

# Systematic Botany. Lecture 34

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# Outline

## Questions and answers

### Classification of angiosperms

## Basal angiosperms

### Magnoliidae—"ANTITA" clade

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## Questions and answers

Classification of angiosperms

## Basal angiosperms

Magnoliidae—“ANTITA” clade

## Previous final question: the answer

Why angiosperms conquered the land?

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Why angiosperms conquered the land?

- ▶ They filled ecological niche of seed herbs because of optimized life cycle
- ▶ Then they expanded to the tree level again because they blocked succession pathways («cenophobe» theory)

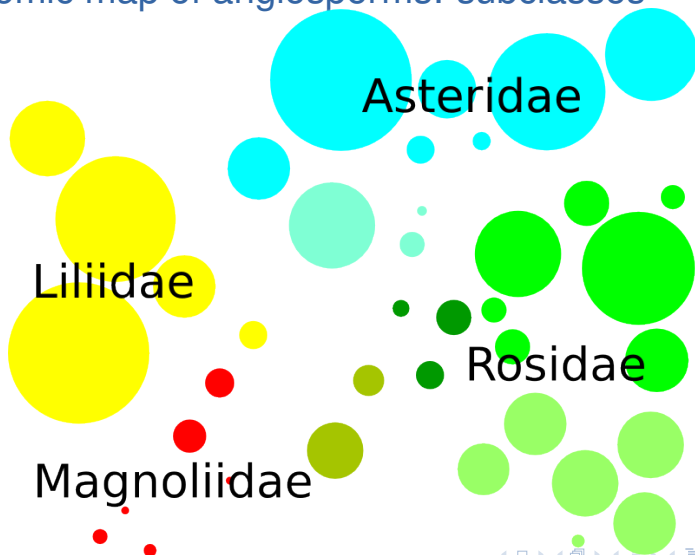
# Questions and answers

## Classification of angiosperms

## Milestones of angiosperm classification

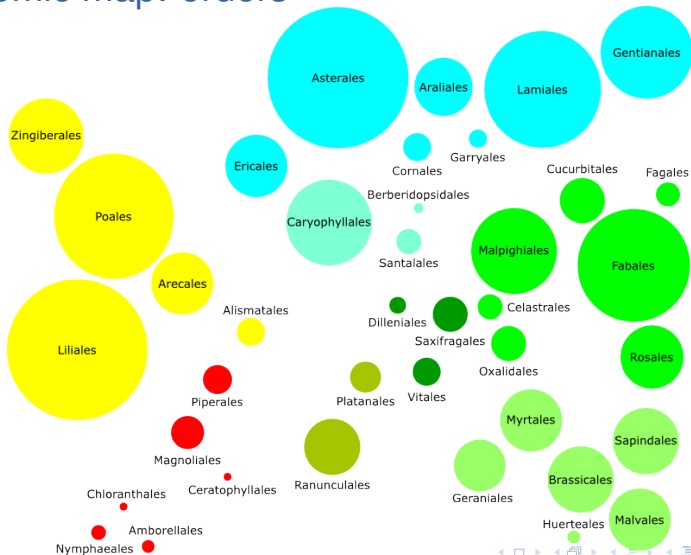
- ▶ **Carolus Linnaeus** (XVIII century) gathered all available information, established species and genera
- ▶ **Michel Adanson** and **Antoine Jussieu** (end of XVIII) established plant families
- ▶ **John Lindley** (middle of XIX) invented plant orders
- ▶ **Alfred Engler** and **Charles Bessey** (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

