

Introduction to Botany. Lecture 38

Alexey Shipunov

Minot State University

December 8, 2014



1 Questions and answers

2 Seed plants

- Flower
- Flower development: ABC model
- Primitive flowers
- Four subclasses of angiosperms
- Pollination
- Inflorescences



1 Questions and answers

2 Seed plants

- Flower
- Flower development: ABC model
- Primitive flowers
- Four subclasses of angiosperms
- Pollination
- Inflorescences



Previous final question: the answer

What is a double fertilization?



Previous final question: the answer

What is a double fertilization?

- 1st sperm cell (1st spermatium, n) + egg cell (n) = zygote ($2n$)
- 2nd sperm cell (2nd spermatium, n) + central cell ($2n$ or sometimes n) = mother cell of endosperm₂ ($3n$ or sometimes $2n$)

In all, the second fertilization is a **signal** that first fertilization has been occurred. Endosperm₂ develops from the “signalized” female gametophyte.



Seed plants

Flower



Definition of flower

- Compact generative shoot (= floral unit, FU) with three zones
- Three main zones: sterile (perianth), male (androecium) and female (gynoecium)
- General characters: sex, merosity, symmetry, position of gynoecium

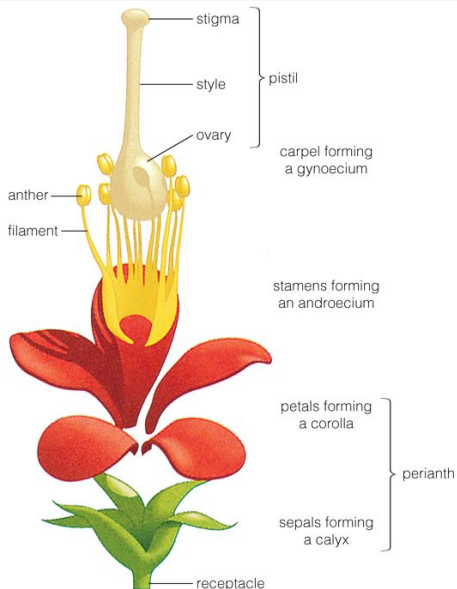


Structure of flower

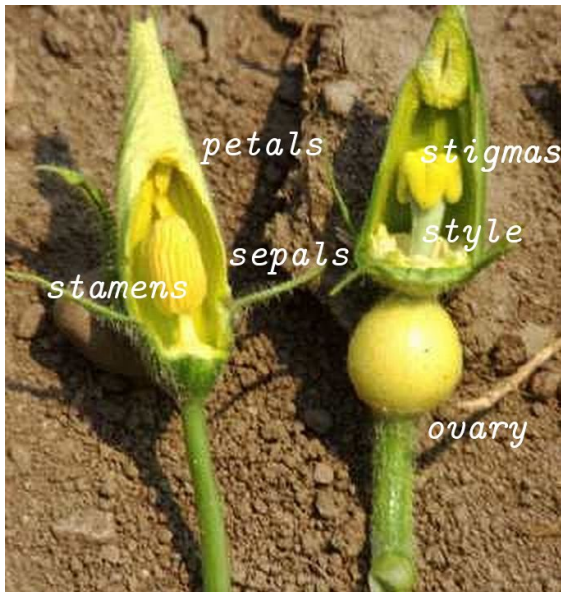
- Perianth (consists of tepals)
 - Frequent case: double perianth
 - Calyx (consists of sepals)
 - Corolla (consists of petals)
- Androecium (consists of stamens)
 - Filament
 - Anther (consists of pollen sacs)
- Gynoecium (consists of pistils)
 - Ovary (consists of carpels)
 - Style
 - Stigma



