

Systematic Botany. Lectures 3–6

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Outline

Important details of plant construction

Flowers and leaves

Most important plant families

Compositae

Gramineae and Cyperaceae

Liliaceae s.l.s.

Leguminosae

Labiatae

Solanaceae

Malvaceae

Rosaceae

Keys

Simple family key for gardeners

Preliminary key for North Dakota plant families (from the checklist)



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Why do we need to know plant families

- ▶ If you know the family, you know characters of hundreds and thousand of genera and species, you may even predict them
- ▶ There are 250,000 species of flowering plants and only 350 families; knowing family will significantly reduce efforts
- ▶ In science, everything is constantly changing, but plant families are exception—they are stable for more than 300 years



History of plant families

- ▶ Famous **Carolus Linnaeus** made the classification of all organic world but he did not use “natural groups”, his classification of plants was artificial
- ▶ French scientist **Michael Adanson** first in the world apply “bioinformatic” methods to the plant diversity and identify plant families
- ▶ **Antoine de Jussieu** adapted this approach to the natural gardening and make these families “alive” as garden beds in Paris.
- ▶ In 90% of cases, molecular methods confirmed Adanson’s findings



Important details of plant construction

Flowers and leaves

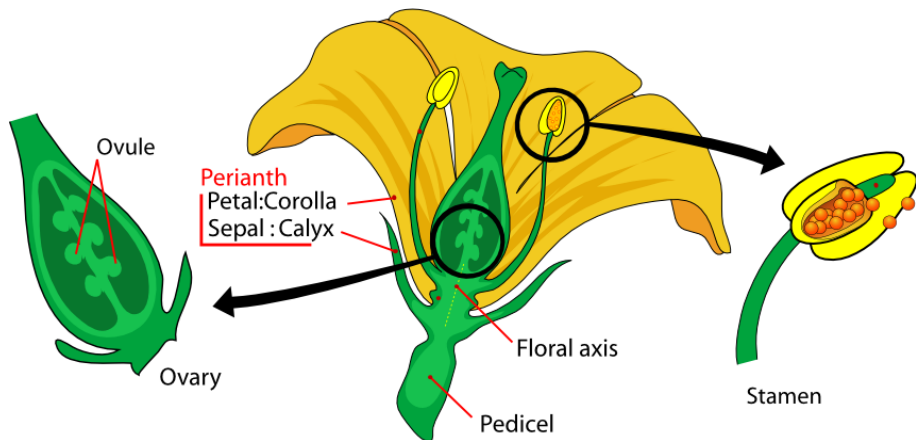


Plant construction: flowers

- ▶ Solitary or in inflorescences
- ▶ Symmetry: star-like and human-like (with left and right sides)
- ▶ Number of: sepals, petals, stamens, pistils and carpels
- ▶ Position of ovary: above or below the other parts of flower



Plant construction: flowers

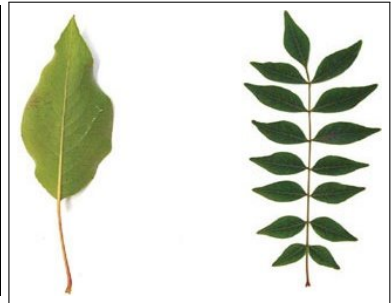


Plant construction: leaves

- ▶ Alternate and opposite leaves
- ▶ Simple (whole or dissected) and compound leaves



Plant construction: leaves



Most important plant families

Compositae



Compositae (Asteraceae), aster family

- ▶ Largest family of flowering plants
- ▶ Flowers are always in flower-like inflorescences (heads)
- ▶ Inferior ovary, fused stamens



Compositae, aster family



Most important plant families

Gramineae and Cyperaceae



Gramineae (Poaceae), grass family; and Cyperaceae, sedge family

- ▶ Grasses and grass-like plants forming turf with their underground rhizomes
- ▶ Simplified, reduced flowers gathered in spikes and next to more complex structures
- ▶ No showy flower parts, everything is adapted to wind pollination
- ▶ Stems hollow, triangular (sedges) or rounded (grasses) in the section



Grasses and sedges



Most important plant families

Liliaceae s.l.s.



