

# Systematic Botany. Lectures 27–29

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# Outline

## Rosanae and Malvanae superorders of Rosidae

Fabales: Leguminosae, or Fabaceae—legume family

Fagales: Fagaceae—beech family

Fagales: Betulaceae—birch family

Rosales: Elaeagnaceae—Russian olive family

Rosales: Rosaceae—rose family

Brassicales: Cruciferae, or Brassicaceae—cabbage family

Malvales: Malvaceae—cotton family

Other Rosanae/Malvanae



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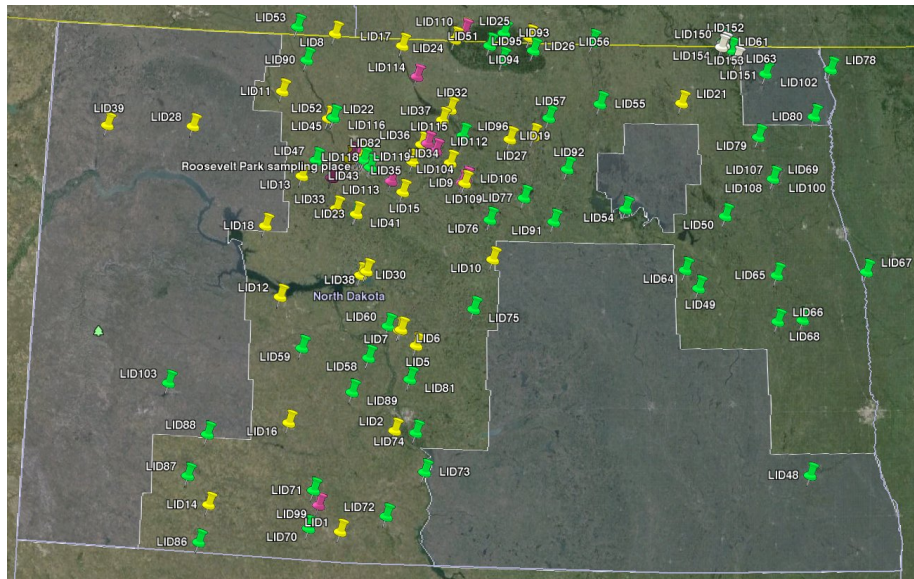
Brassicales: Cruciferae, or Brassicaceae—cabbage family

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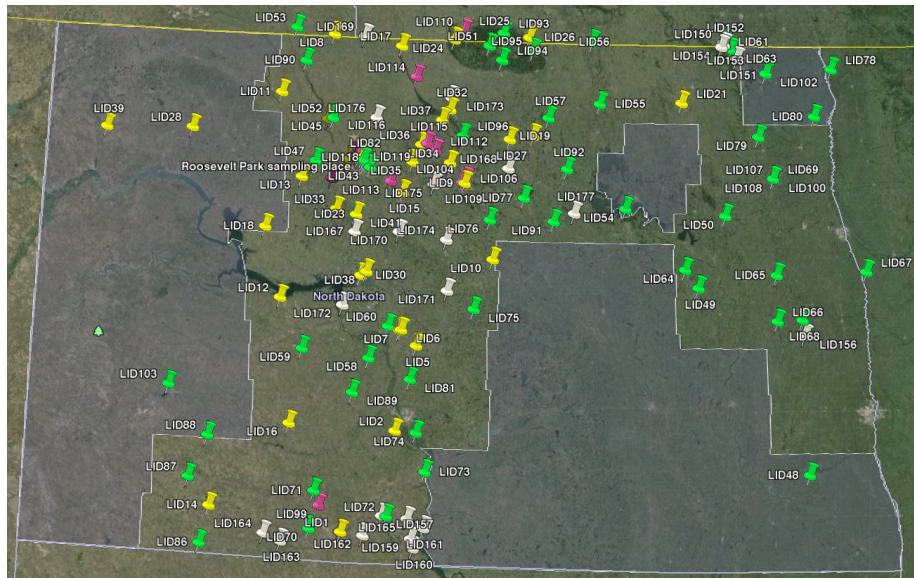
Other Rosanae/Malvanae



