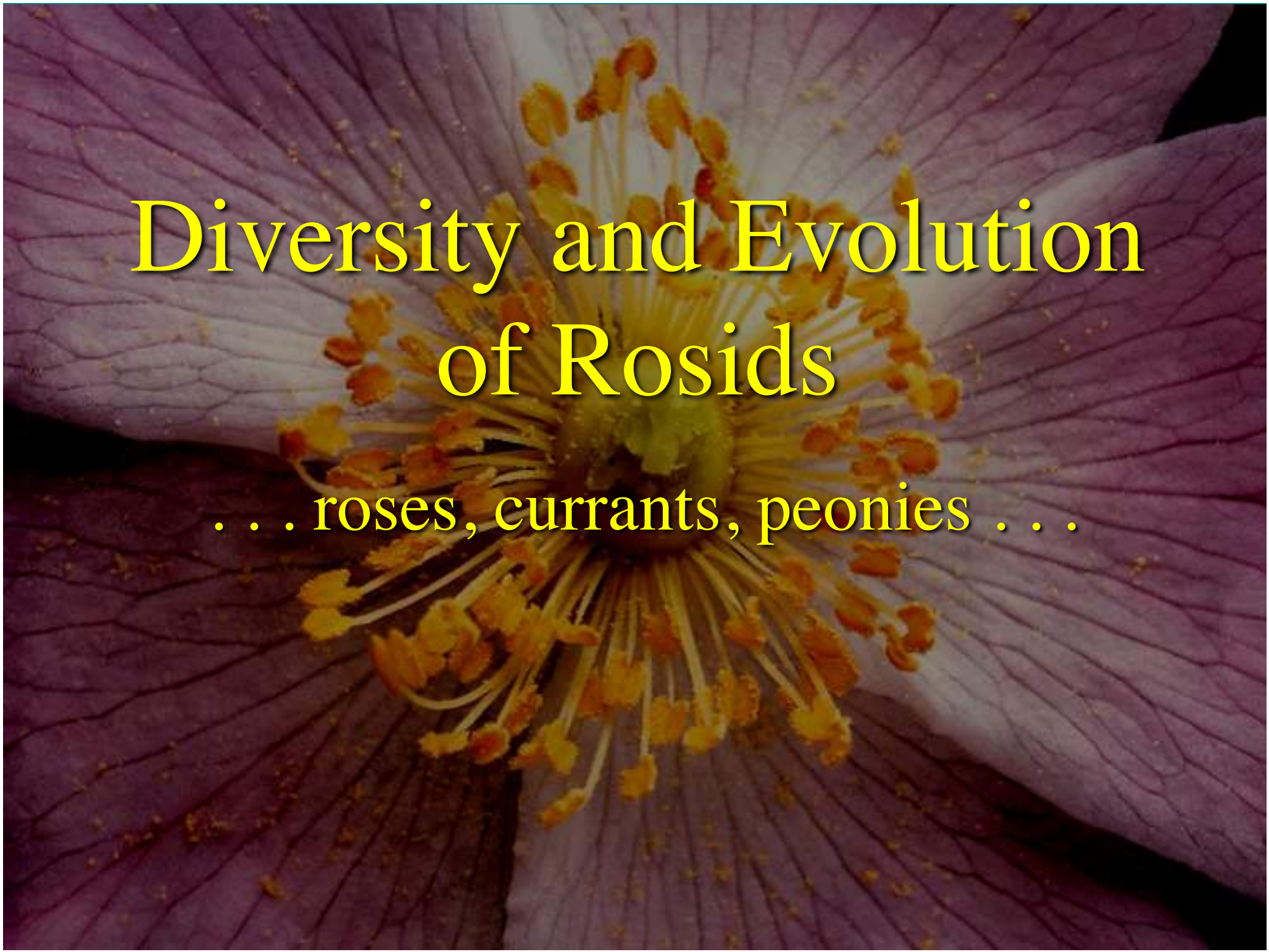
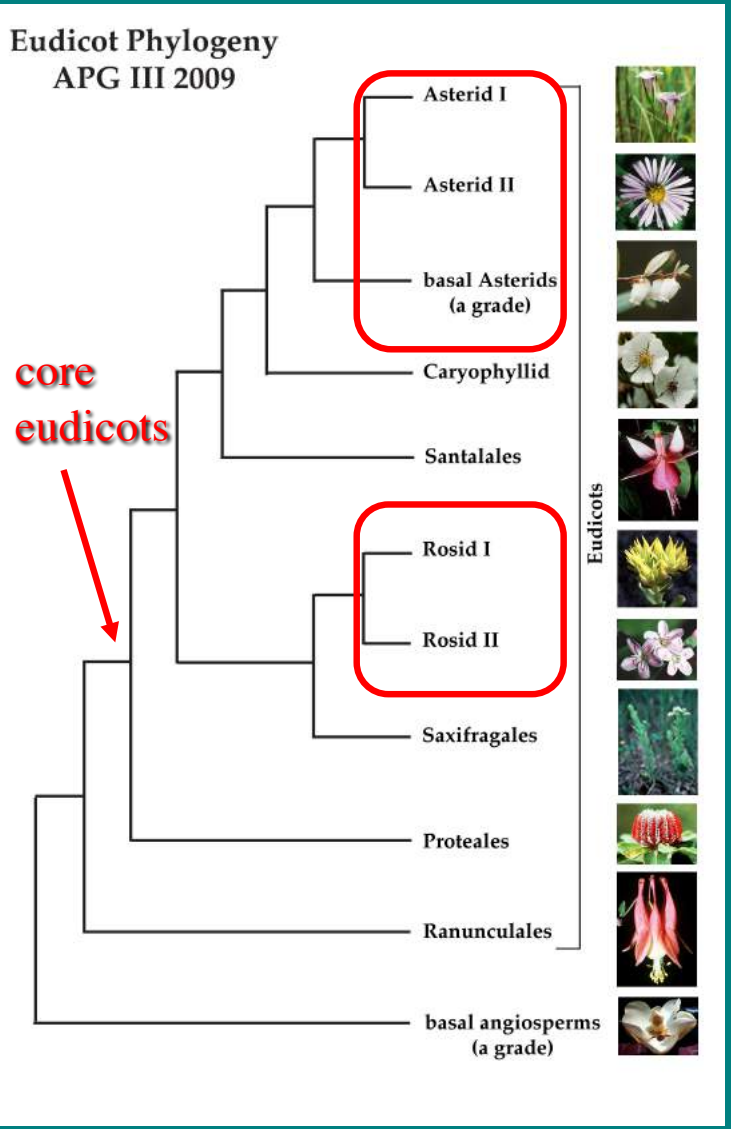

Diversity and Evolution
of Rosids
. . . roses, currants, peonies . . .

