

Introduction to Botany. Lecture 31

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Outline

1 Questions and answers

2 Life cycles and diversity

- Pteridophyta (ferns and allies): life cycles
- Pteridophyta



1 Questions and answers

2 Life cycles and diversity

- Pteridophyta (ferns and allies): life cycles
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Previous final question: the answer

Name two or more specific features of Vegetabilia life cycle



Previous final question: the answer

Name two or more specific features of Vegetabilia life cycle

- Multicellular gametangia (archegonia and antheridia) and sporangia, oogamy and embryo.

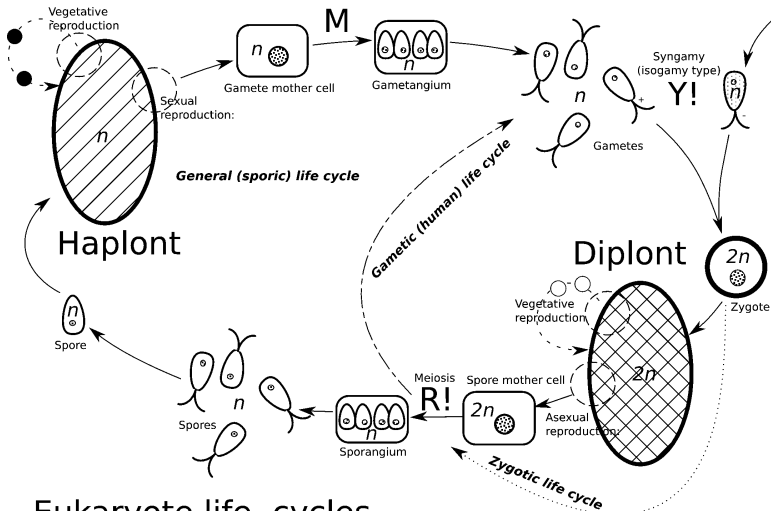


Life cycles and diversity

Pteridophyta (ferns and allies): life cycles



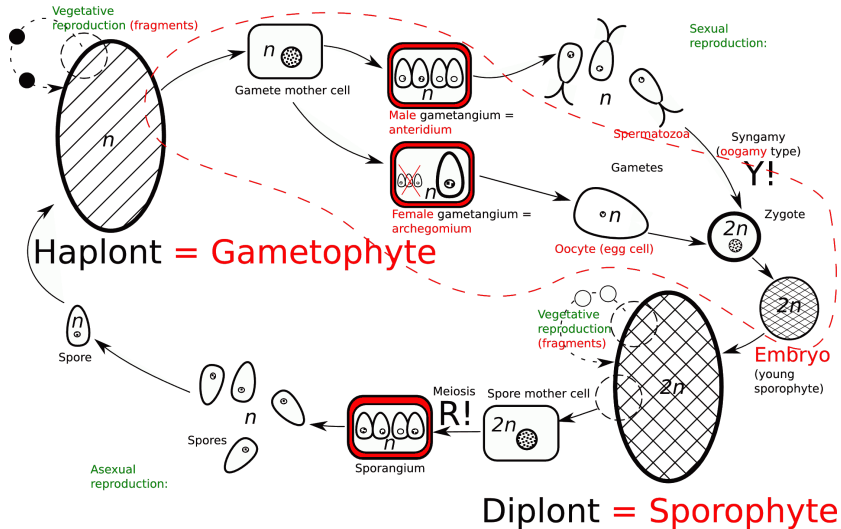
General life cycle



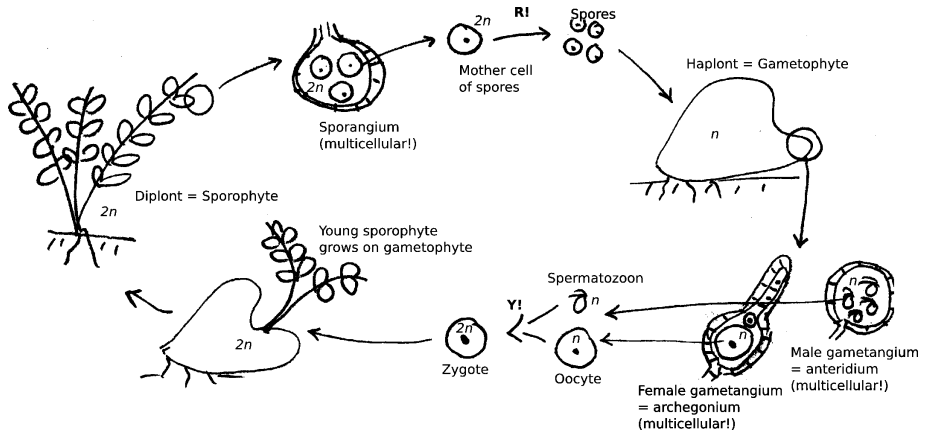
Eukaryote life cycles



Life cycle of land plants: differences



Life cycle of homosporous ferns



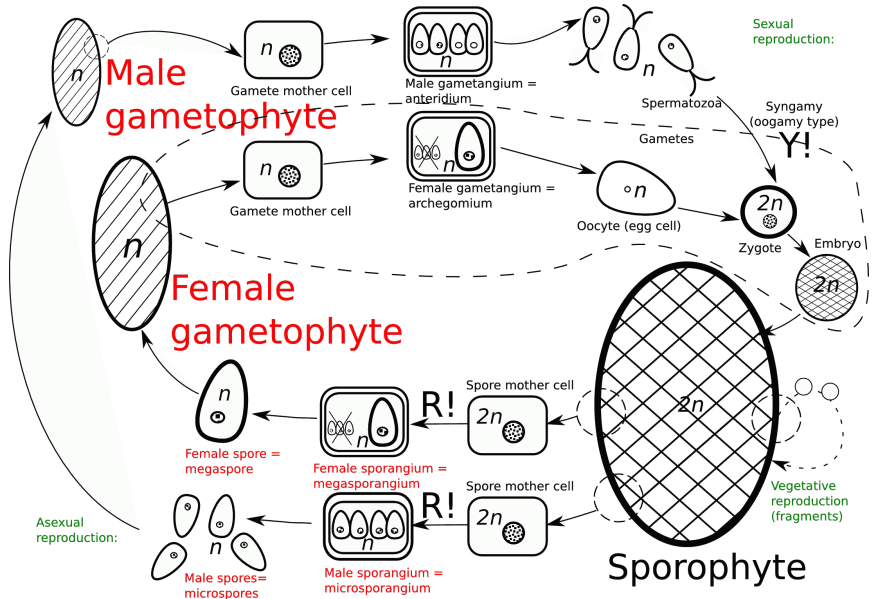
Heterospory

Terms covered:

- Male gametophyte, female gametophyte
- Microspores and microsporangium
- Megaspores and megasporangium



Heterosporic cycle: differences



Life cycles and diversity

Pteridophyta



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 \approx 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* (spike moss) and *Isoëtes* (quillwort) are heterosporous.



Tropical lycophyte, *Huperzia linifolia*



Phylloglossum drummondii, one of smallest lycophytes



