

SA #24	SEEDLESS VASCULAR PLANTS
BIO 2500	Stern, Chapter 21

OVERVIEW: By now, you have probably encountered the “Seedless Vascular Plants” first hand in the laboratory. Scan the Chapter 21 "Outline" and Overview, and notice that there are four phyla of seedless vascular plants, namely the following (with web links here for study):

[PSILOTOPHYTA](#) – Whisk Ferns

[LYCOPHYTA](#) – Clubmosses, Spike Mosses, Quillworts

[EQUISETOPHYTA](#) – Horsetails

[POLYPODIOPHYTA](#) – Ferns

READING: Read Chapter 21, pages 385-408, a particularly well illustrated chapter; see also Internet Links above and from the course home page where you obtain Study Guides; just scroll down to “Seedless Vascular Plants.”

EMPHASIS: We will emphasize the Polypodiophyta or ferns, and aim for the following learning goals:

1. Visually distinguish representatives of the four phyla of seedless vascular plants.
2. Explain the morphology and reproductive cycle of the Polypodiophyta, the ferns.
3. Discuss the significance of heterospory as it represents an increasing role of the sporophyte generation in nutrition and support of the gametophyte generation.

The *Study Outline* will also aid you in identifying the emphasis of the chapter.

LECTURE DISCUSSION QUESTIONS:

1. Attempt to contrast the “Seedless Vascular Plants” collectively from the Bryophytes. Use the table, page 24.2 as an aid to this task.
2. Now, to distinguish the individual phyla of “Seedless Vascular Plants” consider the characteristics one could use to distinguish whisk ferns, clubmosses, horsetails, and ferns. Page 24.4 contains a copy of Table 8.1 from your Laboratory Manual for your convenience in reviewing these distinctions.
3. How would you distinguish *homosporous* from *heterosporous* members of Lycopphyta if given specimens and a microscope? Hint: Compare the genus *Lycopodium* (clubmoss) with *Selaginella* (spike mosses). What is the significance of heterospory with respect to aiding survival of the gametophyte of the spike mosses (*Selaginella*)? See Lecture Discussion-Application box, page 24.3.

STUDY OUTLINE: SEEDLESS VASCULAR PLANTS

I. INTRODUCTION:

- A. Compare "Seedless Vascular Plants" to Bryophytes. Use a "+" or "-" to indicate whether the description applies to each group or not. See Part B. below where you can list exceptions within the groups where necessary.

CHARACTERISTIC	BRYOPHYTES	SEEDLESS VASCULAR
1. Life cycle with <i>sporic meiosis</i>		
2. Archegonia and Antheridia		
3. Zygote develops to multicellular embryo		
4. Chl <i>a,b</i> , carotenoid, cellulose cell walls		
5. Cell Plate in cytokinesis		
6. Sporangia protected with multicellular layer		
7. Cuticle and stomata (well-developed)		
8. Motile sperm require free water		
9. Xylem and phloem (well developed)		
10. Lignified secondary walls for support		
11. Sporophytes nutritionally independent from gametophytes		
12. Sporophyte dominates life cycle		
13. Sporangia borne on leaves		

B. SOME EXCEPTIONS:

1. True roots and leaves (*i.e.* vascularized structures) are both absent in _____
Instead, this genus has an underground rhizome (stem) + mycorrhizal fungi (in cortex)
2. Leaf Type Differs:
 - a. *Megaphylls* – vascularized with branched veins; these “true leaves are present only in _____
 - b. *Microphylls* – small "leaves" with one, unbranched vein; found in _____ and also in _____
3. Sporangia are borne in association with “true leaves” only in _____
4. Strobili – terminal clustering of sporangia found in _____ and _____.

II. SEXUAL REPRODUCTION -- life cycles

A. GENERALIZED LIFE CYCLE -- Figure 12.6, p. 221 -- study it and relate to the following:

1. POLYPODIOPHYTA -- Figures 21.16–21.21 and laboratory manual; our main emphasis
2. PSILOTOPHYTA – Whisk Fern, *Psilotum* Figure 21.1–21.2 – NOTE similarity to Fern cycle
3. LYCOPHYTA -- Clubmosses, Figures 21.3–21.5 – similar to Fern cycle
4. EQUISETOPHYTA -- Horsetails, Figures 21.10–21.15 – similar to Fern cycle

B. SPIKE MOSSES -- members of LYCOPHYTA, but different features:

1. THUS FAR ---> Spores look identical in size/morphology; produce distinct male & female gametophytes due only to genotype of spores
2. HOMOSPOROUS = name for condition wherein spores are the same
> NOTE: Resultant gametophytes are independent, not nourished by spores.
3. HETEROSPOROUS SPECIES = condition wherein the following occurs:
 - a. Spores differ in size – compare spores in strobili of HOMOSPOROUS (*Lycopodium*, Figure 21.4) with strobili of HETEROSPOROUS (*Selaginella*, Figure 21.6).
In *Selaginella*, the smaller spores, or *microspores*, develop into male gametophytes; whereas, the larger spores, or *megaspores*, develop into female gametophytes
 - b. Gametophytes are much reduced; develop within and in dependence upon nourishment from the *megaspore*

Lecture Discussion-Application Question:

In what way is heterospory in *Selaginella* a strategy in which the sporophyte takes a greater part in nurturing the gametophyte generation than the sporophyte of *Lycopodium*? Compare to Bryophytes.

Table 8.1. Distinguishing Features of the Four Divisions of Seedless Vascular Plants

	Whisk Ferns	Club Mosses	Horsetails	Ferns
DIVISION	Psilotophyta	Lycophyta	Equisetophyta	Polypodiophyta
“Leaves”	Only <i>enations</i> ¹	microphylls ²	microphylls ²	megaphylls ³
Stems (vascularized)	Yes	Yes	Yes	Yes ⁴
True Roots (vascular)	No ⁵	Yes	Yes	Yes
Sporangia > Structures that contain the spores	axil ⁶ of enations	axil ⁶ of microphylls <i>i.e. sporophylls</i> forming a <i>strobilus</i>	attached to sporangiophores in <i>strobilus</i>	underside of megaphylls in clusters, or <i>sori</i>
Gametangia	All have archegonia (with neck and venter) and antheridia (sterile jacket)			
Gametes	All have flagellated sperm and sessile egg (<i>i.e.</i> oogamous)			
Make a quick sketch of each showing the spore-bearing portions (e.g. strobili or sori)				

- Notes:
1. Enations are not true leaves; only nonvascular outgrowths on otherwise barren stems.
 2. Microphylls are not considered true leaves in that they have only a single vein. Look closely at the microphylls of club mosses or horsetail (here dry scales that highlight the bamboo-like bands). Can you see the single vein of a clubmoss microphyll?
 3. Megaphyll is the term for all true leaves that have a multi-veined arrangement of vascular tissue.
 4. Fern stems are usually horizontal and at or beneath the soil surface and support the megaphylls from this prostrate position; tree ferns are an exception in having a trunk-like stem.
 5. Whisk ferns have no roots; only horizontal rhizomes from which extend rhizoids; mycorrhizal fungi are also an aid to mineral and water absorption.
 6. Axil refers to the acute angle formed by a leaf or leaf-like structure as it joins a stem. For example, the whisk fern sporangium is “cradled” in the axil formed by an enation. Can you see this relationship?