

Eudicots

- continue survey through the eudicots or tricolpates
- vast majority of eudicots are Rosids (polypetalous) and Asterids (sympetalous)

Eudicots

- unlike Asterids, Rosids (in orange) now represent a diverse set of families

Cronquist's Dicot Subclasses vs. APG

APG system

- = asterids
- = rosids
- = caryophyllids
- = basal eudicots
- = basal angiosperms

Rosidae (orange)
 Asteridae
 Dilleniidae
 Caryophyllidae
 Magnoliidae
 Hamamelidae
 Basal angiosperms

(other groups in Cronquist's system: Aquifoliales, Umbellales, Apiales, Dipsacales, Gentianales, Ranunculales, Proteales, Hamamelidales, Magnoliidae, basal angiosperms)

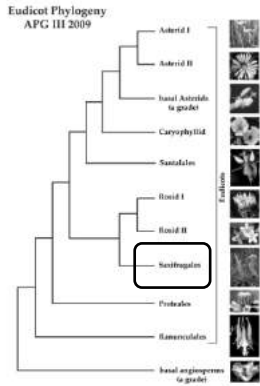
*Saxifragales

- before examining the large Rosid group, look at a small but important order of flowering plants - Saxifragales

Paeonia

Sedum

*Saxifragales



- small group of 16 families and about 2500 species sister to Rosids
- ancient lineage from 120 mya and underwent rapid radiation

Paeonia



Sedum

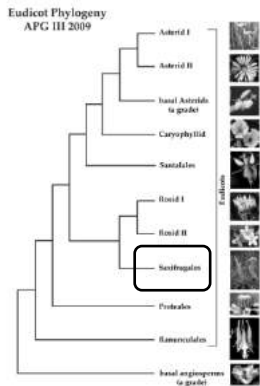


*Saxifragales

- part of this ancient radiation *may* involve this small family of holo-parasites - Cynomoriaceae



*Saxifragales



- they generally can be identified by their two or more separate or semi-fused carpels, but otherwise quite variable

Paeonia



Sedum



Paeoniaceae

1 genus / 33 species

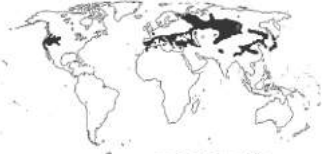


- like many of these families, *Paeonia* exhibits an Arcto-Tertiary distribution



Paeoniaceae

1 genus / 33 species

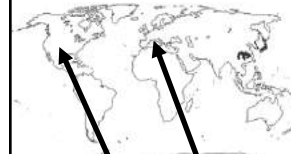


- small shrubs with primitive features of perianth and stamens
- hypogynous with 5-8 separate carpels developing into follicles

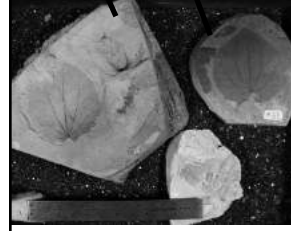


Cercidiphyllaceae

1 genus / 2 species



- small trees (kadsura-tree) restricted to eastern China and Japan . . .
- . . . but fossils in North America and Europe from Tertiary

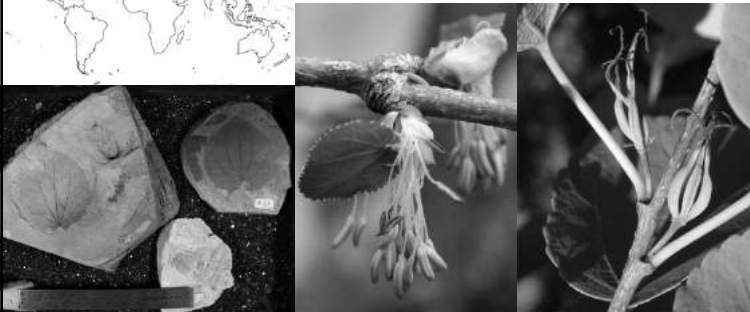


Cercidiphyllaceae

1 genus / 2 species



- unisexual, wind-pollinated but do produce follicles



Hamamelidaceae

27 genera and 80 species - witch hazels



- family of trees and shrubs in subtropical and temperate areas but only 1 species in Wisconsin - witch hazel found in rich deciduous woods



