

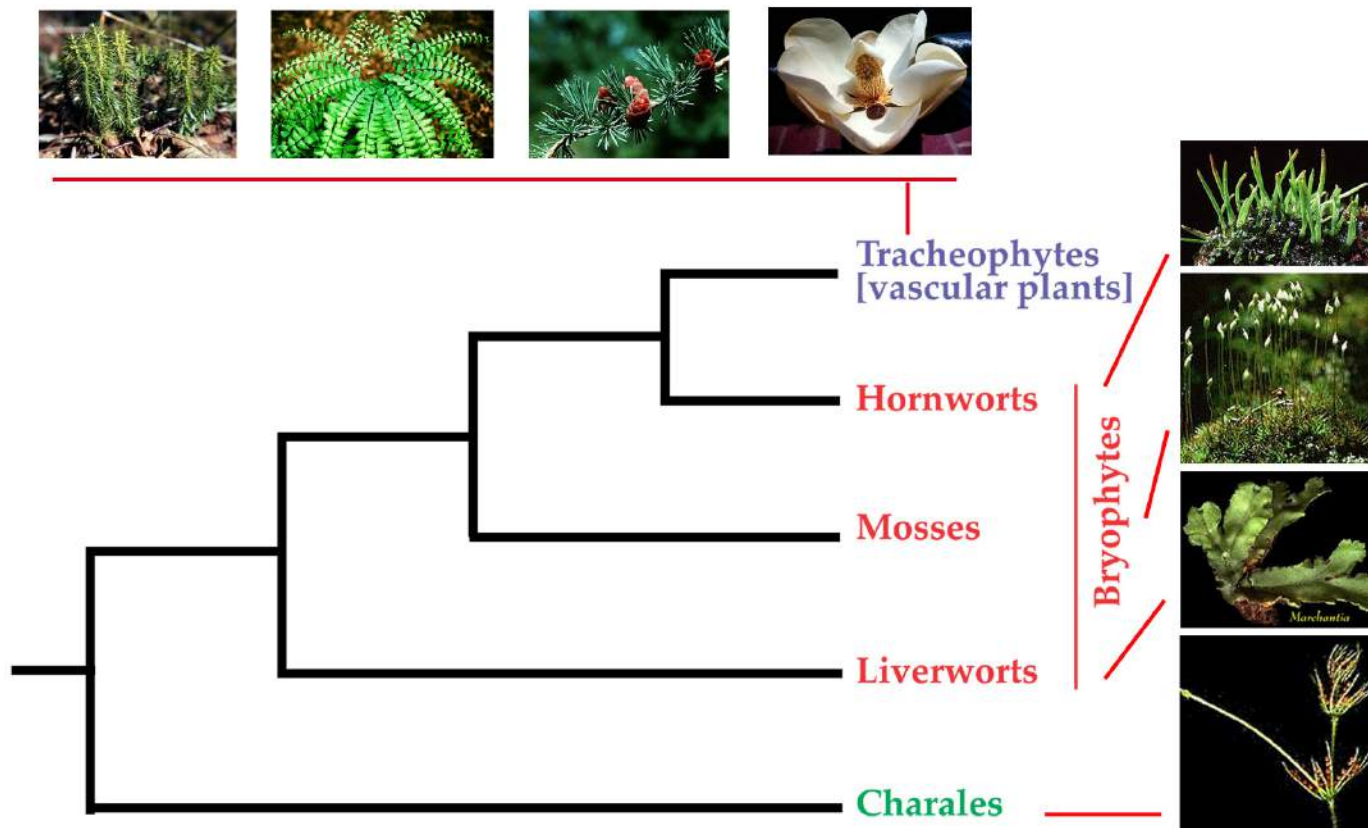
Land Plants - a quick review



Land Plants - a quick review

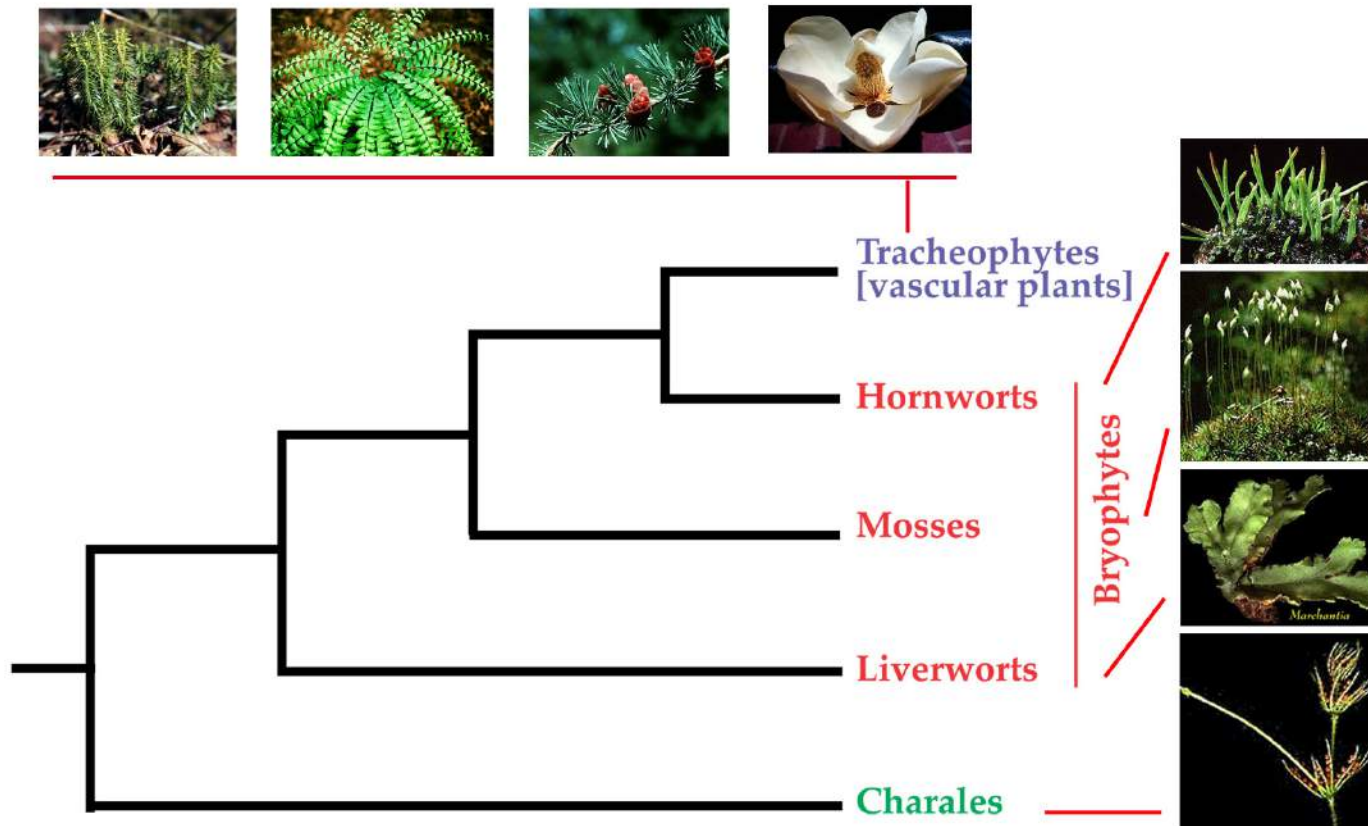
The most primitive land plants are **non-vascular**:

- the Charales (a group of **Green Algae**)
- 3 groups of **Bryophytes** (hornworts, liverworts, mosses)



Land Plants - a quick review

Vascular plants (with phloem + xylem), often called **Tracheophytes**, represent a natural group comprising most of the diversity of land plants.



Non-vascular Plants

Many non-vascular plants are aquatic algae. On land only the Charales - a group of **Green Algae** - represent algae that are adapted to terrestrial life.



Chara (stonewort) is found in clean, fast-moving streams like the Manistee River.

Chara - stonewort

Non-vascular Plants

The largest group of non-vascular land plants, however, are the **Bryophytes** (hornworts, liverworts, mosses). The bryophytes may be divided into 3 separate phyla.



moss



hornwort



liverwort

Marchantia

Non-vascular Plants

The largest group of non-vascular land plants, however, are the **Bryophytes** (hornworts, liverworts, mosses). The bryophytes may be divided into 3 separate phyla.



moss

Bryophytes are characterized by:

- no well-developed vascular tissue (xylem and phloem) for food/water transport — therefore they are called **non-vascular** land plants, and thus need to be close to water.

Non-vascular Plants

The largest group of non-vascular land plants, however, are the **Bryophytes** (hornworts, liverworts, mosses). The bryophytes may be divided into 3 separate phyla.



moss

Bryophytes are characterized by:

- no well-developed vascular tissue (xylem and phloem) for food/water transport — therefore they are called **non-vascular** land plants, and thus need to be close to water.
- a **gametophyte** (1n or haploid) **dominant** life cycle and a **sporophyte** (2n or diploid) stage that is **reduced** to a small structure that quickly produces spores.

