

Introduction to Botany. Lecture 36

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Outline

- 1 Questions and answers
- 2 Spermatophyta, seed plants
 - Class Angiospermae
- 3 Angiosperms
 - Classification of angiosperms

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Previous final question: the answer

Who is the most primitive seed plant? Why?

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- *Ginkgo*, or cycads: open ovules, spermatozoa, no pollen tube, fern-like features

Spermatophyta, seed plants

Class Angiospermae

Angiosperms in general

- Names: Angiospermae (“angion” is a “bottle”), Magnoliopsida, angiosperms, flowering plants
- 250,000 species, more than 90% of all plants diversity, the diversity is comparable with mollusks (200,000) and arthropods ($\approx 1,000,000$) and much more than fungi (75,000) and vertebrates (30,000)
- ≈ 300 families and ≈ 40 orders
- Grow everywhere except open ocean and central Antarctic

Diagnostic characters of angiosperms

- Flower
- Angiospermy
- Stigma
- Double fertilization
- Fruit
- Parcellation
- In all, any of these characters taken alone is not unique, but together they delimit the group

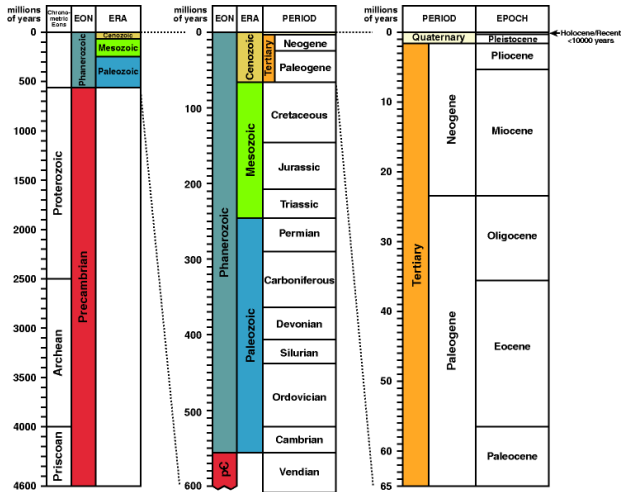
Origin of angiosperms

- Morphologically, angiosperms are similar to Gnetales but molecular data deny this similarity and place angiosperms as outstanding branch of all seed plants
- Transitional forms are still not discovered; candidates are either too close to angiosperms or too far from them
- True angiosperm-like structures appear from late Jurassic, shortly (10–20 mya) after they become dominant
- Several theories are trying to explain the origin of angiosperms and (separately) origin of flower and angiospermy:

Origin of angiosperms: hypotheses

- **Pseudanthial** theories state that flowers are result of integration of unisexual structures similar to *Ephedra*
- **Euanthial** theory insists on flower origin from more complicated bisexual generative shoots
- **Herbaceous** theory explains the rapid evolution of angiosperms and main factors of their transition from gymnosperms
- **Angiospermisation** theory states that many characters of angiosperms appeared independently in multiple lineages of gymnosperms, but only one group was successful