Hamamelidaceae

CA 4-5 CO 4-5 A 4-5 G (2)

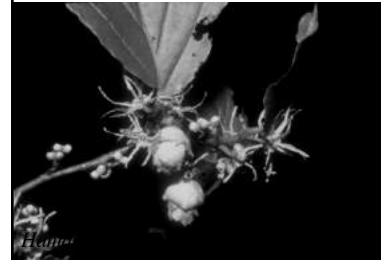
- 4-5 merous and insect pollinated in the fall (images from Sept)
- petals are ribbon-like



Hamamelidaceae

CA 4-5 CO 4-5 A 4-5 G (2)

- ovary is generally inferior or half-inferior with the tops somewhat separated



- fruit woody, dehiscent at top
- Previous year's fruit

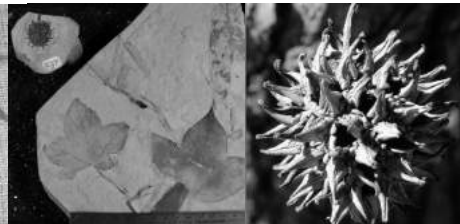
Altingiaceae

1 genus and 27 species - sweet gums



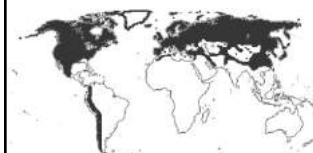
- small family of trees - sweet gum is familiar in North America; Arcto-Tertiary distribution

- clusters of small follicles



*Saxifragaceae

30 genera and 700 species



- family of herbs, Northern Hemisphere in distribution
- basal leaves common - scapose

- prefer wet woods, swampy conditions, or drippy cliffs as in the driftless region of SW WI



*Saxifragaceae

CA 5 CO 5 A 5or10 G (2)

- 5 merous flowers
- Superior pistil is made of 2 carpels, separated, at least from the middle up; perigynous hypanthium often present

2 styles



Micranthes pensylvanica - swamp saxifrage



*Saxifragaceae



Note cup-like
hypanthium

Mitella -
Bishop's cap



Heuchera richardsonii
prairie alumroot

*Saxifragaceae

Tiarella cordifolia
Foamflower
Endangered boreal sp.

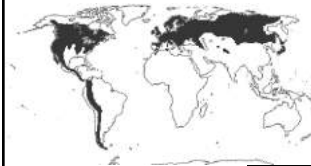


Chrysosplenium -
golden saxifrage



Grossulariaceae

1 genus and 150 species - temperate regions



- characterized by lobed leaves, raceme inflorescences, and fleshy fruits (currants and gooseberries)



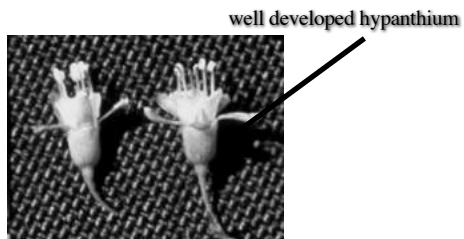
Ribes americanum -
American black currant



Grossulariaceae

CA 5 CO 5 A 5 G (2)

- flowers 5 merous with sepals large and petals smaller
- gynoecium inferior of 2 fused carpels



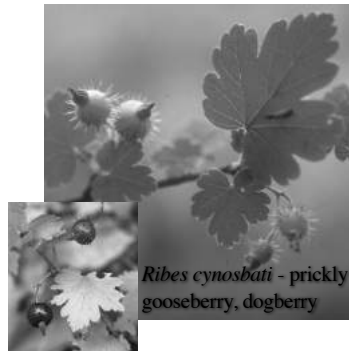
Grossulariaceae

- Currants identified by long racemes of many flowers



Grossulariaceae

- Gooseberries identified by paired flowers; stems often spiny



*Crassulaceae

34 genera and 1370 species - temperate or warm temperate regions of the world



Sedum acre - Gold-moss stonecrop, Yellow sedum

- succulent herbs or small shrubs - jade plants
- CAM (crassulacean acid metabolism) type of photosynthesis
- Wisconsin species are introduced, although yellow sedum is spreading in sandy soils