# North Dakota coverage 2011–2014



# North Dakota coverage 2011–2015



# Rosanae and Malvanae superorders of Rosidae

Fabales: Leguminosae, or  
Fabaceae—legume family



# General features of Leguminosae

## Leguminosae, or Fabaceae—legume family

- ▶ 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



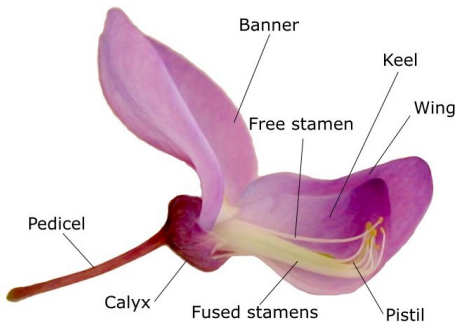
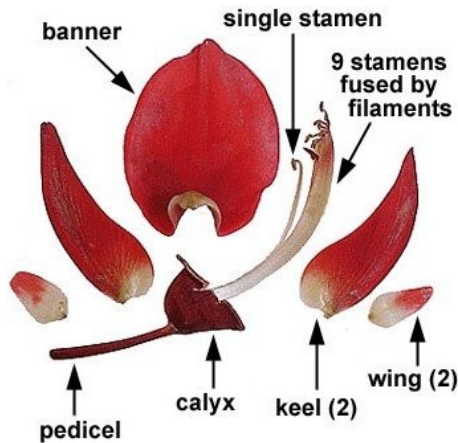
# Morphology of Leguminosae

- ▶ 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

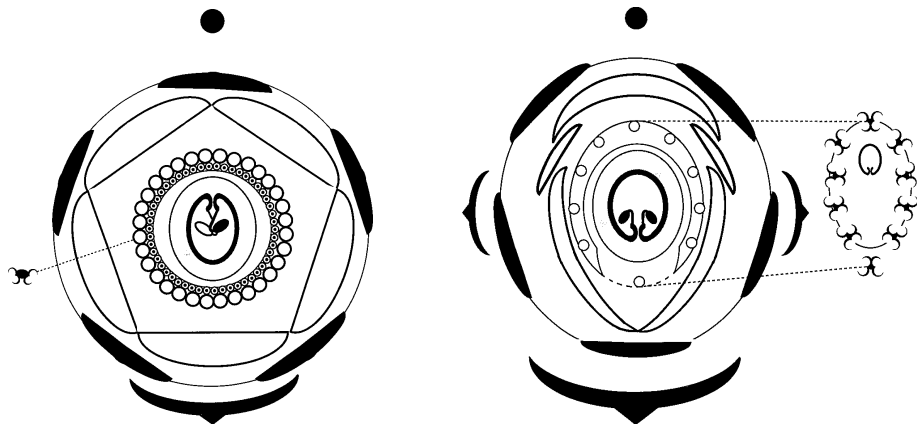




# Flower of Papilionoideae



# Leguminosae flower: Mimosoideae and Papilionoideae



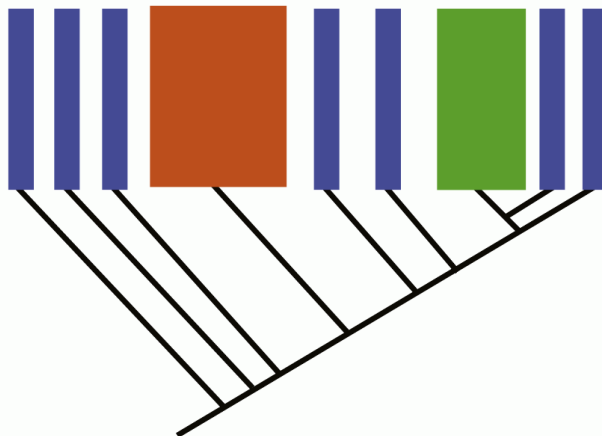
$*K_{(5)}C_{(5)}A_{5-\infty}G_{\underline{1}}$  or  $\uparrow K_{(5)}C_{1,2,2}A_{1,[4+5]}G_{\underline{1}}$