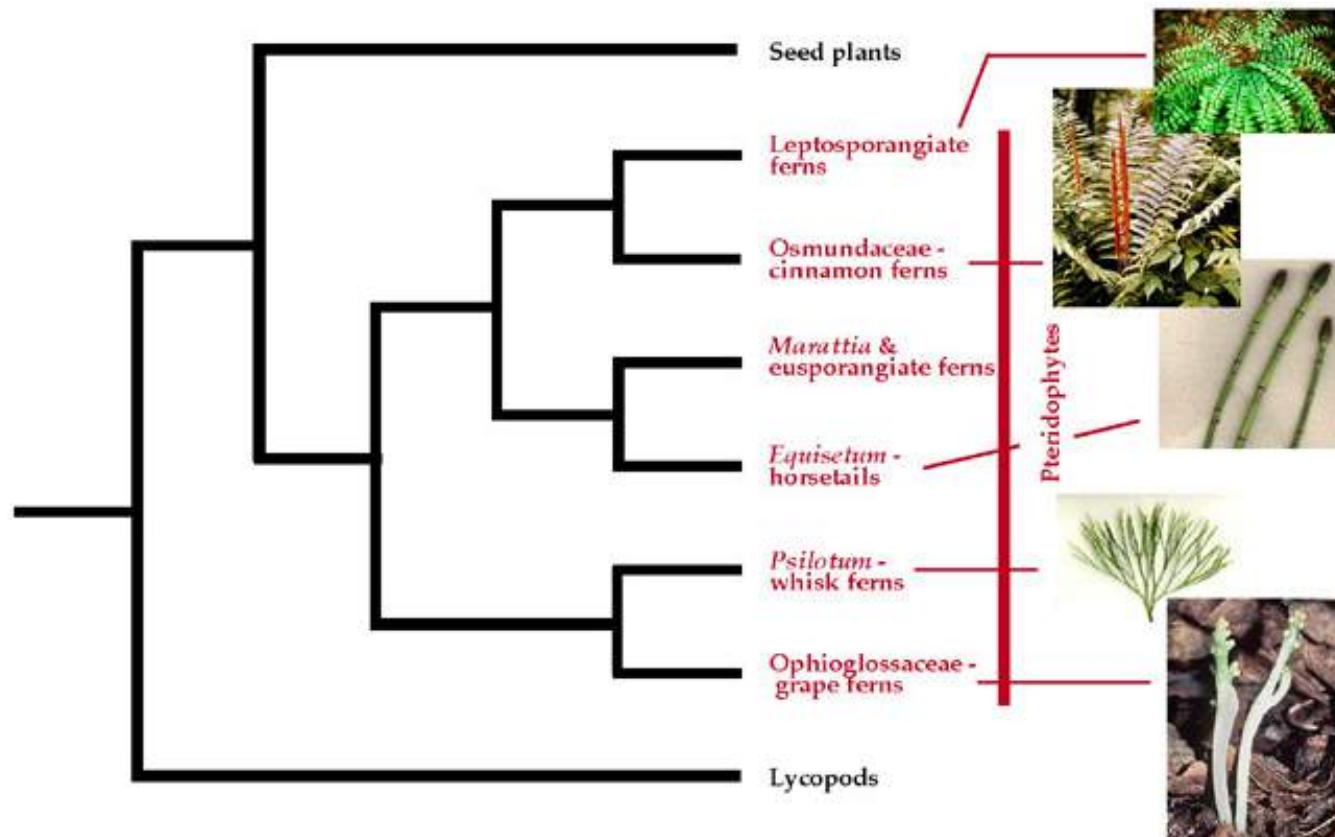
gametophyte

sporophyte

Vascular Plants - a quick review

Two unrelated groups within seed free vascular plants are recognized as phyla:

1. **Lycopodiophyta** : lycopods
2. **Polypodiophyta**: ferns, horsetails, and whisk ferns

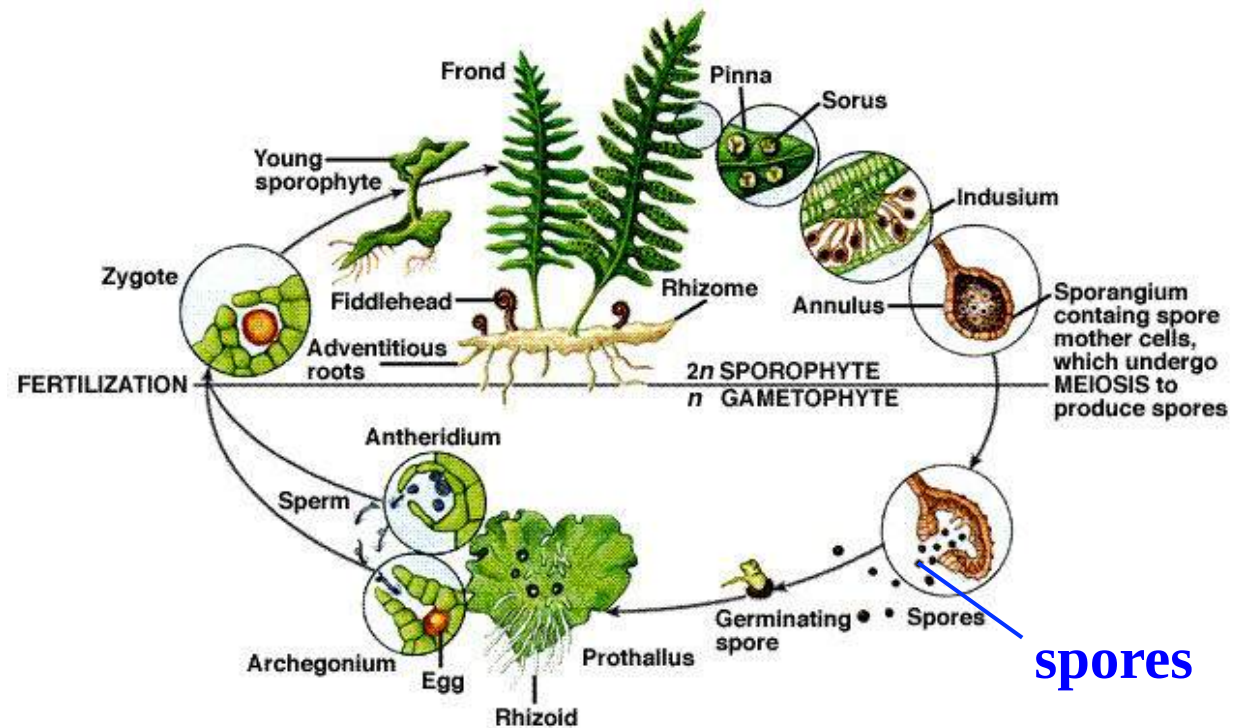


Vascular Plants - a quick review

They produce **free spores**, the principal dispersal units, via **meiosis**.

Spore: a reproductive cell, capable of developing into an adult without fusion with another cell.

Life-cycle

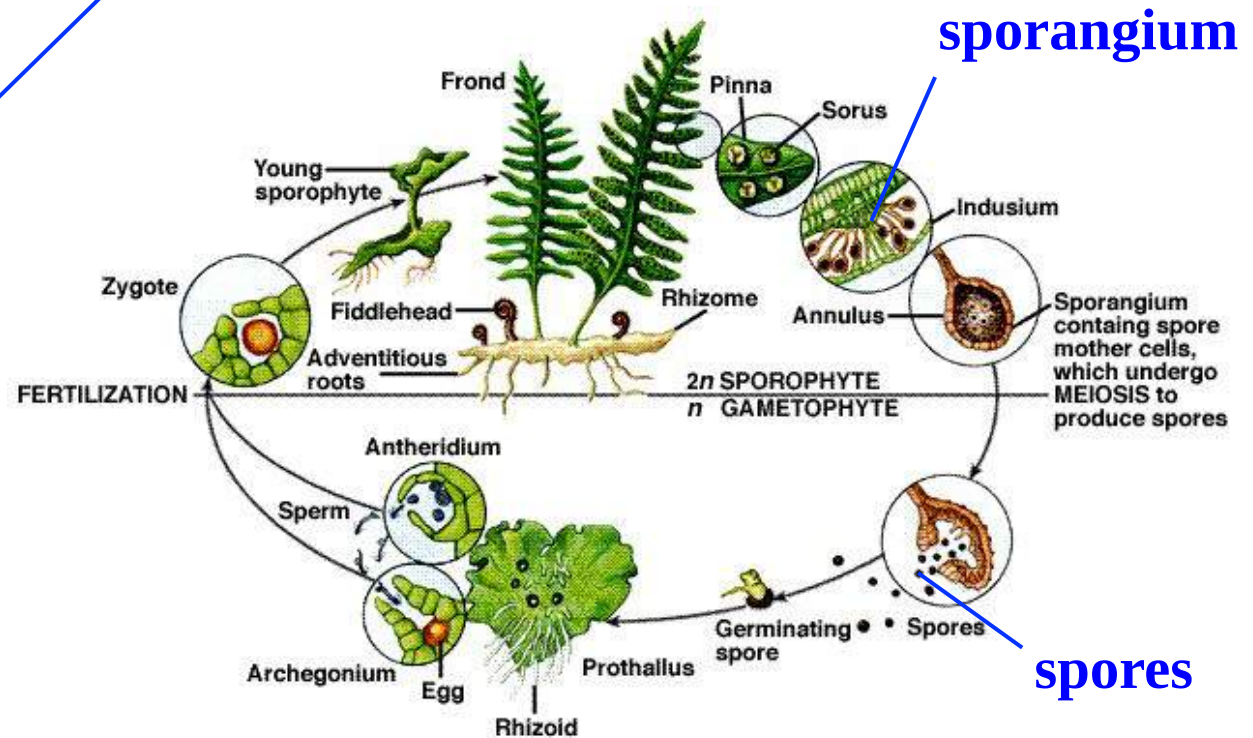


Vascular Plants - a quick review

Why were the seed-free plants “grouped” together?