*Crassulaceae

CA 5 CO 5 A 10 G 5



Sedum acre - Gold-moss stonecrop, Yellow sedum

- 5 merous with stamens 2X number of sepals (3,4, or 6 merous species occur)
- carpels separate and produce follicles when mature
- nectary scales usually evident at base of each carpel

*Crassulaceae

- major radiation of genera in Mediterranean climates (e.g., Canary Islands)



Aeonium



Rhodiola

*Crassulaceae



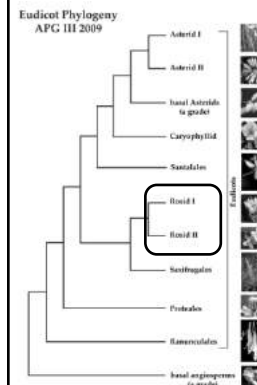
Echeveria



Kalanchoe

Rosids

Rosids are one of two large groups of dicots; the other group are the Asterids



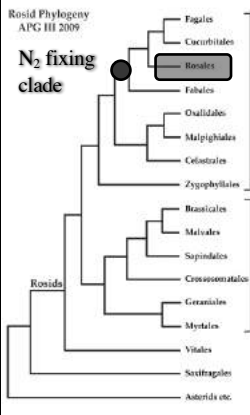
Rosids:
separate petals



Asterids:
fused petals

*Rosales

Rosid Phylogeny
APG III 2009
N₂ fixing
clade



- two major groups within Rosids - we will start with Fabids
- include all N₂ fixing plants

• the order Rosales: not well defined morphologically (roses, elms, marijuana, nettles, figs)

1. N₂ fixing via actinomycetes (*Frankia*)
2. loss of corolla in order; petals in Rosaceae = stamens!
3. serrated leaves (glandular +/-)

*Rosaceae

100 genera and almost 3000 species distributed worldwide but most common in the north temperate regions - commercial fruits

- Comprise herbs, shrubs, or trees and with alternate simple or pinnately or palmately compound leaves



Stipules well developed in compound leaves

*Rosaceae

CA 5 CO 5 A ∞ G [variable!]

- 5 merous, with numerous stamens
- gynoecium is variable and used to define subfamilies



*Rosaceae

CA 5 CO 5 A ∞ G [variable!]

- hypanthium present in all species



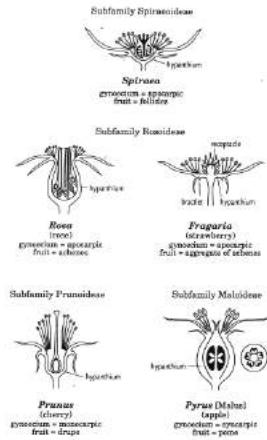
Bracts on calyx (epicalyx) often present

*Rosaceae

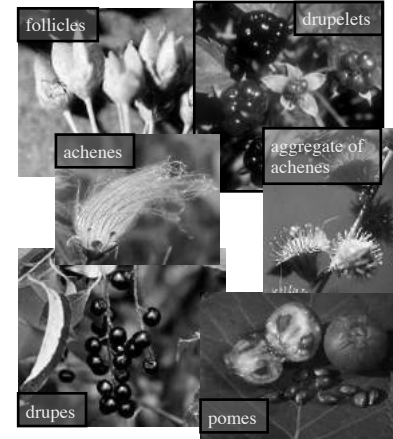
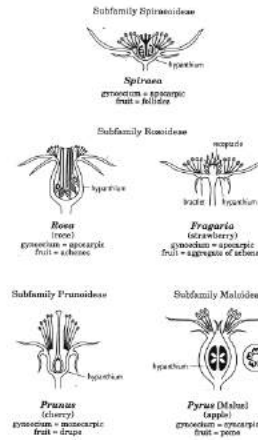
The gynoecium is variable – four basic types

