

Introduction to Botany. Lecture 38

Alexey Shipunov

Minot State University

December 5, 2012



Outline

- 1 Questions and answers
- 2 Diversity of Magnoliopsida
 - Subclasses
- 3 Rosidae, or rosids
 - Leguminosae, or Fabaceae—legume family
- 4 Asteridae, or asterids
 - Compositae, or Asteraceae—aster family
- 5 Liliidae, or monocots
 - Gramineae, or Poaceae—grass family



Outline

- 1 Questions and answers
- 2 Diversity of Magnoliopsida
 - Subclasses
- 3 Rosidae, or rosids
 - Leguminosae, or Fabaceae—legume family
- 4 Asteridae, or asterids
 - Compositae, or Asteraceae—aster family
- 5 Liliidae, or monocots
 - Gramineae, or Poaceae—grass family



Outline

- 1 Questions and answers
- 2 Diversity of Magnoliopsida
 - Subclasses
- 3 Rosidae, or rosids
 - Leguminosae, or Fabaceae—legume family
- 4 Asteridae, or asterids
 - Compositae, or Asteraceae—aster family
- 5 Liliidae, or monocots
 - Gramineae, or Poaceae—grass family



Outline

- 1 Questions and answers
- 2 Diversity of Magnoliopsida
 - Subclasses
- 3 Rosidae, or rosids
 - Leguminosae, or Fabaceae—legume family
- 4 Asteridae, or asterids
 - Compositae, or Asteraceae—aster family
- 5 Liliidae, or monocots
 - Gramineae, or Poaceae—grass family



Outline

- 1 Questions and answers
- 2 Diversity of Magnoliopsida
 - Subclasses
- 3 Rosidae, or rosids
 - Leguminosae, or Fabaceae—legume family
- 4 Asteridae, or asterids
 - Compositae, or Asteraceae—aster family
- 5 Liliidae, or monocots
 - Gramineae, or Poaceae—grass family



Previous final question: the answer

Why our cladistic and phenetic classifications are identical?



Previous final question: the answer

Why our cladistic and phenetic classifications are identical?

- They use same groups and same characters
- Both analyses are based on similarities
- Both elucidate the same pre-existed order
- Both use patterns in data
- There are only few characters and groups



Diversity of Magnoliopsida

Subclasses



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

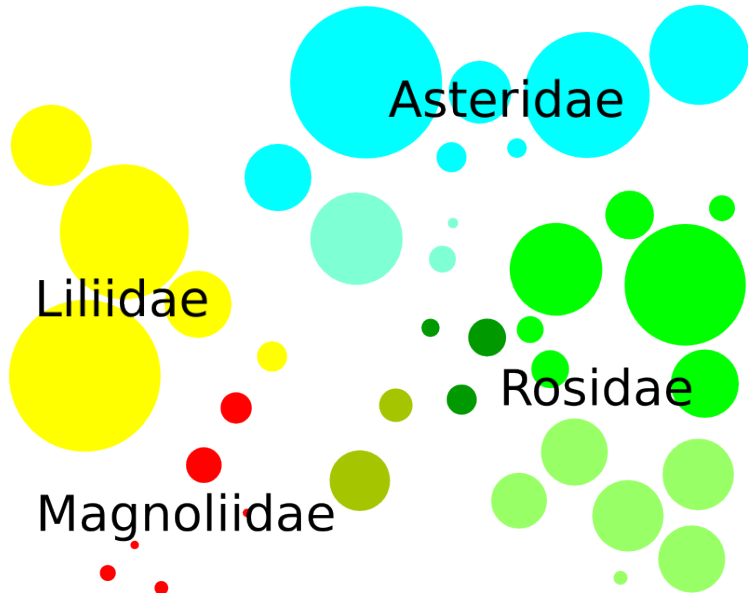


Diagnostic characters of angiosperms

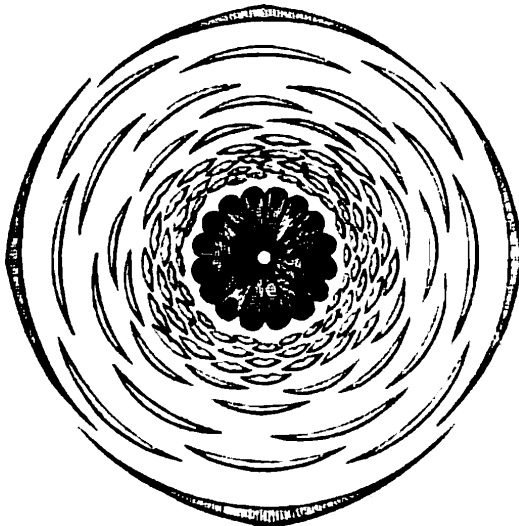
- Flower
- Angiospermy
- Stigma
- Double fertilization
- Fruit
- Parcellation
- In all, any of these characters taken alone is not unique, but together they delimit the group



