BRYOPHYTES: An Ecological Approach

Highlands Biological Station

May 28-June 2

Dr. Sue Studlar

PP#1.

I-COURSE OVERVIEW

II-INTRODUCTION TO BRYOPHYTES

What are Bryophytes?

Distinctive features of Mosses, Liverworts, & Hornworts?

Phylogeny: One Evolutionary Line or Three? Phyla?

Lab #1 Overview: Bryophyte Groups, Dichotomous Key

Photo Credits: Photos in PP Shows are by S. M. Studlar unless otherwise stated, most from WV.

COURSE OUTLINE I: BRYOPHYTES…MAY 28-JUNE 2, 2024

Subject to change as needed (weather, etc.). Meet at Coker Lab unless otherwise announced.

Tentative Daily Schedule, Tuesday-Thursday. See Friday-Sunday Tentative Schedule below.

9 AM-Noon Lecture-Discussion PP shows & Lab (or Field trip, depending on weather)

1 PM- 5 PM Field Trip (or Lab if it's raining). After Lunch. ***Bring hand lens, collecting bags, handouts, etc.***

6-9 PM Open Lab: Independent Work on Collections. Use Keys in available References. Packet specimens for Personal or HBS Reference Collections.

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T 5-28 AM Course Overview. Contrast in lab liverworts (leafy & thalloid), mosses (acrocarps & pleurocarps), & hornworts; make dichotomous key (class/individual exercise, as feasible).

PM FT #1 Lindenwood Loop Trail. Discuss bryophytes (species & growth-forms) as habitat indicators. Collect bryophytes from wetlands & woods, mineral & organic soil, rocks & walls.

W 5-29 AM Examine & discuss featured species from FT#1. Observe water uptake in 5 species (poikilohydry in action!) & see symbiotic association of *Frullania* & rotifers.

PM FT #2 Sunset Rock Trail. Discuss Geology of Highlands & Sunset Rock. Make very limited collections (or share) from special habitats such as Sphagnum seeps & peak rocks.

COURSE OUTLINE II BRYOPHYTES...MAY 28-JUNE 2, 2024

R 5-30 **AM** **Examine & discuss featured species from FT#2. Observe water uptake from selected taxa, via hydroids (endohydry) & capillary movement (ectohydry).**

PM. FT #3. Falls Trail. Discuss adaptations to aquatic life, collect from streams & nearby habitats, along Falls Trail & associated trails at the SE end of Lake Lindenwood.

F 5-31 **AM. FT #4. Dry Falls. Discuss geology & bryophyte niches of Dry Falls & cliff spray communities before visiting the Falls (noisy). Take photos or notes**

PM. Discuss Dry Falls Field Trip. Examine & Discuss collections from Falls Trail FT#3.

Sat. 6-1 **AM. FT #5. Coker Trail. Discuss & collect old growth epiphytes & bryophytes of seepy cliffs along this narrow path under hemlocks on the edge of a gorge.**

PM. Examine & discuss Coker Trail collections & epiphytic & saxicolous bryophytes.

Sun. 6-2 **AM. FT #6. Review Walk. HBS Campus & Practice Quiz.**

PM. Lab closed at 3:30 PM to set up Quiz for those earning Course Credit.

4:30-5:30 PM. Lab & Field Quiz for those taking course for credit.

6:00 PM – 9:00 PM. *Open Lab to Finish, Clean Up & Take your Personal Reference Collections. Leave in lab any Reference Collections for HBS.*

WHAT DEFINES A BRYOPHYTE?