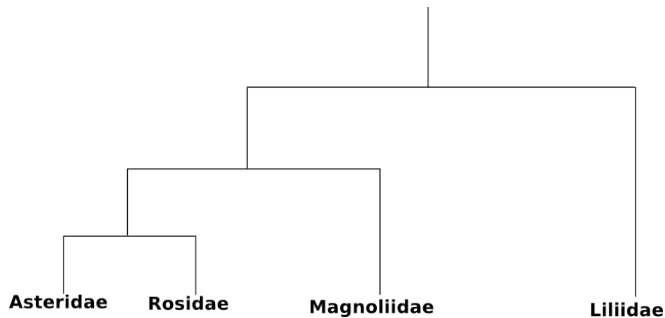




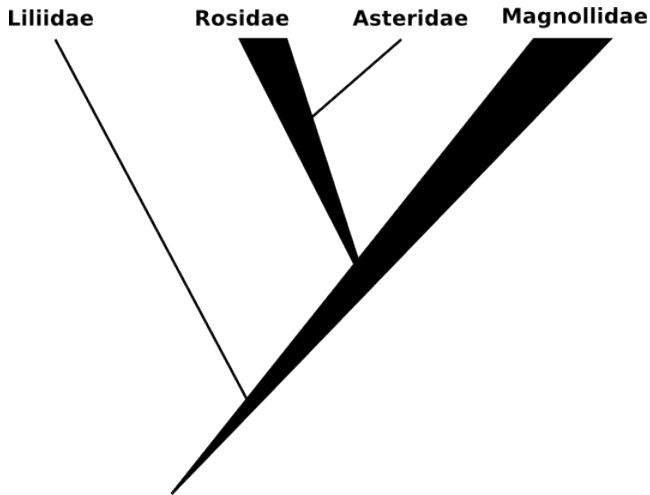
# Taxonomic map: orders



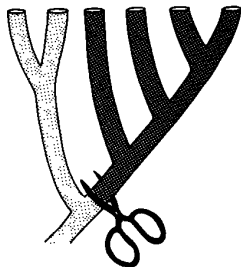
# Dendrogram of subclasses



## Cladogram of subclasses



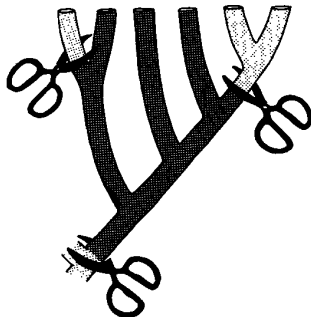
# Paraphyly



**Monophyletic**

one and  
only one cut

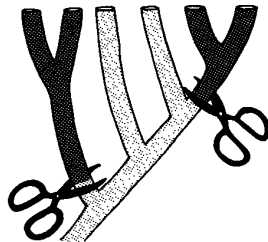
One branch



**Paraphyletic**

one cut below the  
group and one or more  
cuts higher up

A piece of a branch

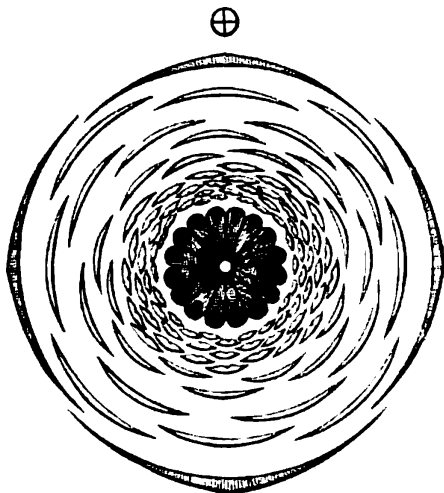


**Polyphyletic**

more than one cut  
below the group

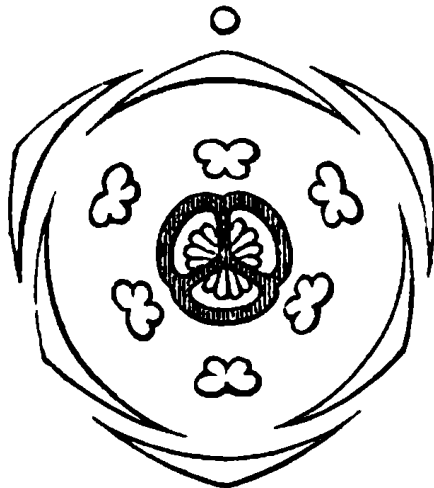
More than one  
piece of a branch

## Magnoliidae portrait



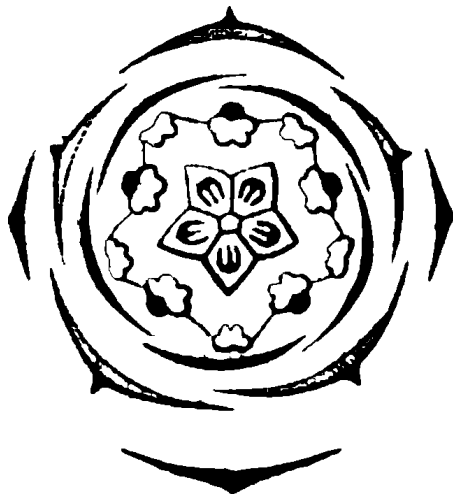
*Nymphaea* sp. (water-lily)