Liliaceae s.l.s., lily families

- ▶ This is a group of several families
- ▶ Simple and alternate leaves, well-developed underground parts (bulbs, rhizomes etc.)
- ▶ Six tepals (neither sepals nor petals), 6 stamens, pistil of three carpels



Liliaceae, lily families



Most important plant families

Leguminosae

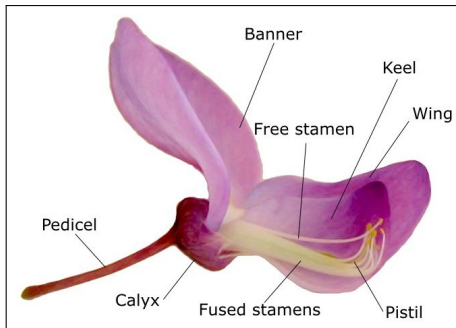
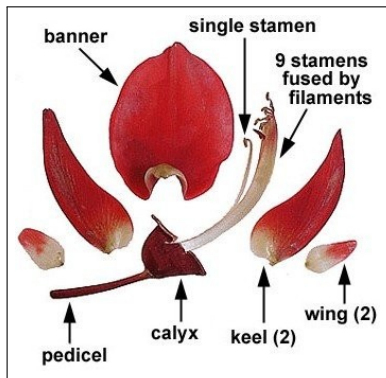


Leguminosae (Fabaceae), legume family

- ▶ Third largest family; tropical trees and temperate herbs
- ▶ Butterfly-like or boat-like flowers with “keel”, “banner” and “wings”
- ▶ Always one pistil of one carpel
- ▶ Alternate compound leaves, root nodules



Leguminosae, legume family



Most important plant families

Labiatae



Labiatae (Lamiaceae), mint family

- ▶ Aromatic herbs and shrubs
- ▶ Bilateral flowers with upper and lower lips
- ▶ Stamens in two pairs; pistil of two divided carpels
- ▶ Simple opposite leaves



Labiatae, mint family



Most important plant families

Solanaceae



Solanaceae, potato family

- ▶ Herbs and shrubs, often poisonous
- ▶ Polysymmetric flowers with 5 sepals, 5 fused petals and 5 stamens
- ▶ Pistil of two carpels
- ▶ Simple (but often dissected) alternate leaves



Solanaceae, potato family



Most important plant families

Malvaceae



Malvaceae, cotton family

- ▶ Trees (like basswood or chocolate tree), shrubs (like cotton) or herbs (like mallow)
- ▶ Big showy flowers with numerous fused stamens, 5 sepals and 5 petals
- ▶ Pistil of 5 carpels
- ▶ Simple alternate leaves



Malvaceae, cotton family



Most important plant families

Rosaceae

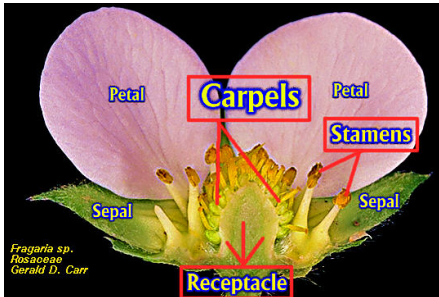


Rosaceae, rose family

- ▶ Trees (like apple), shrubs (rose), herbs (strawberry)
- ▶ Polysymmetric flowers with 5 fused sepals, 5 petals, multiple stamens
- ▶ Multiple or one pistil sitting inside a “cup” or on the receptacle
- ▶ Simple or compound but always alternate leaves



Rosaceae, rose family



Other economically important plant families

- ▶ **Cabbage family**, Cruciferae (Brassicaceae): cabbages, radishes, horseradishes, cress etc.
- ▶ **Umbel family**, Umbelliferae: carrot, dill, celery etc.
- ▶ **Pumpkin family**, Cucurbitaceae: pumpkins, melon, cucumber, watermelon
- ▶ **Palm family**, Palmae: coconut, oil palm etc.
- ▶ **Orchid family**, Orchidaceae: tropical epiphytes, famous ornamental plants



Keys

Simple family key for gardeners



How to identify our seven families: steps 1–3

- ▶ Flowers in dense flower-like inflorescences?

Yes Compositae, aster family

No Go to the next step

- ▶ Grass-like plants with green or yellow, small flowers in spikes?

Yes Gramineae, grass family, and Cyperaceae, sedge family

No Go to the next step

- ▶ Flowers with upper and lower lips and 4 stamens?

Yes Labiatae, mint family (and some others)

No Go to the next step



Identification: steps 4–6

- ▶ Flowers with six tepals?

Yes Liliaceae, lily family (and some others)

No Go to the next step

- ▶ Flowers with banner and keel; leaves compound?

Yes Leguminosae, legume family

No Go to the next step

- ▶ Flowers with 5 sepals, petals and stamens and pistil of two carpels?