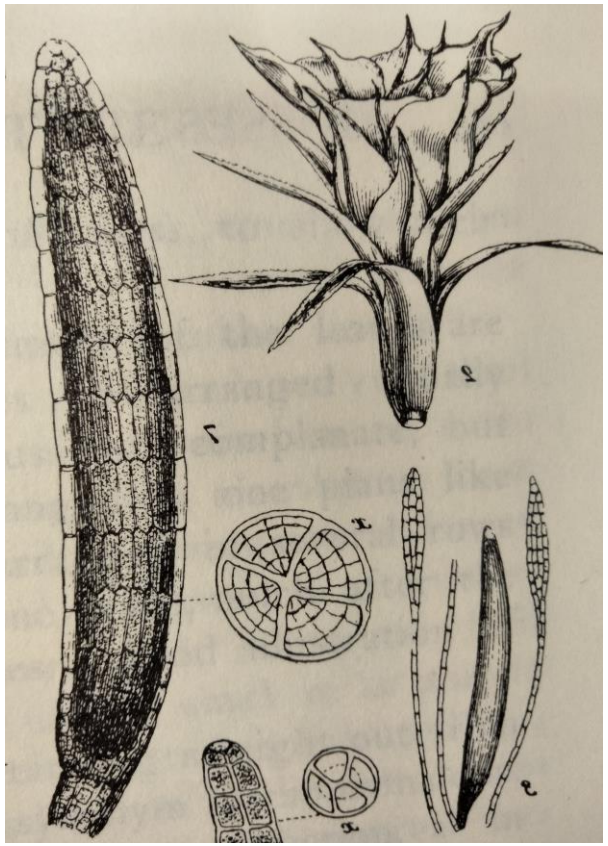
MOSS
***Sematophyllum demissum*,**

LEAFY LIVERWORT
Lophocolea heterophylla

HORNWORT
Phaeoceros carolinianus

- ***Small Size?*** **Above all under 2 cm high.**
- ***Non-Vascular? Do Bryophytes lack Conducting Tissue?***
- ***Non-Woody, lacking Lignin?***
- ***Unique Life Cycle?***

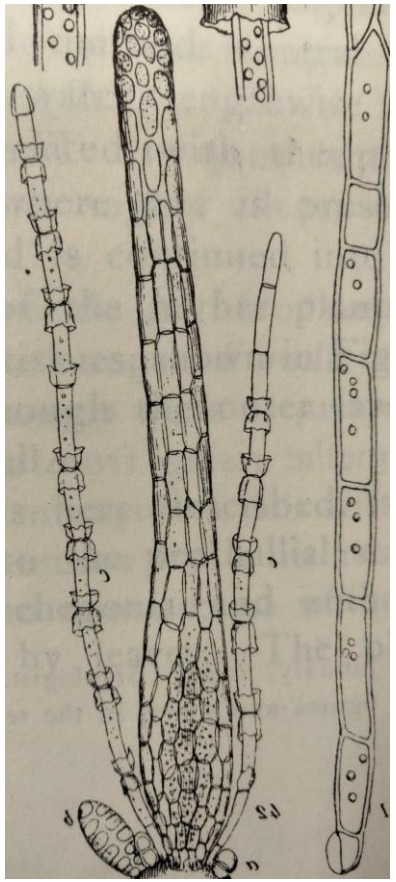
UNIQUE LIFE CYCLE OF BRYOPHYTES



Moss Antheridium
Male Cup, Sterile
Paraphyses (mucilage)
Grout 1965 , Polytrichum

❖GAMETE-BEARING PLANT (GAMETOPHYTE): green, conspicuous, perennial phase of life cycle with stems, leaves, & rhizoids.

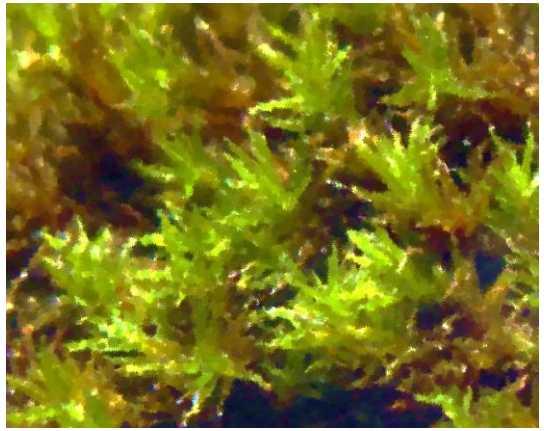
- Male plant – Antheridium produces sperm
- Female plant – Archegonium produces one egg
- Hermaphroditic plant- egg & sperm
- Dioicous: male or female Vs Monoicous: hermaphroditic