1. Spiraea group
2. Rose group
3. Cherry group
4. Apple group

Gynoecium variability encompasses size of receptacle, position of ovary, size of hypanthium, and the resulting fruit types:



*Rosaceae



*Rosaceae – spiraea group

Physocarpus opulifolius - ninebark

CA 5 CO 5 A ∞ G 2-8

apocarpic, superior pistils
short hypanthium - perigynous
follicle fruits



*Rosaceae – spiraea group

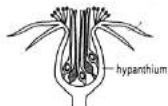


Spiraea alba - meadow-sweet

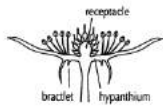


Spiraea tomentosa - hardhack

*Rosaceae – rose group



Rosa
(rose)
gynoecium = apocarpic
fruit = achenes



Fragaria
(strawberry)
gynoecium = apocarpic
fruit = aggregate of achenes

CA 5 CO 5 A ∞ G ∞

Herbs with compound leaves

Plants with stolons (running stems above ground) or running rhizomes

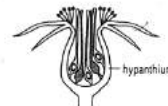
Flowers apocarpic with many carpels

Hypanthium well-developed or receptacle elongated - perigynous

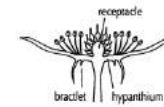
One-seeded achenes



*Rosaceae – rose group



Rosa
(rose)
gynoecium = apocarpic
fruit = achenes



Fragaria
(strawberry)
gynoecium = apocarpic
fruit = aggregate of achenes

CA 5 CO 5 A ∞ G ∞

Achenes often modified into aggregate of achenes (from one flower) as in the strawberry or fleshy drupelets as in raspberry, dewberry



*Rosaceae – rose group



*Rosaceae – rose group



2 achenes, but hypanthium disperses as a unit with "velcro"-like barbs from top of hypanthium

***Rosaceae – rose group**



Potentilla simplex
Common cinquefoil

Potentilla argentea
silverweed

***Rosaceae – rose group**



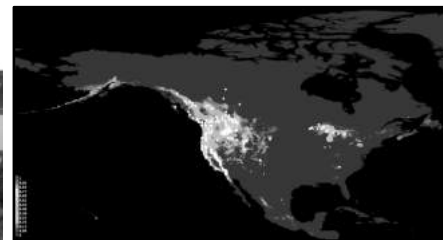
Sky Islands of North America
A Globally Unique and Threatened Inland Archipelago

Potentilla breweri complex
Western cinquefoils

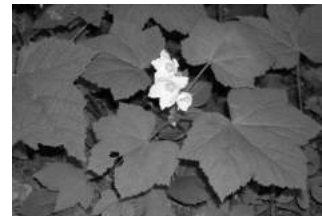
***Rosaceae – rose group**



Rubus parviflorus
thimbleberry



***Rosaceae – rose group**



Rubus parviflorus
thimbleberry

Rubus hispidus
swamp dewberry



Rubus allegheniensis
blackberry

*Rosaceae – rose group



Rosa rugosa
Beach rose



Rosa palustris
Swamp rose

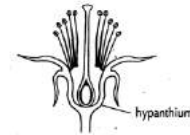


Rosa multiflora
Multiflora rose
Invasive weed

*Rosaceae – cherry group

Subfamily Prunoideae

CA 5 CO 5 A ∞ G 1



Prunus
(cherry)
gynoecium = monocarpic
fruit = drupe

Shrubs and trees with simple leaves, often with glands along petiole (cherries, plums, peaches, almonds)

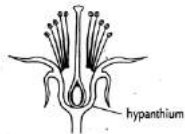


Prunus serotina – black cherry

*Rosaceae – cherry group

Subfamily Prunoideae

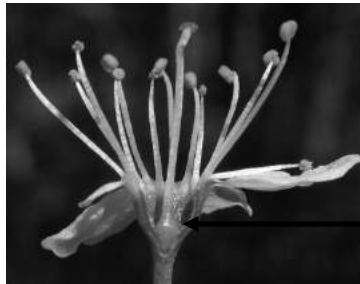
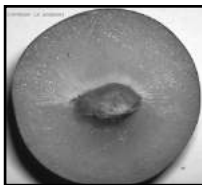
CA 5 CO 5 A ∞ G 1



