Introduction to Botany. Lecture 30

Alexey Shipunov

Minot State University

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Outline

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Exam-like Monday test (5 points)

1. Which components are characteristic of the brown algae (Phaeophyceae):
   - A chlorophylls *a*, *c*; xanthins
   - B chlorophylls *a*, *b*; carotenoids
   - C chlorophyll *a*, phycobilins

Exam-like Monday test (5 points)

2 The most primitive bryophytes are:

A. true mosses
B. liverworts
C. Anthocerotophytina

Exam-like Monday test (5 points)

3 The correct sequence of moss gametophyte development is:

- A protonema, bud, leafy gametophyte
- B leafy gametophyte, bud, protonema
- C protonema, leafy gametophyte, bud
- D bud, leafy sporophyte, protonema

Exam-like Monday test (5 points)

4 The structure that best fits the description “spore bearing leaves” is:

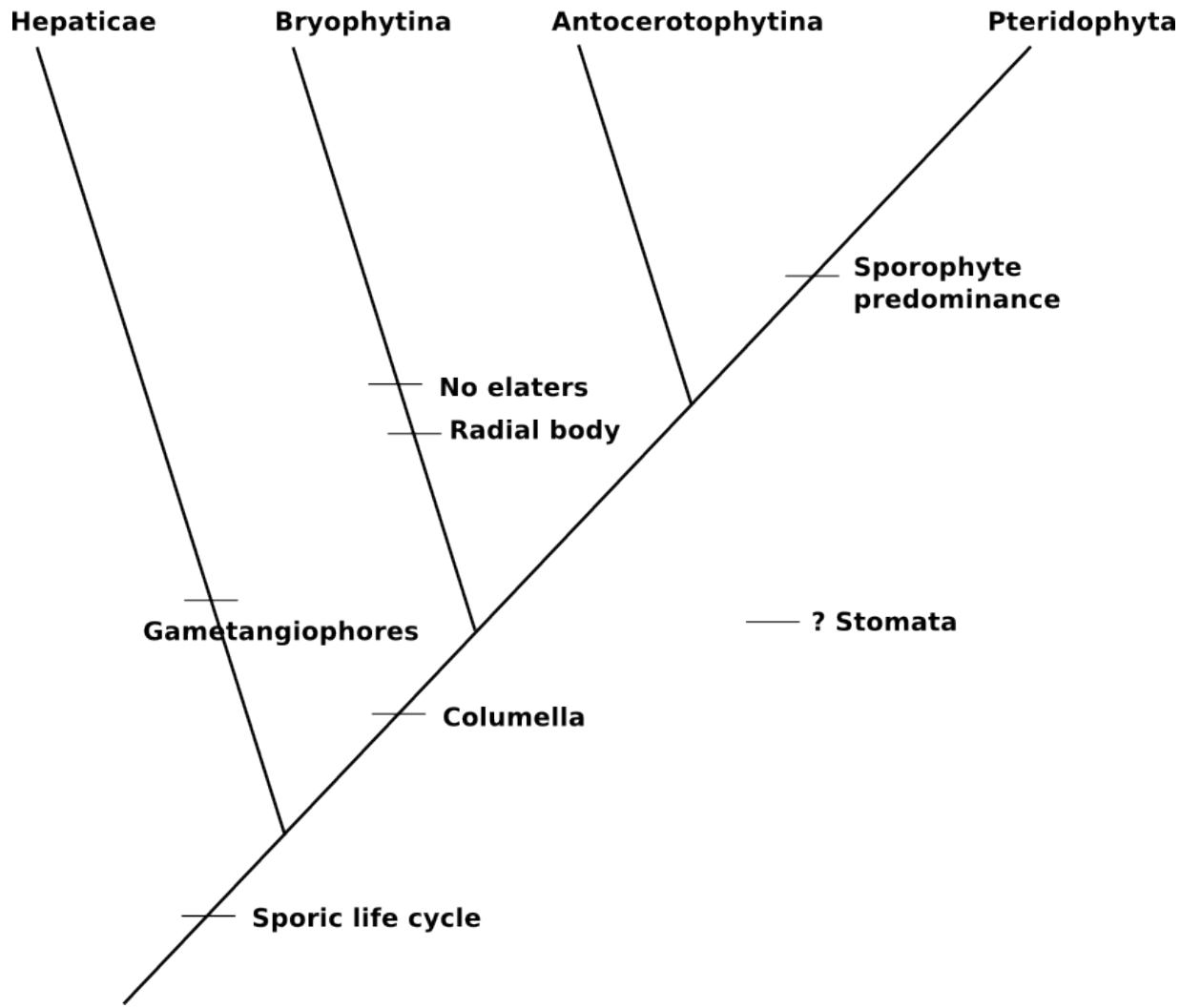
- A microphylls
- B sporophylls
- C megaphylls
- D sporangium
- E enation

