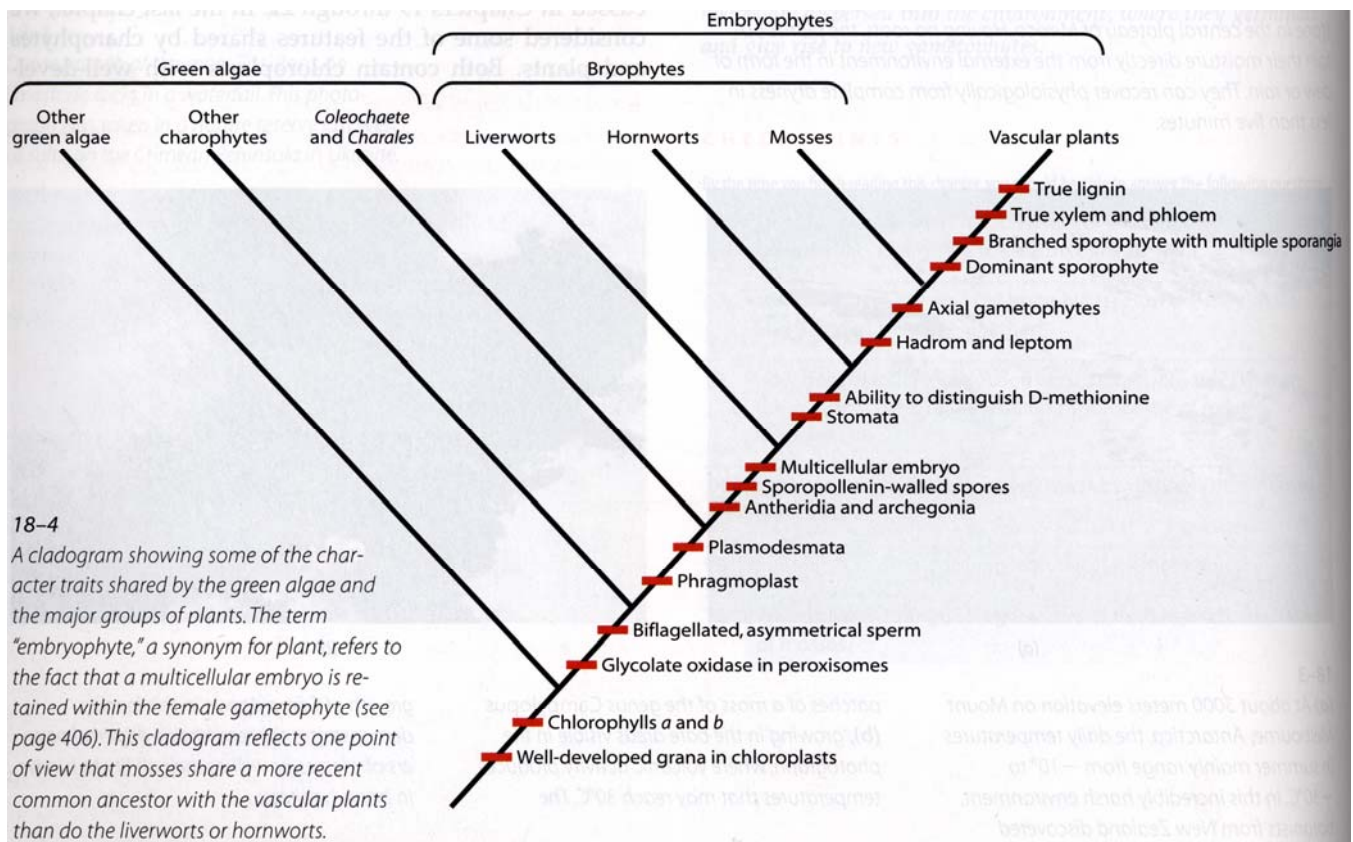


Topic 03: **Early Land Plants: Bryophytes, Ferns & Fern Allies**

**A. Objectives for today's lab**

1. Get to know 2 of the three groups of bryophytes (liverworts & mosses).
2. Get to know some of the Ferns and Fern Allies, which include some of the earliest lineages of vascular plants (represented today by *Psilotum*, *Lycopodium*, *Equisetum*, & various ferns)
3. Think about the morphological/anatomical innovations that are represented by each. Place these in the context of the origins of leaves, roots, and the fossil record and green plant phylogeny.
4. Know the general sequence of appearance in evolutionary history:  
 Green Algae ==> Bryophyte Lineages ==> Lycopod & Horsetail Lineages ==> Fern Lineages ==> Seed Plants (Gymnosperms & Angiosperms)