Prunus
(cherry)
gynoecium = monocarpic
fruit = drupe

Gynoecium superior with one carpel = monocarpic - perigynous

Fruit a drupe = fleshy, with one bony seed



*Rosaceae – cherry group



Prunus serotina
wild black cherry



Prunus virginiana
choke cherry

***Rosaceae – cherry group**



Prunus pumila - sand cherry

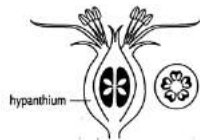
***Rosaceae – cherry group**



Prunus americana
Wild plum

***Rosaceae – apple group**

CA 5 CO 5 A ∞ G̅ (3-5)



Pyrus (*Malus*)
(apple)
gynoecium = syncarpic
fruit = pome

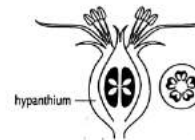
Shrubs or trees with showy 5 merous flowers

Gynoecium inferior of 3 to 5 fused carpels



***Rosaceae – apple group**

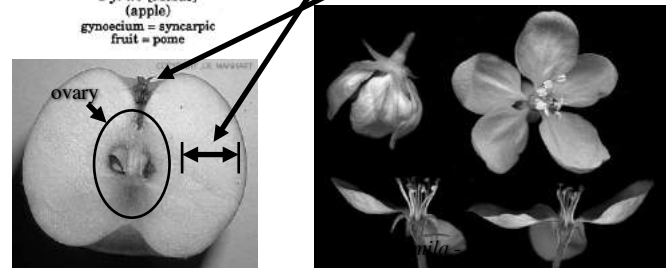
CA 5 CO 5 A ∞ G̅ (3-5)



Pyrus (*Malus*)
(apple)
gynoecium = syncarpic
fruit = pome

Hypanthium thickens in fruit to form pome fruit

Calyx (& CO + A) inserted at top of ovary = epigynous flower



*Rosaceae – apple group



Pyrus communis
Pear (introduced)



Aronia melanocarpa
black chokeberry

*Rosaceae – apple group



Amelanchier laevis
Serviceberry, Juneberry



*Rosaceae – apple group

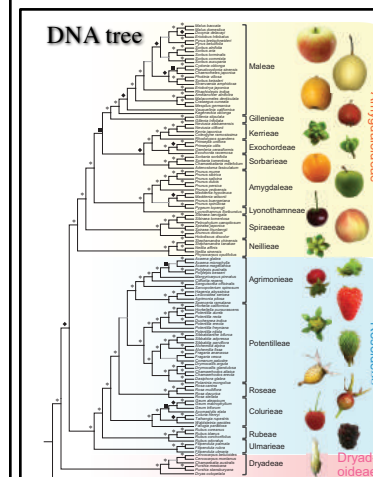


Crataegus crus-galli - cockspur hawthorn



Crataegus mollis - downy hawthorn

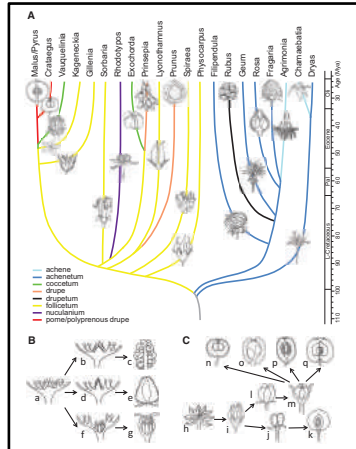
*Rosaceae



- spiraea group is polyphyletic - not first diverging group
- rose core group is monophyletic, but others are scattered around
- cherry group and apple group form a monophyletic clade

Xiang et al. 2017

*Rosaceae



What does this tell us about fruit evolution?

- achenes are ancestral
- pomes and drupes evolved once or twice
- follicles evolved many times

Xiang et al. 2017