# The Leguminosae

**Caesalpinioideae**  
(2,250 species)

**Papilionoideae**  
(13,800 species)

**Mimosoideae**  
(3,270 species)



# Leguminosae classification

- ▶ Three subfamilies: Caesalpinioideae, Mimosoideae and the biggest is Papilionoideae (Faboideae)
- ▶ Caesalpinioideae:
  - ▶ *Gleditsia*—gleditsia
  - ▶ *Bauhinia*—orchid tree
  - ▶ *Cercis*—redbud
  - ▶ *Delonix*—royal poinciana
- ▶ Mimosoideae:
  - ▶ *Desmanthus*—prairie mimosa
  - ▶ *Prosopis*—mesquite
  - ▶ *Acacia*—acacia
  - ▶ *Mimosa*—sensitive plant, mimosa



## *Delonix regia* in flower



## Unusual legume—*Harleyodendron unifoliatum*



## Phyllodes of Australian *Acacia glaucoptera*



## *Desmanthus illinoensis*





## *Mimosa pudica* before touch



## *Mimosa pudica* after touch



# Representatives of Papilionoideae (Faboideae)

- ▶ Swartzioids (*Swartzia*: highly unusual, but only in tropics)
- ▶ Genistioids
  - ▶ *Lupinus*—lupinus
- ▶ Dalbergioids
  - ▶ *Amorpha*—false indigo
  - ▶ *Petalostemon*, or *Dalea*—prairie-clover
  - ▶ *Arachis*—peanut
  - ▶ *Desmodium*—tick-trefoil
- ▶ Millettoids
  - ▶ *Apios*—ground nut
  - ▶ *Phaseolus*—beans
  - ▶ *Glycine*—soybeans
  - ▶ *Psoralea*—breadroot



## *Swarzia* sp.



# Representatives of Papilionoideae (Faboideae) (contd.)

- ▶ Robinioids
  - ▶ *Lotus*—trefoil
  - ▶ *Robinia*—locust
- ▶ IRLC (“inverted repeat-lacking”) group
  - ▶ *Caragana*—Siberian peashrub
  - ▶ *Astragalus*—milkvetch
  - ▶ *Oxytropis*—loco-weed
  - ▶ *Trifolium*—clover
  - ▶ *Vicia*, *Lathyrus*—vetch
  - ▶ *Medicago*—alfalfa
  - ▶ *Melilotus*—sweet clover
  - ▶ *Pisum*—pea



