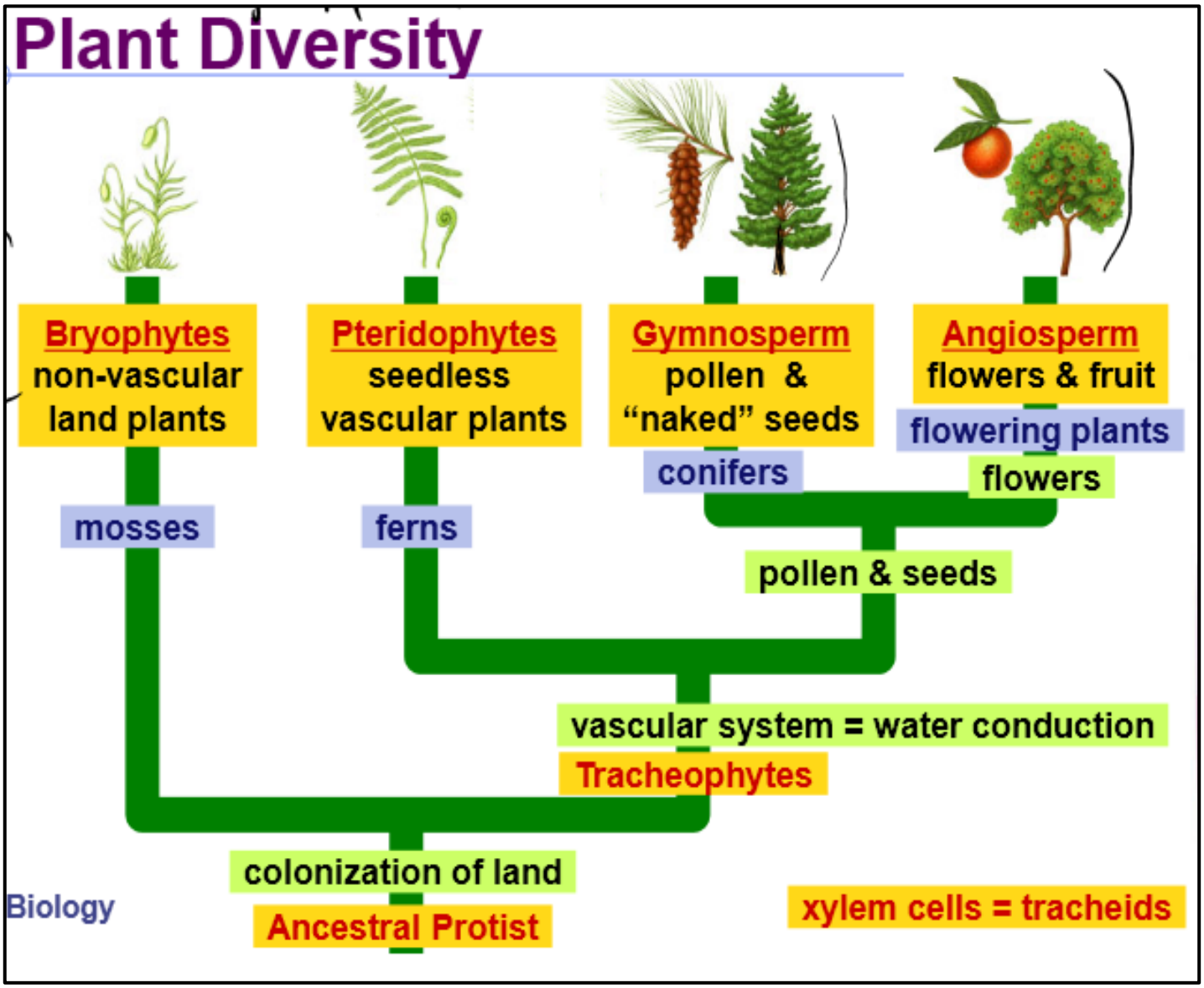
THE NATIONAL UNIVERSITY OF LESOTHO

DEPARTMENT OF BIOLOGY

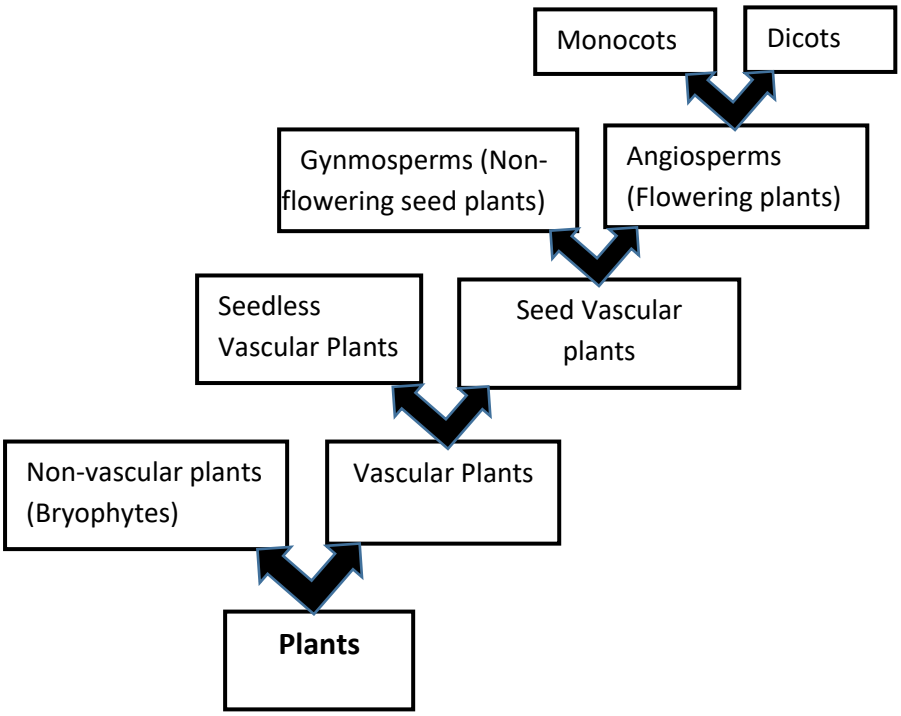
B1401: INTRODUCTORY BIOLOGY

INTRODUCTORY PLANT DIVERSITY NOTES



Plant Diversity

Plant Tree Diagram showing the major plant groupings



Major groups of plants and estimated number of species

Group of plants	Common name	Estimated number of species
Algae		
Phylum Chlorophyta	Green algae	>3000
Phylum Phaeophyta	Brown algae	>5000
Non-vascular Plants (bryophytes)		
Phylum Hepatophyta	Liverworts	9,000
Phylum Anthocerophyta	Hornworts	100
Phylum Bryophyta	Mosses	15,000
Vascular Plants		
Seedless Vascular Plants		
Phylum lycophyta	Lycophytes	1,200
Phylum Pterophyta	Pterophytes	12,000
Seed Plants		
Gymnosperms		
Phylum Ginkgophyta	Ginkgo	1
Phylum Cycadophyta	Cycads	130
Phylum Gnetophyta	Gnetophytes	75
Phylum Coniferophyta	Conifers	600
Angiosperms		
Phylum Anthophyta	Flowering Plants	250,000

Bryophytes

- They are represented by phyla of small herbaceous plants and are the simplest land plants.
- They are thought to have evolved from green algae.
- These include Phylum Hepatophyta (liverworts), Phylum Anthocerophyta (hornworts) and Phylum Bryophyta (mosses).

