mostly photosynthetic (sometimes saprophytic), non-vascular and thalloid gametophyte.**
6. Prothallus require cool, damp, shady place to grow.
7. In most of **homosporus pteridophytes (e.g. Pteris, Equisetum, Adiantum, Dryopteris and Lycopodium)** prothallus is monoecious (male and female sex organ present on same prothallus).
8. Male sex organ (antheridia) and female sex organ (archegonia) develop on protoallus.
9. Antheridia form Bi-flagellated (Selaginella) or multiflagellated (Most of pteridophytes like Dryopteris) male gamete / Antherozoids by mitosis.
10. Archegonia form egg in venter and have neck of 4 rows.
11. Male gametes swim in water (Zoodiogamy) and reach upto mouth of archegonia where fertilization take place to form zygote (2N).
12. Zygote develops into embryo and form main sporophytic plant.



1. Fertilization takes place by **zoodiogamy** and zygote is formed as a result of fertilization.
2. Zygote develops **mitotically** and forms an **embryo.**
3. Now this **embryo** develops and forms a **sporophytic plant** with **root, stem, leaf.**

Heterosporus pteridophytes

1. Some of the pteridophytes are **heteroporus (e.g. Azolla, Isoetes, Marsilia, Selaginella and Salvinia)** in which two type of spores are formed, microspore (in microsporangia) and megaspore (in megasporangia).
2. Microspore produce male gametophyte and megaspore form female gametophyte **(Dioecious prothallus)**.
3. The female gametophyte in these plants are retained on parent sporophyte for variable periods (Prococious development).
4. Male gametophyte form male gametes (antherozoids) which move through water to reach the neck of archegonia (female gametophyte).
5. Fertilization and embryonic development take place within the female gametophyte. This event is precursor to seed habit and considered important step in evolution.

Economic importance:

(i) Pteridophytes are used for medicinal purposes and as soil-binders.

e.g

(a) An antihelminthic drug is obtained from rhizomes of Dryopteris.

(b) omeopathic medicine is obtained from Lycopodium.

(c) Selaginella is helpful in soil conservation.

(ii) They are also frequently grown as ornamentals. e.g. Ferns.

Points to be remember

- Type of sexual reproduction in pteridophyta is oogamous.
- Their life cycle is diplo-haplontic type.
- The unique character of life cycle of Pteridophyte is - Independent alternation of generation i.e. sporophyte and gametophyte are separate to each other and morphologically different.
- In some Heterosporus species female gametophyte retained on parent sporophyte and develop embryo after fertilisation on same sporophyte eg. Selaginella.
- This event is precursor to **seed habit** in evolution.

Pteridophyta is divided in to 4 classes

1. **Psilopsida** 2. **Lycopsida** 3. **Sphenopsida** 4. **Fillicinae/Pteropsida**

1. PSILOPSIDA

- The most **ancient vascular plants** are placed in this class.
- The plants in this class have many primitive characters –
- Their plant body is differentiated in to **stem, scaly leaves** and **rhizoids.**
- **Rhizoids** are present **instead of roots**. In psilopsida **stem** is **underground** i.e. **rhizome**.
- This rhizome bears some **aerial branches**. Sporangia are formed on these branches.

  Note : Vascular tissue is present only in stem.

- **Tropophylls** are absent, **scaly leaves** are known as **cataphylls.**
- **Scaly leaves** - dry, brown coloured and **non photosynthetic**. They are only for **protection** of sporangia
- Their leaves do **not** have the capacity of photosynthesis, therefore photosynthesis is done by **stem**.
- Sporangia are formed on stem. **Sporophylls are absent**
- Most of the plants in this class are **extinct**.

Only one living genus is present in this class - **Psilotum → A living fossil Rhynia and Horneophyton - Fossil plants**

Lycopsida :

(i) Club mosses are placed in this class.

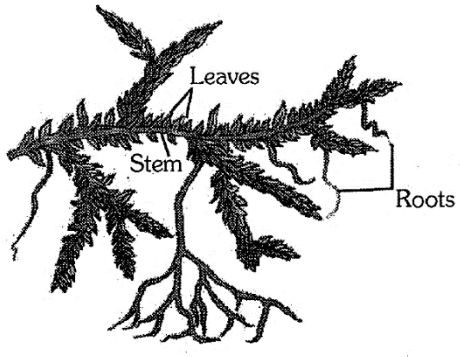
(ii) The plant body of club mosses is differentiated into root, stem and leaves. Leaves are green and photosynthetic and known as trophophylls.

