Diversity and Evolution of Rosids... hemp, figs, and legumes...

*Rosales – the rest*
- Rosaceae is sister to all other families of the order
- Tendencies in rest of the order to loss of petals and shift to unisexual flowers with wind pollination or specialized insect pollination

Rhamnaceae - buckthorns
- 52 genera 925 species of trees and shrubs in the tropics and temperate areas
- Many of our species are armed with thorns
- Leaves are simple and alternate or opposite, often with areinate venation (arching along the edge), and serrated edges

Rhamnus cathartica - European or common buckthorn [invasive]
Elaeagnaceae - Russian olive

3 genera 45 species of trees and shrubs largely in north temperate areas

- N₂-fixing small trees and shrubs easily recognized by silvery or reddish glandular hairs covering bottom leaves and/or stems.

- Elaeagnus angustifolia - Russian olive

Elaeagnaceae - Russian olive

3 genera 45 species of trees and shrubs largely in north temperate areas

- 4 merous flowers and berry fruits

- Shepherdia - buffalo berry

Rosales - Urticalean Families

The remainder of the Rosales show the transition to reduced, unisexual flowers and one-seeded fruits - “Urticales”

- *Ulmaceae - elms

6 genera 35 species of North Temperate trees

- best known for the American elm with its distinctive vase shaped growth form. Dutch Elm disease, caused by the fungus Ceratostomella sp., has destroyed most large adults.

- Ulmus americana - American elm
**Ulmaceae - elms**

- *Ulmus americana* - American elm
  - Leaves are distichously arranged - 2 ranks in one plane - and pinnately veined; leaf bases are strongly asymmetric

- *Zelkova serrata* - European elm

**Ulmaceae - elms**

- Flowers are bisexual but reduced and wind pollinated; they appear before the leaves
  - *Ulmus americana* - American elm

**Ulmaceae - elms**

- Pistil is made of two fused carpels but only one seed matures; fruit is a samara - a winged achene in this case

- *Ulmus americana* - American elm

**Ulmaceae - elms**

- Note 2 styles on samara

**Cannabaceae - hackberry, hops**

- *Celtis* (hackberries) and relatives are tropical and temperate small trees with unisexual flowers

- *Celtis occidentalis* - hackberry

- Leaves are strongly palmi-pinnate - with 3 main veins at base

- This leaf features defines all the other remaining urticaean families

- *Celtis occidentalis* - hackberry
Cannabaceae - hackberry, hops

- note distinctive warty bark
- fruit is a one-seeded drupe

*Celtis occidentalis* - hackberry

Cannabaceae - hackberry, hops

- *Cannabis* with one species is a coarse herb native to Eurasia
- two subspecies are recognized: one the source of the drug Δ9 tetrahydrocannibol (THC) and the other the source of hemp fiber/oil

*Humulus lupulus* - American hops

- *Humulus* has two viney hop species: one is the source of lupulin used in the brewing industry

*Humulus lupulus* - hemp, marijuana

- hemp rope
- manila rope

Cannabaceae - hackberry, hops

- *Cannabis* is either dioecious or monoecious

*Cannabis sativa* - hemp, marijuana

- Female inflorescence
- Seeds 1-seeded
- Male inflorescence

Cannabaceae - hackberry, hops

- Male flowers
- Female flowers
**Urticaceae - nettles**
54 genera, 2600 species - largely a tropical family of herbs, shrubs, or treelets

- Leaves have **palmate venation**; either alternate or opposite

- Some species are a source of irritants found in specialized hair-like cells on stems and leaves

**Urticaceae - nettles**
54 genera, 2600 species - largely a tropical family of herbs, shrubs, or treelets

- Flowers are reduced, unisexual, congested, wind-pollinated, and form one-seeded drupelets

- Stamens have a peculiar elastic spring-like mechanism that flings pollen further out from the plant

**Urticaceae - nettles**
54 genera, 2600 species - largely a tropical family of herbs, shrubs, or treelets

- Opposite leaves, stinging

- Alternate leaves, stinging
**Urticaceae - nettles**

- *Parietaria pensylvanica*
  - pellitory

- *Boehmeria cylindrica*
  - false nettle

- *Filea pumila*
  - clearweed

***Moraceae - mulberry, fig***

Large tropical family of 38 genera, 1100 species of trees or vines

- *Morus alba*
  - white mulberry [left - female; right - male]

  - flowers reduced, unisexual, no petals, single seeded ovary

- *Ficus*
  - fig

  - sister family to the nettle family
  - latex system well-developed
  - leaves are alternate, strongly palmately veined

- *Moraceae - mulberry, fig* (CA.4 CO.0 A.4 G.2)

  - flowers reduced, unisexual, no petals, single seeded ovary

  - *Morus alba* - white mulberry [left - female; right - male]
*Moraceae - mulberry, fig

- single seeded fruits from many flowers coalesce to form one fleshy, multiple fruit [e.g., mulberry, fig, breadfruit]

*Morus rubra - red mulberry

Osage orange is not native but often seen escaped; note the large grapefruit sized multiple fruit

*Maclura pomifera - osage orange

Osage orange multiple fruits rolling down to University Avenue behind Birge Greenhouses.