General characteristics of bryophytes

- They show alternation of generation in which the gametophyte generation is dominant.
- No vascular tissue i.e. no xylem or phloem
- Body is thallus or differentiated into simple “leaves” or “stems”
- Strengthening or conducting tissues absent or poorly developed.
- No true roots, stems, or leaves; the gametophyte is anchored by rhizoids.
- Sporophyte is attached to, and dependent upon, the gametophyte for its nutrition.
- Spores are produced by the sporophyte in a spore capsule at the end of a slender stalk above the gametophyte.
- Need water for reproduction
- Produce flagellated sperm
- Live mainly in moist shady places because they need water for reproduction and they lack vascular tissue for transporting water and mineral salts.
- Water and mineral salts can be absorbed by the whole surface of the gametophyte
- Lacks cuticle or have a very delicate one so no barrier against loss or entry of water
- The plants are low-growing (short)

Bryophyte gametophyte

- When bryophyte spores are dispersed to a favourable habitat, such as moist soil or tree bark, they germinate and grow into gametophyte.
- The gametophyte is larger and longer-living than the sporophyte.
- The gametophytes are anchored by delicate rhizoids, which are long, tubular single cells (in liverworts and hornworts) or filaments of cells (in mosses). Rhizoids are just for anchorage and not specialized for water and mineral absorption.

- A mature gametophyte forms gametangia that produce gametes and are covered by a protective tissue.
- The gametophyte may have multiple gametangia. Eggs are produced singly in the pear-shaped archegonium, whereas the antheridium produces many flagellated sperm.
- Some bryophyte gametophytes are bisexual, but in mosses the archegonia and antheridia are typically carried on separate female and male gametophytes.
- Flagellated sperm swim through a film of water toward eggs, entering the archegonia in response to chemical attractants. Eggs are not released but instead remain within the bases of the archegonia.
- After fertilization the embryo is retained within the archegonia and develops into the saprophyte which remains attached to the gametophyte.