Yes Solanaceae, potato family (and some others)

No Go to the next step



Identification: steps 7–8

► Flowers with multiple stamens?

Yes Rose or cotton family, go to the next step

No Some other family

► Flowers with multiple (or one) pistils sitting inside a “cup” or on the receptacle?

Yes Rosaceae, rose family

No Malvaceae, cotton family (and some others)



Keys

Preliminary key for North Dakota plant families (from the checklist)



1. Inflorescence dense, flower-like head. Leaves without stipules, sometimes with milky sap. Calyx reduced to pappus or scales. Anthers united into the tube around the style. Fruit small, solid and dry achene, usually with long hairs on the top (pappus).

..... **Compositae**, Aster family

- Inflorescences with different structure 2.

2. Leaves narrow, linear, alternate in two ranks, with sheath and ligules; stems cylindrical in section, internodes usually hollow. Flowers each compressed between a bract (lemma) and bracteole (palea). Flowers arranged in 2 ranks in spikelets subtended by empty bracts (glumes); spikelets themselves grouped in more complex inflorescences, usually spikes, racemes, or panicles. Seed fused to pericarp to form a one-seed dry caryopsis.

..... **Gramineae**, Grass family



- Leaves narrow, linear, alternate in (usually) 3 ranks, with sheath and ligules (leaves could be reduced); stems triangular or cylindrical in section, internodes usually not hollow. Flowers reduced in many different ways, very often (sedges) the female flower is just a pistil surrounded with bag-like bract (perigynium). Flowers arranged in spikelets and/or spikes or more branched inflorescences. Seed is not fused to pericarp, the fruit is the one-seed dry nutlet. **Cyperaceae**, Sedge family
- = Plants have different characters 3.
- 3. Flowers with upper and lower lips 4.
- Flowers without lips 5.
- 4. Flowers with 4 stamens. Ovary split in four parts. Leaves opposite, stems quadrangular in section. **Labiatae**, Mint family
- Flowers with 10 stamens, corolla with banner (top petal) and keel (two front petals). Ovary solid. Leaves compound, with paired stipules. **Leguminosae**, Pea family
- = Flowers labiate, but not as above Other families (e.g., Polygalaceae, Phrymaceae, Orchidaceae)



- 5 (3). Flowers showy, typically with the double perianth: calyx and corolla. Sometimes, flowers have more than 12 stamens. 6.
- Flowers often inconspicuous, with the uniform perianth (greenish or colored). Flowers always with less than 12 stamens. 9.
6. Flowers normally with more than 12 stamens, and often also with more than 1 pistil. 7.
- Flowers with less (usually 4, 5, 6 or 10) stamens, and always with one pistil. 8.
7. Flowers with multiple (or one) pistil(s) sitting inside a receptacle “cup” (*hypanthium*) or on the enlarged receptacle. Perianth double. Leaves with paired stipules. **Rosaceae**, Rose family
- Flowers without hypanthium (but enlarged receptacle may present). Perianth double or uniform. Leaves without stipules **Ranunculaceae**, Buttercup family
- = Flowers with multiple stamens, but not as above Other families (e.g., Nymphaeaceae, Alismataceae, Cistaceae)



- 8 (6). Flowers with one central pistil, receptacle is not enlarged.
 Stamens 6, two of them are smaller than others. Leaves without
 paired stipules. **Cruciferae**, Mustard family
- = Plants with different characters Most of non-listed families
- 9 (5). Flowers often more than 3 mm in diameter, arranged in spikes
 or more branched inflorescences. Every node has an *ochrea*:
 “sleeve” which continues upward with the stem.
 **Polygonaceae**, Buckwheat family
- Flowers often very small, less than 3 mm in diameter, arranged in
 more compact inflorescences (often in glomerules). *Ochrea*
 absent. **Amaranthaceae**, Amaranth family
- = Plants with small, inconspicuous, often reduced flowers, but other
 characters are different from above Other families (e.g.,
 Potamogetonaceae, Urticaceae, Juncaceae)



Summary

To know plant family, we should check:

- ▶ Position and structure of leaves
- ▶ Symmetry and number of flower parts



For Further Reading



A. Shipunov.

Systematic Botany [Electronic resource].

2011—onwards.

Mode of access:

http://ashipunov.info/shipunov/school/biol_448



M. Hickey, C. King.

Common families of flowering plants.

Cambridge, U.K.; New York, NY, USA : Cambridge University Press, 1997.