(iii) Sporophylls are present in group. at the tip of plant. This groups is called as strobilus or cone.

Lycopodium - Common club moss

It is a medicinal plant. It is used as tonic in Homeopathic medicines.

Selaginella - Spike moss or Resurrection plant. It is known as "Sanjeevani"

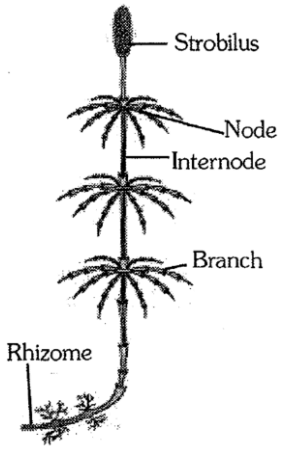


Selaginella

PHENOPSIDA OR ARTHROPHYTE OR CALAMOPHYTA

- In this class **Horse tails** are included.
- The plant body of horse tails are differentiated into **root, stem** & **leaves**.
- Their stem **is nodulated** i.e. stem distinctly differentiated into **node** and **internode**.
- **Scaly leaves** are present on these **nodes (Microphyllous).**
- **Silica** is present in the **epidermis of stem** and **leaves**.
- Due to silicated surface, leaves become **rough**. If two horse tail plants **collide**, then there is a dangerous chance of **fire** in the forest.
- The formation of **sporangia** takes place on **sporophylls**.
- Sporophylls are arranged in a **group** and form a tall and condensed **cone** or **strobilus**.

- This cone is formed at the **apical** part of **aerial stem**. The stem on which cone is formed is called as **sporangiophore**.
  eg. **Equisetum (Pipe), Sphenophylla, Hyenia**



Equisetum

FILICINAE OR PTEROPSIDA OR FERNS

This is the **largest group** of pteridophytes.

- **Ferns** are included in this class. Most of the pteridophytes are **ferns.**
- Ferns are **megaphyllous** (macrophyllus) i.e. stem is small and **leaves** are comparatively **larger** these leaves are known as **'Fronds'**
- Leaves are **multinerved.**
- **Young** leaves show **circinate ptyxis,** as they are **coiled** in the form of a watch **spring**.
- This coiling protects the growing point which comes to lie in the centre.
- **Multicellular hair** are present on the **young leaf** and **young** stem of ferns which are called as **rementa.** They are for **protection**.
- There is no difference between tropophylls in fern i.e. every leaf of fern bear **sporangia** at the time of **reproduction**. Therefore **cones** are **not** produced in **ferns**.
- Sporangia occurs **on the ventral surface** of leaves in **clusters** called **sori** (singular-**sorus**).

- The **fertile** leaves are known as **sporophylls.**
- A **sorus** is covered by a **flap-like outgrowth** from its surface called **Indusium** (**true indusium** e.g., Dryopteris) or **turned margin** of the sporophyll **(false indusium, e.g.,** Adiantum).
- **Development of sporangium** in true ferns is **leptosporangiate**.

e.g. Pteridium

Pteris	-	They are called **'Braken fern'** or **'Sun fern'**
Dryopteris		Also called as **'Brook shield fern'**
Adiantum	-	**Walking fern** or **Maiden hair fern** This name is given to them due to rapid **vegetative reproduction**. Vegetative reproduction in Adiantum takes place means of **leaf tip**. It spreads very fast.
Osmunda	-	Royal fern or flowering fern
Ophioglossum	-	**Adler's tongue fern**
Salvinia	-	**Heterosporus Aquatic fern**
Marsilea	-	**Pepper wort fern (Aquatic fern)**
Azolla	-	Aquatic fern (**smallest pteridophyte** and **biofertilizer**)
Onychium	-	Gloden fern
Cyathea	-	**Lofty tree fern**
Alsophila	-	Tree fern **(Largest pteridophyte)**
Chielanthus	-	Silver fern
Botrychium	-	Moon wort fern

POINTS TO BE REMEMBERED

- **Selaginella** - **Vivipary** is present in it i.e, **partial endosporic** germination.

  Seed habit originated in Selaginella like pteridophytes.

  - **Ligulate** leaves (**tongue** shaped) are present in it

    Function - Ligule is **secretory** structure, which **secretes water** and keeps the sporangium and the yound leaf **moist**.

- In some pteridophytes sporangia are formed at the **axil of leaf**.

  eg. **Selaginella**

- In some pteridophytes sporangia are formed in **spike**.

  eg. **Ophioglossum**

- In some pteridophytes sporangia are formed in **sporocarp**.

  eg. **Marsilea, Azolla**