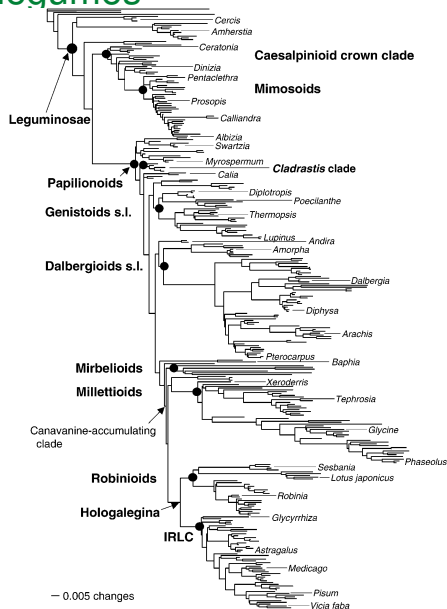
## *Glycine max*, soybean



## *Arachis hypogaea*, peanut



# Phylogeny of legumes





# Rosanae and Malvanae superorders of Rosidae

Fagales: Fagaceae—beech family

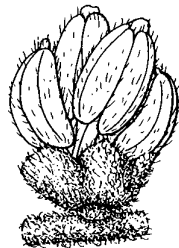


## Fagaceae—beech family

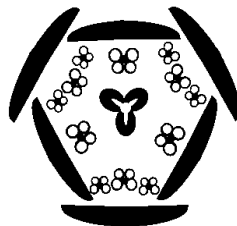
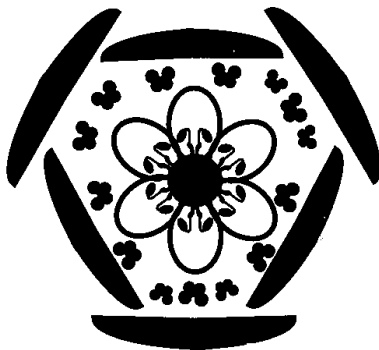
- ▶  $\approx$  800 species
- ▶ Distributed mostly in broad-leaved forests of North hemisphere
- ▶ Life forms: trees, rarely shrubs with mycorrhizal roots
- ▶ Leaves simple, entire or lobed, alternate, with minute stipules
- ▶ Flowers in catkins, very reduced due to wind pollination, unisexual; carpellate flowers with involucre of multiple fused bracts; perianth scale-like, stamens from 4 to numerous
- ▶ Pistil of 3–6 carpels, ovary inferior, 5 of 6 ovules are aborting
- ▶ Fruit a nut (acorn is a nut + involucre) with one seed with large embryo and no endosperm



# *Quercus* flowers and inflorescences



# Fagaceae flowers



$$\begin{aligned} &\text{♀} * P_{6-9} \overline{G_{(6)}} \\ &\text{♂} * P_{6-9} A_{6-12} \end{aligned}$$

# Representatives of Fagaceae

Importance: wood producers, sometimes (chestnut) also food plants

- ▶ *Quercus*—oak
- ▶ *Fagus*—beech
- ▶ *Castanea*—chestnut



# Rosanae and Malvanae superorders of Rosidae

## Fagales: Betulaceae—birch family

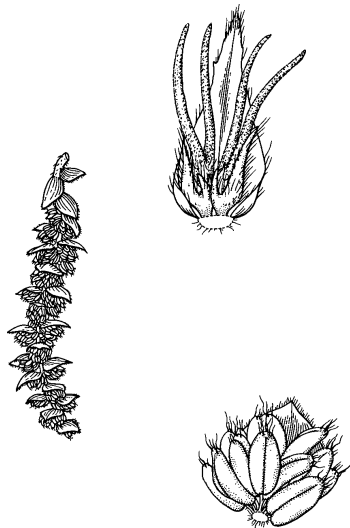


# Betulaceae—birch family

- ▶  $\approx$  150 species
- ▶ Distributed in Northern hemisphere, frequent from temperate to arctic regions
- ▶ Life forms: trees and shrubs with mycorrhizal roots
- ▶ Leaves alternate, simple, serrate, deciduous, with stipules
- ▶ Flowers in catkins or compact inflorescences, very reduced, unisexual, associated with bracts; perianth minute or absent, stamens 1–4
- ▶ Pistil bicarpellate, ovary inferior, ovules 2, one aborting
- ▶ Fruit a nut or nutlet, with subtended bracts, seeds with large embryo and almost no endosperm

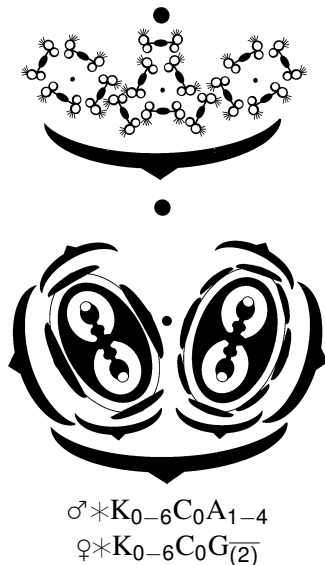


# *Carpinus* flowers and inflorescences





# Betulaceae flowers and inflorescences



# Representatives of Betulaceae

Importance: ornamental, wood, edible nuts (*Corylus*)

- ▶ *Corylus*—hazelnut (in subfamily Coryloideae: naked male flowers and female flowers with perianth)
- ▶ *Betula*—birch
- ▶ *Alnus*—alder