**B. Green Plant Phylogeny**



### **C. NonVascular Free-Sporing Land Plants (Bryophytes)**

- No vascular (xylem/phloem) tissues for conduction or support.
- Simple, dichotomous branching.
- True leaves not formed.
- Gametophyte the dominant phase.
- Water required for fertilization of egg by free-swimming sperm.
- Free-sporing.

#### **C1. Liverworts**

- a. **\*\*LIVING MATERIAL\*\***: *Marchantia* &/or *Conacephalum* (thallose liverworts).

The conspicuous green plants are the *gametophytes*.

With a dissecting scope, observe the polygonal outlines of the air chambers. On parts of the thallus that are drier, it is easy to see the pore opening to the chamber. These are not stomata. They cannot open and close and so the thallus can easily dry out if taken from water.

Look for gemmae cups on some of that thalli. Depending upon the condition of your material, these may or may not be present.

*What are gemmae cups for?*

*Draw them.*

- b. **\*\*SLIDES\*\***.

Using the compound microscope, make observations of the vegetative and reproductive parts of various liverwort species. Note the structure of the air-chambers and the photosynthetic cells inside on the *Marchantia* sections!

## C2. Mosses

a. **\*\*LIVING MATERIAL\*\***: Various mosses, gametophytes and sporophytes.

1) The conspicuous green and leafy plants are the *gametophytes*.

a) This is the multicellular haploid phase of the life cycle.

b) The leaves on this gametophyte are really not true leaves, in that they are not vascularized and are not organized into tissues.

*Make a wet mount of the lamina of the moss "leaf". Lay it flat in a drop or two of water. Except at the midrib, how many cells thick is the "leaf"? Make a drawing.*

2) Moss *sporophytes*.

a. **\*\*LIVING MATERIAL\*\***:

On some of the female gametophytes (those which carried the egg and the archegonium) there are long stalks (either light green or brown) terminating in a capsule. These are the *sporophytes*. The capsule is the sporangium, where meiosis takes place to produce haploid spores. The young capsules wear a *calyptra* (capsule cover) as if it were a mop-head of hair. This calyptra will come off when the capsule is ready to release its spores.

*What is the calyptra?*

- b. **\*\*LIVING MATERIAL\*\***: Moss protonemas! (Ask you instructor if these are available today).

The mosses have a intermediary phase between spores and the leafy gametophytes. This is called a protonema and it is filamentous and photosynthetic, much like an alga! You can think of it as a juvenile gametophyte. Eventually, buds will form to produce the mature leafy version of the gametophyte. Make observations!

- c. **\*\*SLIDES\*\***.

Using the compound microscope, make observations of the vegetative and reproductive parts of various moss species. Note also the protonema phase (a filamentous multicellular phase in mosses that develops directly from the spore).

#### **D. Vascular Free-Sporing Land Plants (Ferns & Fern Allies)**

- Vascular tissues (xylem/phloem) for conduction and support.
- More complex branching in some.
- True leaves are formed in most groups.
- Sporophyte the dominant phase.
- Water required for fertilization of egg by free-swimming sperm.
- Free-sporing.

#### **D1. Psilotophyta (whisk-fern)**

- No roots.
- No leaves (only *enations*).
- Dichotomous branching.
- Protostele (an anatomical feature: a solid core of vasculature in the stem; specifically made up of xylem surrounded by phloem).
- Homospory.

##### a. **\*\*LIVING MATERIAL\*\***: *Psilotum*.

###### 1) Vegetative Characteristics:

This funny looking plant resembles the earliest vascular plants we see in the fossil record.

###### 2) Sporangia:

The sporangia on this species is three-lobed (tripartite) and yellow at maturity. The sporangia are subtended by enations.

##### b. **\*\*SLIDES\*\***: if available.

If available, make observations of sections of the stem (note the protostele) and sporangia.