## Liliidae portrait



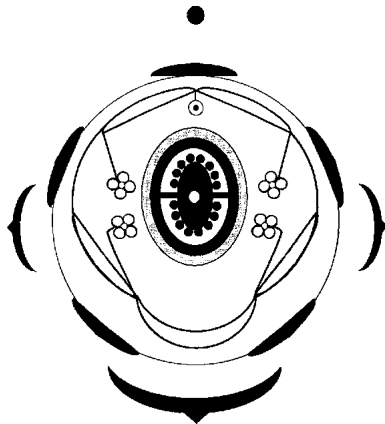
*Acorus calamus* (calamus, or sweet flag)

## 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

# Basal angiosperms

## Magnoliidae—"ANTITA" clade

## *Archaeofructus*

- ▶ Fossil water plant from lower Cretaceous of China
- ▶ Very primitive fructifications which are not yet compacted in flower
- ▶ Multiple free carpels, paired stamens

## *Archaeofructus* reconstruction



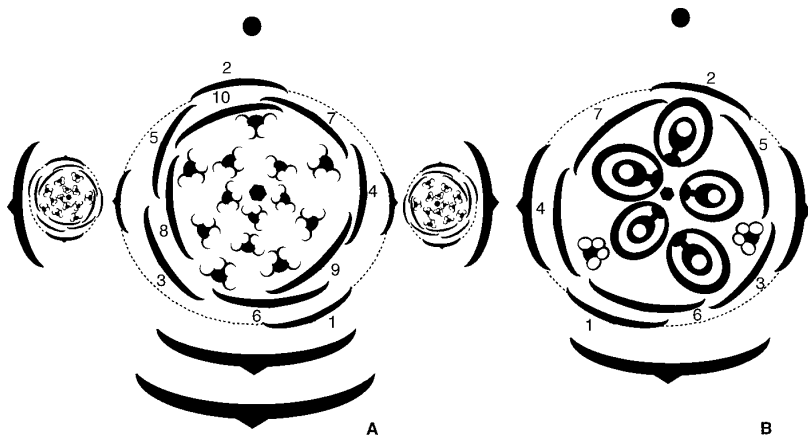
## *Amborella*

- ▶ Small forest shrub of New Caledonia (big island in Pacific ocean)
- ▶ Have irregular flowers, stilar canal, unusual embryo sac (with three synergids and no antipods)

## *Amborella*, branch with male flowers



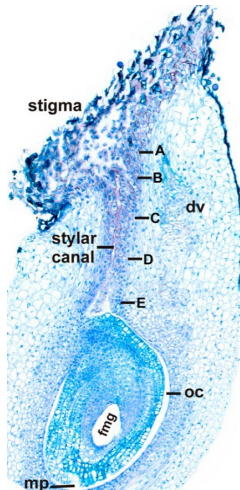
## *Amborella*, diagram and formula



$\partial P_{9-11} A_{12-21}; \partial P_{7-8} St_2 \underline{G_{4-6}}$   
 (where "St" are staminodes, non-functional stamens)

- └ Basal angiosperms
  - └ Magnoliidae—"ANTITA" clade

## *Amborella* stylar canal





## *Trithuria*

- ▶ Wetland and water plants from south Asia and Australia
- ▶ Have unusual structure of fructifications ("non-flowers") where male organs typically positioned in the center of ?inflorescence/flower

## *Trithuria* general view



## *Trithuria* fructification



# Summary

- ▶ From four subclasses of angiosperms, two (Magnoliidae and Rosidae) are paraphyletic
- ▶ Fossil *Archaeofructus*, *Amborella* and *Trithuria* are most primitive angiosperms

## Final question (3 points)

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Which of four subclasses is basal? Why?

- └ Basal angiosperms
  - └ Magnoliidae—"ANTITA" clade

## For Further Reading



Margulis and Chapman. 2009.

*Kingdoms and domains: an illustrated guide to the phyla of life on Earth.* 4th edition.