Topic 22. Introduction to Vascular Plants: The Lycophytes

Introduction to Vascular Plants

Other than liverworts, hornworts, and mosses, all plants have vascular tissues. As discussed earlier, the mosses have cells that serve to conduct water and photosynthate, and these cells may be homologous to vascular tissues. True vascular tissues, however, include **xylem** with tracheary elements, and **phloem** with sieve elements. The tracheary elements of xylem, like the hydroids in the mosses. are dead at maturity and serve as pipes through which water moves by mass flow. Unlike the hydroids, the tracheary elements have secondary walls impregnated with **lignin**. This substance make tracheary elements (and other cells with secondary walls) strong, rigid and self-supporting. The presence of lignin allows vascular plants to grow tall and erect.

In all vascular plants the sporophytic generation is the dominant form. Only sporophytic plants have vascular tissue. As we go from the non-vascular plants to the seedless vascular plants to the seed plants, we observe an evolutionary tendency where the gametophyte becomes progressively reduced relative to the sporophyte. In the angiosperms, this reduction is so complete that, without a microscope, we would not easily recognize these plants as having an alternation of generations at all. In the following exercises we want to consider this trend.

Kingdom Plantae/ Lycophytes

Vegetative Structures: As in all vascular plants, the sporophytic generation is most prominent, and represents what we would consider to be the plant. While Lycophytes have leaves, these are not homologous to the leaves of all the other plants which were derived from a separate evolutionary event. Lycopod leaves are termed **microphylls**, the leaves of all other plants are termed **megaphylls**. Microphylls have only one vein, and are not associated with a leaf gap or with axillary buds. In lycophytes, nodes are not associated with buds, hence, the branching of the shoot cannot occur from the growth of axillary buds. Branching arises from the dichotomous division of the apical meristem resulting in either equal or unequal forked branches.

Reproductive Structures: **Spores** are formed in sporangia which are borne on leaves that are termed **sporophylls**. If a cluster of sporophylls terminate a shoot this constitutes a **strobilu**s.

Club Mosses. In club mosses, only one type of spore is produced resulting in the production of bisexual gametophytes. This condition is termed **homospory** and the club mosses are **homosporous**.

Selaginella. In the case of the spike mosses (genus *Selaginella*), two types of spores are formed. One type is larger and results in the formation of only female gametophytes. These larger spores are termed **megaspores**, and the female gametophytes resulting from their germination are termed **megagametophytes**. Megaspores are borne in **megasporangia**, which are borne on **megasporophylls**. Another type of spore is smaller and results in the formation of only male gametophytes. These smaller spores are termed **microspores**, and the male gametophytes resulting from their germination are termed **microgametophytes**. Microspores are borne in **microsporangia**, which are borne on **microsporophylls**. In the case of *Selaginella*, megasporophylls and microsporophylls are borne in the same strobilus.

Names: Recognize **club mosses** (the homosporous lycophtytes). Know the genus name of the spike mosses, ***Selaginella***, and that it is heterosporous.

I. The Club Mosses - the Homosporous Lycophytes

Vegetative Morphology: Observe the living examples of the club mosses on the side bench. Carefully verify that the pattern of branching in all three cases involves the dichotomous division of the apical meristem. Note the sporangia and the sporophylls on the non-strobilus forming, *Huperzia lucidulum*. The sporophylls of

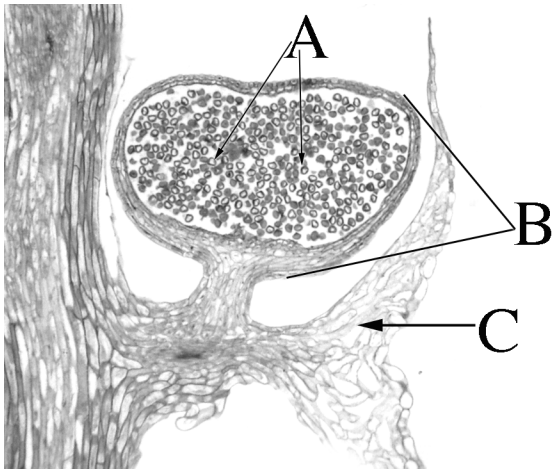
this plant alternate with leaves that are associated with asexual reproductive structures called bulbils. Note if you see strobili on either of the two other plants. Also observe the pressed specimens, especially note the rhizomes with roots attached. View the illustrations on the next page can compare them with the living plants on the side bench.

Prepared Slide of Strobilus of *Lycopodium*: Take this slide and hold it to the light. It was made from a longitudinal slice through a strobilus (compare with strobili on the living and/or pressed plants). Place the slide under the microscope and look for the following: the central stem serving as the axis for the structure; the **sporophylls** bearing the **sporangia**, the sporangia and the **spores** all of which are the same size. Label the diagram below:

A = _____

B = _____

C = _____



Dissected Strobilus of Lycopodium.