## D2. Lycopodiophyta (Club-mosses & Spike-mosses)

- Roots invented!
  - Microphylls (simple leaves, with one vascular bundle).
  - Dichotomous branching.
  - Semi-lunar sporangia, often aggregated into *strobili*.
  - *Homospory* vs. *heterospory*
- a. **\*\*HERBARIUM MATERIAL\*\***: Various *Lycopodium* (club-moss) species.  
The genus *Lycopodium* has sporangia aggregated into strobili. Strobili are composed of sporangia in axils of (or sometimes borne on) *sporophylls*. Homosporous.
- b. **\*\*LIVING MATERIAL??\*\***: *Selaginella lepidophylla* (resurrection-fern).  
Note the dry (dormant) plant and the plant, which has been soaked in water, coming back to life!!
- c. **\*\*SLIDES\*\***: if available.  
If available, make observations of sections of sporangia. If *Selaginella* slides are available, make observations of microsporangia (male) and megasporangia (female). Unlike *Lycopodium*, *Selaginella* is heterosporous.

### D3. Arthrophyta (horsetails & scouring rushes)

- Roots.
- Whorled microphylls.
- Whorled axillary branching.
- Strobili with *sporangiophores*.
- Homospory.
- Spores with *elaters*, which aid in dispersal.

a. **\*\*LIVING MATERIAL\*\***: *Equisetum* (horsetail, scouring-rush).

Note the strobili. Make observations of “sporangiophores” with the sporangia attached to the underside.

- Try to obtain some spores from the sporangia and place them under the light on the stage of the dissecting scope. See if you can find the elaters.

Also note the form of the leaves, branching, if any, and stems.

Also, make a cross-section of the stems. Are they hollow or solid?

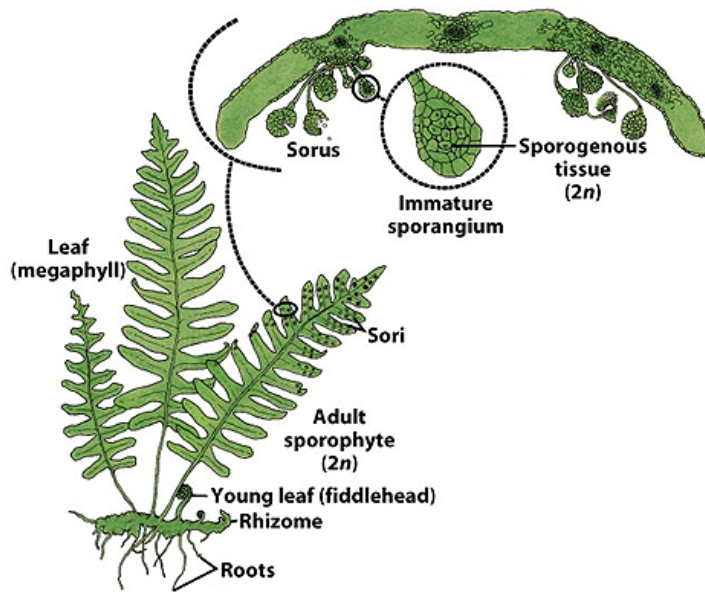
b. **\*\*HERBARIUM MATERIAL\*\***: Various *Equisetum* species.

c. **\*\*SLIDES\*\***:

Make observations of sections of the strobilus and sporangia.

## D4. Pteridophyta (ferns)

a. Sporophyte – the spore-producing plant.



e.g., *Polypodium*

Know your sporophyte parts, as exemplified in the living specimens of:

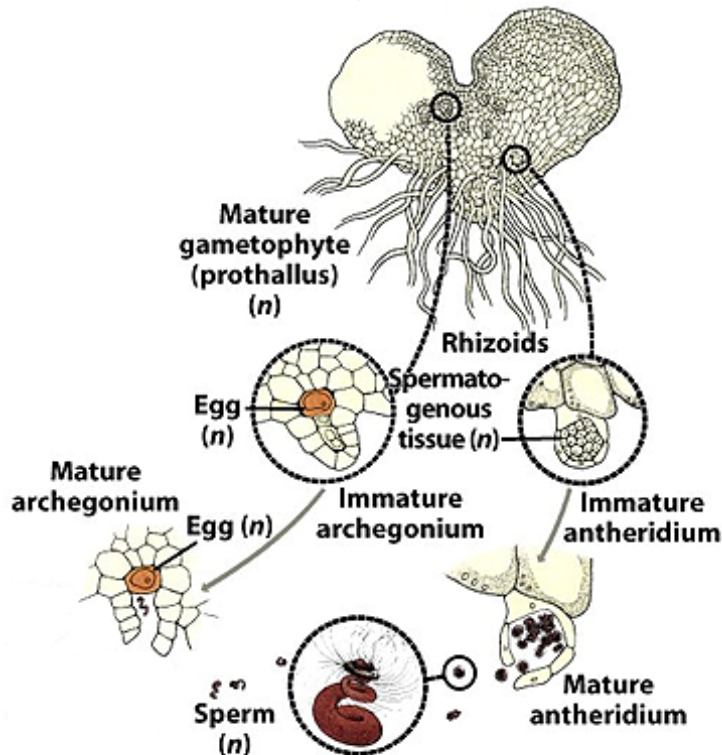
- 1.) Boston fern (*Nephrolepis* sp.)
- 2.) Staghorn fern

\*Note the different arrangements of sporangia (clusters of sporangia on fern leaves are called sori; singular sorus).

\*Some sori are covered by indusia (singular “indusium”).

\* Note the sporangium.

b. Gametophyte – the gamete-producing plant.



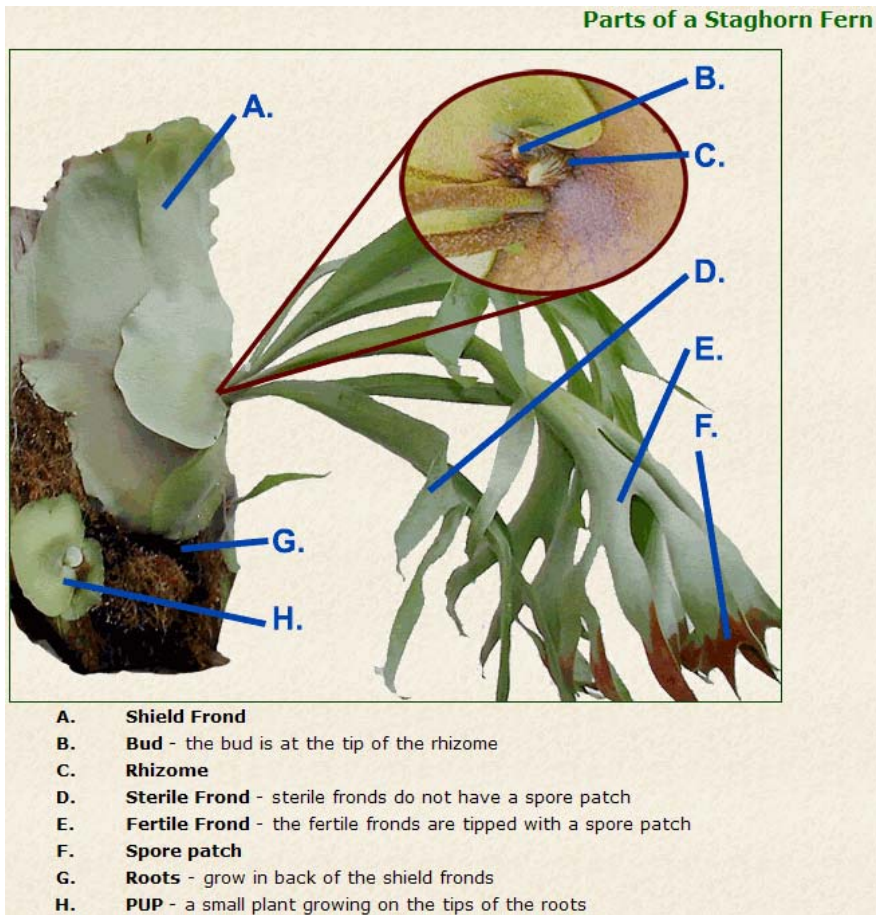
Know your gametophyte parts, as exemplified in the drawing.

\*Note the multicellularity.

\*Note the gametangia:  
 archegonium (egg producing)  
 antheridium (sperm-producing)



c. Staghorn fern observations (living material).



d. IF AVAILABLE TODAY: Leptosporangium dehiscence observations.