Spores develop within a **sporangium** (pl. sporangia)

Life-cycle

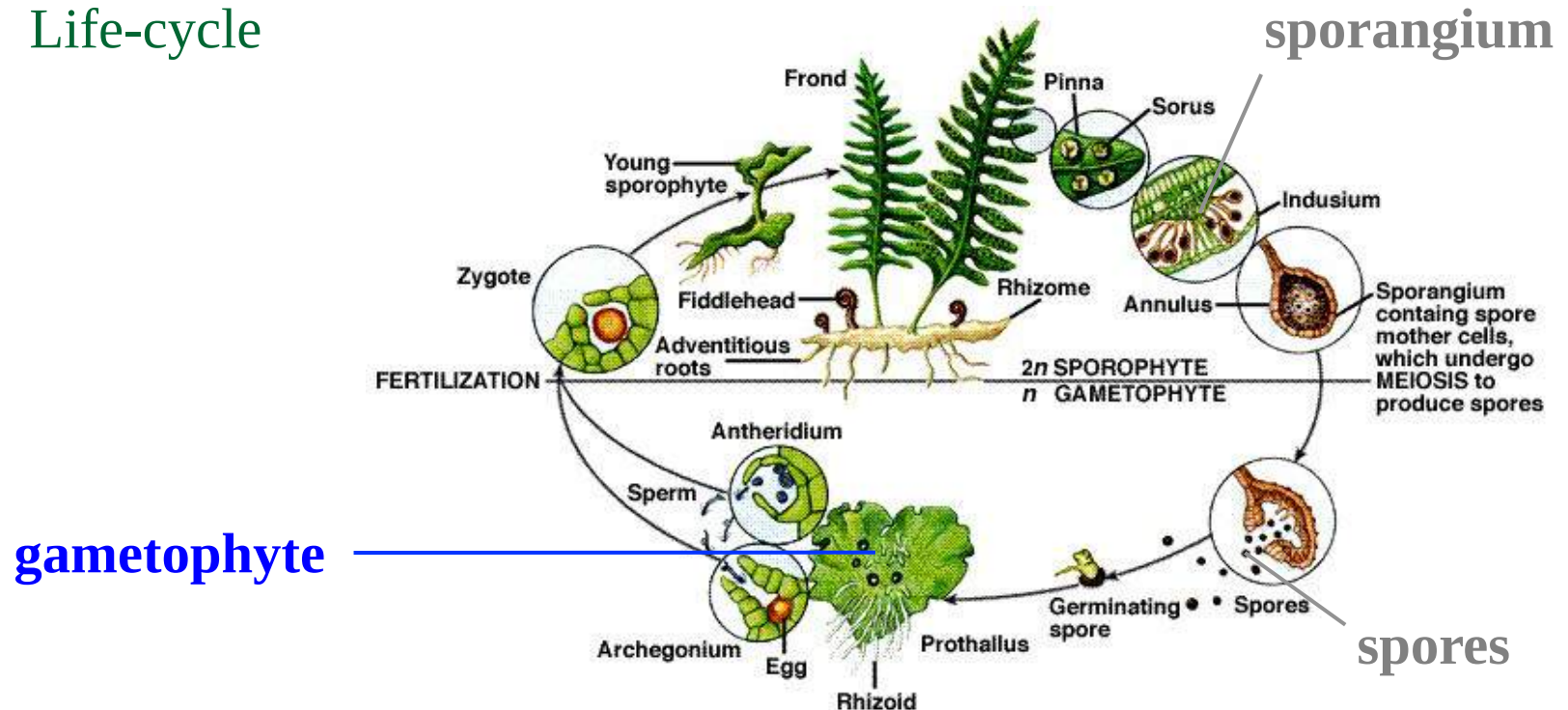


Vascular Plants - a quick review

Why were the seed-free plants “grouped” together?

Spores germinate and develop into **gametophytes** that exist **independently** of the spore-producing plants. The gametophytes (haploid, n) tend to be inconspicuous and short-lived.

Life-cycle

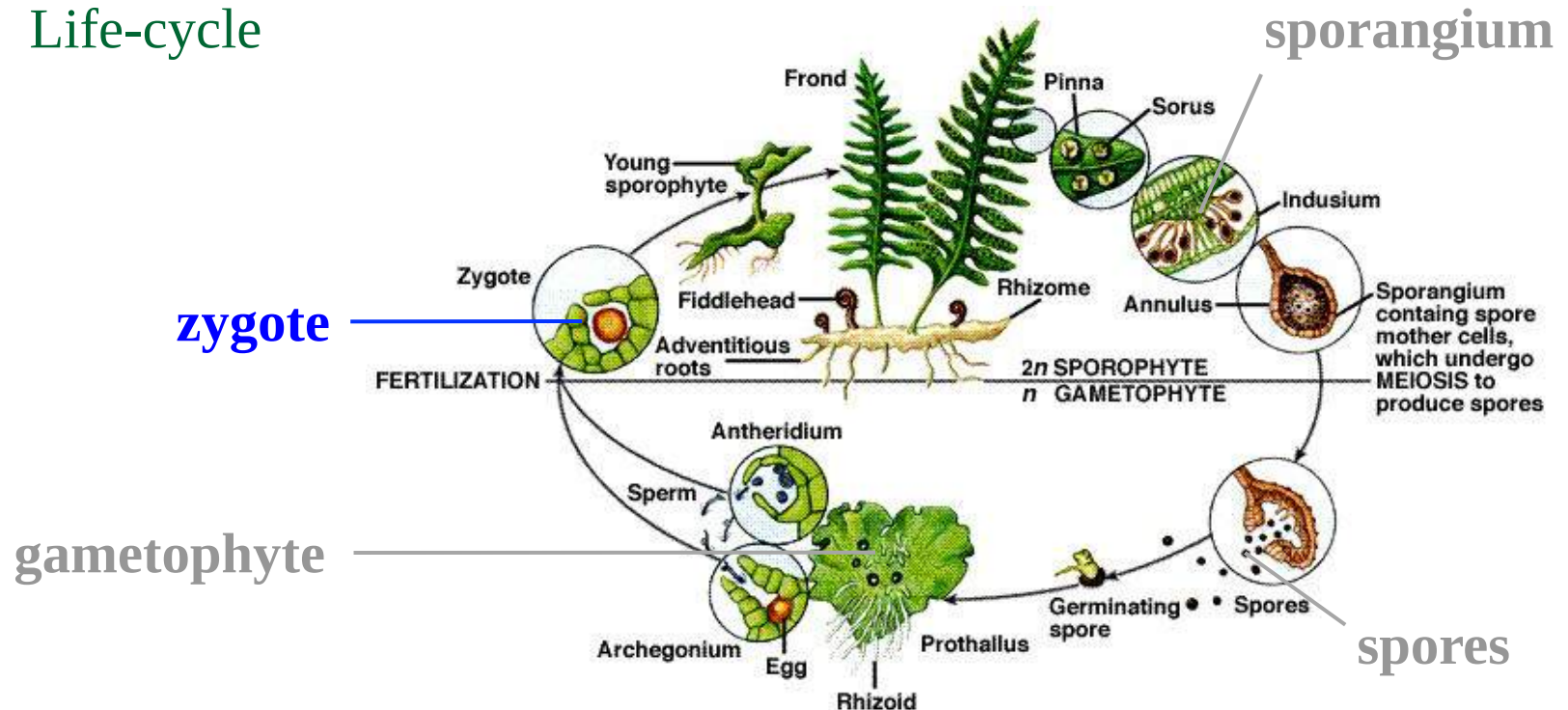


Vascular Plants - a quick review

Why were the seed-free plants “grouped” together?

