

Introduction to Botany. Lecture 34

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1 Questions and answers

2 Seed plants

- Seed
- Diversity of seed plants



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- 2 Seed plants
 - Seed
 - Diversity of seed plants



Previous final question: the answer

What is the male gametophyte of seed plants?



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What is the male gametophyte of seed plants?

- Pollen grain
- Structure that performs pollination
- ...



Seed plants

Seed

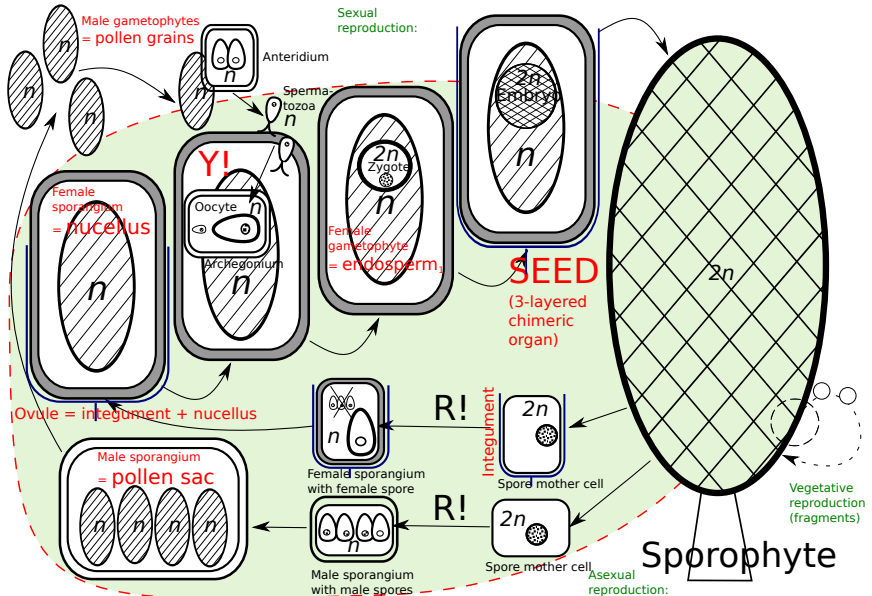


Origin of seed

- **“Dinosaur problem”**: without control on the *r*-strategic gametophyte, *K*-strategic tree sporophyte cannot guarantee its reproduction
- **Seed is the result of enforced control of sporophyte over gametophyte**
- Growing of gametophytes, syngamy (fertilization) and growing of daughter sporophyte—everything happens **directly on mother sporophyte**



Seed plant life cycle



eSeed plants have life cycle where almost all stages happen on mother sporophyte

Terms covered:

- Ovule and integument
- Nucellus and pollen sac
- Pollen grains and endosperm
- Seed



The seed

- Seed is a **chimeric organ** with three layers: (1) mother sporophyte tissue (integument + nucellus), (2) female gametophyte tissue (endosperm) and (3) daughter sporophyte (embryo)
- Biggest disadvantages of having seed are: (a) low probability of fertilization (pollination needed) and (b) overall slowness of cycle



Seed plants

Diversity of seed plants



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 Gnetales, archegonia are also reduced.
- Sporophyte always starts development from embryo located inside nutrition tissue, endosperm₁ (female gametophyte) or endosperm₂ (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 *Ginkgo 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 multi-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 ≈ 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, with 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)



Final question (2 points)



Final question (2 points)

What are integument and nucellus?



Summary

- Seed plants have compact life cycle where almost all stages happen on mother sporophyte



For Further Reading



A. Shipunov.

Introduction to Botany [Electronic resource].

2010—onwards.

Mode of access:

http://ashipunov.info/shipunov/school/biol_154



Th. L. Rost, M. G. Barbour, C. R. Stocking, T. M. Murphy.

Plant Biology. 2nd edition.

Thomson Brooks/Cole, 2006.

Chapter 24.