-Take a half of a holly-fern leaflet and observe under dissecting scope as it lays upon a piece of white paper. The heat of the scope lamp should cause the sporangia to open and release the spores inside. With patience you can see this. Otherwise, return for a check-up every 4-5 minutes or so and note the accumulation of spores on the white paper surrounding the sample.

e. Life-cycle.

-Connect the sporophyte and gametophyte generations of the fern life cycle.  
 -Use the plastic-embedded preps prepared by Carolina Biological Supply.

-Note the similarity to the life cycles of *Psilotum*, *Lycopodium*, and *Selaginella* in that the sporophyte is dominant.

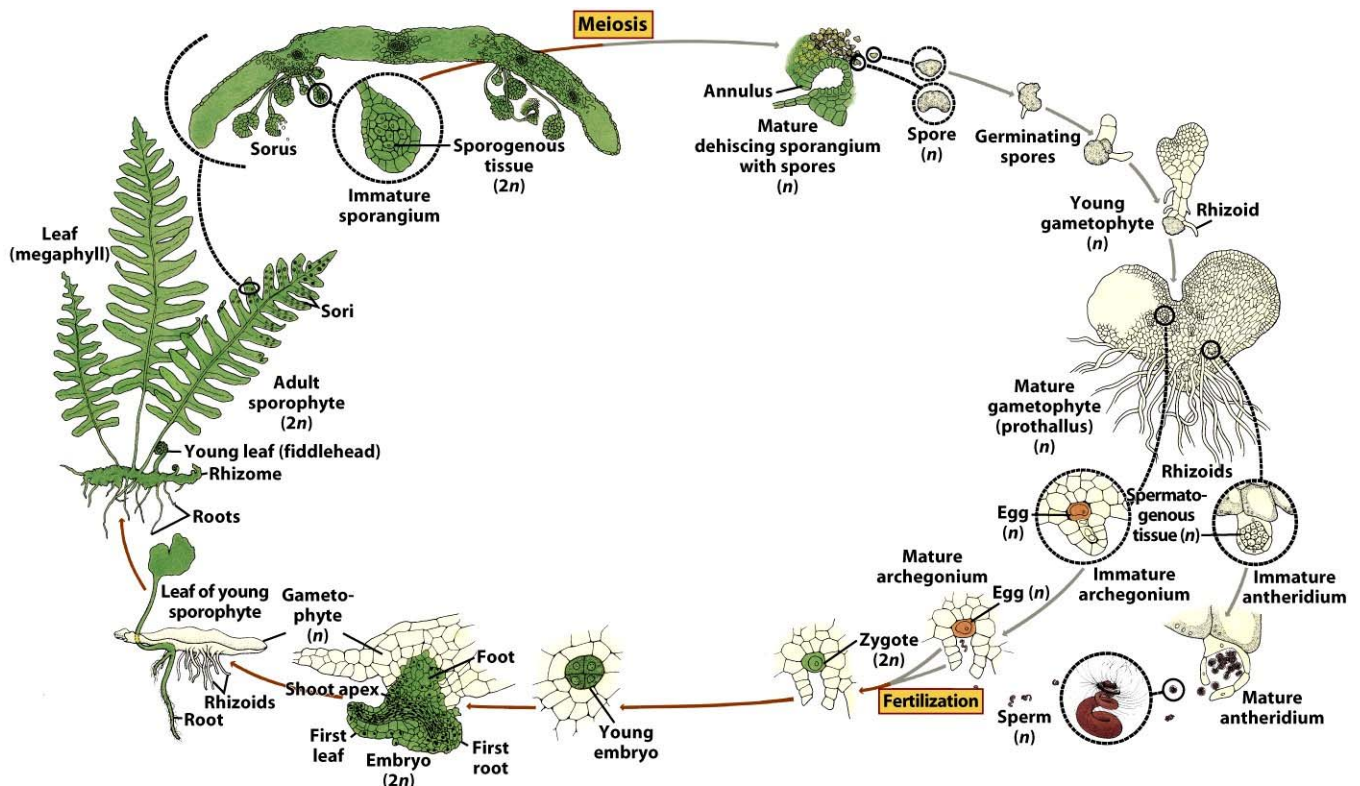


Figure 17-30  
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f. \*\*SLIDES\*\*: Make observations of the prepared slides.