Like all plants, seed-free plants produce two kinds of **gametes** in their gametophytes: **sperm** and **egg** that unite to form a **zygote** ($2n$ or diploid) via **fertilization**

Life-cycle

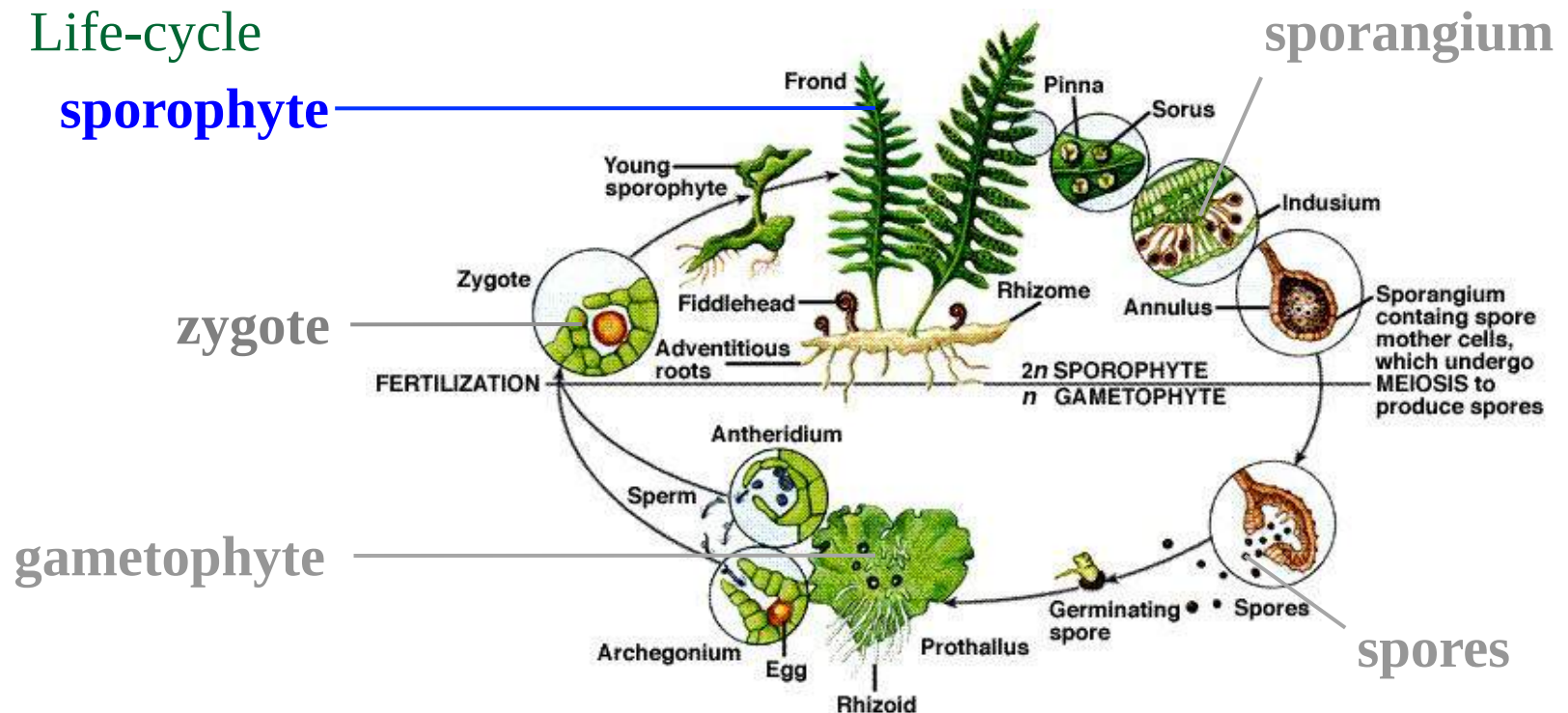


Vascular Plants - a quick review

Why were the seed-free plants “grouped” together?

The **sporophyte** ($2n$) develops from the zygote and is more conspicuous, usually perennial and lives for an indefinite period

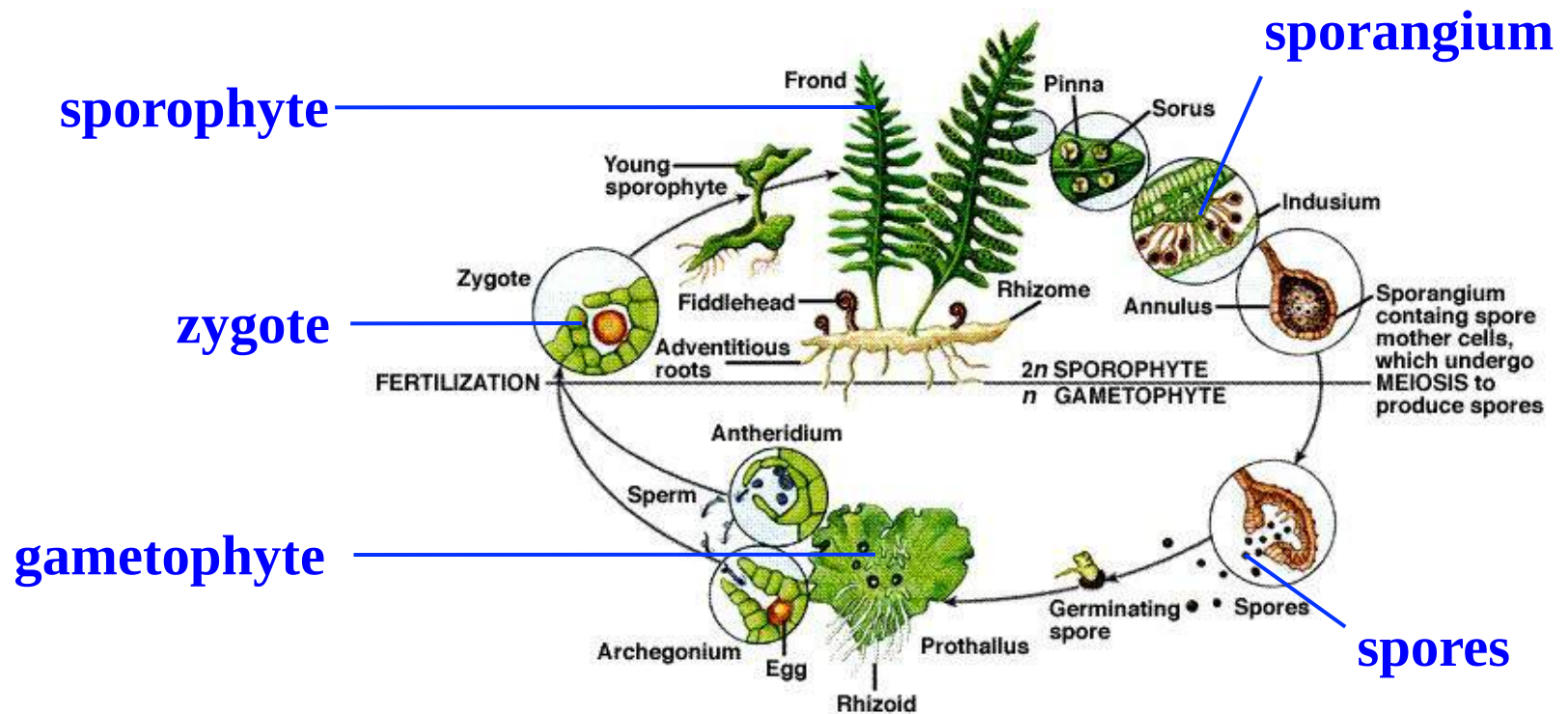
Life-cycle



Vascular Plants - a quick review

Why were the seed-free plants “grouped” together?

Life-cycle – alternation of generations



Vascular Plants - a quick review

The best website to identify and see images of the Great Lakes' seed-free plants is Gary Fewless' at UW-Green Bay; links provided below



[Key to Ferns and Fern Allies of Wisconsin](#)
[List of Pteridophytes of Wisconsin](#)
[Glossary of Fern Terminology](#)

also:

[Michigan Online Flora](#)

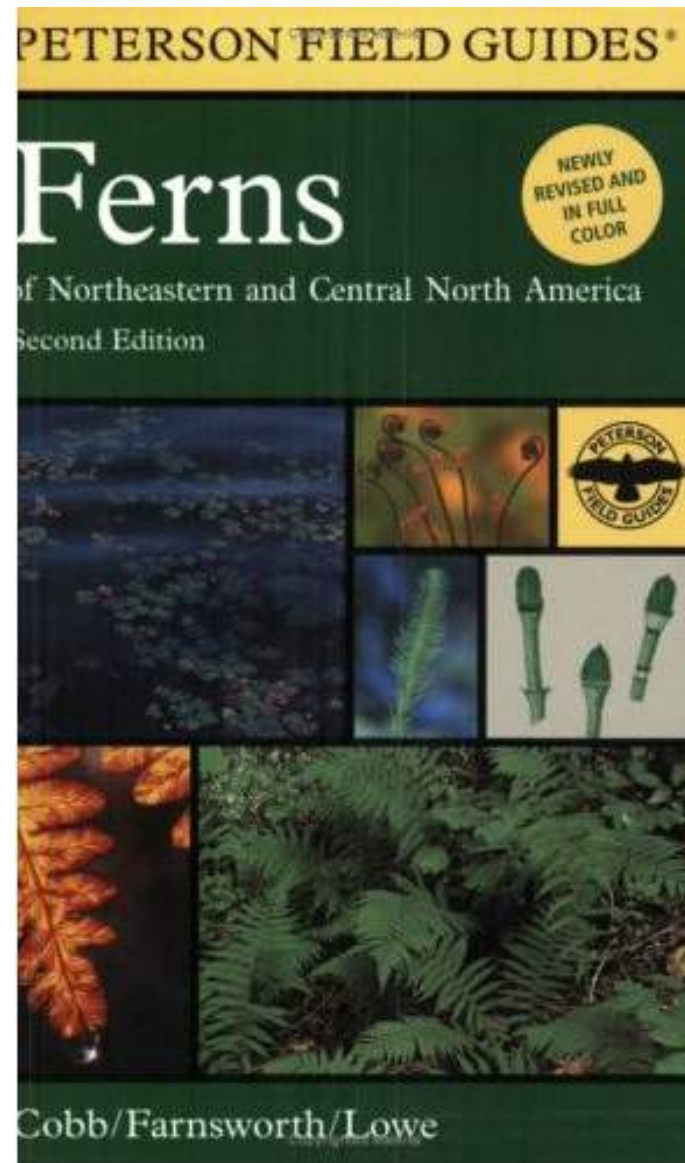


Vascular Plants - a quick review

The best manual to identify lycopods and ferns is *Ferns of Northeastern and Central North America* (2nd ed.) in the Peterson Field Guides