# Rosanae and Malvanae superorders of Rosidae

Rosales: Elaeagnaceae—Russian  
olive family

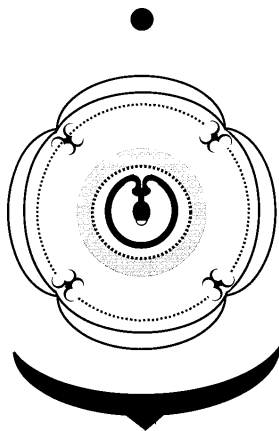


## Elaeagnaceae—Russian olive family

- ▶  $\approx$  50 species
- ▶ Distributed in temperate and subtropical parts of Northern hemisphere
- ▶ Life forms: shrubs or small trees, often thorny, roots nodulated with nitrogen-fixing bacteria
- ▶ Leaves alternate or opposite, simple, entire, without stipules, with specific lepidote trichomes
- ▶ Flowers solitary or in inflorescences, 4-merous, without petals; 4 sepals attached to the hypanthium, stamens also 4.
- ▶ Pistil monomeric, with one basal ovule, ovary superior
- ▶ Fruit consists of dry achene inside of fleshy hypanthium



# Elaeagnaceae flower



$$*K_{4-5}C_0A_{4-5}\underline{G_1}$$

# Representatives of Elaeagnaceae

Importance: fruits are edible, *Hippophaë* is cultivated as berry plant

- ▶ *Elaeagnus*—Russian olive: we have *E. angustifolia*, Russian olive, and *E. argentea*, silverberry
- ▶ *Shepherdia*—buffaloberry, two species in ND: *Sh. argentea* and *Sh. canadensis*
- ▶ *Hippophaë*—sea-buckthorn



## *Hippophaë*—sea-buckthorn



# Rosanae and Malvanae superorders of Rosidae

Rosales: Rosaceae—rose family





# General features of Rosaceae

## Rosaceae—rose family

- ▶  $\approx 3,000$  species
- ▶ Nearly cosmopolitan, but more common to temperate and subtropical regions of Northern Hemisphere
- ▶ Forest and meadow plants, do not prefer dry places

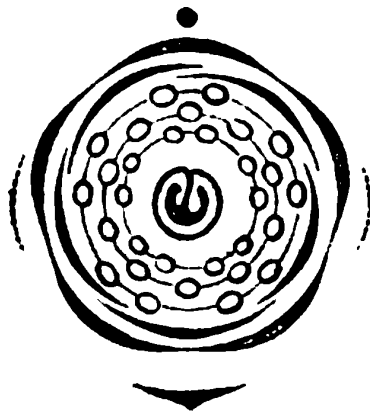
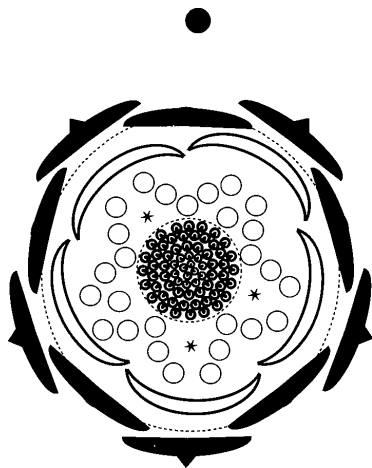


# Morphology of Rosaceae

- ▶ Trees, shrubs and herbs
- ▶ Often accumulate cyanogenic compounds (contains  $\text{—C} \equiv \text{N}$  group); some Rosaceae have nitrogen-fixing bacteria as symbionts
- ▶ Alternate, simple or dissected leaves with stipules
- ▶ Flowers with hypanthium; in Maloideae hypanthium fuses with pistils and produces inferior ovary
- ▶ Calyx with connected sepals, corolla with distinct petals
- ▶ Stamens numerous, typically in sets of 5 (or 10)
- ▶ Fruits diverse: multiple nuts/drupes in Rosoideae, multiple follicles or single drupes in Spiraeoideae, pomes in Maloideae
- ▶ Mature seeds without endosperm