Moss Archegonium & Paraphyses

GAMETOPHYTE: POIKILOHYDRIC "RESURRECTION PLANT"

- **Tolerates drying out (very thin waxy cuticles). Yet membranes & cell structures remain relatively intact though with some damage.**
- **Revives quickly with hydration, repairing membrance damage and reabsorbing lost nutrients.**
- **Species of xeric (dry) habitats are often exceptionally tolerant, (e.g., Grimmiaceae or Black Ross Mosses)**



Schistidium apocarpum

Grimmia laevigata

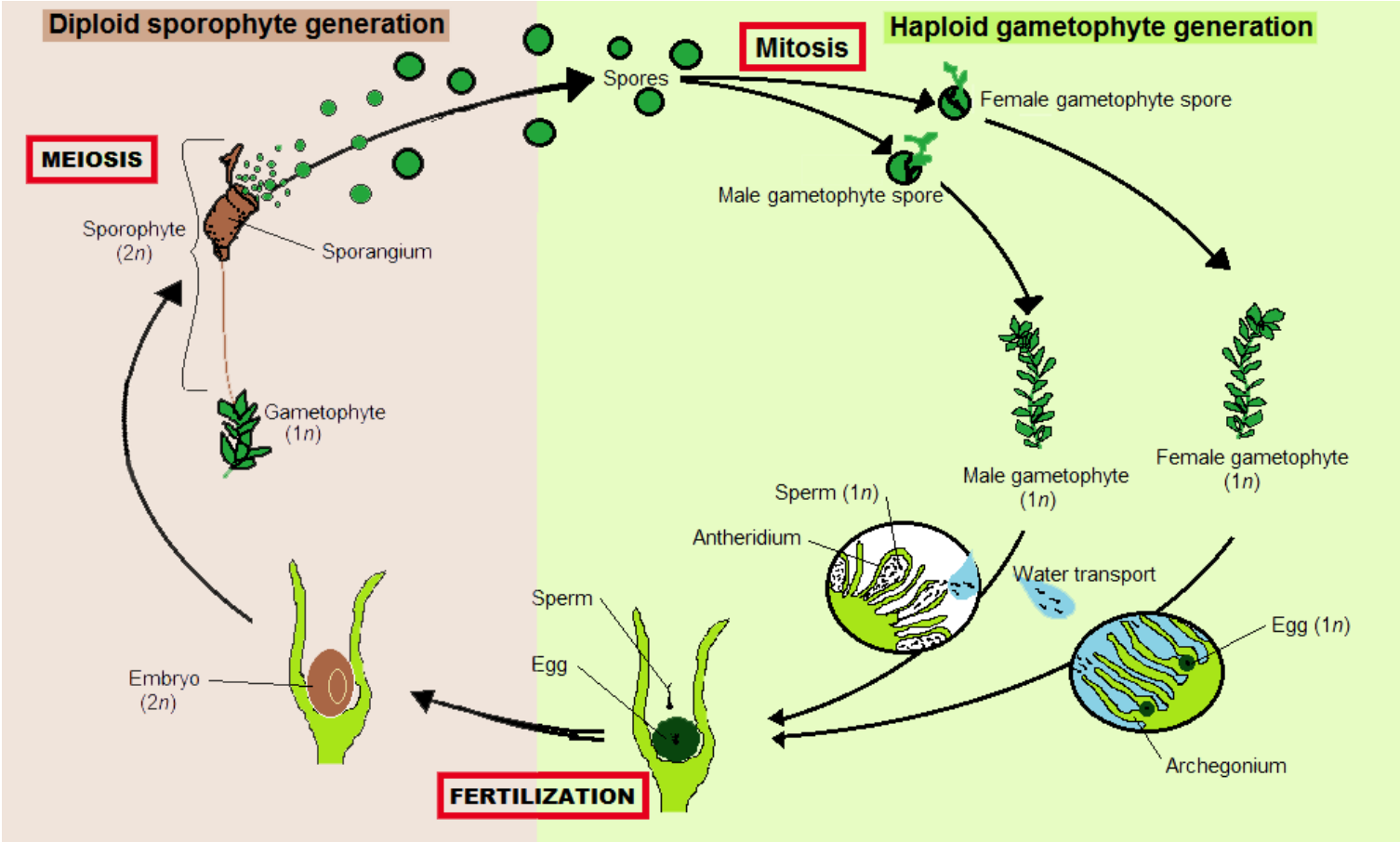
SPORE- BEARING PLANT (SPOROPHYTE)