Warning:

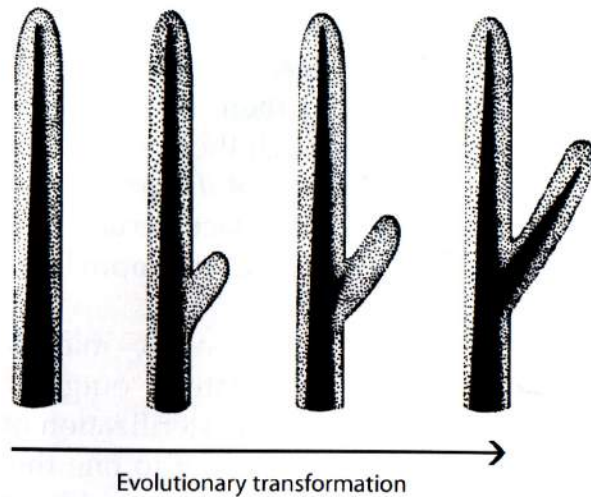
Families and genera (and thus species names) are changing quickly in the seed-free plants



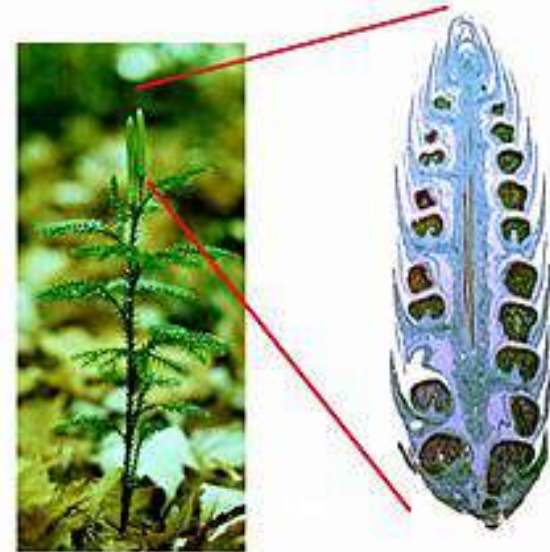
Phylum Lycopodiophyta

club mosses, spike mosses, quillworts

Leaves **microphylls**: small, simple, one-veined leaves



Sporangia: the spore producers on the sporophytes are located singly on the upper surfaces or in axils of the bracts of a cone or of green leaves



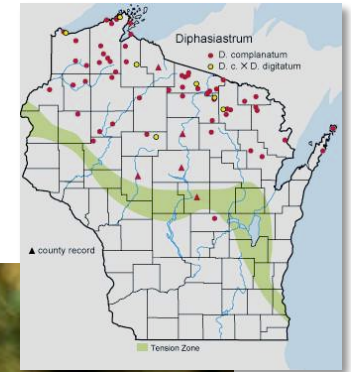
Phylum Lycopodiophyta

Lycopodiaceae - club mosses

15 genera and about 375 species
Lycopodium now split into several genera

Evergreen, stems elongate and dichotomously branching. Leaves often densely covering the stem. Many species over-collected for Christmas wreaths.

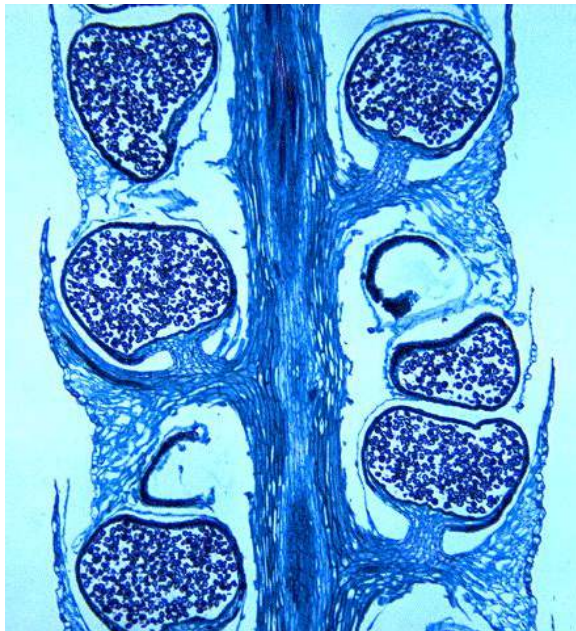
Oily compounds in the cell walls ignite rapidly into a flash of light



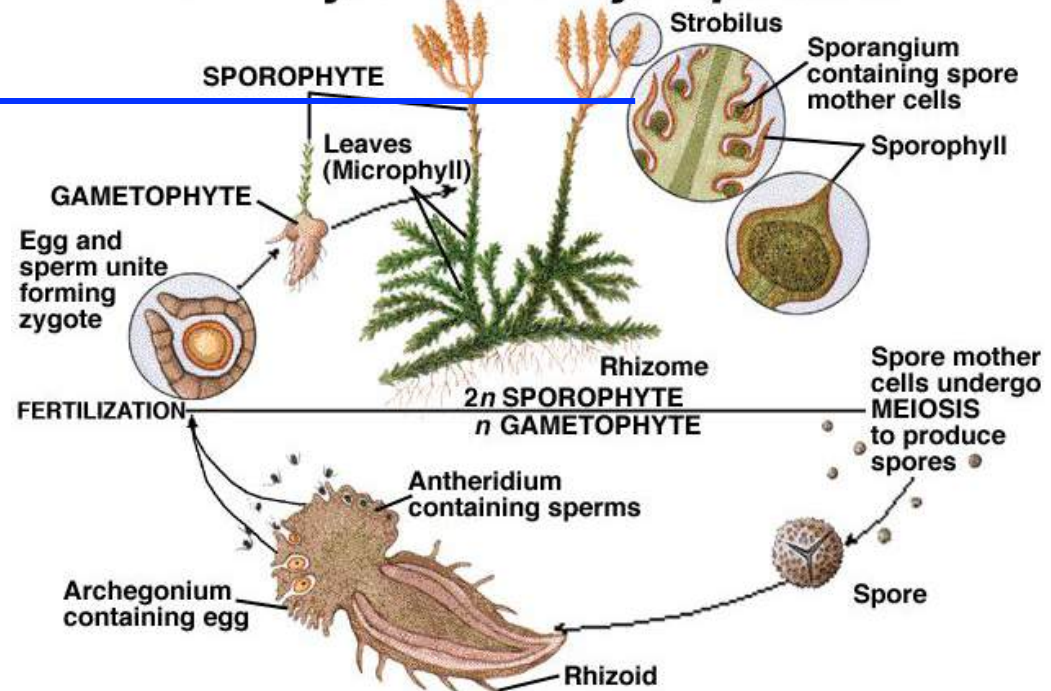
Diphasiastrum complanatum
Ground cedar, crowfoot

Phylum Lycopodiophyta

Lycopodiaceae - club mosses



Life Cycle of a *Lycopodium*



Homosporous: “same spore” - one kind of spore produced; cones terete (rounded)

Phylum Lycopodiophyta

Lycopodiaceae - club mosses other examples

Lycopodium obscurum
(*Dendrolycopodium*)
Ground pine



Huperzia lucidula
Shiny club moss



Lycopodiella inundata
Bog club moss

Phylum Lycopodiophyta

Selaginellaceae - spike mosses

1 genus and about 750 species

Mainly tropical family with some species extending into arctic regions of both hemispheres

Leaves spirally arranged and often 4-ranked on the secondary and ultimate branches.

Spores borne in or near the axils of well-differentiated sporophylls, usually on 4 sided strobilus.

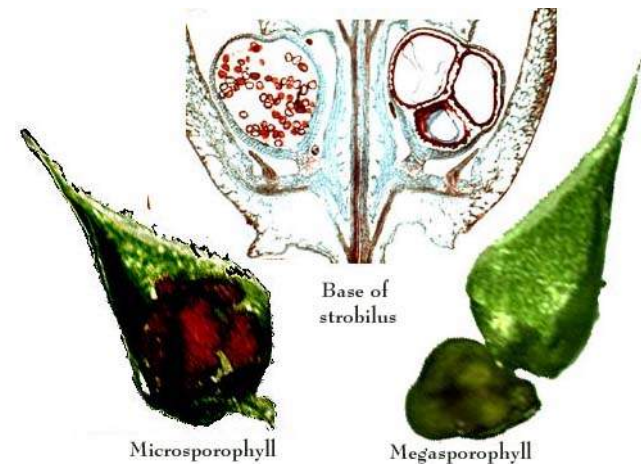


Phylum Lycopodiophyta

Selaginellaceae - spike mosses

Heterosporous: “different” spores

Unlike Lycopodiaceae,
Selaginellaceae are heterosporous
with different types of spores:
microspores and **megaspore** - the
micro give rise to male gametophytes
and the mega give rise to the female
gametophytes.