Structure of flower



Pumpkin (*Cucurbita pepo*) flower



Seed plants

Flower development: ABC model

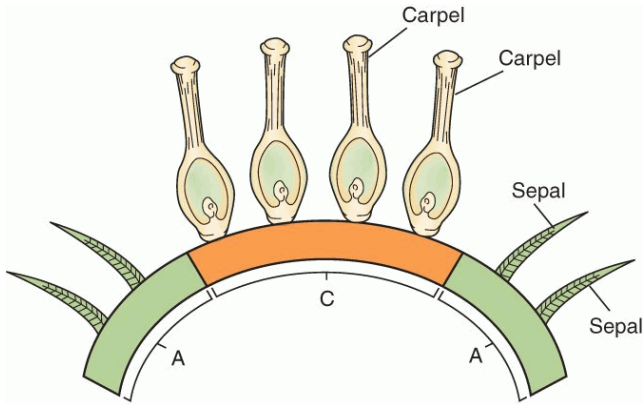


ABC-genes

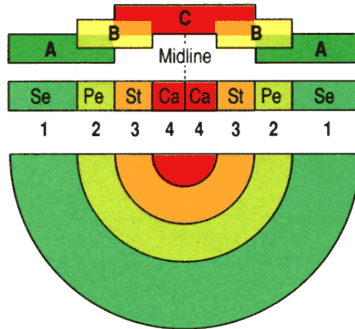
- There are 3 classes of genes expressed in overlapping, concentric rings.
- The A class (like *apetala2* gene) is expressed in the outermost ring and C (like *agamous*) is expressed in the center; B (e.g., *apetala3*) is expressed at the boundary of A and C:
 - A alone → calyx
 - A + B → corolla
 - C + B → androecium
 - C alone → gynoecium



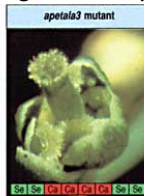
A and C genes “make” sepals and pistils



B genes “transform” them into petals and stamens



Corresponding *Arabidopsis* mutants:



Seed plants

Primitive flowers

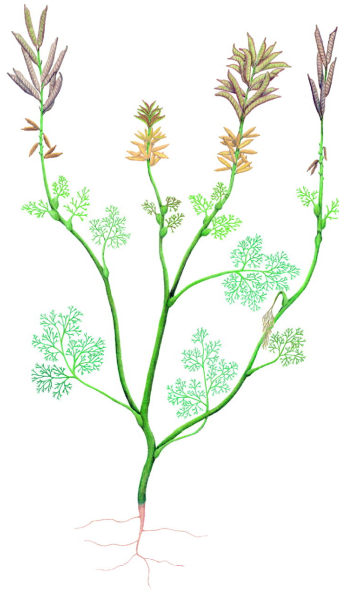


Archaeofructus

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



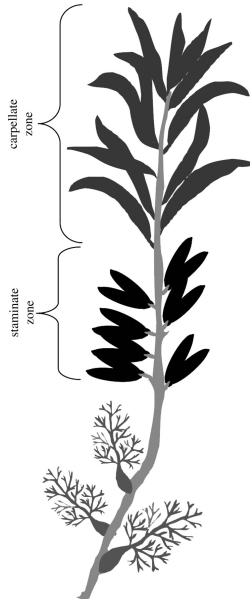
Archaeofructus reconstruction



Archaeofructus reconstruction, 3D



Archaeofructus, scheme of “flower”



Amborella

- Small forest shrub of New Caledonia (big island in Pacific ocean)
- Have irregular flowers, stylar canal, unusual embryo sac (5 cells)



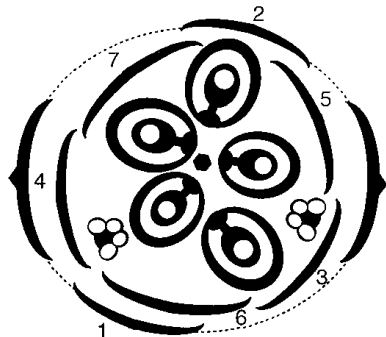
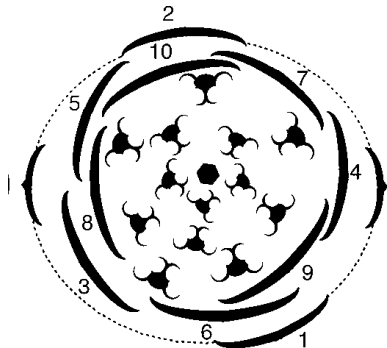
Amborella, branch with male flowers