# Rosaceae flower: Rosoideae and Spiraeoideae



\*K<sub>5</sub>C<sub>5</sub>A<sub>5-10-∞</sub>G<sub>1-5-∞</sub> ∨ G<sub>(3-5)</sub> (Maloideae)

# Representatives of Rosaceae

Several subfamilies, each with economically important members:

- ▶ **Rosoideae** (multiple one-seeded fruits)
  - ▶ *Rosa*—rose
  - ▶ *Fragaria*—strawberry and close genus *Potentilla*—cinquefoil
  - ▶ *Rubus*—blackberry, raspberry
- ▶ **Spiraeoideae** (fruits—follicles of solitary drupes)
  - ▶ *Prunus*—cherry, peach, apricot, plum
  - ▶ *Spiraea*—meadowsweet, important component of prairies
- ▶ **Maloideae** (now often inculded in Spiraeoideae; have inferior ovary, fruits are pomes)
  - ▶ *Pyrus*—apple, pear
  - ▶ *Crataegus* (hawthorn), *Sorbus* (mountain ash), *Amelanchier* (serviceberry), *Aronia* (chokeberry) and others



## *Spiraea tomentosa*, prairie plant



## *Aronia* × *mitchurinii*



Spontaneous hybrid between American chokeberry and European  
*Sorbus aria*



## *Potentilla fruticosa*, shrubby cinquefoil



# Rosanae and Malvanae superorders of Rosidae

Brassicales: Cruciferae, or  
Brassicaceae—cabbage family





# General features of Cruciferae

## Cruciferae, or Brassicaceae—cabbage family

- ▶  $\approx 3,000$  species
- ▶ Found mostly in temperate regions, especially in dry climates
- ▶ Morphologically and ecologically uniform family

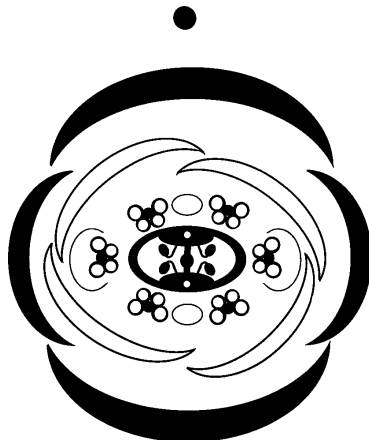


# Morphology of Cruciferae

- ▶ Herbs, often hairy, contain mustard oils
- ▶ Leaves simple, often dissected, alternate, without stipules
- ▶ Flowers dimerous, in racemes
- ▶ 4 sepals, 4 petals, ancestrally also 4 stamens but inner stamens split each in two = 6 stamens in total
- ▶ Pistil has two carpels
- ▶ Fruit is a siliqua: dehiscent, with two cameras and replum bearing seeds
- ▶ Mature seeds with small amount of endosperm



# Cruciferae flower



$$*K_4C_4A_{2+2,2}\underline{G_{(2)}}$$

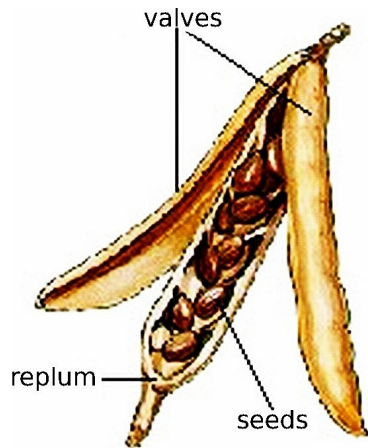
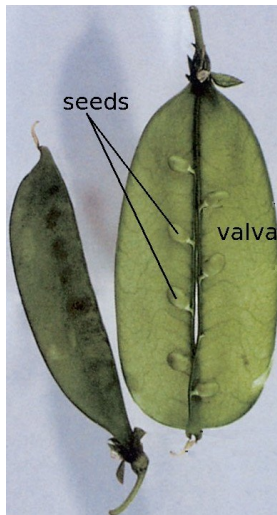
# Representatives of Cruciferae

Important vegetables and spices, e.g.