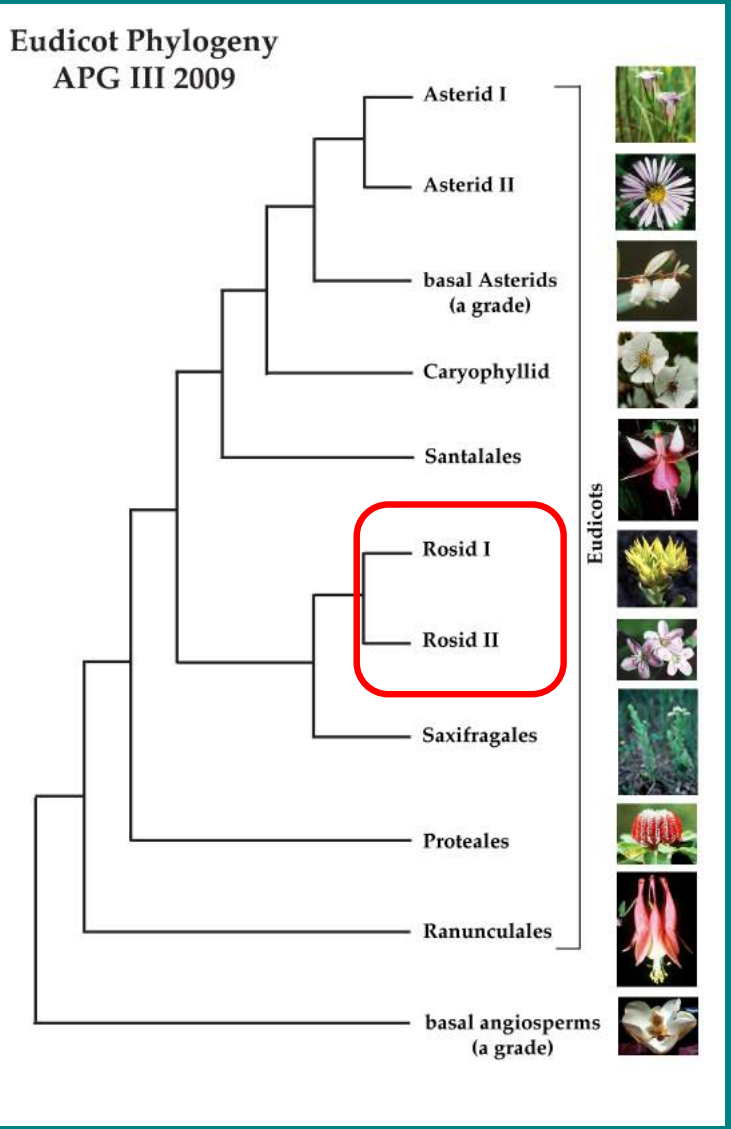
Eudicots

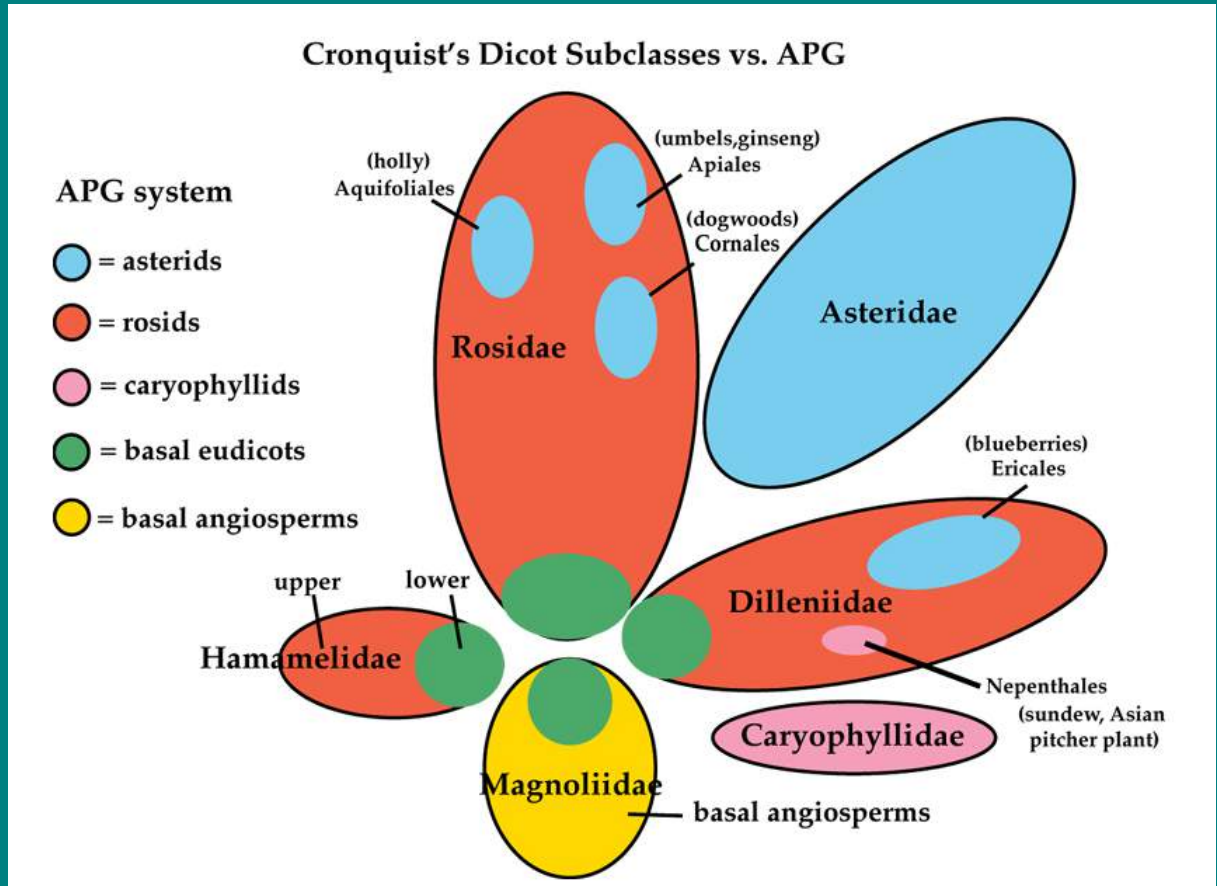
- continue survey through the eudicots or tricolpates
- vast majority of eudicots are Rosids (polypetalous) and Asterids (sympetalous)



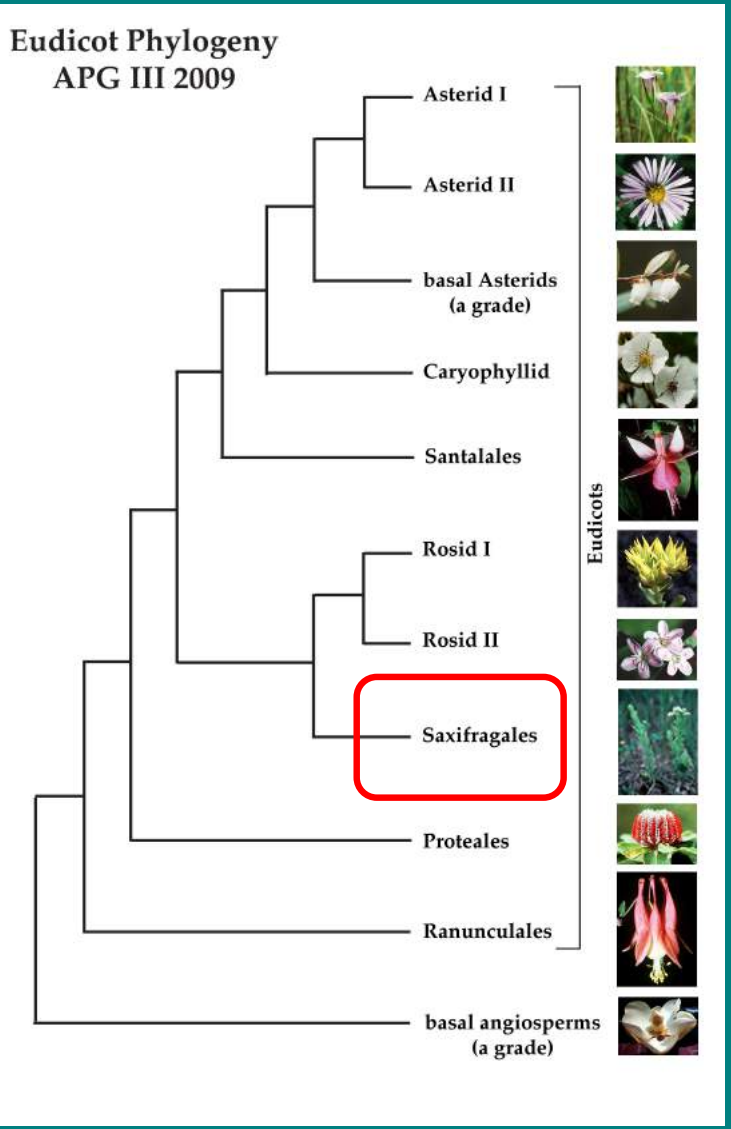
Eudicots

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





*Saxifragales

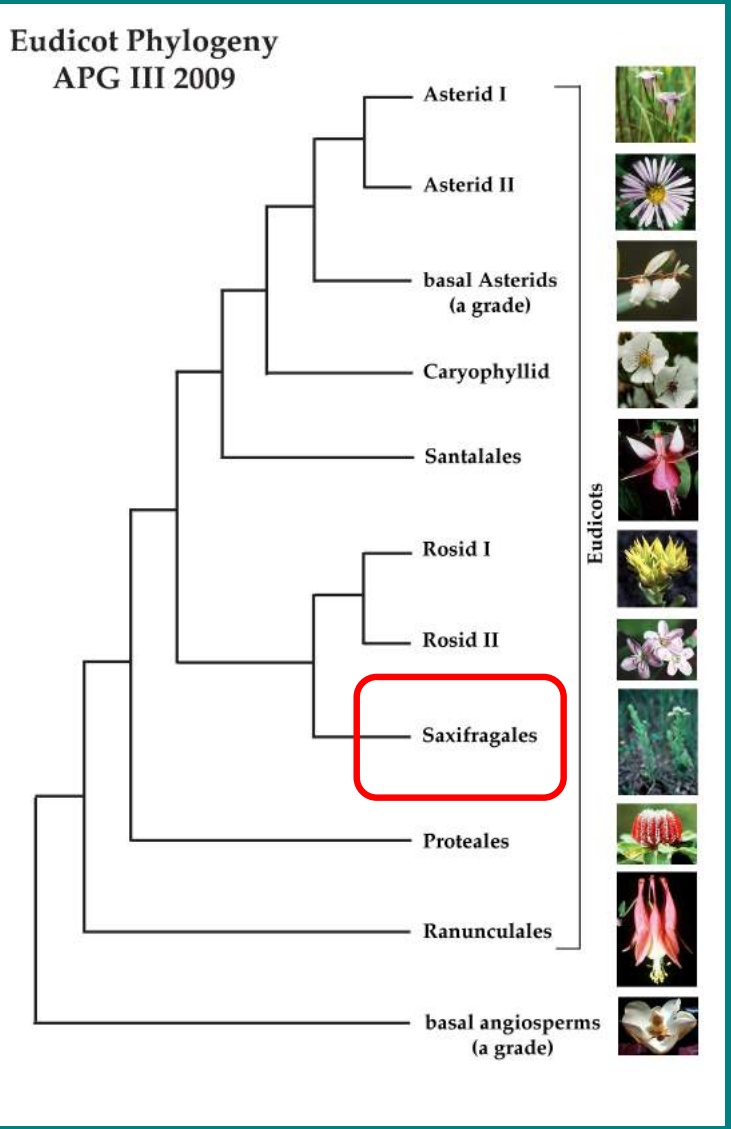


- before examining the large Rosid group, look at a small but important order of flowering plants - Saxifragales