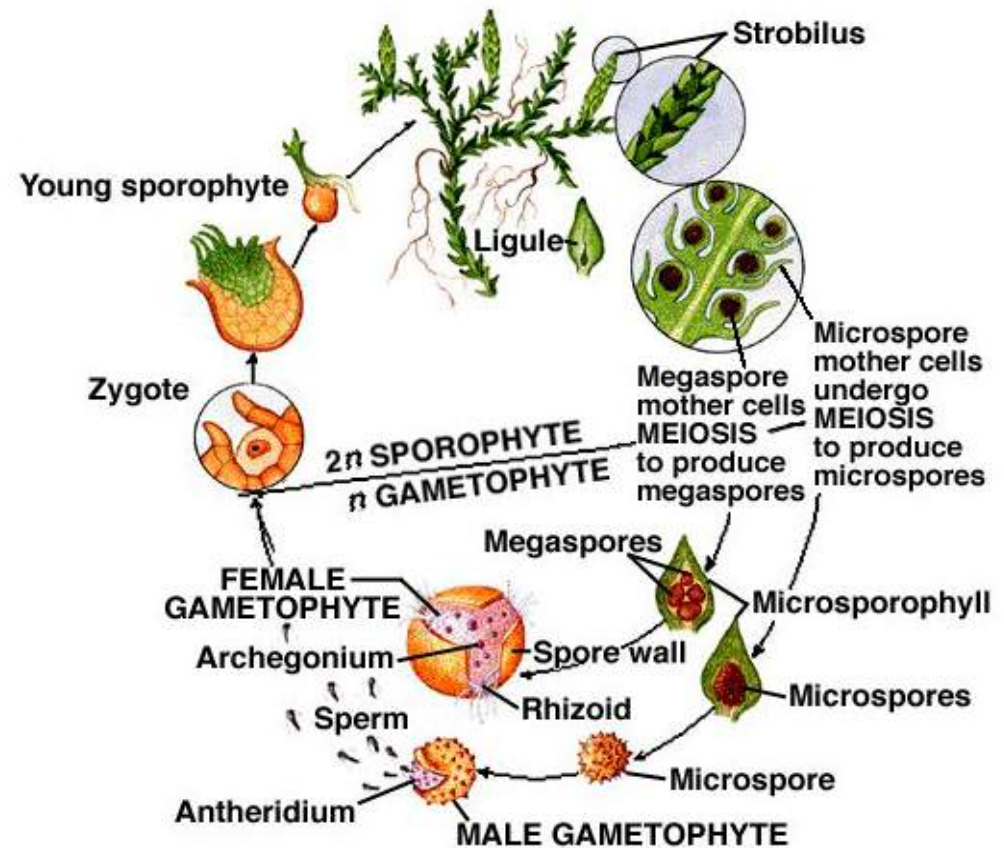


Phylum Lycopodiophyta

Selaginellaceae - spike mosses

Heterosporous: “different”

Life Cycle of *Selaginella*



Phylum Lycopodiophyta

Selaginellaceae - spike mosses



Selaginella selaginoides
meadow spike moss



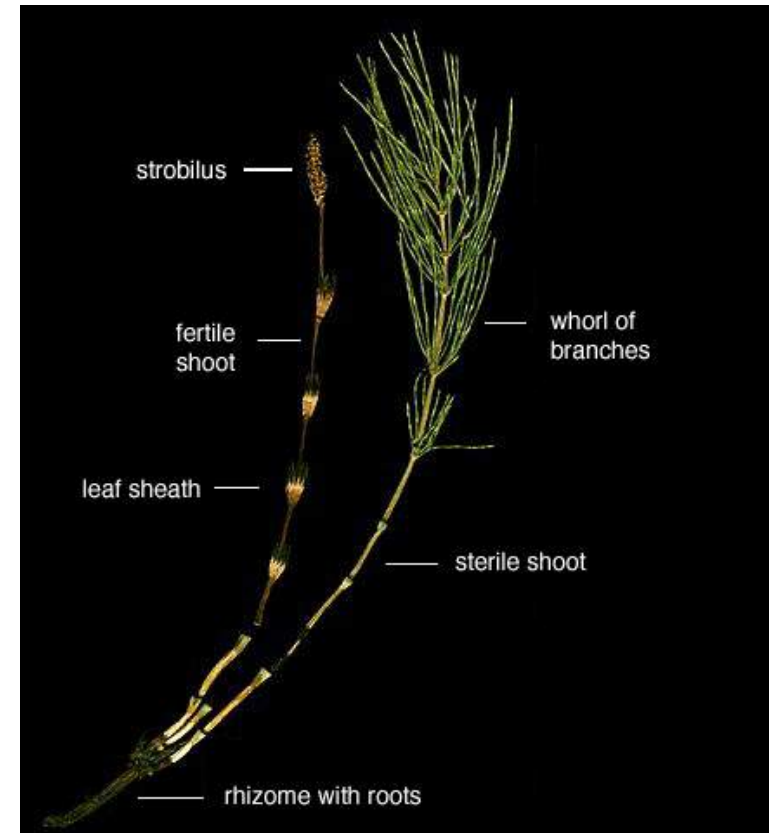
Phylum Polypodiophyta - ferns & horsetails

Equisetaceae - horsetails, scouring rushes

1 genus, *Equisetum*, 15 species with a cosmopolitan distribution except for Australia or New Zealand [9 species in Wisconsin]

Shoots **monomorphic** or **dimorphic** (see right).

Often highly branched (horsetails) appearing like leaves. Others not branched (scouring rushes).



Phylum Polypodiophyta

Equisetaceae - horsetails, scouring rushes



Internodes with conspicuous vertical ridges; jointed stems; stems hollow (both important taxonomic features for keying species)



Phylum Polypodiophyta

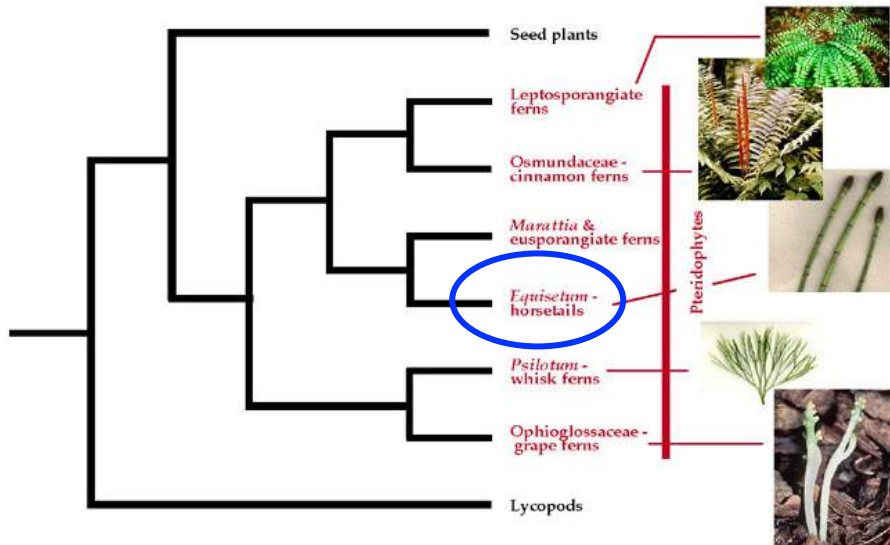
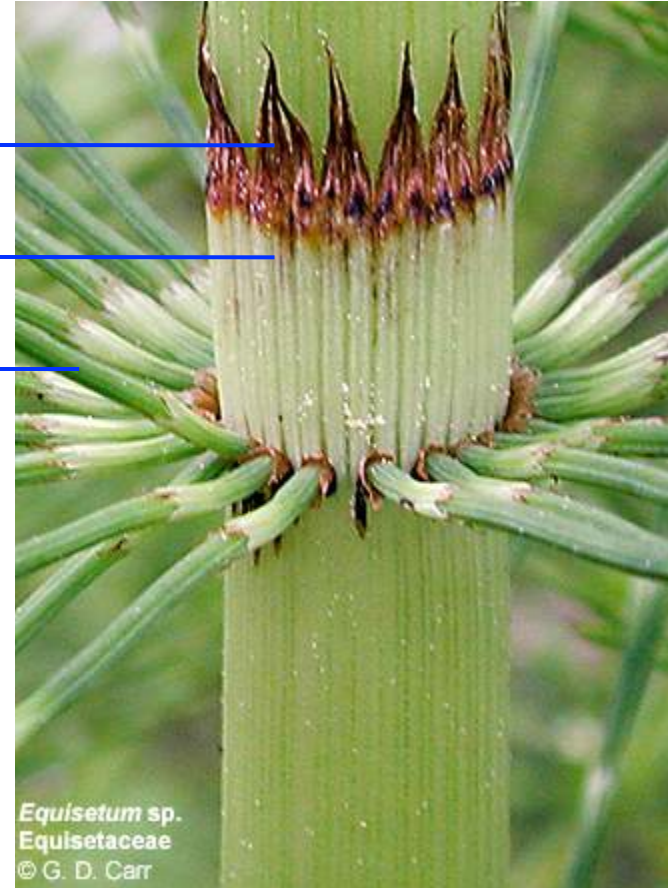
Equisetaceae - horsetails, scouring rushes