Taxonomic map of angiosperms: subclasses



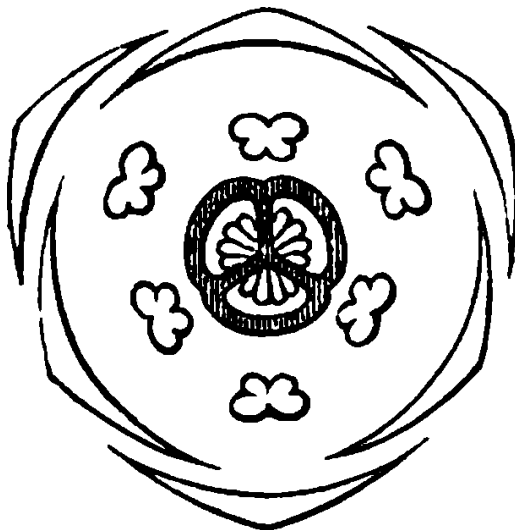
Magnoliidae portrait



Nymphaea sp. (water-lily)



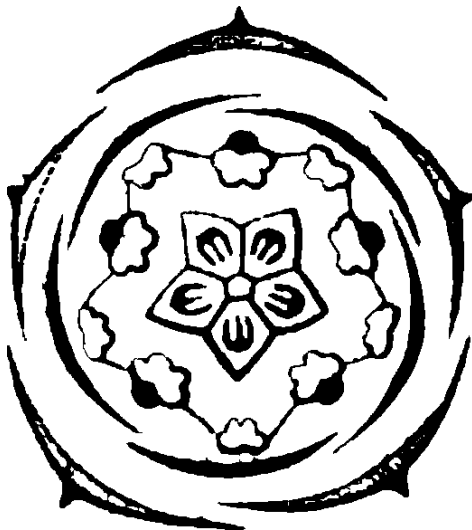
Liliidae portrait



Acorus calamus (calamus, or sweet flag)



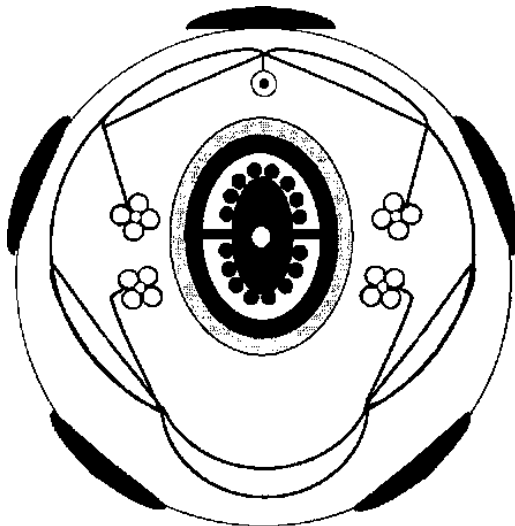
Rosidae portrait



Geranium sp. (wild geranium)



Asteridae portrait



Penstemon sp. (beard-tongue)



Archaeofructus reconstruction



Amborella, branch with male flowers



Rosidae, or rosids

Leguminosae, or Fabaceae—legume family



General features of Leguminosae

- Up to 17,000 species, third largest angiosperm family after Compositae (aster family) and Orchidaceae
- Widely distributed throughout the world but preferably in tropics
- Three subfamilies (Caesalpinioideae, Mimosoideae, Papilionoideae) often treated as separate families

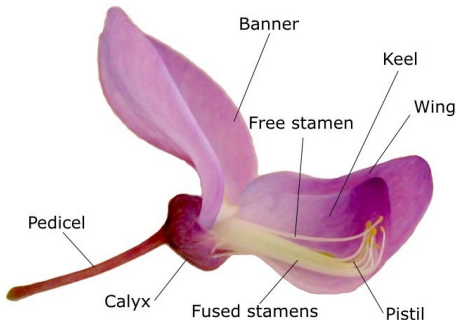
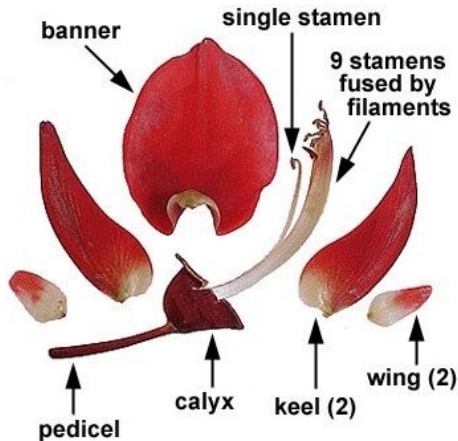