Paeonia

Sedum

*Saxifragales



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

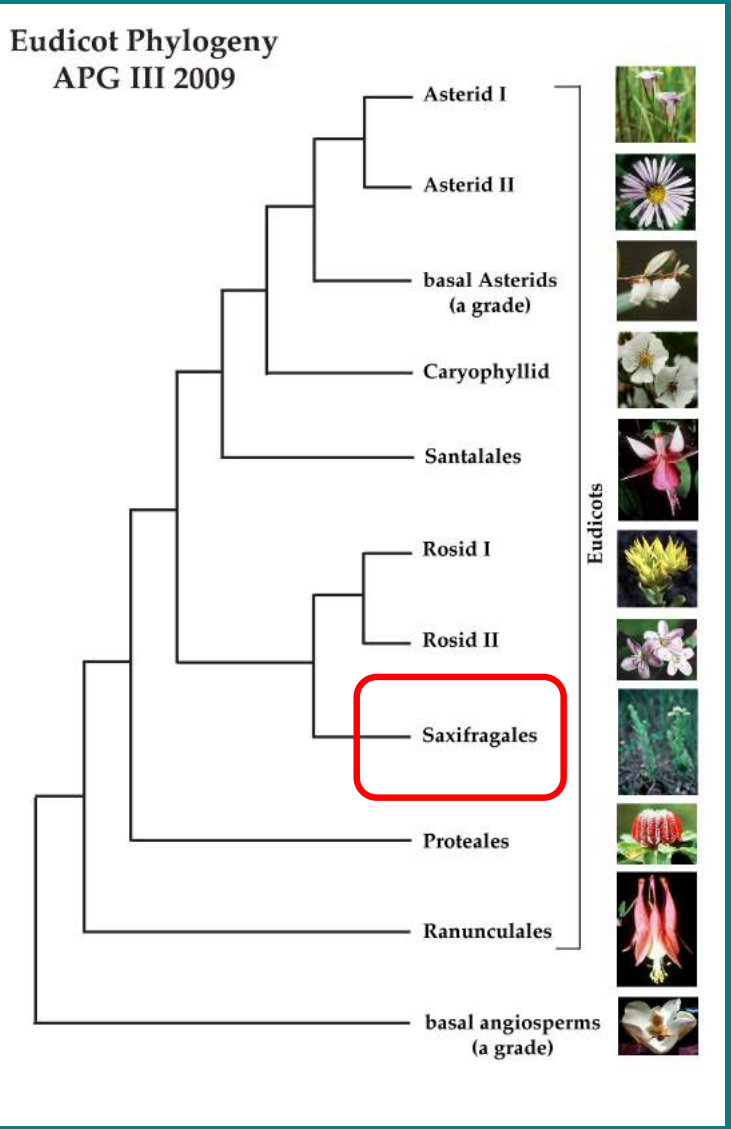
Paeonia

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

Hamamelis virginiana - witch hazel

Hamamelis mollis

Hamamelidaceae

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

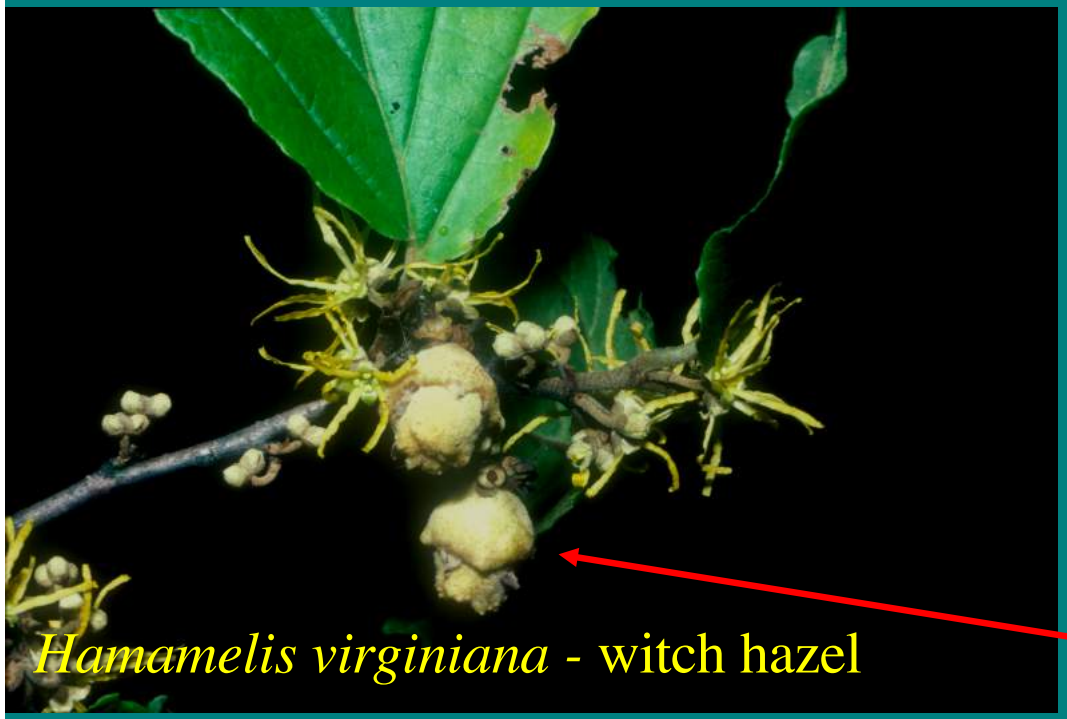
- 4-5 merous and insect pollinated in the fall (images from Sept)
- petals are ribbon-like

Hamamelis virginiana - witch hazel

Hamamelidaceae

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

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



Hamamelis virginiana - witch hazel

- 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

Liquidambar styraciflua

*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

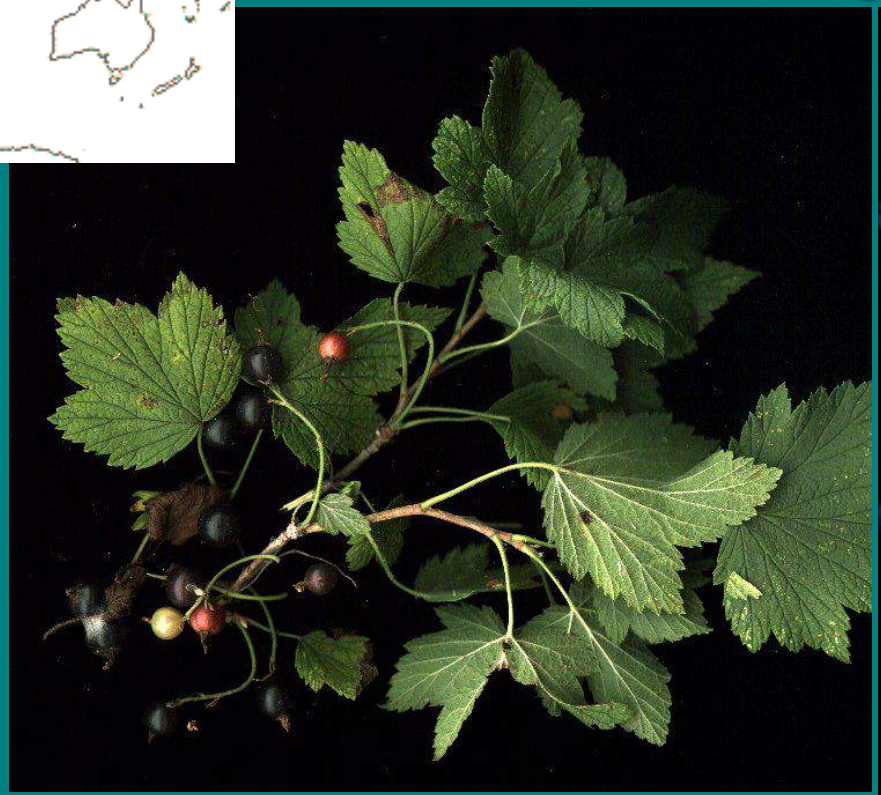
*Saxifragaceae

Tiarella cordifolia
Foamflower
Endangered boreal sp.

Grossulariaceae

1 genus and 150 species - temperate regions

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



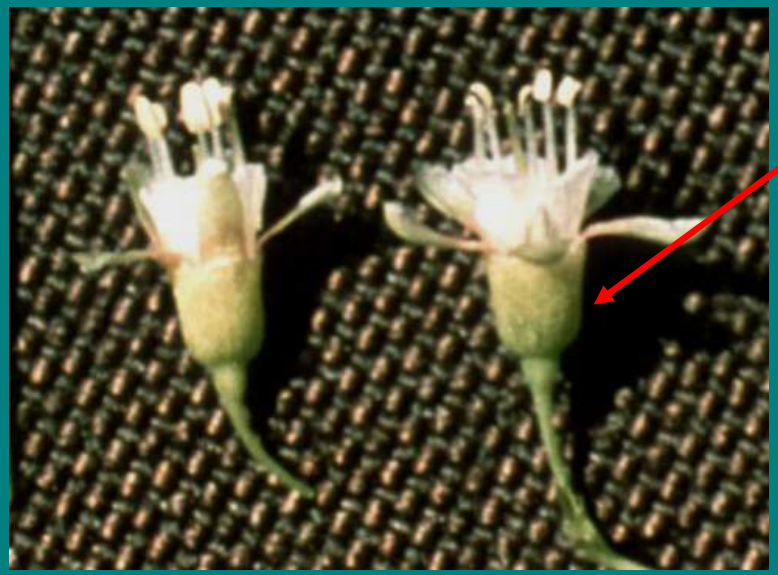
Ribes americanum - American black currant

Grossulariaceae

CA 5 CO 5 A 5 G (2)