MOSS
Fissidens bryoides

- **Develops from fertilized egg (Zygote) in Archegonium.**
- **Dependent on Female Gametophyte for food & water taken up through its foot *(Matrotrophy)***
- **Never has stem bearing leaves, & rhizoids**
- **Single stalk (*Seta*) bears a single Sporangium inside a single Capsule (Monosporangiate)**
- **Relatively short-lived (1-2 years)**
- **Typically produces thousands of spores by meiosis that may (if lucky) become gametophytes.**

MOSS LIFE CYCLE

Are gametophytes always haploid & sporophytes diploid?



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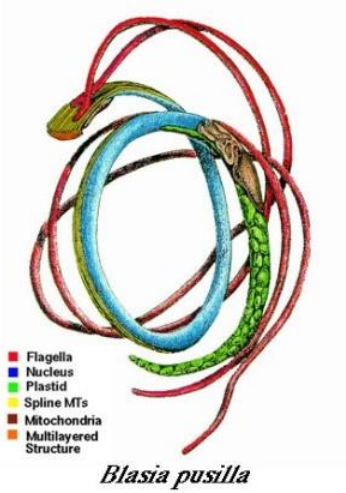
BRYOPHYTES ARE THE AMPHIBIANS OF THE PLANT WORLD!



http://www1.biologie.uni-hamburg

Biflagellate Moss Sperm (left)

Male Splash Cup in *Aulacomnium palustre*. Catches rain & splashes out sperm hopefully to a nearby female.

- **Both need external water source for fertilization.**
- **Both (many species) prefer moist shady habitats.**

BRYOPHYTES ARE THE AMPHIBIANS OF THE PLANT WORLD II

- **Both display moist outer tissues in direct contact with the environment making them excellent ecological indicators – and vulnerable to pollution.**

- **Bryophyte leaves are typically only one-cell thick, except for midrib (costa). Most leafy plants (gametophytes) are haploid (though some species are polyploid), simplifying interpretation of responses to environment.**

Pseudotaxiphyllum distichaceum **. Sprouting Silk Moss.** Often on steep moist banks.

How Does Bryophyte Life Cycle Differ from Tracheophyte (All Other Land Plants) Life Cycle?

e.g., Lycopodium, **a Clubmoss or Lycophyte, an Ancient Line of Tracheophytes**

- ***Dominant Phase of Life Cycle =?***
- ***Where is the Gametophyte?***
- ***How does Sporophyte differ from that of Bryophytes?***
  - ***Branched?***
  - ***Bears leaves?***
  - ***Bears multiple Sporangia?***

What Unites Bryophytes & Distinguishes them from Tracheophytes ("Vascular Plants")?