Exam-like Monday test (5 points)

5 Which genus is heterosporous?

A *Psilotum*
B *Isoëtes*
C *Equisetum*
D *Lycopodium*

Bryophytes phylogeny



Pteridophyta classes

	1	2	3	4	5	6	7	8	9	10
Lycopodiopsida	1	0	0	1	0	0	1	1	0	0
Equisetopsida	0	1	0	1	0	1	0	1	0	1
Psilotopsida	0	1	1	0	0	0	0	0	0	1
Ophioglossopsida	0	1	0	0	0	0	1	0	0	0
Marattiopsida	0	1	1	0	0	1	0	1	1	0
Pteridopsida	1	1	0	0	1	1	0	1	1	0

1 Big (> 1,000 species); 2 Megaphyllous; 3 Synangia; 4 Strobilus; 5 Leptosporangia; 6 Terrestrial gametophyte; 7 Biflagellate sperm; 8 Roots; 9 Fronds; 10 Reduced leaves (enatia and scales). Characters are not necessary relevant to all members of class.

Marattiopsida

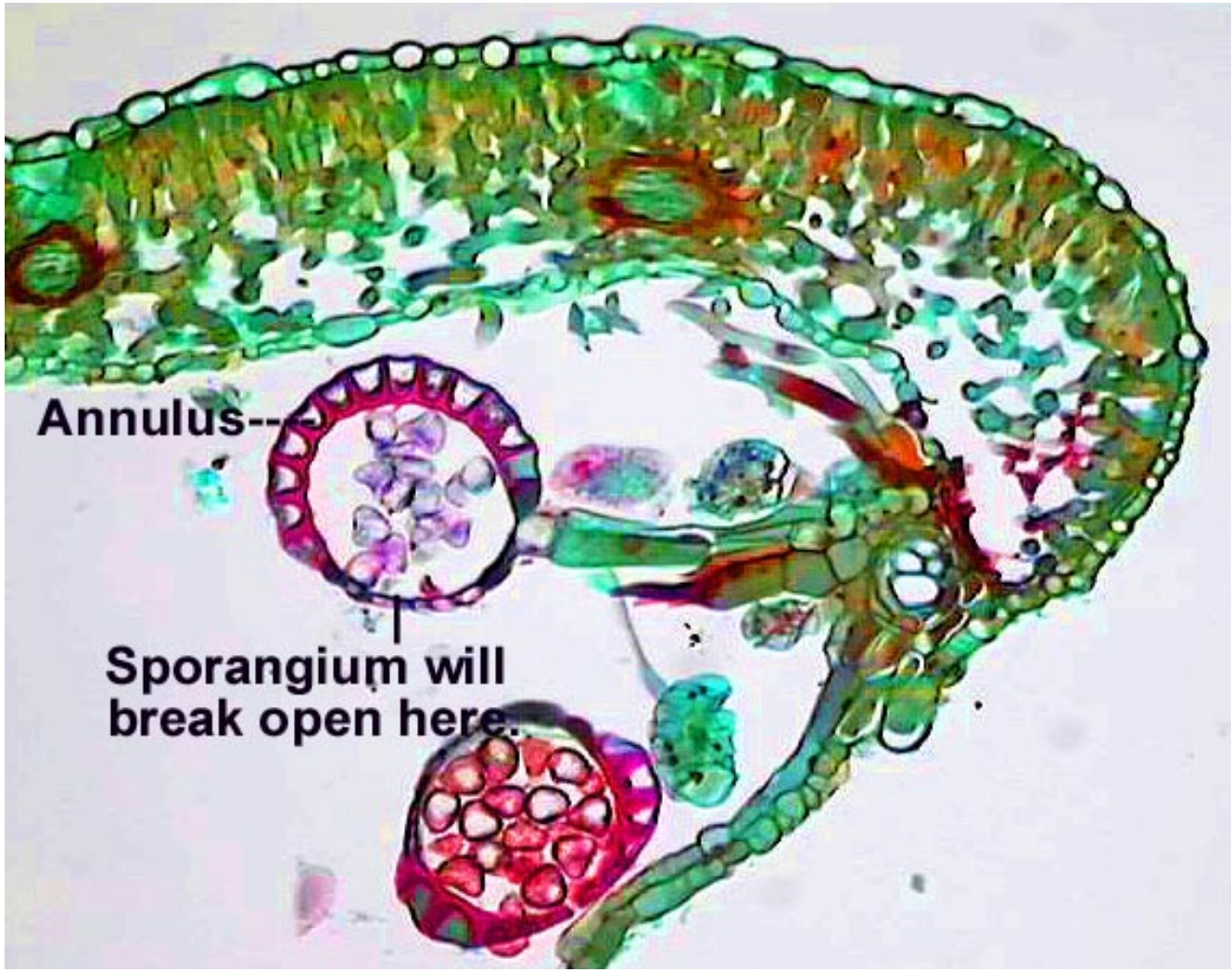
- Tropical ferns, several genera with $\approx$ 100 species
- Biggest ferns, one leaf (frond) could be 6 m length, but stems are smaller. Leaves with stipules.
- Sporangia (**eusporangia** like in all other Pteridophyta except “true” ferns) usually unite in **synangia**, gametophytes 1-2 cm in diameter, 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 acquilinum*, 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”