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

well developed hypanthium



Grossulariaceae

Ribes americanum
American black currant

- Currants identified by long racemes of many flowers

Ribes triste -
swamp currant

Grossulariaceae

- Gooseberries identified by paired flowers; stems often spiny

Ribes missouriense
Missouri gooseberry

Ribes cynosbati - prickly gooseberry, dogberry

*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

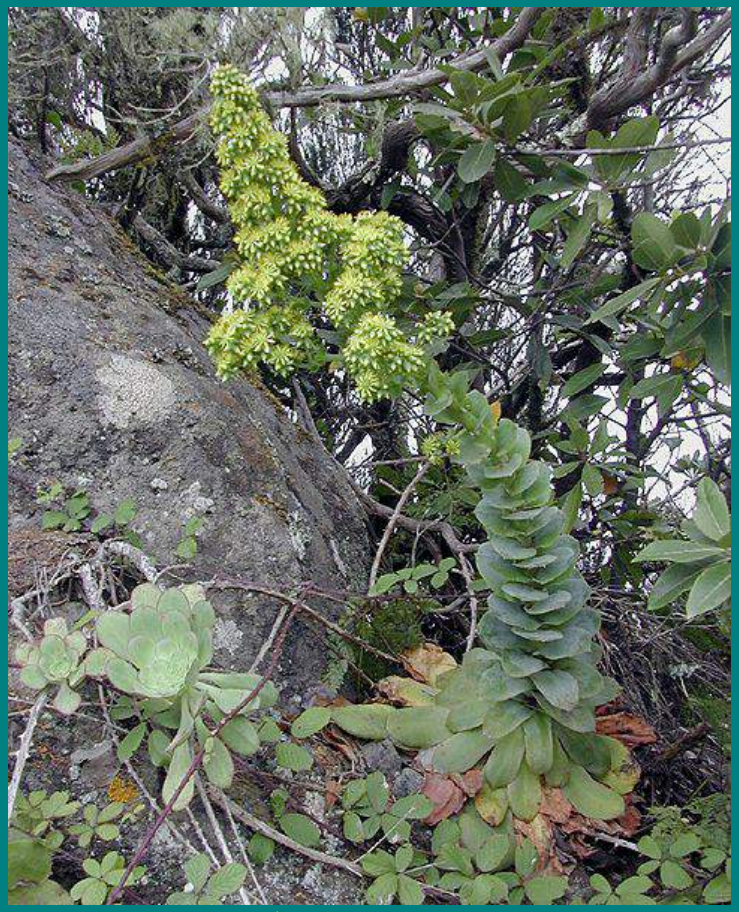
CA 5 CO 5 A 10 G 5

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

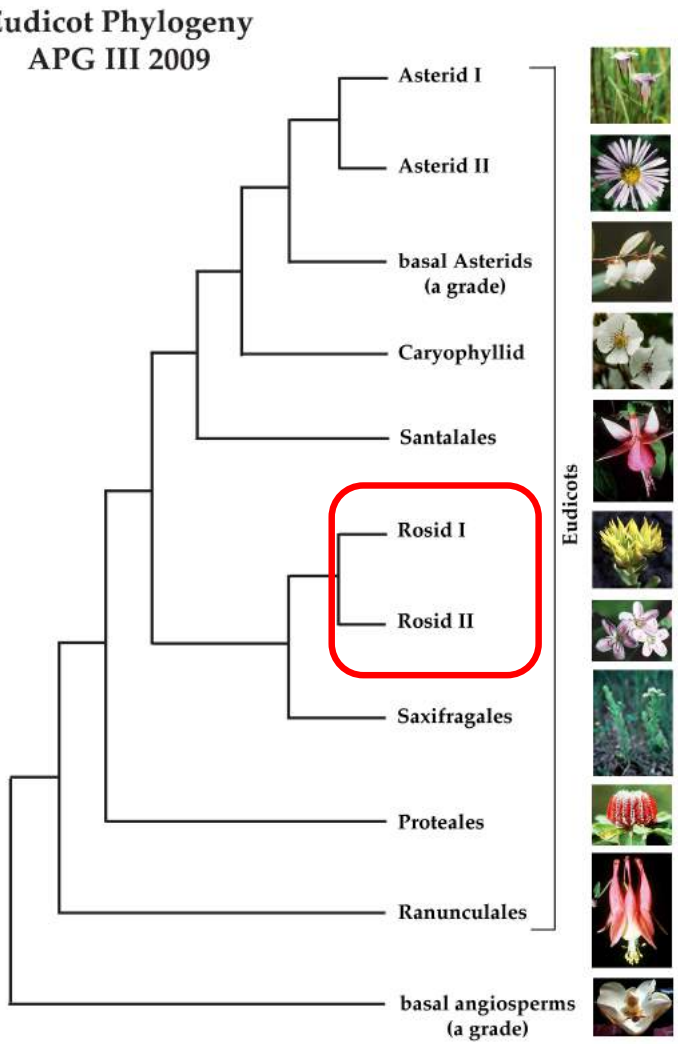
*Crassulaceae

Echeveria

Kalanchoe

Rosids

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



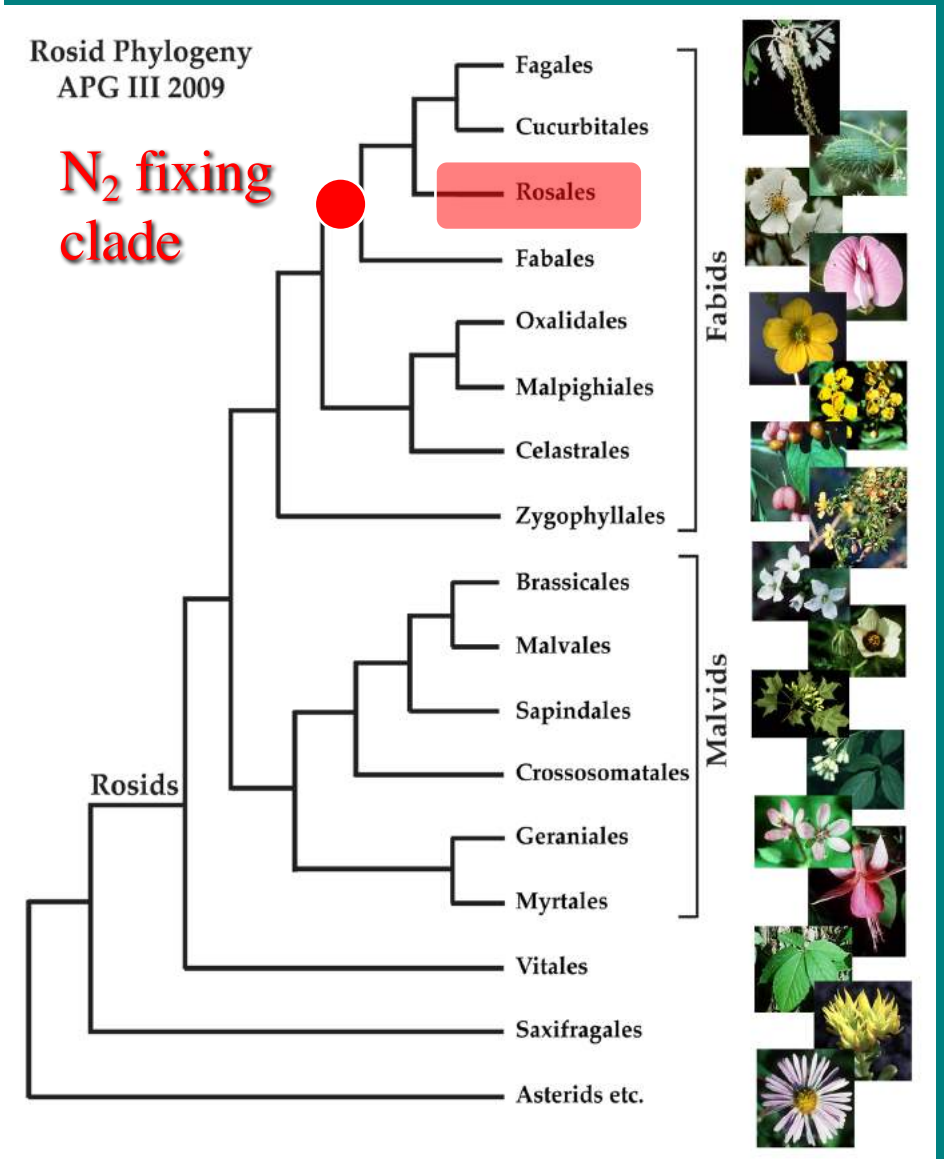
Rosids:

separate petals

Asterids:

fused petals

*Rosales



- two major groups within Rosids - we will start with Fabids
- include all N_2 fixing plants

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

1. N_2 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

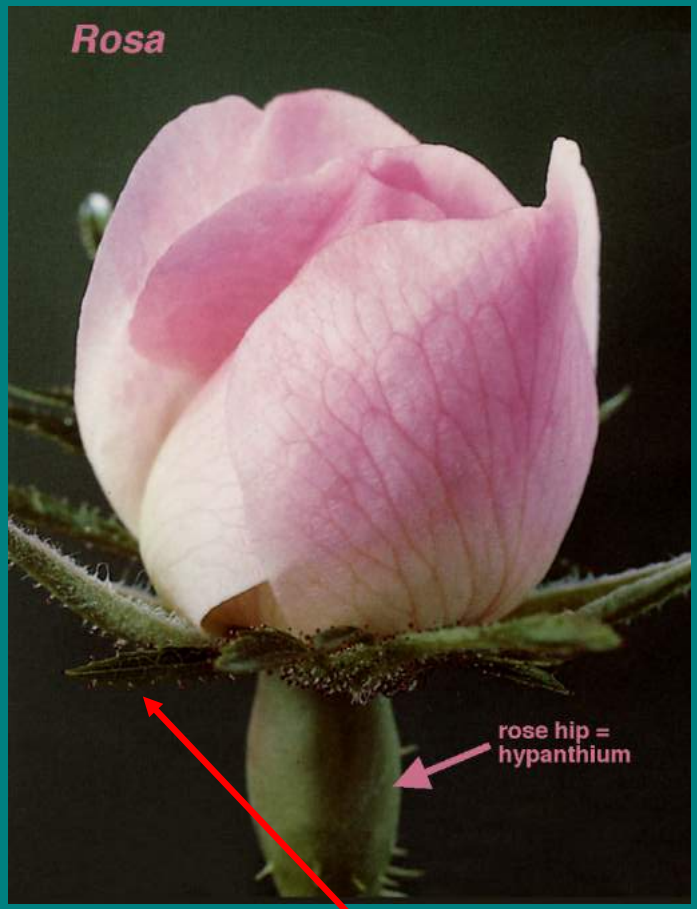
CA 5 CO 5 A ∞ G [variable!]

