

Systematic Botany. Lecture 10

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Flower formula of lily family alliance

Previous final question: the answer

Flower formula of lily family alliance

► $*P_{3+3}A_{3+3}\underline{G_{(3)}}$

Pteridophyta: ferns and allies

- ▶ \approx 12,000 species and six classes
- ▶ Sporic life cycle with sporophyte predominance
- ▶ Gametophyte is often reduced to **prothallium** (small hornwort-like plant), some Pteridophyta have male and female gametophytes
- ▶ Have true roots (only whisk ferns, Psilotopsida are exception)
- ▶ Homoiohydric plants (same as seed plants)
- ▶ Sporophyte always starts development from embryo located on gametophyte
- ▶ Have true xylem and phloem, but do not have secondary thickening (exceptions: fossils and extant *Isoëtes* and *Botrychium*)

Pteridophyta classes

- ▶ Subphylum Lycopodiophytina (lycophytes)
 - ▶ Class **Lycopodiopsida**
- ▶ Subphylum Pteridophytina (monilophytes)
 - ▶ Class **Equisetopsida** (horsetails)
 - ▶ Class **Psilotopsida** (whisk ferns)
 - ▶ Class **Ophioglossopsida** (ophioglossalean ferns)
 - ▶ Class **Marattiopsida** (giant, or marattialean ferns)
 - ▶ Class **Pteridopsida** (“true” ferns)

Lycopodiopsida

- ▶ Four main genera (*Huperzia*, *Lycopodium*, *Selaginella* and *Isoëtes*) and ≈ 1000 species
- ▶ Separate, **microphyllous*** lineage of Pteridophyta (all other groups are **megaphyllous**)
- ▶ Sporangia associated with leaves and often form **strobilus***. Spermatozoon typically with two flagella (like in mosses). Homosporous genera have achlorophyllous, mycoparasitic underground gametophyte.
- ▶ In the past, were dominant trees of Carboniferous tropical swamp forests (lepidodendrids) and their remains became a coal
- ▶ Two genera, *Selaginella* (Selaginellaceae, club moss) and *Isoëtes* (Isoëtaceae, quillwort) are heterosporous.
- ▶ Other genera, from Huperziaceae and Lycopodiaceae families, have equal spores.

Tropical lycophyte, *Huperzia linifolia*



A close-up photograph of a small, green, upright plant with a yellowish, fuzzy, cone-shaped inflorescence at the top, growing from a sandy, dark substrate. The plant has several thin, green, upright stems. The background is blurred, showing more of the same plant and the sandy ground.



Aquatic lycophyte *Isoetes* sp.



The only North Dakota lycophyte, *Selaginella densa*



Chicago 300 Million Years Ago (lepidodendrids)



Equisetopsida

- ▶ Small group of one genus, *Equisetum* with ≈ 30 species
- ▶ Leaves are reduced into scales, stems are segmented, photosynthetic. Have specific anatomy of stem (stele)—**artrostele** with specific central, **valecular** and **carinal** canals (similar to stele of some grasses)
- ▶ Sporangia associated with specialized leaves—sporangiophores. Spores have attached **elaters**. Gametophyte minute, usually dioecious but plants are homosporous
- ▶ One family, Equisetaceae, with 6 species in North Dakota

Strobili and sporangiophores of *Equisetum arvense*



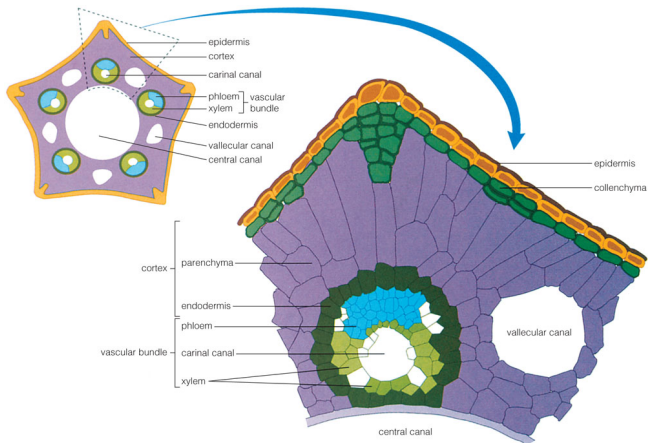
Equisetum giganteum



Equisetum sp. elaters



Artrostele



Psilotopsida

- ▶ Small tropical group of two genera, *Psilotum* and *Tmesipteris* and 7 species
- ▶ Have protostele (like lycophytes), underground long-lived gametophytes but multiflagellate spermatozoa (like horsetails and all ferns). Sporangia unite into **synangia**. Leaves may absent (*Psilotum*) and replaced with **enatia**.
- ▶ Externally remain fossil rhyniophytes, the oldest extinct Pteridophyta