Leaves in whorls, united to form a **sheath** around the stem; these leaves are reduced **megaphylls** – with a blade that has a complex system of veins.

megaphyll

sheath

branch

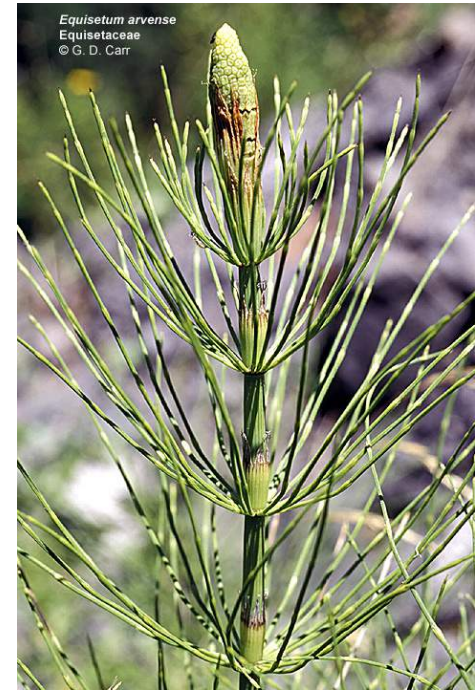
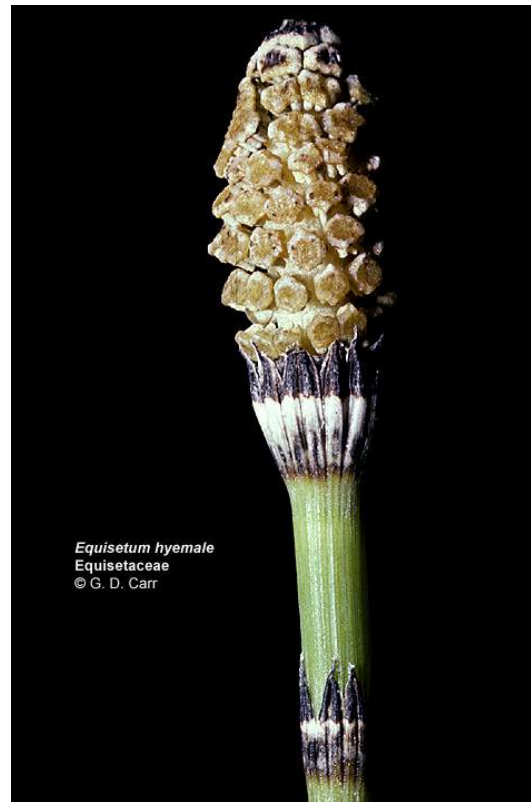


Horsetails belong with the “normal” looking-leaved ferns

Phylum Polypodiophyta

Equisetaceae - horsetails, scouring rushes

Sporangia clustered terminally in **cones** composed of polygonal, umbrella-like structures with sporangia beneath.



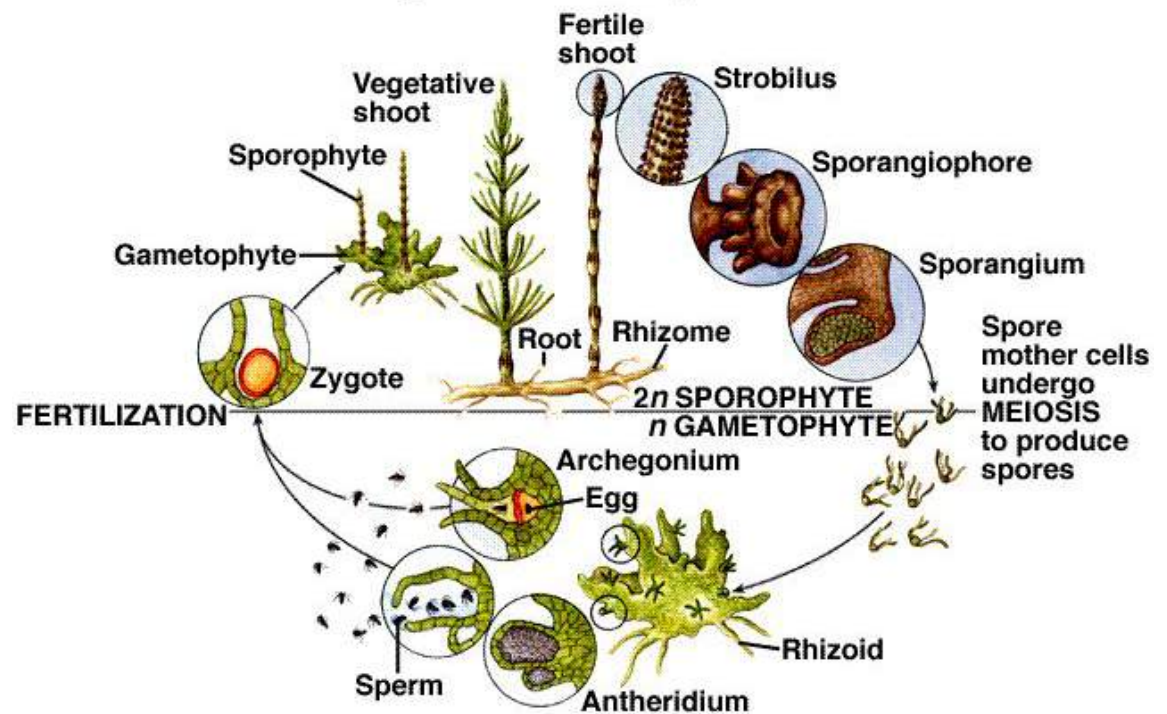
Phylum Polypodiophyta

Equisetaceae - horsetails, scouring rushes

Horsetails are **homosporous**, have green spores with hygroscopic elaters, and form conspicuous green gametophytes

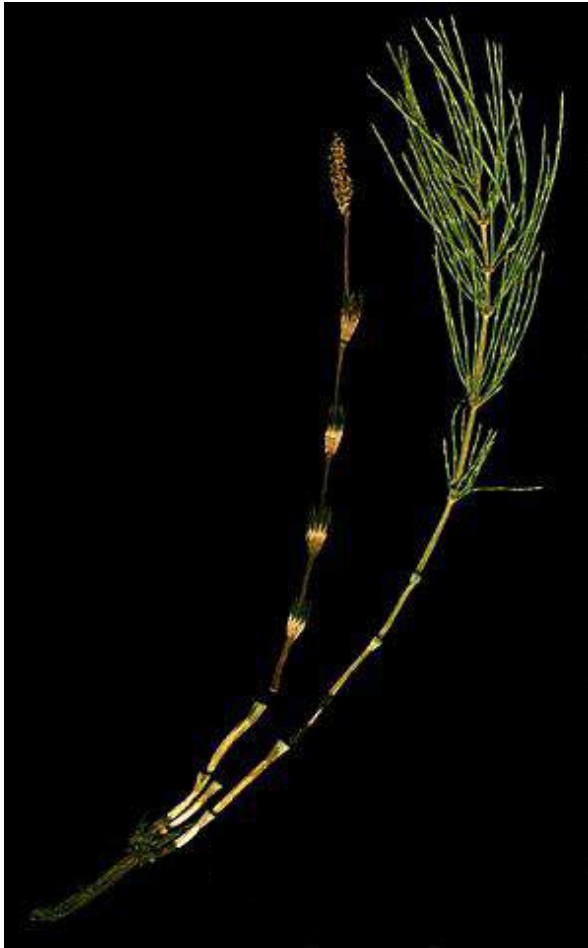


Life Cycle of *Equisetum*



Phylum Polypodiophyta

Equisetaceae - some examples of native horsetails & scouring rushes



Equisetum arvense
Field horsetail



Equisetum sylvaticum
Woodland horsetail

Phylum Polypodiophyta

Equisetaceae - some examples of native horsetails & scouring rushes



Equisetum laevigatum
Smooth scouring rush

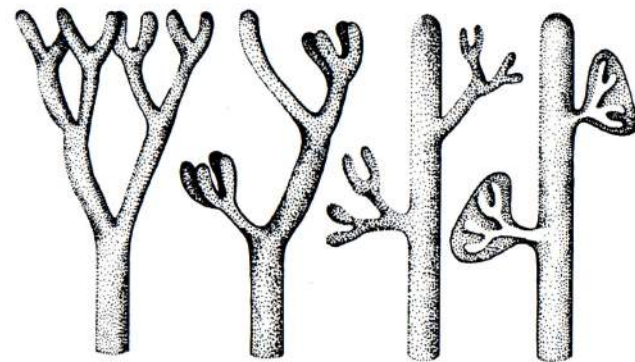
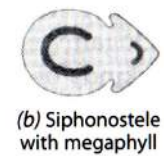
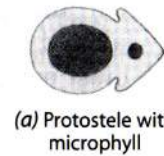
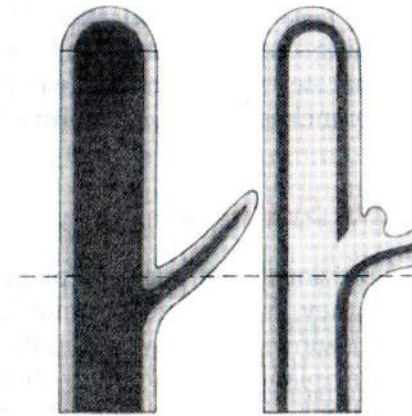


Equisetum scirpoides
Dwarf horsetail

Phylum Polypodiophyta

the true ferns

Like the horsetails, leaves are **megaphylls**; blade is called a **frond** and the petioles as **stipes**.