Cross section of multiple fruit showing individual one-seeded fruitlets

*Maclura pomifera - osage orange

Ficus (figs) represent 750 of the 1100 species
**Moraceae - mulberry, fig**

*Ficus* (figs) represent 750 of the 1100 species.
- The fig (multiple) fruit or sycomium is a “key innovation” for fig species radiation.

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**Fabales**

- Fabales is an order in the Eurosid I or fabid lineage of Rosids (N$_2$ fixing).
- Contains 4 families, but Fabaceae - the legumes - comprise the vast majority of the 20,000+ species.

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**Fabaceae - legumes**

- 730 genera, 19,400 species of herbs, shrubs, and trees that produce specialized follicles - legumes - that open along two lines of dehiscence.
- Fabaceae = Leguminosae.
- Worldwide, N$_2$ (*Rhizobium*) fixers.
*Fabaceae - legumes

3 subfamilies previously recognized

- faboideae (beans, peas) and mimosoid (acacia, mimosa) legumes are highly modified
- but descended from the common ancestor of caesalpinoids

Three major characteristics

1. Monocarpic - single superior carpel

2. Legume - follicle but with 2 lines of suture

2. Legume - or modified as one-seeded fruitlets (lomenta, articles)
*Fabaceae - legumes

Three major characteristics:

- trifoliolate
- palmately compound
- pinnately compound
- simple

3. Alternate, compound leaves - (rarely simple)

Caesalpinoid legumes form a paraphyletic grade at base of family - the tropical Bauhinia is one of the first.

*Caesalpinoid legumes

CA 5 CO 5 A 10 G 1

- flowers 5 merous with 10 unequal stamens
- topmost petal = banner sits in front of the 2 lateral or wing petals

*Senna marilandica - southern wild senna
*Caesalpinoid legumes

Cercis canadensis - eastern redbud

Gleditsia triacanthos - honey locust

Gymnocladus dioica - Kentucky coffee tree

*Caesalpinoid legumes

*Mimosoid legumes

Mimosoid legumes are tropical or subtropical shrubs and trees, often with doubly compound leaves - large genera are taxonomically messy

Calliandra

• flowers small, but in showy "powder puff" inflorescences

• calyx, corolla, and numerous stamens each show connation

Inga

CA (5) CO (5) A (∞) G I

Albizia
**Mimosoid legumes**

*Mimosa* - 500 species of shrubs and herbs

*Mimosa pudica* - sensitive plant

*Acacia* - giant genus of 1/3 of mimosoid species
- Arid species show *phyllode* leaves = petiole?
- Modified stipules for *Azteca* ants
- Extrafloral nectaries and Beltian bodies for ants

**Faboid legumes**

*CA (5) CO 3+(2) A (9)+1 G 1*

- Calyx often fused
- Banner petal behind lateral (wing) petals
- Bottom *keel* petals often fused
- Stamens diadelphous = 9 fused + 1 separate

*Apios americana* - groundnut
* Baptisia bracteata* - creamy wild indigo
* Desmodium canadense* - ticktrefoil
*Faboid legumes

- *Faboid legumes
  - three important legume crops

  - *Faboid legumes
    - three important “clover” or “alfalfa” species from Eurasia - now naturalized

*Faboid legumes

- *Faboid legumes
  - native to further south, but invasive in Great Lakes region

*Faboid legumes

- *Faboid legumes
  - invasive in Great Lakes region

*Faboid legumes

- Lathyrus japonicus - beach pea
- Lupinus perennis - lupine, blue bonnet
- Robinia pseudo-acacia - black locust
- Faboid legumes
- Pisum sativum - pea
- Phaseolus vulgaris - common bean
- Glycine max - soybean
- Trifolium pratense - red clover
- Medicago sativa - alfalfa
- Melilotus albus - white sweet clover
*Faboid legumes

- *Coronilla varia* - crown vetch
- *Lotus corniculatus* - bird’s foot trefoil

- Other Eurasian species brought in for soil stabilization - and now naturalized