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

*Rosaceae

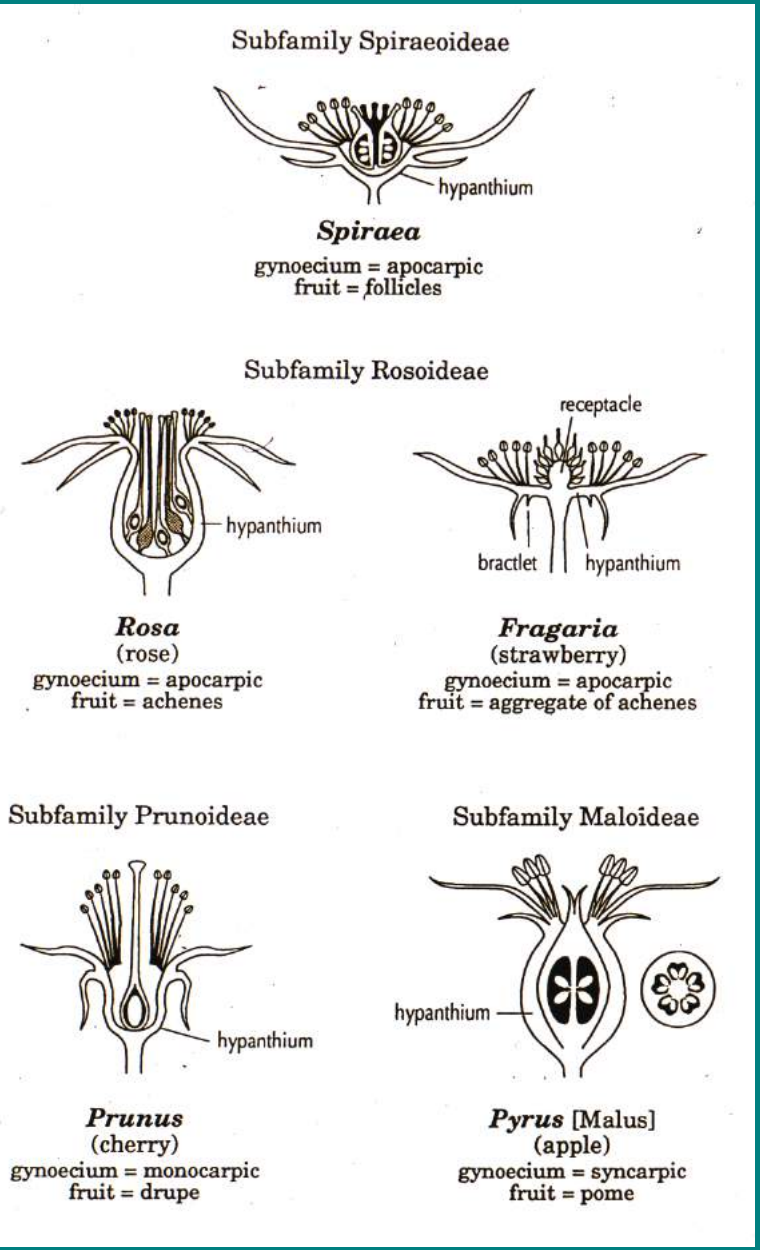
CA 5 CO 5 A ∞ G [variable!]

- 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

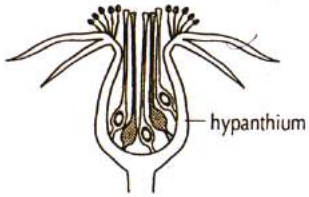
Gynoecium variability encompasses size of receptacle, position of ovary, size of hypanthium, and the resulting fruit types:

*Rosaceae

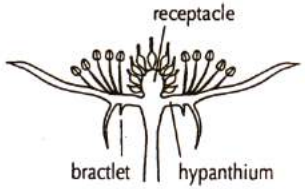
Subfamily Spiraeoideae

Spiraea
gynoecium = apocarpic
fruit = follicles

Subfamily Rosoideae

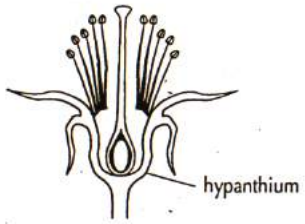


Rosa
(rose)
gynoecium = apocarpic
fruit = achenes



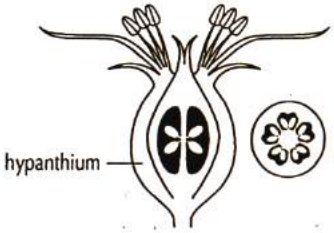
Fragaria
(strawberry)
gynoecium = apocarpic
fruit = aggregate of achenes

Subfamily Prunoideae



Prunus
(cherry)
gynoecium = monocarpic
fruit = drupe

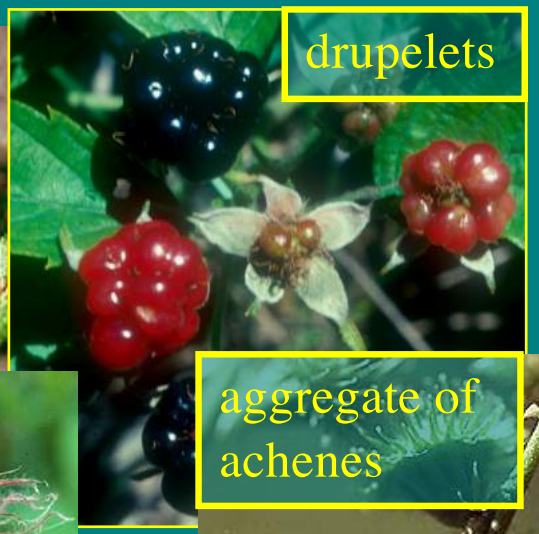
Subfamily Maloideae



Pyrus [Malus]
(apple)
gynoecium = syncarpic
fruit = pome

follicles

drupelets



achenes

aggregate of achenes

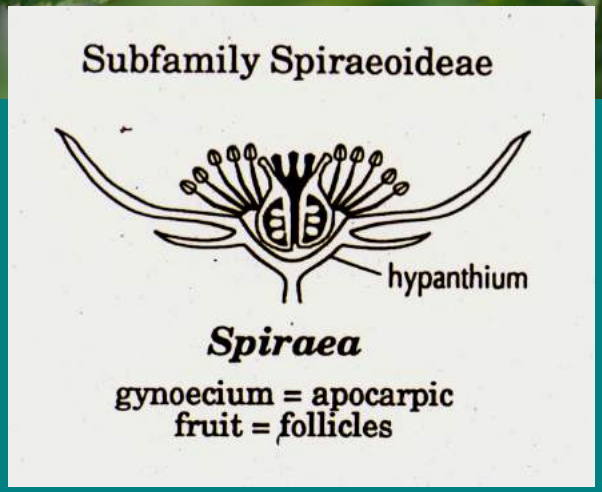
drupes

pomes

*Rosaceae – spiraea group

CA 5 CO 5 A ∞ G 2-8

apocarpic, superior pistils
short hypanthium - perigynous
follicle fruits

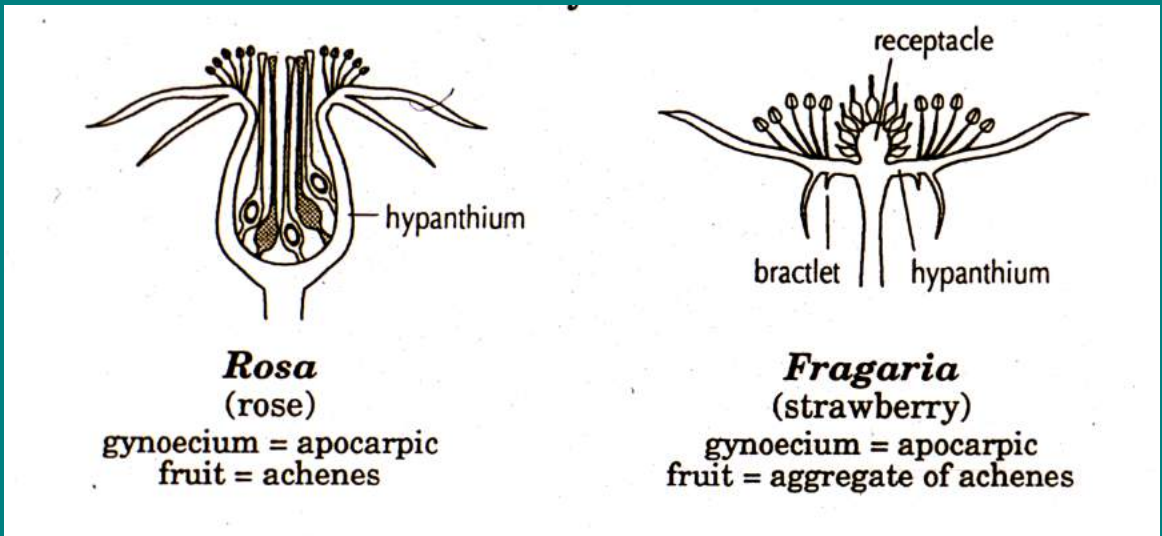


*Rosaceae – spiraea group

Spiraea alba - meadow-sweet

Spiraea tomentosa - hardhack

*Rosaceae – rose group



CA 5 CO 5 A ∞ G ∞

Herbs with compound leaves

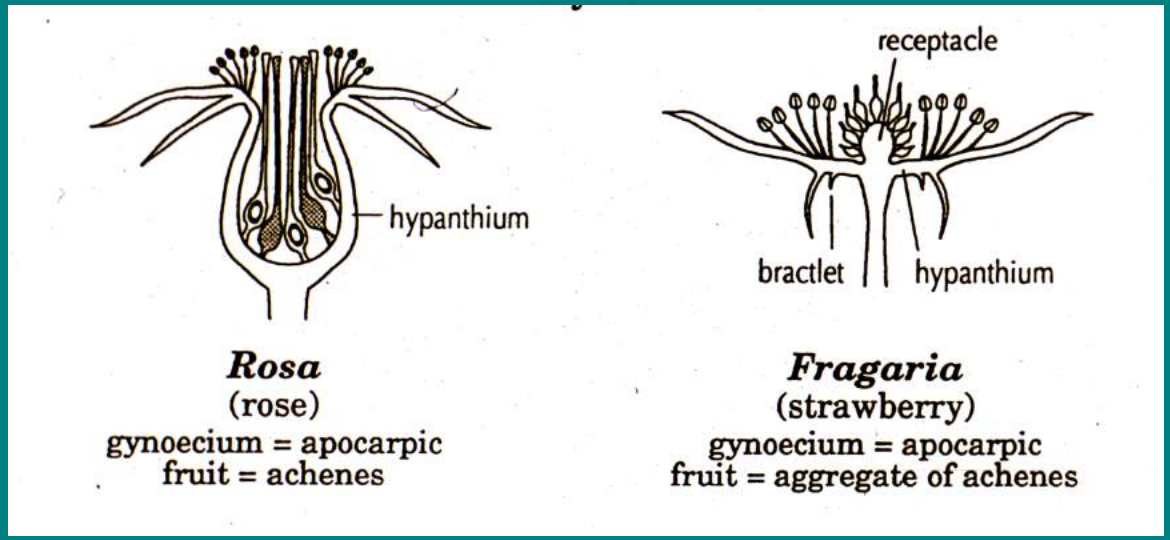
Plants with stolons (running stems above ground) or running rhizomes