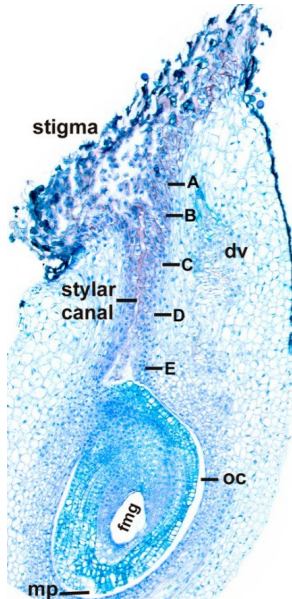
Amborella, male and female flowers



Amborella, diagrams of male and female flowers



Amborella stylar canal

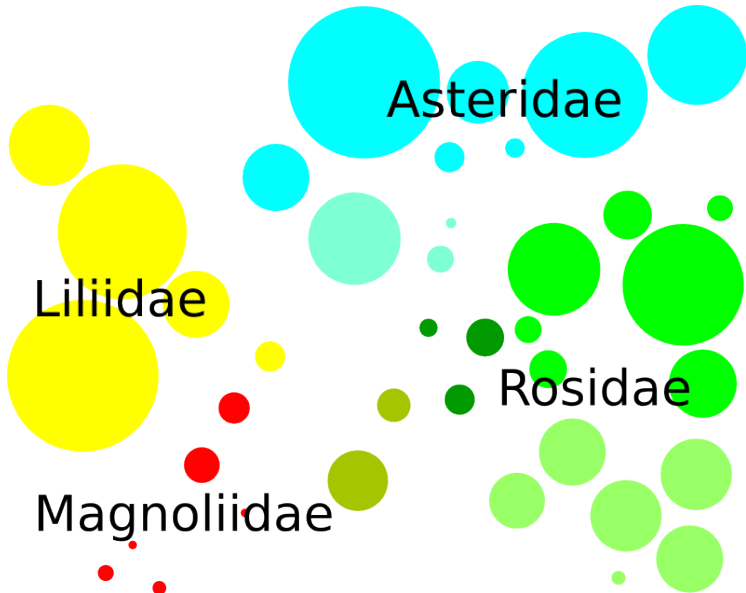


Seed plants

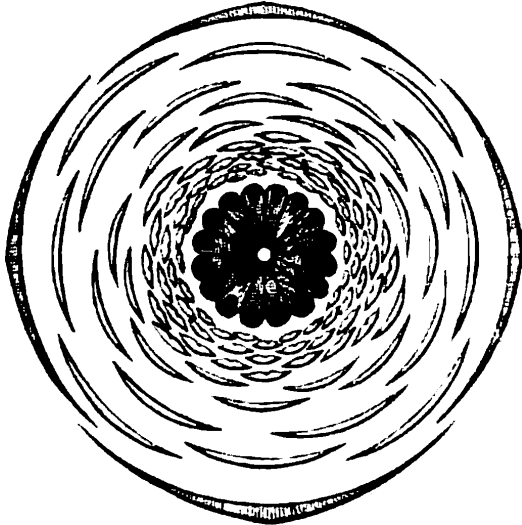
Four subclasses of angiosperms



Angiosperms: subclasses and orders



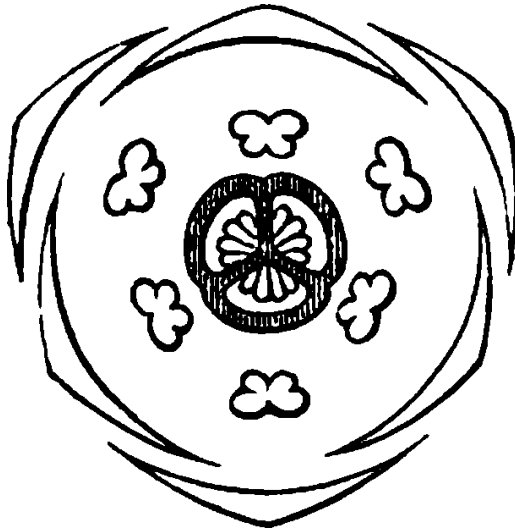
Magnoliidae portrait



Nymphaea sp. (water-lily): multiple, disorganised



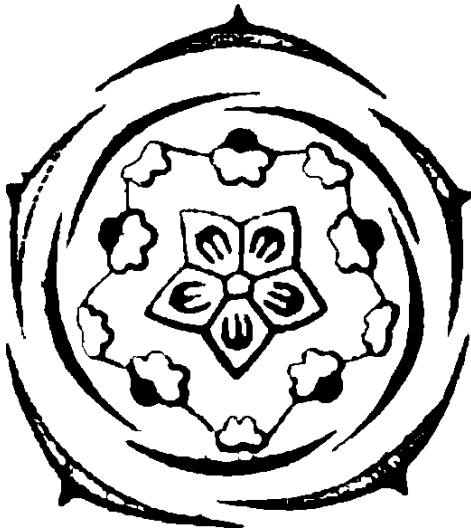
Liliidae portrait



Acorus calamus (calamus, or sweet flag): trimerous



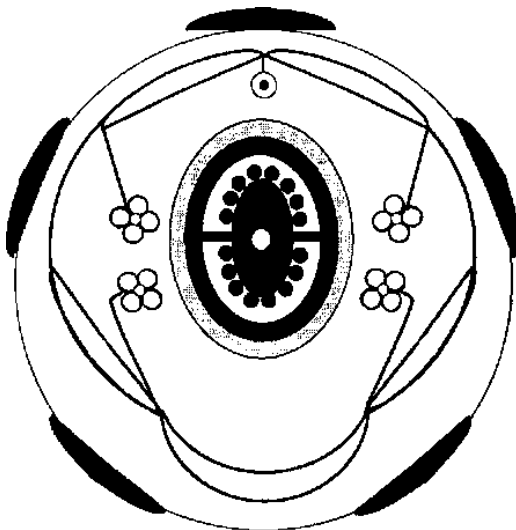
Rosidae portrait




Geranium sp.: pentamerous or tetramerous, petals free



Asteridae portrait



Penstemon sp. (beard-tongue): petals fused, more petals than carpels 

Seed plants

Pollination



How to avoid pollination: apomixis

- Apomixis is a reproduction with reproductive organs but without fertilization
- **Apospory**: embryo develops from maternal diploid tissue, without meiosis; here asexual reproduction becomes vegetative
- **Apogamy** (i.e., parthenogenesis): embryo develops from unfertilized gamete after diploidization; sexual reproduction becomes vegetative



Pollination

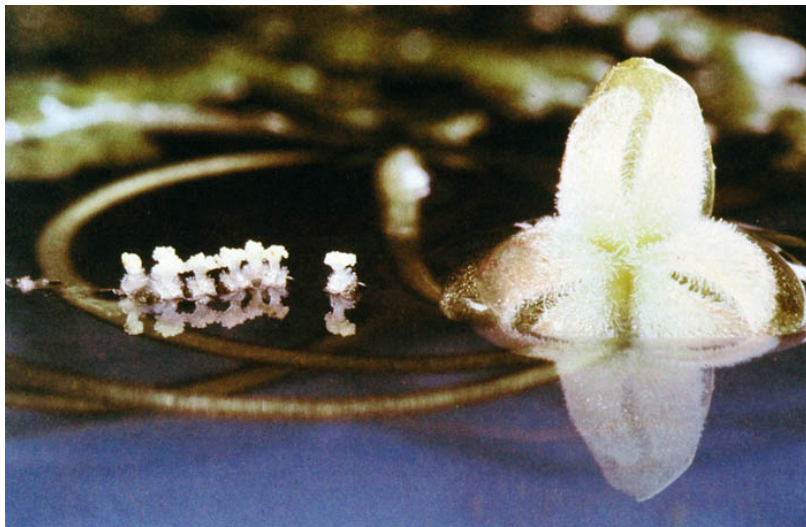
- Self-pollination (only slightly better than apogamy)
- Cross-pollination: abiotic (gravity, wind, water) and biotic (insects, birds, bats, sometimes even possums)