- ▶ *Brassica oleracea*—broccoli, cabbage, cauliflowers
- ▶ *Brassica nigra*—black mustard
- ▶ *Brassica rapa*—turnip
- ▶ *Raphanus*—radish
- ▶ *A Armoracia*—horseradish  
and
- ▶ *Arabidopsis thaliana*—famous model plant



# Legume and siliqua



## *Arabidopsis thaliana*



## Malvaceae—cotton family

- ▶  $\approx$  2,300 species, now united several families (Bombacaceae, Sterculiaceae, Tiliaceae and Malvaceae s.str.)
- ▶ Distributed in tropical and temperate regions, equally in forests and grasslands
- ▶ Life forms: mostly trees and shrubs, core Malvaceae are herbs
- ▶ Leaves simple (or palmately compound), often with actinodromous venation, alternate, with stipules, often with star-like hairs
- ▶ Flowers mostly in inflorescences, bisexual, actinomorphic, usually with double perianth and often also with epicalyx, 5-merous; stamens multiplied and often fused in 1, 5 or more groups
- ▶ Pistil with superior ovary and 5 carpels
- ▶ Fruit is a capsule

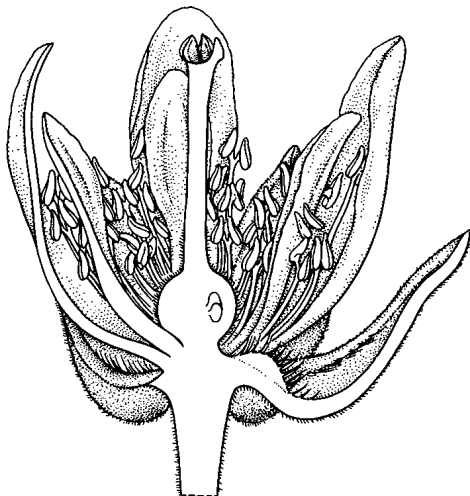
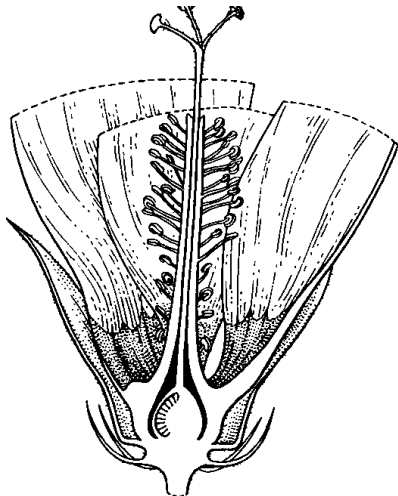


# Malvaceae flowers

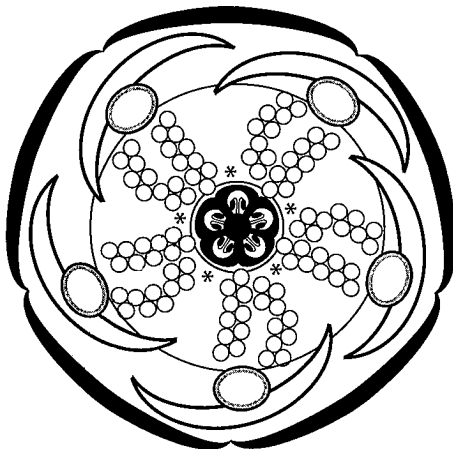




## *Hibiscus* and *Tilia* flowers



## Malvaceae flower



$$*K_5C_{0\vee 5}A_{5-\infty}\underline{G(5)}$$

# Representatives of Malvaceae

Importance: textile (cotton), food (cocoa, hibiscus) and ornamental (mallows, basswood)

- ▶ *Malva*, *Abutilon*, *Sphaeralcea*—mallows
- ▶ *Theobroma*—cocoa tree
- ▶ *Gossypium*—cotton
- ▶ *Hibiscus*—hibiscus