Hawaiian *Psilotum complanatum*



New Zealand *Tmesipteris tannensis* with double synangium



Ophioglossopsida

- ▶ Small group of one family (Ophioglossaceae, 3–4 species in North Dakota) and three genera (*Ophioglossum*, *Botrychium* and *Helminthostachys*) and ≈ 75 species
- ▶ Always have underground rhizome and aboveground bisected leaves: one half is the leaf blade and other half is **sporangiophore**. Gametophytes grow underground
- ▶ Some (*Botrychium*, grape fern) have secondary thickening of underground rhizome.
- ▶ *Ophioglossum vulgatum*, adder's tongue fern, has $2n = 1360$, the largest chromosome number ever.

Ophiloglossum vulgatum, $2n = 1360$ hero



Helminthostachys zeylanicum (Ophioglossopsida)



Botrychium boreale, Kiv islands, White sea (1)



Botrychium boreale, Kiv islands, White sea (2)



Kiv islands, White sea



Marattiopsida

- ▶ Tropical ferns, several genera with ≈ 100 species
- ▶ Biggest ferns, one leaf (frond) could be 6 m length, but stems are smaller. Leaves with stipules.
- ▶ Sporangia (**eusporangia** like in all other Pteridophyta except “true” ferns) usually unite in **synangia**, gametophytes 1-2 cm in diameter, photosynthetic, terrestrial, usually long-lived.
- ▶ In a past, also were dominants of Carboniferous swamp forests.

Angiopteris sp. (Marattiopsida)



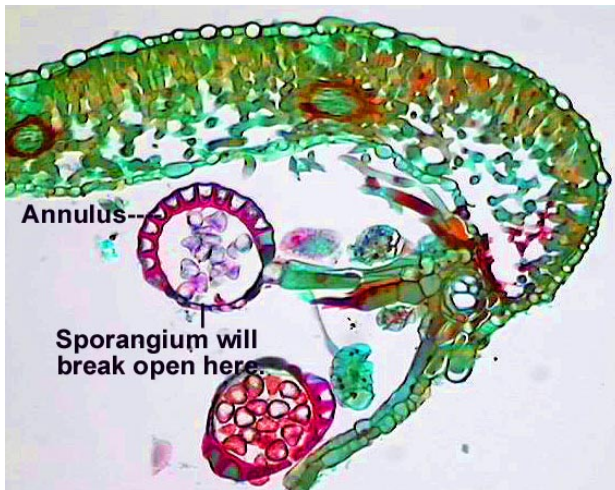
Pteridopsida

- ▶ “True” ferns, more than 10,000 species
- ▶ Leaves are fronds, with apical growth. Young leaves are coiled in **fiddleheads**.
- ▶ Sporangia have one-celled wall (**leptosporangia**) and grouped in sori (often covered with indusium)
- ▶ Gametophyte minute, grow aboveground. Some genera of ferns are heterosporous
- ▶ Bracken, *Pteridium aquilinum*, is the most widespread plant in the world
- ▶ Many ferns have vegetative reproduction originated from asexual (**apospory**) or sexual (**apogamy**)

Leaf of *Woodsia obtusa* (Woodsiaceae) with sori



Sorus, indusium, leptosporangium and annulus



Representatives of Pteridopsida in North Dakota

- ▶ Marsileaceae
 - ▶ *Marsilea*—water fern (heterosporous!)
- ▶ Onocleaceae
 - ▶ *Matteuccia*—ostrich fern
 - ▶ *Onoclea*—sensitive fern
- ▶ Dennstaedtiaceae
 - ▶ *Pteridium*—braken
- ▶ Pteridaceae
 - ▶ *Pellaea*—cliffbrake
- ▶ Woodsiaceae
 - ▶ *Woodsia*—woodsia
- ▶ Cystopteridaceae
 - ▶ *Cystopteris*—bladder fern
- ▶ Athyriaceae
 - ▶ *Athyrium*—lady fern
- ▶ Dryopteridaceae
 - ▶ *Dryopteris*—shield fern
 - ▶ *Ctenitis*—comb fern (not in North Dakota)

Marsilea vestita (Marsileaceae)



Pellaea glabella (Pteridaceae)



Young leaves of bracken (*Pteridium*,
Dennstaedtiaceae) become famous Korean food
“gosari”



- ▶ Pteridophyta consist of two lineages (subphyla): microphyllous lycophytes and megaphyllous molinophytes
- ▶ Leptosporangiate ferns (“true” ferns) have thin sporangia with annulus

Final question (2 points)

Heterosporous vs. homosporous ferns: explain the difference

For Further Reading



O. A.Stevens.

Handbook of North Dakota plants. 3rd edition.

NDSU, 1963.