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

Rubus idaeus - American raspberry

Fragaria sp. - strawberry

*Rosaceae – rose group

Fragaria virginiana - wild strawberry

Geum triflorum - prairie smoke

*Rosaceae – rose group

Agrimonia gryposepala - common agrimony, harvest lice

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

*Rosaceae – rose group

Potentilla argentea
silverweed

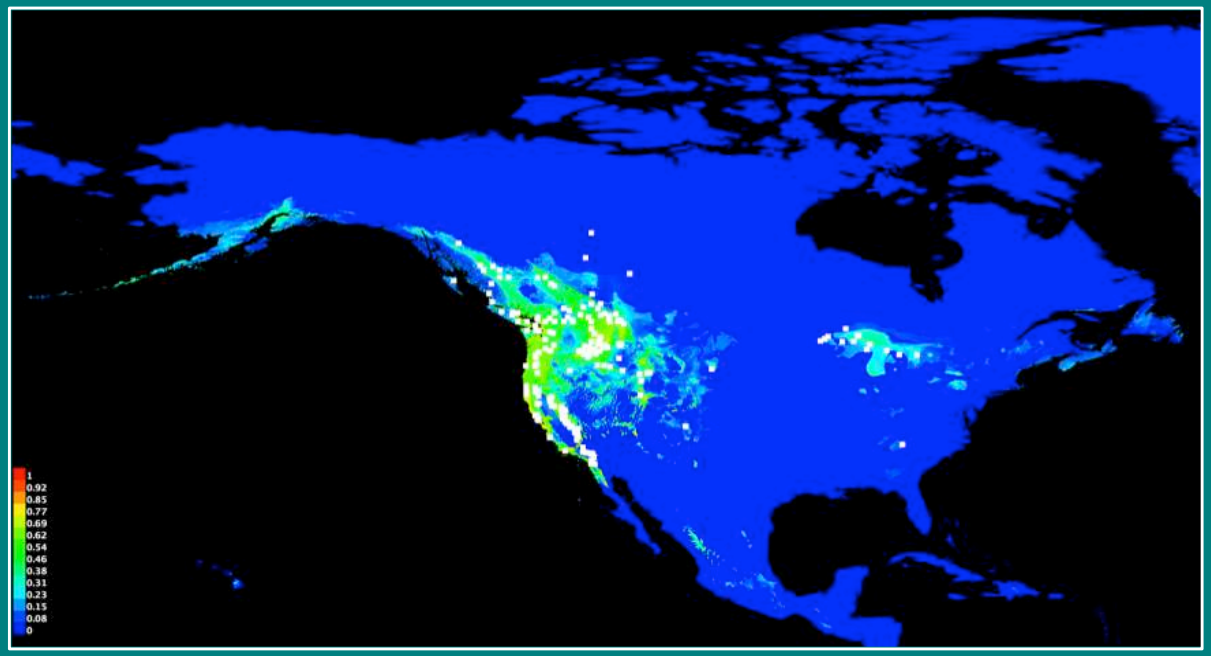
Potentilla simplex
Common cinquefoil

*Rosaceae – rose group

Potentilla breweri complex
Western cinquefoils

*Rosaceae – rose group

Rubus parviflorus
thimbleberry



*Rosaceae – rose group

Rubus parviflorus
thimbleberry

Rubus hispidus
swamp dewberry

Rubus allegheniensis
blackberry

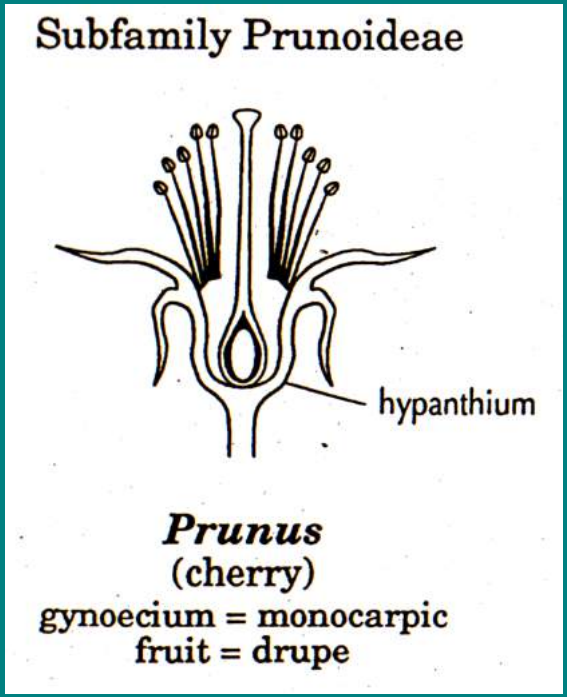
*Rosaceae – rose group

Rosa rugosa
Beach rose

Rosa palustris
Swamp rose

Rosa multiflora