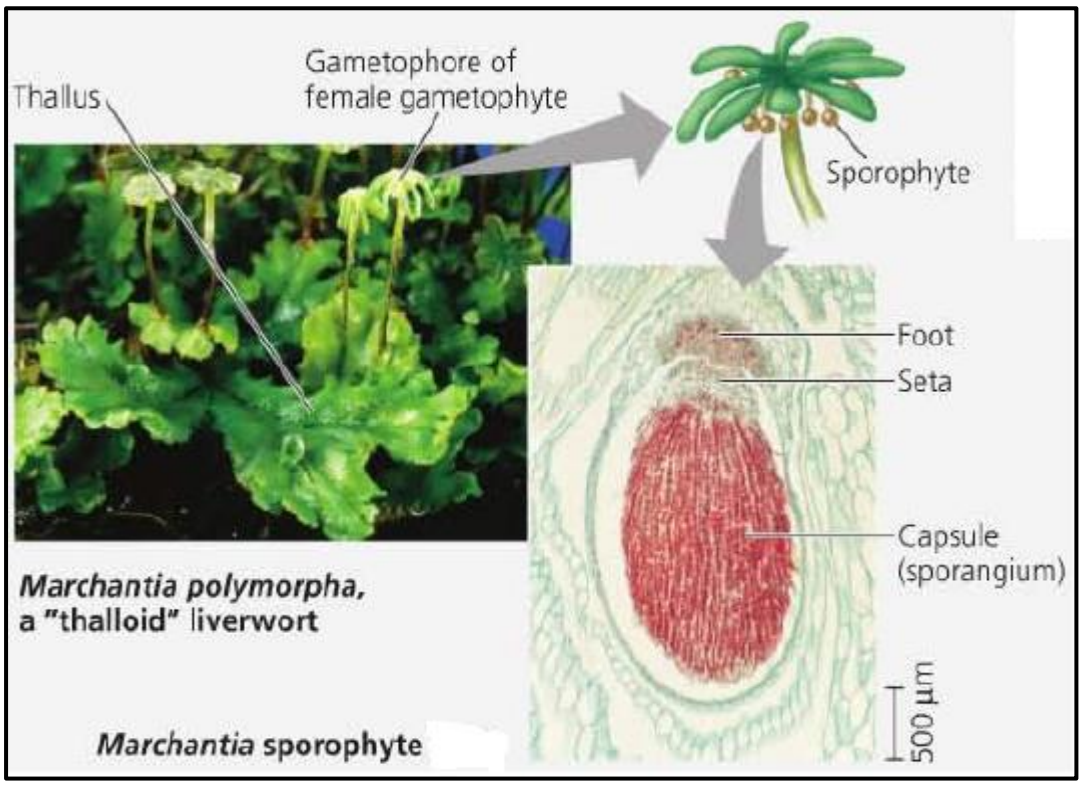
Bryophyte sporophyte

- Though usually green and photosynthetic when young, bryophyte sporophytes cannot live independently.
- They remain attached to their parental gametophytes, from which they absorb sugars, amino acids, minerals and water.
- Bryophytes have the smallest sporophytes among plants.
- A typical bryophyte sporophyte consists of a foot, a seta (stalk), and a sporangium (capsule).
- Embedded in the archegonia, the foot absorbs nutrients from the gametophyte. The seta (plural-setae) or stalk conducts these materials to the sporangium (capsule). In most mosses the seta becomes elongated, enhancing spore dispersal by elevating the capsule.

Phylum Hepatophyta (Liverworts)

- They are simpler in structure than other bryophytes.
- They are more confined to damp and shady habitats.
- They have a flattened and liver-shaped gametophyte. **"Leaves" are in 3 ranks (rows) along the "stem"**.
- Rhizoids are unicellular.

- Capsules of sporophyte split into four valves for spore dispersal and elaters aid dispersal.
- They can be thallus (rare), “leafy” with “stem” majority and intermediate lobed types.
- Examples of liverworts include 1) *Marchantia*, a thallus liverwort with antheridia and archegonia on stalked structures above the thallus; 2) *Pellia*; 3) *Lophocolea*, a leaf liverwort, common on rotting wood.

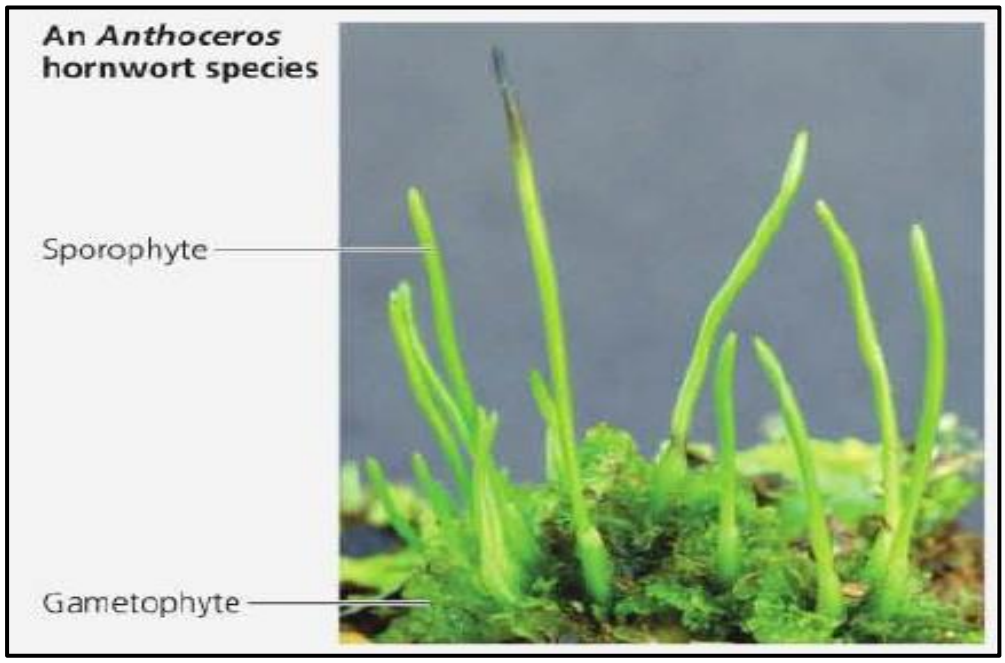


- Some liverworts e.g. *Marchantia* can undergo asexual reproduction by production of gemmae in gemmae cups.
- The gemmae are released by splashing rain drops or over-flowing water.
- Gemmae are small circular or spherical asexual reproductive structures which are borne inside gemmae cups. The gemmae cups form on top of the thallus.