Observe the dissected strobilus on the side bench. Note that all the sporophylls bear sporangia which are all alike. Also observe the dish of *Lycopodium* spores. In the past, these were harvested commercially for use as flash powder.

Gametophyte: See the demonstration on the side bench of the club moss gametophyte (*Lycopodium*) with attached young sporophyte. This particular gametophyte is non-photosynthetic being dependent on fungi in the soil for nutrition.

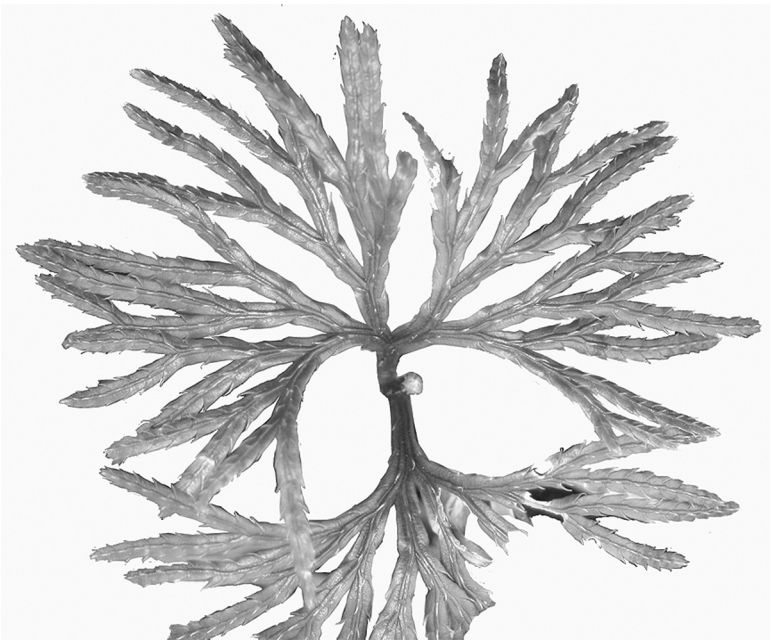
Since *Lycopodium* is homosporous which sexual structures were borne on this gametophyte?

_____

Some Club Mosses Native to Wisconsin

Huperzia lucidulum: Shining Club Moss
This club moss' sporophylls are not clustered into terminal strobil

Lycopodium obscurum:
Running Ground Pine



Diphasiastrum complanatum

Rhizome of
Diphasiastrum complanatum

II. *Selaginella*.

Observe the living examples of *Selaginella* on the side bench. Take a strobilus from the side bench and take it to your seat. Now take the prepared slide of the longitudinal section of a *Selaginella* strobilus and compare that section with the whole strobilus. Place the slide under the microscope and look for the following: the central stem serving as the axis of the structure; **microsporophylls** bearing the **microsporangia** with **microspores**; **megasporophylls** bearing **megasporangia** with **megaspores**. Label the diagram below:

A = _____

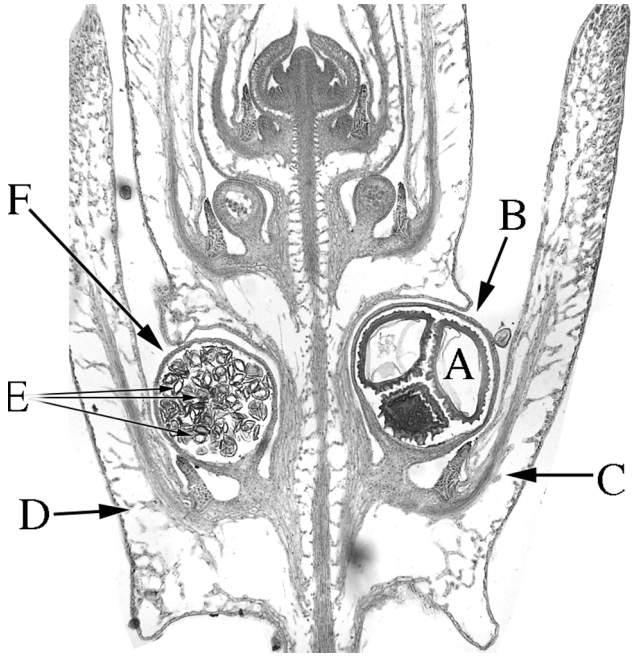
B = _____

C = _____

D = _____

E = _____

F = _____



Dissection of a Strobilus.

Take a fresh strobilus of *Selaginella* to your seat. Compare the whole structure to the longitudinal section of a *Selaginella* strobilus on your prepared slide. Note that it is simply a terminal shoot. The central stem bears leaves each with a sporangium. While observing through a dissecting microscope, pull leaves off the stem using teasing needles. Identify megasporophylls bearing megasporangia and microsporophylls bearing microsporangia. Crush each type of sporangium and compare the relative size of each spore.

Draw a microsporophyll - label the microsporangium.

Draw a megasporophyll - label the megasporangium.

Draw a megaspore and microspore in the same view illustrating the relative size of each.