Morphology of Leguminosae

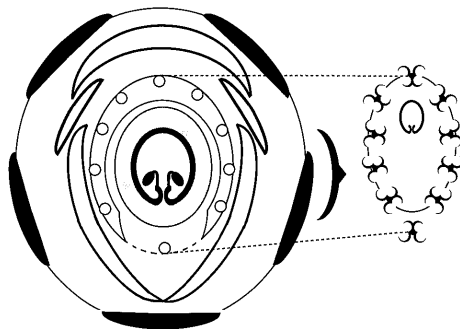
- Have root nodules with *nitrogen-fixing bacteria*
- Leaves alternate, pinnately compound (once or twice), with stipules
- Sepals 5, united; petals 5, in Papilionoideae they are free, unequal and have special names (banner, keel and wing), in Mimosoideae they fuse and form tube
- Stamens often 10 with 9 fused and one free stamen; in Mimosoideae, stamens are numerous
- Single pistil with single carpel
- Fruit is a legume: dehiscent with one camera
- Mature seeds without endosperm



Flower of Papilionoideae



Leguminosae flower: Mimosoideae and Papilionoideae



$*K_{(5)}C_{(5)}A_{5-\infty}G_{\underline{1}}$ or $\uparrow K_{(5)}C_{1,2,2}A_{1,[4+5]}G_{\underline{1}}$

Representatives of Leguminosae

- Mimosoideae: stamens numerous, petals connected
 - *Acacia*—dominant tree of African and Australian savannas, often with phyllodes
 - *Mimosa*—sensitive plant
- Papilionoideae: stamens 9+1, petals free; this subfamily contains many extremely important food plants with high protein value
 - *Glycine*—soybean
 - *Arachis*—peanut with self-buried fruits
 - *Phaseolus*—bean
 - *Pisum*—pea



Phyllodes of Australian *Acacia glaucoptera*



Mimosa pudica before touch



Mimosa pudica after touch



Glycine max, soybean



Arachis hypogaea, peanut



Asteridae, or asterids

Compositae, or Asteraceae—aster family



General features of Compositae

- More than 20,000 species
- Cosmopolitan, but better represented in temperate and subtropical regions
- Prefer open spaces

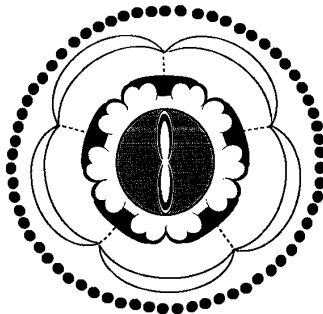


Morphology of Compositae

- Herbs, rarely woody plants; store carbohydrates as inulin (not starch), sometimes have resin or laticifers (subfamily Cichorioideae)
- Leaves alternate or opposite, without stipules, with pterodromous venation
- Flowers in involucrate heads which mimic one flower
- Calyx reduced to hairs or bristles (pappus), petals fused in tube or ligula (with 5 or 3 teeth)
- Stamens 5, fused by anthers
- Pistil has 2 carpels, ovary inferior
- Fruit is achene, mature seed has almost no endosperm



Compositae flower



$*K_{\infty}C_{(5)}A_{(5)}\overline{G_{(2)}}$ (tubular flower) or $\uparrow K_{\infty}C_{(3\vee 5)}A_{(5)}\overline{G_{(2)}}$ (ligulate flower)

Tubular and ligulate flowers in *Matricaria* sp. (chamomile)



Representatives of Compositae

Oil plants, vegetables, ornamentals and medicinal plants distributed in 12 (!) subfamilies, most important are three subfamilies:

- **Carduoideae**: mostly tubular flowers
 - *Centaurea*—knapweed
 - *Cynara*—artichoke
 - *Carthamus*—safflower
- **Cichorioideae**: mostly 5-toothed ligulate flowers + laticifers with latex
 - *Taraxacum*—dandelion
 - *Lactuca*—lettuce
- **Asteroideae**: tubular + 3-toothed ligulate flowers
 - *Helianthus*—sunflower (BTW, “canola”, or *Brassica napus* from Cruciferae is the second main source of vegetable oil)
 - *Artemisia*—sagebrush
 - *Tagetes*—marigold and lots of other ornamentals



Cynara cardunculus (artichoke)



Carthamus tinctorius (safflower)



Tagetes patula (marigold)



Liliidae, or monocots

Gramineae, or Poaceae—grass family



Main features of grasses

- $\approx 8,000$ species distributed thorough all the world, but most genera concentrate in tropics
- Prefer dry, sunny places
- Ofren form tussocks—compact structures where old grass stems, rhizomes and roots are intermixed
- Grasses form grasslands—specific ecological communities widely represented on Earth. North Dakota prairies are grasslands.