Phylum Anthocerophyta (Hornworts)

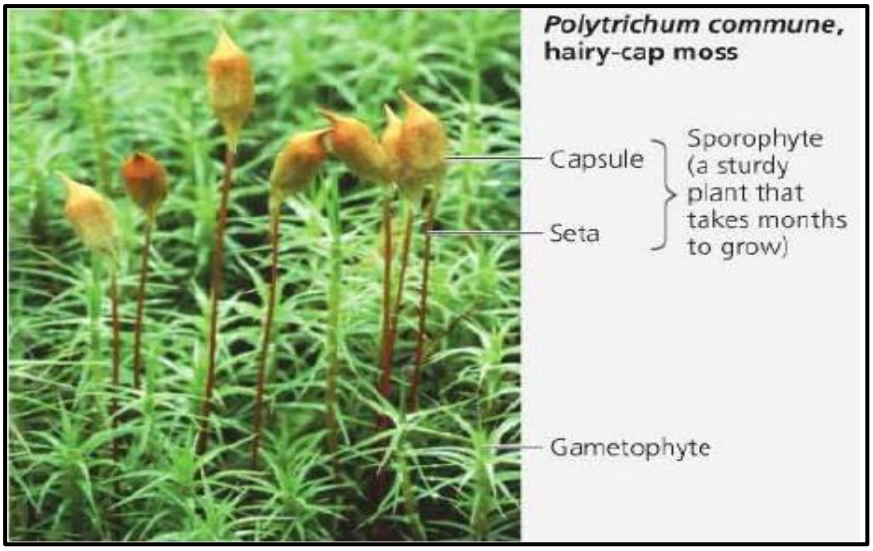
- They have a horn-like sporophyte coming out of the gametophyte.
- The sporophyte is long and tapered.
- Sporophyte can grow to about 5cm high.
- The sporophyte lacks a seta and consists only of a sporangium.

- The gametophyte, usually 1-2cm in diameter, grows mostly horizontally and often have multiple sporophytes attached.
- Examples of hornworts include *Anthoceros, Phaeoceros* and *Dendroceros.*



Phylum Bryophyta (Mosses)

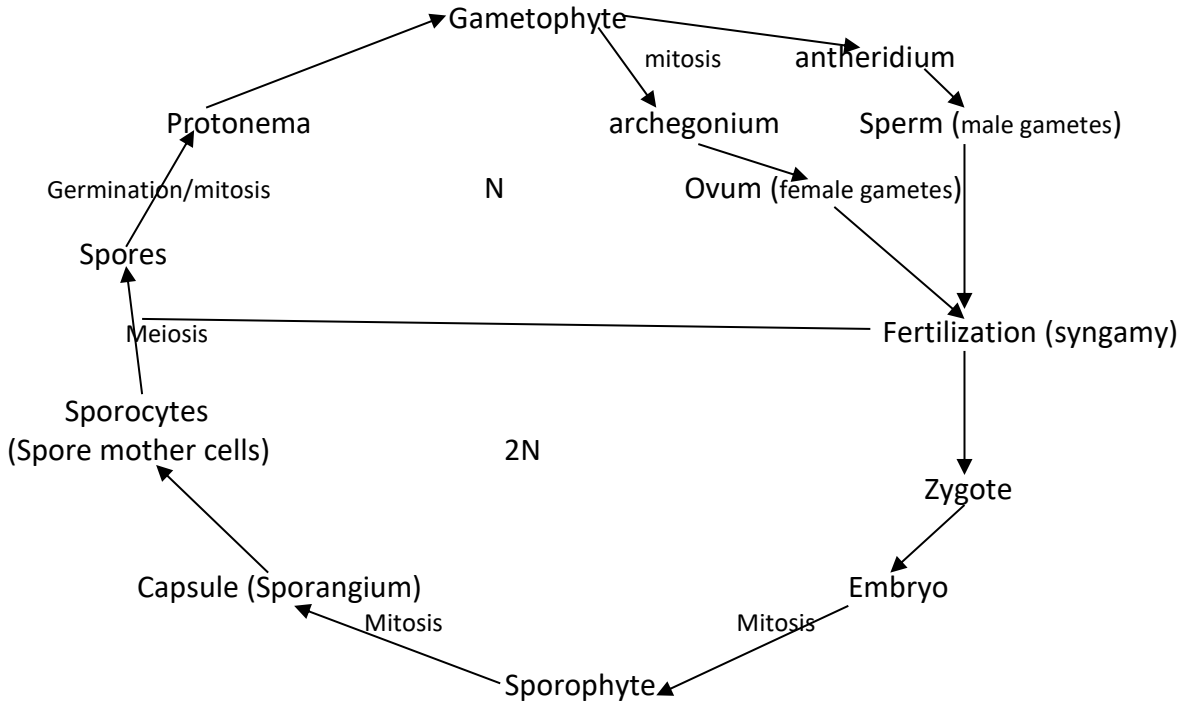
- They are more differentiated than liverworts.
- The gametophyte is "leafy" with "stem".
- Sporophytes elongated with height ranging up to 20cm.
- Gametophyte ranges from 1cm to 15cm in height.
- Rhizoids are multicellular.
- Though green and photosynthetic when young, the capsule turns tan or brownish when ready to release spores.
- Produce light weight spores that are dispersed by wind.
- Water is essential for fertilization. When the surface of the plant is wet, mature antheridia absorb water and burst, releasing the male gametes (sperm) each with two flagella onto the surface which then swim towards the archegonia.
- Examples of mosses include *Funaria*, *Mnium, Sphagnum* and *Polytrichum*.