- Every pollination type has associated **pollination syndrome**



Wind pollination: hazelnut



Water pollination: vallisneria



Bat pollination: cacti



Possum pollinator: Australian Myrtaceae



Seed plants

Inflorescences



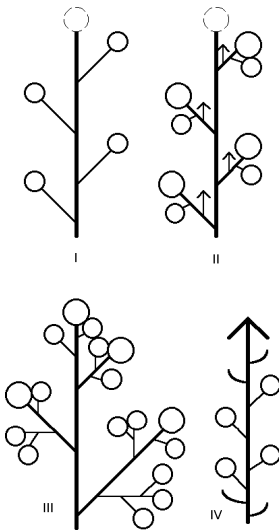
Types of inflorescences

Inflorescence is an isolated generative shoot bearing flowers

- Model I. Raceme and its derivatives
 - Simple: raceme (developed main axis, developed lateral axes: 11), spike/catkin (developed main axes, reduced lateral axes: 10), umbel (01), head (00)
 - Compound: compound raceme (11/11), compound umbel (01/01) etc.
- Model II. Thyrsus and its derivatives
 - Reduced (cymes): dichasium, cincinnus (scorpioid inflorescence) etc.
 - Thyrses in a strict sense
- Model III. Closed panicle (also umbel-like panicles)
- Model IV. Intercalary inflorescences



Models of inflorescences



Final question (2 points)



Final question (2 points)

What is a flower?



Summary

- **Flower** is a compact three-zoned generative shoot
- Three main zones of flower: sterile (**perianth**), male (**androecium**) and female (**gynoecium**)
- **ABC-genes** determine the fate of cells which are forming flower
- **Inflorescence** is an isolated generative shoot bearing flowers



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.

Chapters 13 and 25.