Multiflora rose
Invasive weed

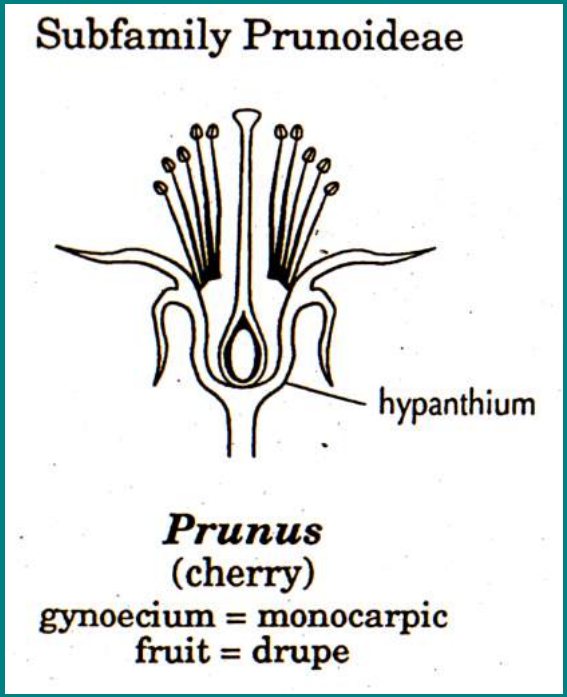
*Rosaceae – cherry group



CA 5 CO 5 A ∞ G 1

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

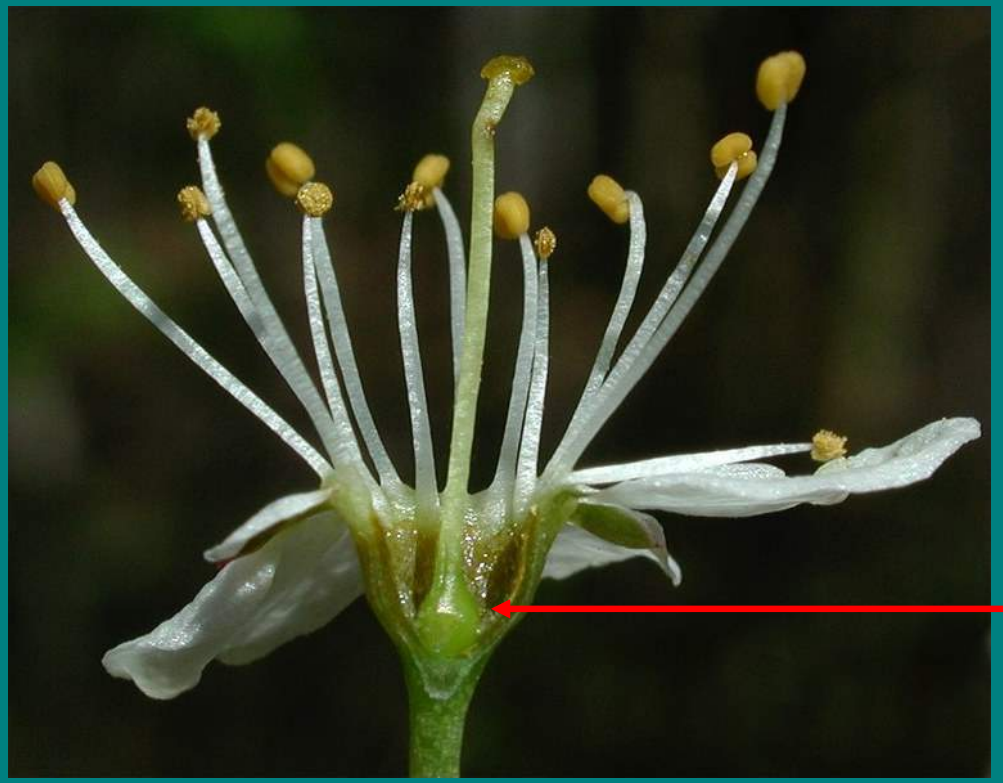
*Rosaceae – cherry group



CA 5 CO 5 A ∞ G 1

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

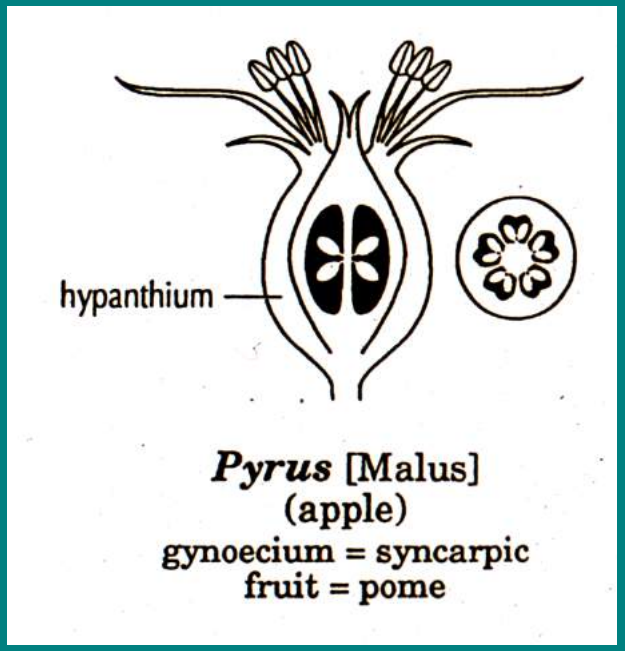
*Rosaceae – cherry group

Prunus pumila - sand cherry

*Rosaceae – cherry group

Prunus americana
Wild plum

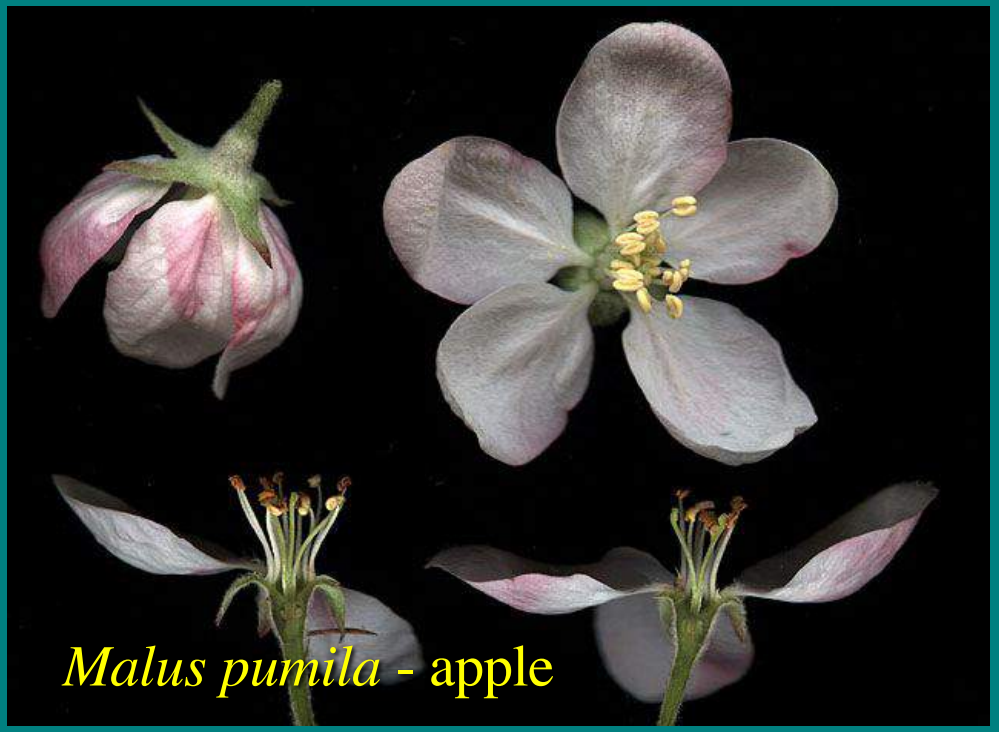
*Rosaceae – apple group



CA 5 CO 5 A ∞ $\overline{G}$ (3-5)

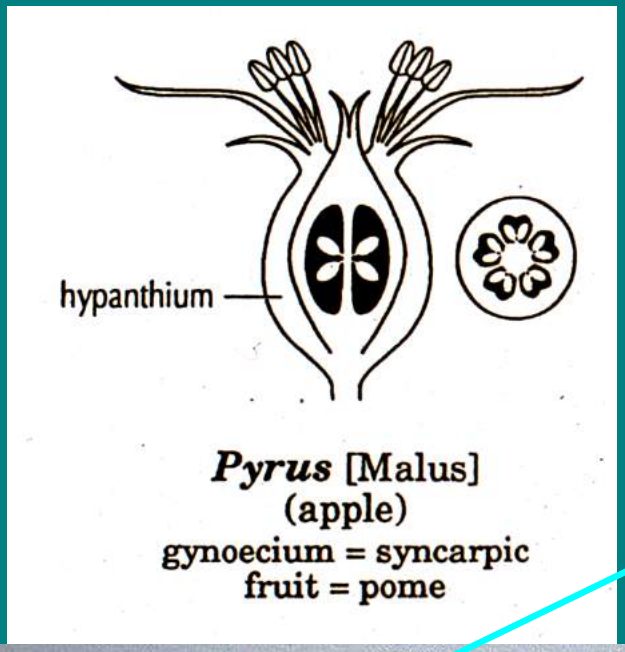
Shrubs or trees with showy 5 merous flowers

Gynoecium inferior of 3 to 5 fused carpels



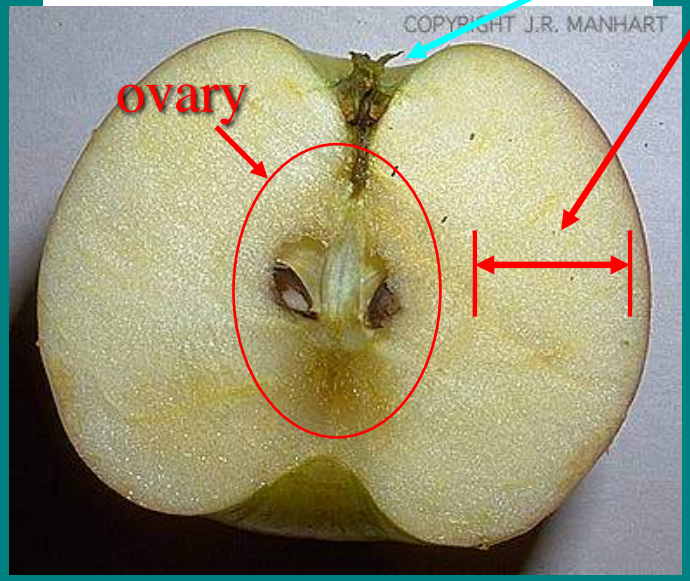
*Rosaceae – apple group

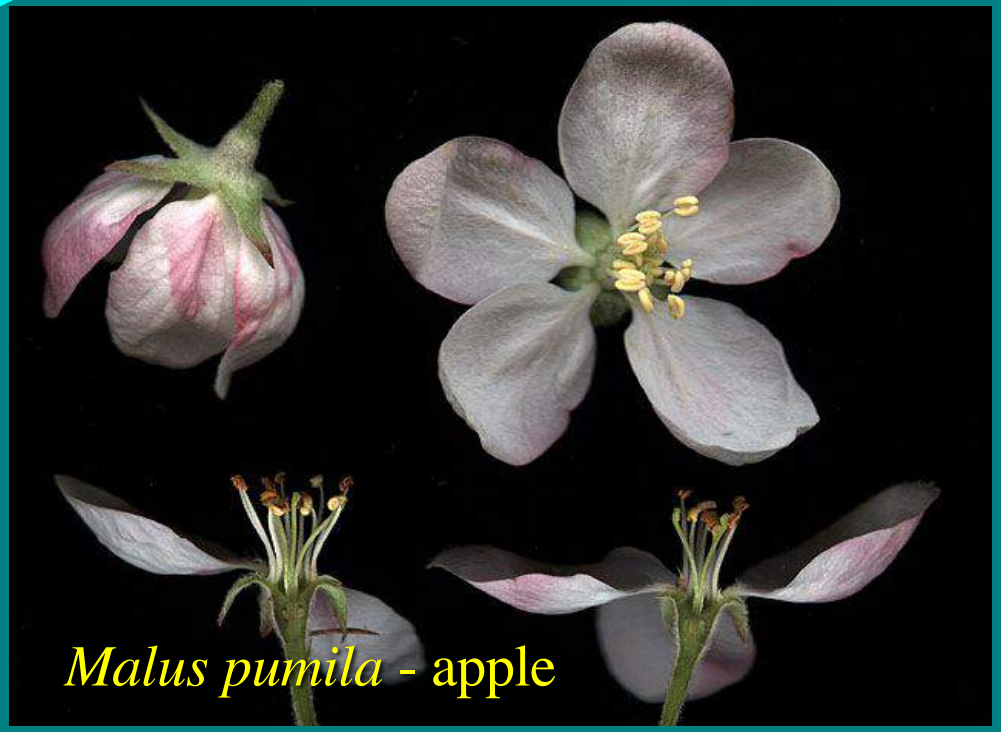
CA 5 CO 5 A ∞ $\overline{G}$ (3-5)