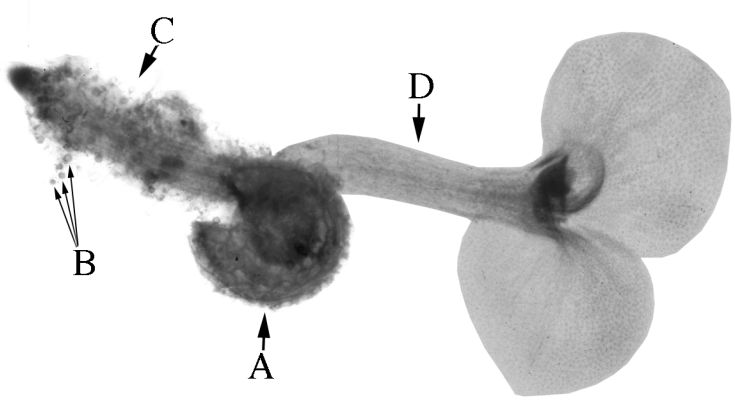
Gametophyte: Observe the demonstration of the megagametophyte with attached young sporophyte on the side bench. Note that it develops entirely within the old megaspore wall.

A = Megagametophyte inside old megaspore wall.

B = Microspores

C = Root of young sporophyte

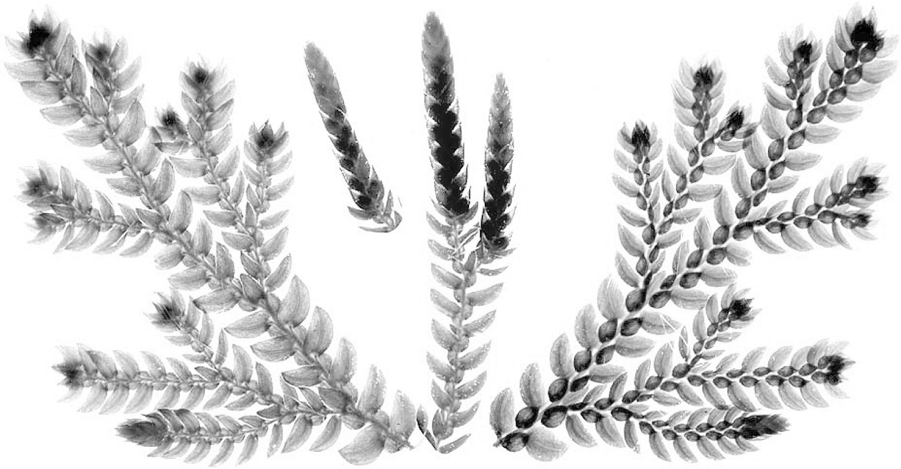
D = Shoot of young sporophyte

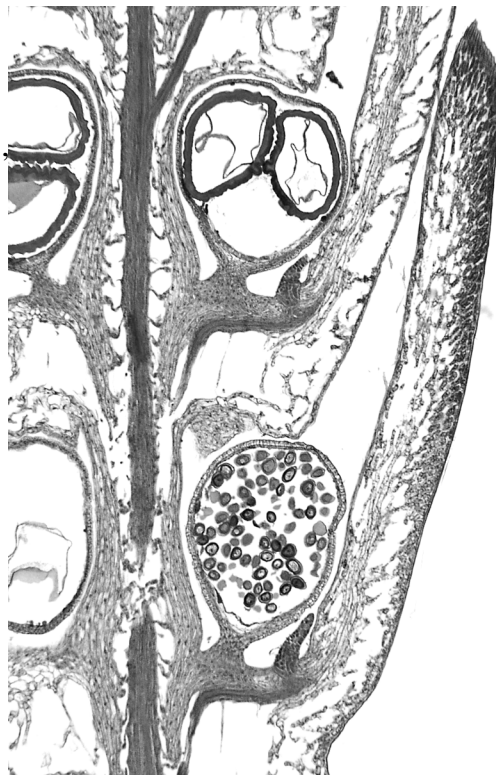


Observe the illustrations of *Selaginella* on the next page. Associate all the terms listed to the living materials and/or prepared slide during lab.

Selaginella

You should recognize dichotomous branching, microphylls, strobili, megasporangia, megasporophylls, microsporangia, microsporophylls, microspores and megaspores.





III. Extinct tree-sized lycophytes from the Carboniferous, *Lepidodendron*.

Observe the demonstrations of *Lepidodendron*. Recognize the reconstruction of the plant and the fossils of the plant as an example of an extinct member of the Lycophytes, and that these trees were a significant part of the vegetation that gave rise to much of the coal in North America.

Why was *Stigmaria* considered a genus different from *Lepidodendron*?

Discussion Topics

Heterospory evolved independently at least four times. What is an adaptive advantage of heterospory?

From an evolutionary perspective, why don't we find vascular tissues in the gametophytes of the vascular plants?

Club mosses are unimportant ecologically and economically. W should they be protected?