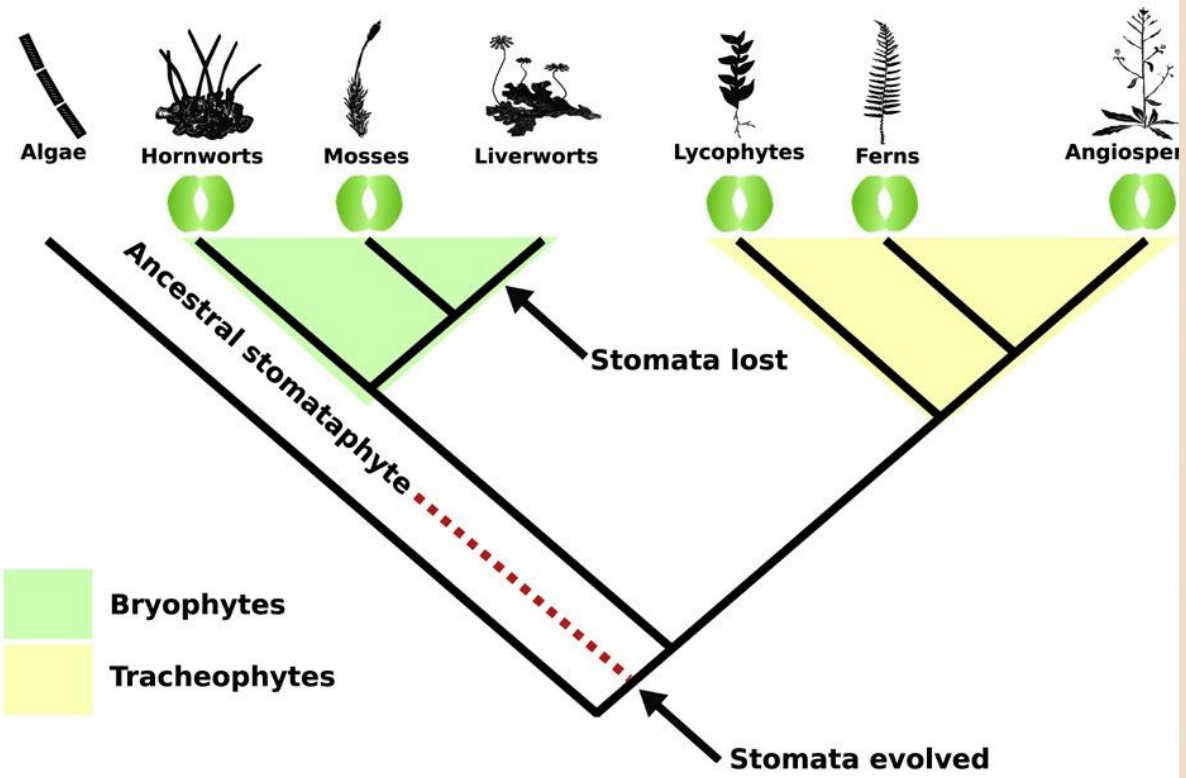
- **MONOSPORANGIATE: Sporophyte (spore producing plant) is comprised only of a single stalked (usually) spore capsule, developed from a fertilized egg or zygote.** ***Mosses, Liverworts, Hornworts.***

- ***Versus* POLYSPORANGIATE: Sporophyte developed from a zygote has a branching stem with leaves and roots and with many Sporangia.** ***Ferns, Lycophytes, Horsetails, Seed Plants.***