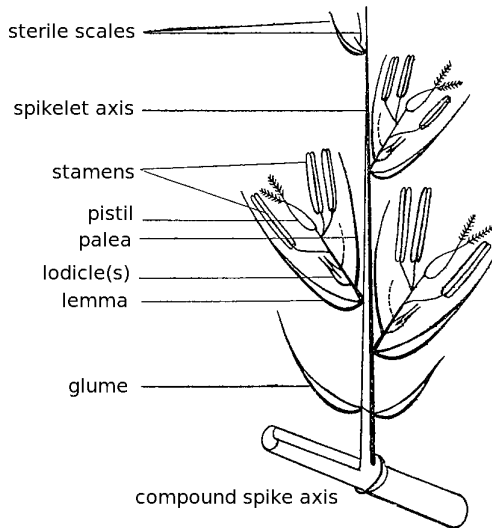


Morphology of grasses

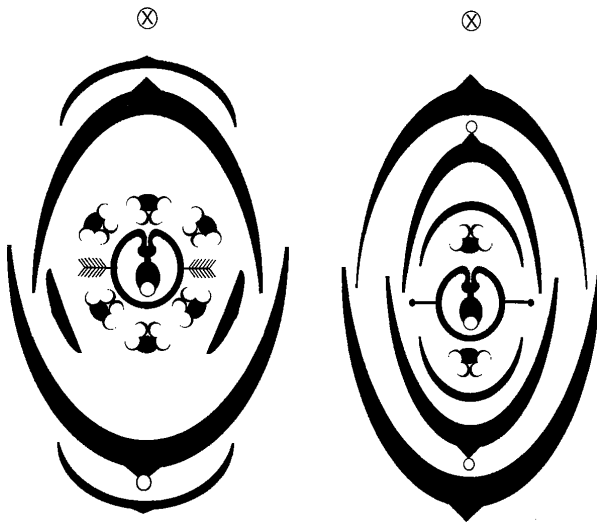
- Stems usually hollow and round
- Leaves flat, in two ranks
- Flowers reduced, wind-pollinates, usually bisexual, form complicated spikelets*
- Each spikelet bear two glumes; each flower has lemma and palea scales
- Perianth is reduced to lodicules
- Stamens from 6 to 1 (most often 3), with large anthers
- Fruit is a caryopsis, it includes flower scales
- Seed has a specific structure—embryo with coleoptile, coleorhiza and scutellum



Scheme of grass spikelet



Grasses: *Oryza* and *Anthoxanthum* diagrams



$\uparrow P_{0-3} A_{0-3+2-3} \underline{G_{(2)}}$



Representatives of grass family

- Most primitive grasses are bamboos (Bambusoideae subfamily)
- Pooid grasses usually are C_3 plants, wheat (*Triticum*), rice (*Oryza*), barley (*Hordeum*) and rye (*Secale*) belong to this group
- Panicoid grasses are mostly C_4 plants, corn (*Zea*) and sugarcane (*Saccharum*) belong here



Rare event: bamboo (*Schizostachyum* sp.) is flowering!



Festuca sp.



Rice (*Oryza sativa*), the most important world crop



Corn (*Zea mays*), the most productive world crop (up to 10 MT/ha)



Short anonymous absolutely voluntary survey

- ➊ What do you **like** most in Biology 154?
- ➋ What do you **dislike** most in Biology 154?
- ➌ **Which lab** do you remember most of all?
- ➍ Please grade (1—bad, 5—excellent):
 - ➊ Lectures
 - ➋ Labs
 - ➌ Final questions
 - ➍ Exams



Summary

- Magnoliidae, Rosidae, Asteridae and Liliidae are main four subclasses of angiosperms
- Compositae is probably the most advanced family of angiosperms
- Grasses (Gramineae) have general monocot characters but their flower structure deviated from “typical” monocot due to the adaptation for wind pollination.
- BOTANY IS COOL!



For Further Reading



J. E. Bidlack, Sh. H. Jansky.

Stern's introductory plant biology. 12th edition.

McGraw-Hill, 2011.

Chapter 23.



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

Plant Biology. 2nd edition.

Thomson Brooks/Cole, 2006.

Chapter 25.