Geological time scale



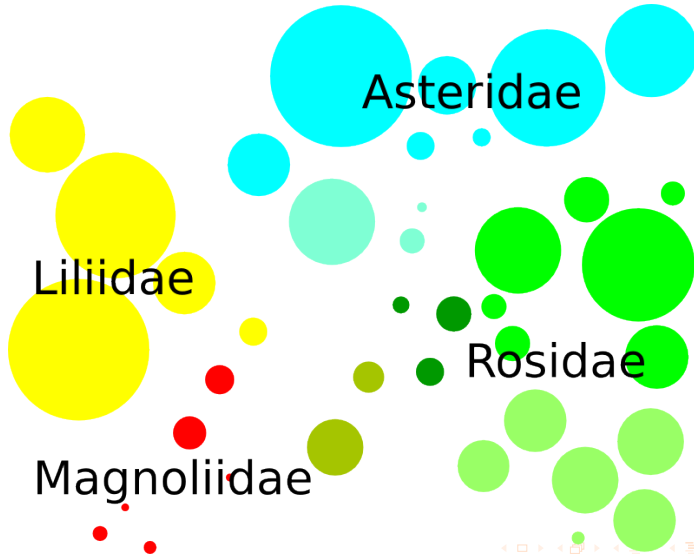
Angiosperms

Classification of angiosperms

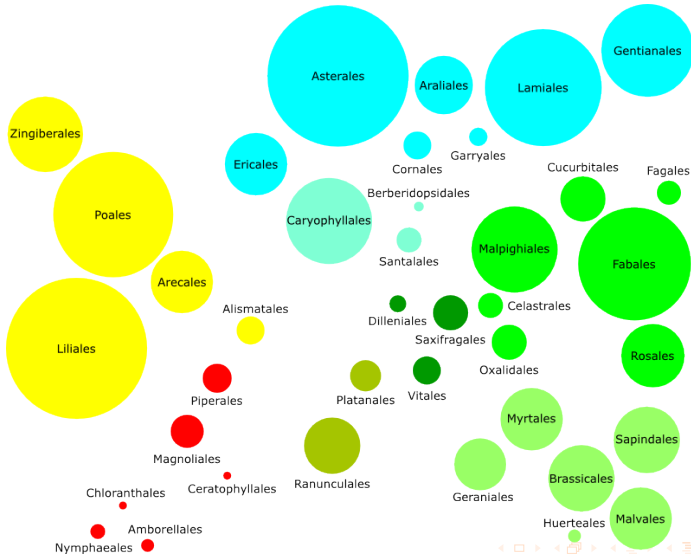
Milestones of angiosperm classification

- **Carolus Linnaeus** (XVIII century) gathered all available information, established species and genera
- **Michel Adanson** and **Antoine Jussieu** (end of XVIII) established plant families
- **John Lindley** (middle of XIX) invented plant orders
- **Alfred Engler** and **Charles Bessey** (XIX-XX) started evolutionary classifications
- **Arthur Cronquist, Rolf Dahlgren, Armen Takhtajan** and **Robert Thorne** (XX-XXI) developed different well-argued contemporary classifications based on morphology
- From 1993, **Angiosperm Phylogeny Group** (APG) as well as several individuals started to employ molecular characters. Luckily, one of the most accessible chloroplast DNA genes, *rbcL*, appeared to be extremely useful for tracing changes on family and order levels

Taxonomic map of angiosperms: subclasses



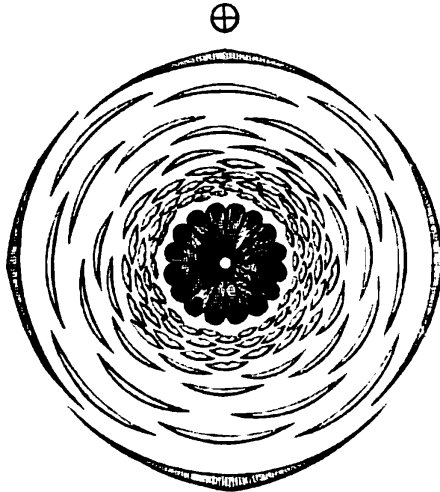
Taxonomic map: orders



Paraphyletic subclasses

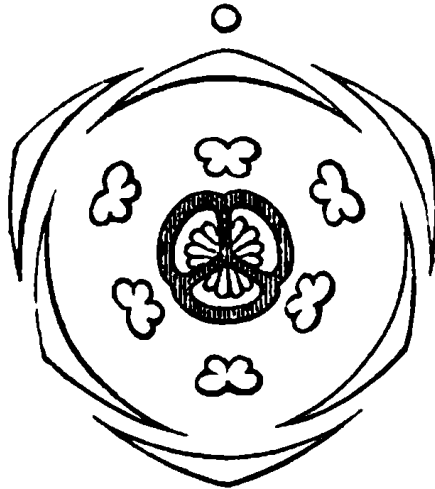
- Magnoliidae and Rosidae are *paraphyletic*: they are ancestors of two other subclasses
- Situation is similar to the reptiles who are ancestors of mammals and birds

Magnoliidae portrait



Nymphaea sp. (water-lily)

Liliidae portrait



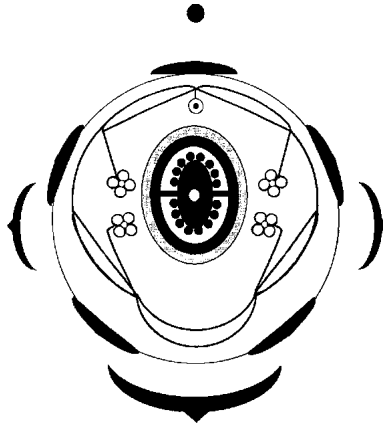
Acorus calamus (calamus, or sweet flag)

Rosidae portrait



Geranium sp. (wild geranium)

Asteridae portrait



Penstemon sp. (beard-tongue)

Evolutionary history of subclasses

- **Magnoliidae** are historically most ancient, first fossils appear in Late Jurassic. They dominate fresh waters and maybe, filled lower floors of forests in Cretaceous
- **Liliidae** appeared in Lower Cretaceous, they started to dominate grasslands in Neogene
- **Rosidae** appeared in Lower Cretaceous, they made broad-leaf forests in Late Cretaceous and onwards
- **Asteridae** originated in Middle Cretaceous, they started a rapid divergence in Paleogene

Summary

- Angiosperm characters are not unique but taken together they are able to distinguish the group
- From four subclasses of angiosperms, two (Magnoliidae and Rosidae) are paraphyletic

Final question (3 points)

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Why angiosperms conquered the land?

For Further Reading



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Stern's introductory plant biology. 12th edition.
McGraw-Hill, 2011.
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Th. L. Rost, M. G. Barbour, C. R. Stocking, T. M. Murphy.
Plant Biology. 2nd edition.
Thomson Brooks/Cole, 2006.
Chapter 25.