Hypanthium thickens in fruit to form pome fruit

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





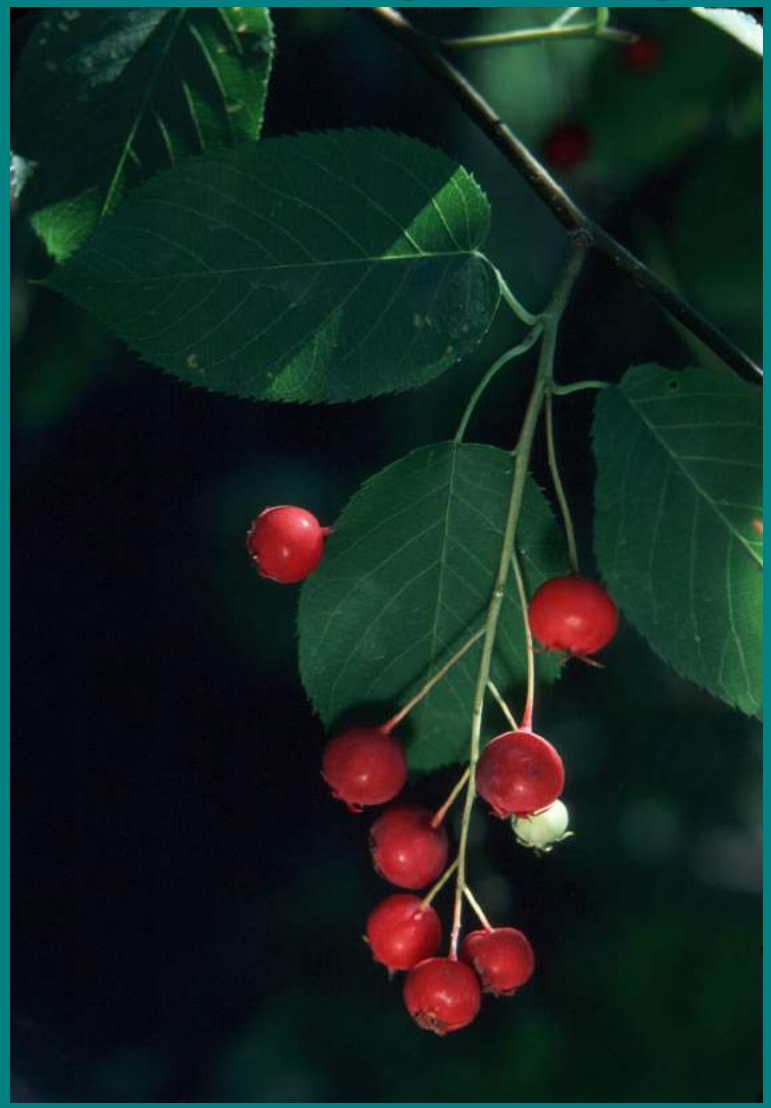
*Rosaceae – apple group

Pyrus communis
Pear (introduced)

Aronia melanocarpa
black chokeberry

*Rosaceae – apple group

Amelanchier laevis
Serviceberry, Juneberry

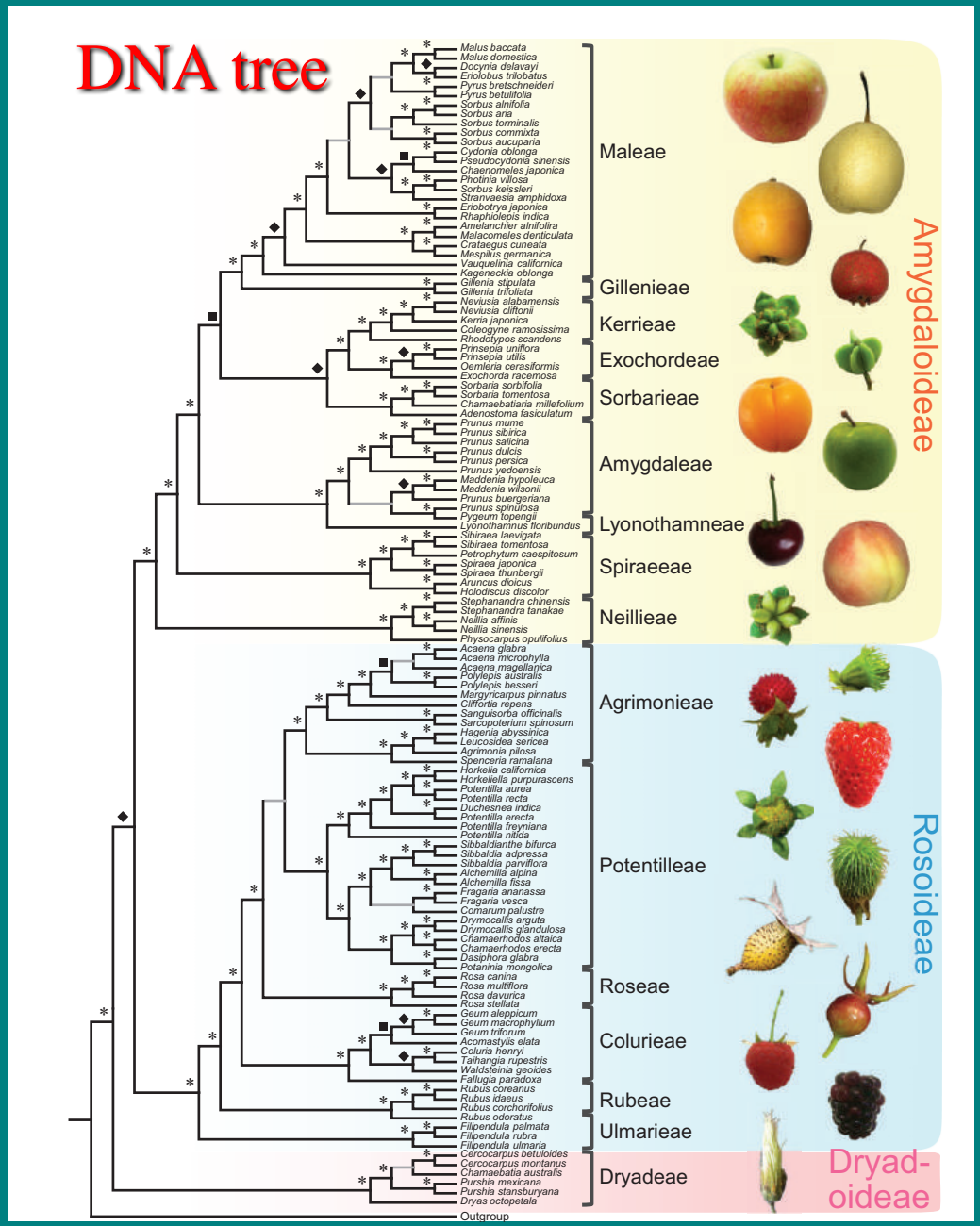


*Rosaceae – apple group

Crataegus crus-galli - cockspur hawthorn

Crataegus mollis - downy hawthorn

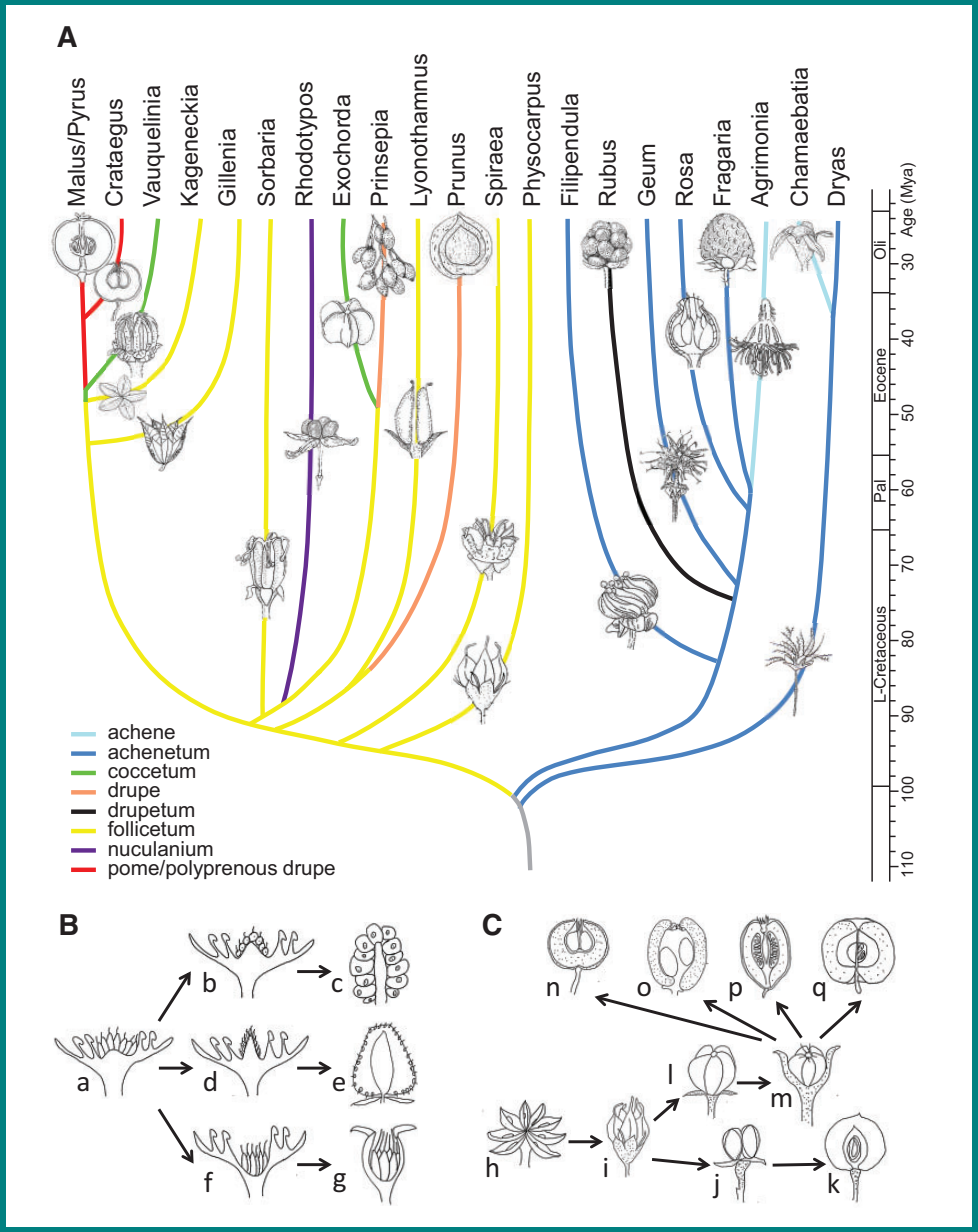
*Rosaceae



- 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