Spermatophyta: seed plants

- $\approx$ 600 species of non-angiosperms and $\approx 250,000$ species of angiosperms
- Sporic life cycle with sporophyte predominance and **seed**
- Gametophyte is reduced to cells inside ovule or inside pollen grain. Minimum number of cells is 3 for male gametophyte (pollen grain) and 4 for female gametophyte (embryo sac of angiosperms). Anteridia are reduced. In angiosperms and Gnetopsida, archegonia are also reduced.
- Sporophyte always starts development from embryo located inside nutrition tissue, endosperm$_1$ (female gametophyte) or endosperm$_2$ (second embryo)
- Have axillary buds
- Homoiohydric plants (same as ferns)
- Have secondary thickening

Spermatophyta classes

- **Ginkgoopsida**, ginkgo class
- **Cycadopsida**, cycads
- **Pinopsida**, conifers
- **Gnetopsida**, gnetophytes or chlamydosperms
- **Angiospermae**, or Magnoliopsida, flowering plants

Ginkgoopsida

- Smallest class, only one species (!), Chinese tree *Gigkgo biloba* which became extinct several thousand years ago but saved as a ”church tree”.
- Distinctive triangle-shaped leaves with dichotomous venation
- Ovules are solitary or paired; microsporangia are in catkin-like structures; has sexual chromosomes (!)
- Pollen grains produce two mutli-flagellate spermatozoa which swim to large oocyte
- Seeds are fruit-like (generally edible), become ripe laying on a ground for a long time
- Almost no phytophagous insects damage *Ginkgo* leaves; the fungal symbiont of *Ginkgo* also belongs to separate class inside basidiomycetes, Bartheletiomycetes.

Ginkgo biloba ovules

Ginkgo biloba male organs

Ginkgo biloba seeds

Cycadopsida

- Two families, dozen genera and $\approx$ 300 species distributed mostly in tropics
- Palm-like plants, with large (and usually very rigid) pinnate leaves
- Stem structure is not similar to conifers and *Ginkgo*; cycads have large pith and anomalous secondary thickening via multiple cambium rings
- Ovules are attached to modified leaves (sporophylls) and usually gathered in large upright cones; microsporangia are always in cones
- Also have multi-flagellate spermatozoa, archegonia and large oocyte
- Large seeds are animal-distributed; life cycle is extremely slow (several years from initiation of cone to germination of seed).

Cycadopsida families

- Two families, sometimes even placed in different orders:
  - **Cycadaceae**, whith only genus *Cycas*. They do not have female cones, ovules are attached to leaves which are not radically modified. Leaves have fiddleheads (same in ferns!).
  - **Zamiaceae**, with all other genera (*Zamia integrifolia* is native to USA). Have female cones.

Cycas sp.: young leaflets form fiddleheads

Male *Cycas* sp. in dry season

Cycas sp. seeds

Encephalartos gratus (Zamiaceae)

Zamia integrifolia (Zamiaceae)

Summary

- Leptosporangiate ferns (“true” ferns) have thin sporangia with annulus
- Primitive seed plants, **Ginkgoopsida** and **Cycadopsida** have well-developed leaves, archegonia and spermatozoa and do not have pollen tube

For Further Reading

Th. L. Rost, M. G. Barbour, C. R. Stocking, T. M. Murphy.
Plant Biology. 2nd edition.
Thomson Brooks/Cole, 2006.
Chapter 24.