Aquatic lycophyte *Isoëtes* sp.



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 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



Strobili and sporangiophores of *Equisetum arvense*



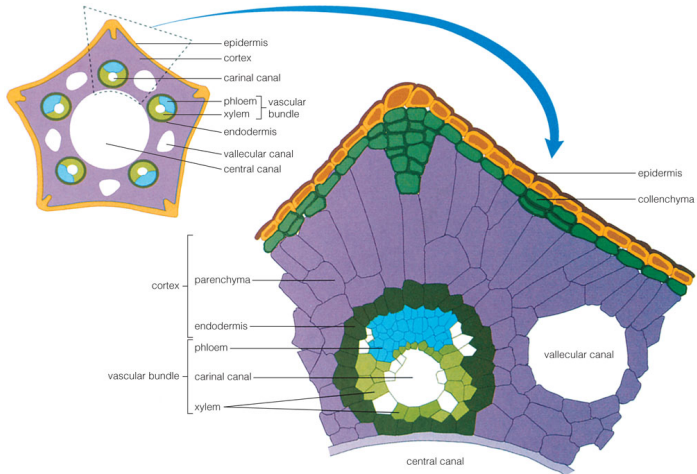
Equisetum giganteum



Equisetum sp. elaters



Artrostele



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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 **syngangia**. 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 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)



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)

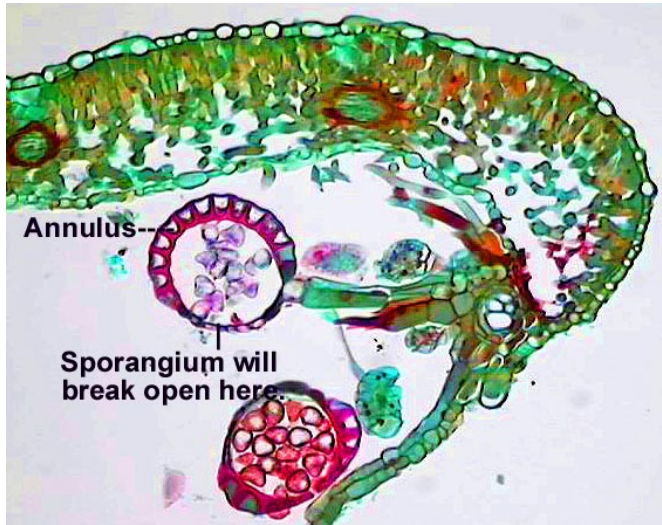


Pteridopsida

- “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 fern, *Pteridium aquilinum*, is the most widespread plant
- Many ferns have vegetative reproduction originated from asexual (**apospory**) or sexual (**apogamy**)



Sorus, indusium, leptosporangium and annulus



Heterosporous fern *Marsilea quadrifolia*, the enemy of leprechaun :)



Young leaves of bracken fern become famous Korean food “gosari”



Final question (2 points)



Final question (2 points)

What are microphylls?



Summary

- Heterosporic plants have two kinds of spores: female (megaspores) and male (microspores)
- Pteridophyta consist of two lineages (subphyla): microphyllous **lycophytes** and megaphyllous **molinophytes**
- Leptosporangiate ferns (“true” ferns) have thin sporangia with annulus



For Further Reading



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