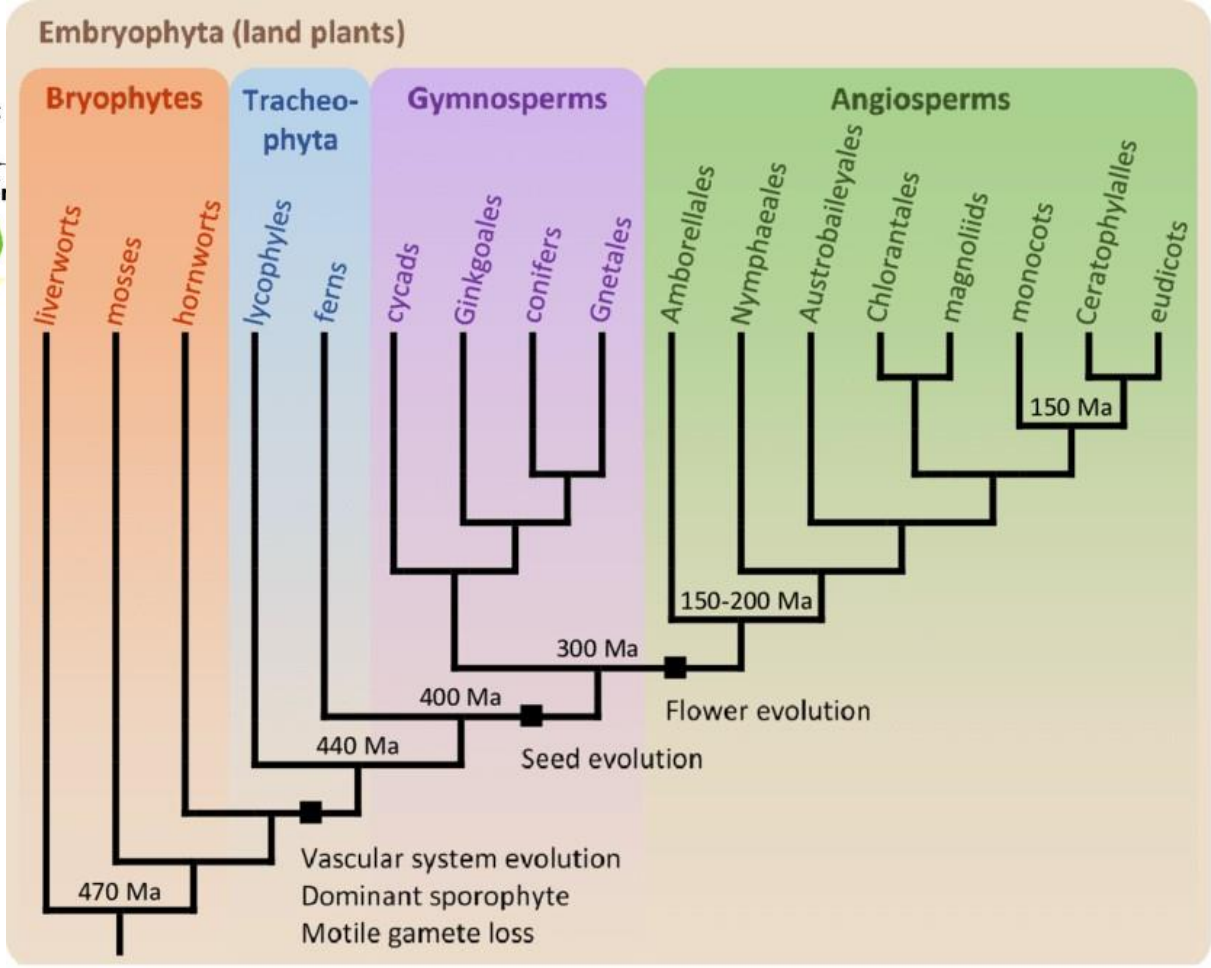
- **DOMINANT (CONSPICUOUS) GAMETOPHYTE (gamete plant) with gametangia, rhizoids, & either stems & leaves or thalloid.**

- ***Versus* DOMINANT (CONSPICUOUS) SPOROPHYTE with Gametophytes hidden in moist niches (Ferns) or inside cones or flowers (Seed Plants).**

Bryophytes: One Phylum with 3 Classes or 3 Phyla?



Rich et al. 2020



ResearchGate.
Accessed 4-9-24

THREE PHYLA? (Generally preferred for the past several decades)

BRYOPHYTA- MOSSES
MARCHANTIOPHYTA- LIVERWORTS
ANTHOCEROTOPHYTA- HORNWORTS

OR

ONE PHYLUM? (Older Scheme)

BRYOPHYTA - BRYOPHYTES

CLASS MUSCI – MOSSES
CLASS HEPATICAE- LIVERWORTS
CLASS HORNWORTS- ANTHOCEROTAE

TODAY: Molecular work suggests the bryophytes DO represent one phylogenetic group but 3-phyla terminology is retained for now, e.g. see (PDF) BRYOPHYTE Phylogeny Poster (BPP, 2023)

LAB #1 INTRODUCTION TO BRYOPHYTES

❖ MAJOR GROUPS OF BRYOPHYTES & REPRESENTATIVE GENERA & SPECIES

- Leafy Liverworts
- Simple Thalloid Liverworts
- Complex Thalloid Liverworts
- Hornworts
- Acrocarpous Mosses
- Pleurocarpous Mosses

❖ WRITING A DICHOTOMOUS KEYTO SELECT TAXA (Class Exercise)

- Create a Branching Diagram (Decision Tree) that repeatedly divides the species into two groups until there is just one species per branch

- Convert the Diagram to a Dichotomous Key in standard format with couplets.