# Hibiscus tea plant



# Malvales: Malvaceae—cotton family

Other Rosanae/Malvanae



# Other Rosanae/Malvanae in flora of North Dakota

- ▶ Cucurbitales

- ▶ Cucurbitaceae: *Echinocystis* (wild cucumber), *Cucurbita* (pumpkin) *etc.*

- ▶ Rosales

- ▶ Urticaceae: *Urtica* (nettle) *etc.*
  - ▶ ... and other smaller families

- ▶ Myrtales

- ▶ Onagraceae: *Oenothera* (evening primrose) *etc.*
  - ▶ ... and some smaller

- ▶ ... and several other orders



# Cucurbitaceae, melon family

- ▶  $\approx$  900 species, mostly tropical and subtropical plants
- ▶ Prefer dry regions, important component of different deserts



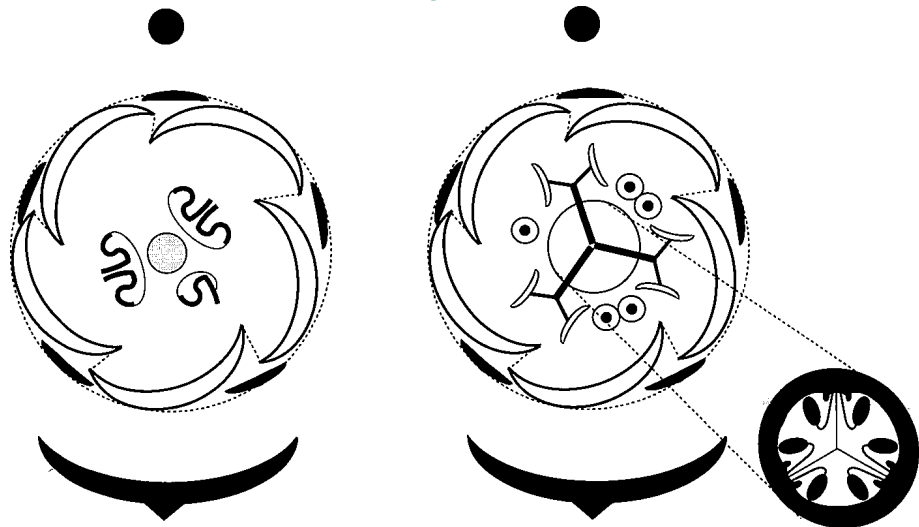
# Morphology of Cucurbitaceae

- ▶ Hairy herbs or vines with tendrils (modified shoots)
- ▶ Vascular bundles bicollateral: phloem located on both sides of xylem
- ▶ Leaves alternate, without stipules, sometimes palmately dissected, with actinodromous venation
- ▶ Flowers unisexual, in raceme-like inflorescences
- ▶ Petals fused, form a tube
- ▶ Stamens usually fused
- ▶ Pistil with 3 carpels, ovary inferior (flower epigynous)
- ▶ Fruit is a berry





# Cucurbitaceae flower diagram



$*K_{(5)}C_{(5)}A_{(3-5)}; *K_{(5)}C_{(5)}\overline{G_{(3)}}$



# Representatives of Cucurbitaceae

- ▶ Many famous crops:
  - ▶ Pumpkin, squash—*Cucurbita*
  - ▶ Melon—*Melo*
  - ▶ Watermelon—*Citrullus*
  - ▶ Cucumber—*Cucumis*
  - ▶ Gourd—*Lagenaria*
- ▶ In North Dakota, invasive wild cucumber (*Echinocystis*) is a common plant now
- ▶ Exploding cucumber—*Ecballium* is a famous example of mechanical seed distribution
- ▶ *Hodgsonia* is one of the most attractive Cucurbitaceae



## Wild watermelon, *Citrullus colocynthis*



## Wild cucumber, *Echinocystis lobata* (near Minot)



## *Hodgsonia heteroclita*, female plant



# For Further Reading



A. Shipunov.

*Systematic Botany* [Electronic resource].

2011—onwards.

Mode of access:

[http://ashipunov.info/shipunov/school/biol\\_448](http://ashipunov.info/shipunov/school/biol_448)



A. Shipunov.

Flora of North Dakota: Checklist

2012—onwards.

Mode of access: <http://ashipunov.info/shipunov/fnddb>