Differences between liverworts and mosses

Liverworts	Mosses
Less differentiated	More differentiated
More confined to damp/moist and shady areas	Less confined to damp/moist and shady areas
Gametophyte flattened and liver-shaped	Gametophyte mainly "leafy" with "stem"
Gametophyte anchored by unicellular rhizoids	Gametophyte anchored by multicellular rhizoids
Sporophyte is shorter, up to 5cm high	Sporophyte grows taller, up to 20cm high

Life cycle of a moss



Sperm must swim through a film of moisture to reach the egg and fertilization occurs in the archegonium.

NB. Bryophyte reproduction depends on water for two main reasons:

1. Antheridia only burst to release sperm in the presence of water
2. Sperm need a film of moisture (water) in order to swim to the archegonia.

Adaptations of Bryophytes to life on land

- Presence of rhizoids on the gametophyte for anchorage/ support on solid substratum
- The gametes develop in protected structures (jacketed gametangia), the antheridia and archegonia
- The embryo develops while protected within the archegonium
- Spores are produced within protective sporangia
- Mode of spore dispersal depends on drying out of the capsule
- Dispersal of small light spores by wind
- Have an epidermis to reduce water loss
- The epidermis has pores for gaseous exchange
- Presence of a tough sporopollenin in the exine (outer walls) of spores.

Importance of bryophytes

- Used in medicine e.g. *Sphagnum* and *Marchantia*, *Sphagnum* has antibiotic properties
- Nutrient cycling and also help to retain nitrogen in the soil e.g. mosses
- Form peat (e.g. *Sphagnum*) which inhibit decay of mosses and other organisms due to low temperatures, pH and oxygen levels. The peat is (1) a source of fuel e.g. in Europe, Asia, Ireland and Canada (2) useful as a soil conditioner (3) a carbon sink.
- Help in retaining soil moisture e.g. *Sphagnum* has a high moisture holding capacity
- They also control soil erosion.
- Help in accumulation of humus
- They provide food and habitat for other organisms such as arthropods.
- Used as a filtering and absorption agent in the treatment of wastewater from factories and domestic areas.
- It is used in babies' nappies because of their absorptive properties.
- Indicators of surface water
- Indicators of air and water pollution.
- Help in soil formation
- They can be used as an absorbing agent for oil spills.