Evolutionary transformation

(b)

Phylum Polypodiophyta

ferns

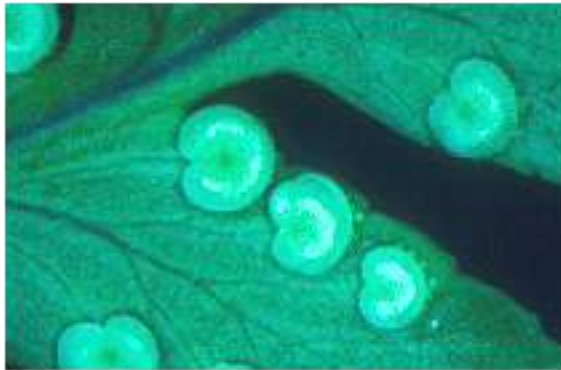
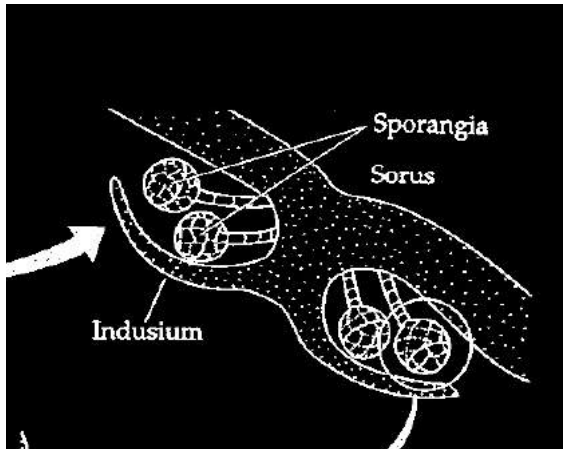
Circinate vernation: vernation is the arrangement of folded leaves in a bud, forming a crozier or **fiddlehead**, i.e. coiled or rolled up at the tip and unfolding lengthwise when emerging - due to auxin and differential growth of tissue. Protects young bud.



Phylum Polypodiophyta

ferns

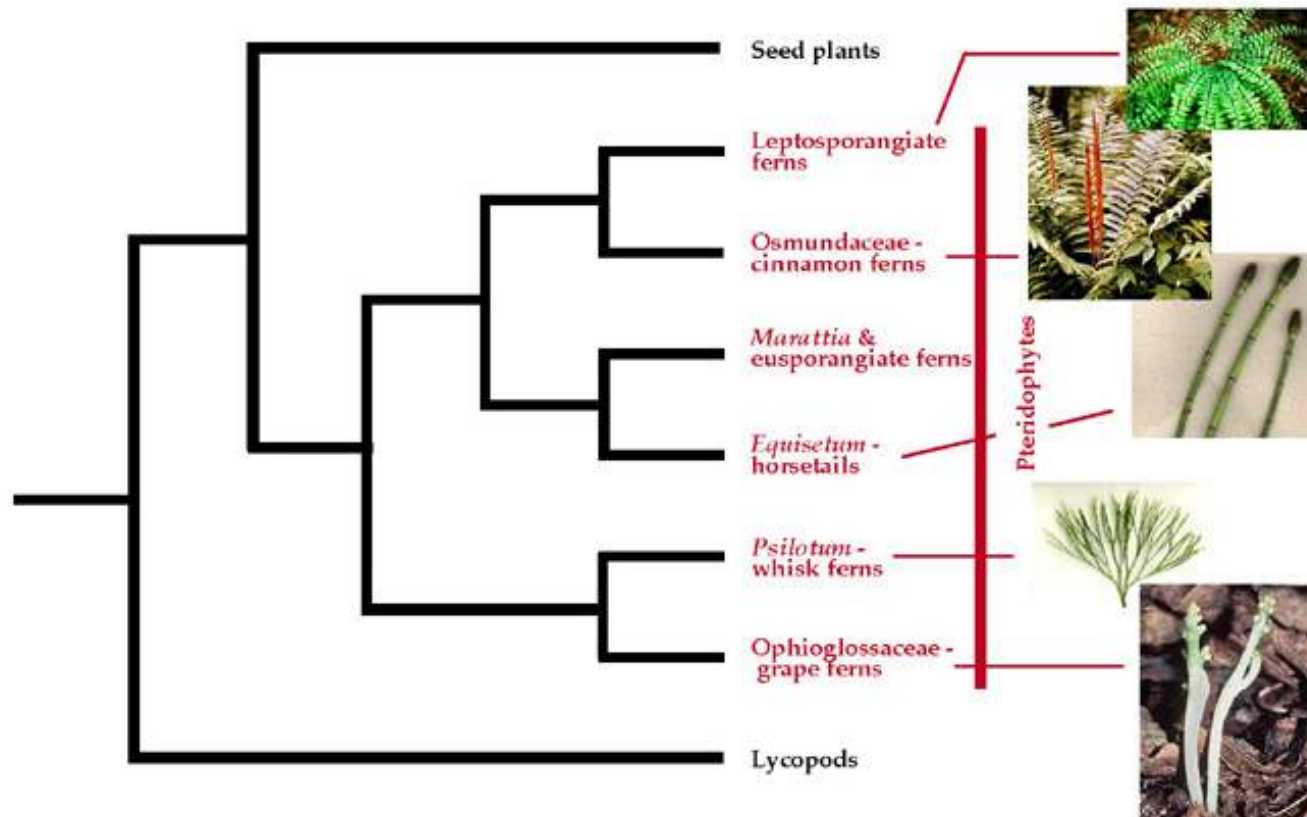
Sporangia borne on the margin or the lower surface of the leaf; often grouped in **sori** (pl.) **sorus** (sing.); a sorus may be protected by a flap-like structure called the **indusium**.



Phylum Polypodiophyta

ferns

- Major disagreement on what are the fern families, but 30 are generally recognized worldwide
- Great Lakes region there are 9 families



Phylum Polypodiophyta

Ophioglossaceae - adder's tongue family

Primitive ferns; 4 genera in Great Lakes Region:



Botrychium lunaria
Moonwort fern

Botrychium mormo
Goblin fern



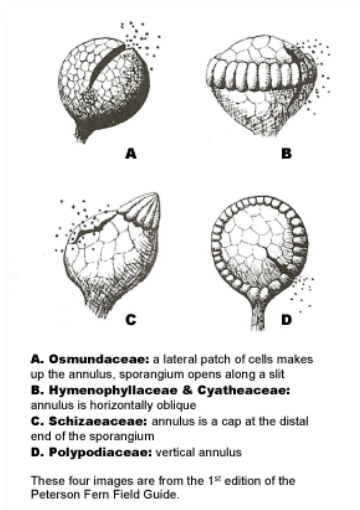
Botrypus virginianum
Rattlesnake fern

Phylum Polypodiophyta

Osmundaceae - royal fern family

Primitive ferns;
1 genus : *Osmunda*

Fertile and sterile
leaves **dimorphic**



Phylum Polypodiophyta

Osmundaceae - royal fern family

3 species of *Osmunda*; easily separated by position of fertile portions



Osmunda cinnamomea
Cinnamon fern



Osmunda claytoniana
Interrupted fern



Osmunda regalis
Royal fern

Phylum Polypodiophyta

Dennstaedtiaceae - bracken family

Includes one of the most widespread of all vascular plants.

Clonal with rhizome; large compound leaves.
Ubiquitous in Great Lakes.



Pteridium aquilinum
Bracken fern

Marginal sori with no indusia but with **revolute** (rolled over) leaf edge protecting sori.



Phylum Polypodiophyta

Pteridaceae - maidenhair fern family

4 genera

Sori that lack indusia or are protected by a reflexed or revolute margins



Distinctively compound frond with dark purple stipe and rachis

Adiantum pedatum
Maidenhair fern

Phylum Polypodiophyta

Onocleaceae- sensitive fern family

2 genera (also *Matteuccia* – ostrich fern).
Dimorphic fronds - sterile frond pinnately lobed.
Fertile frond turning black.



Onoclea sensibilis
Sensitive fern



Phylum Polypodiophyta

Dryopteridaceae - woodfern family

Large and diverse group of ferns; often broadly defined to include other smaller families. 2 genera and 13 species in Great Lakes Region.



Polystichum acrostichoides
Christmas fern



Dryopteris intermedia
Shield fern