



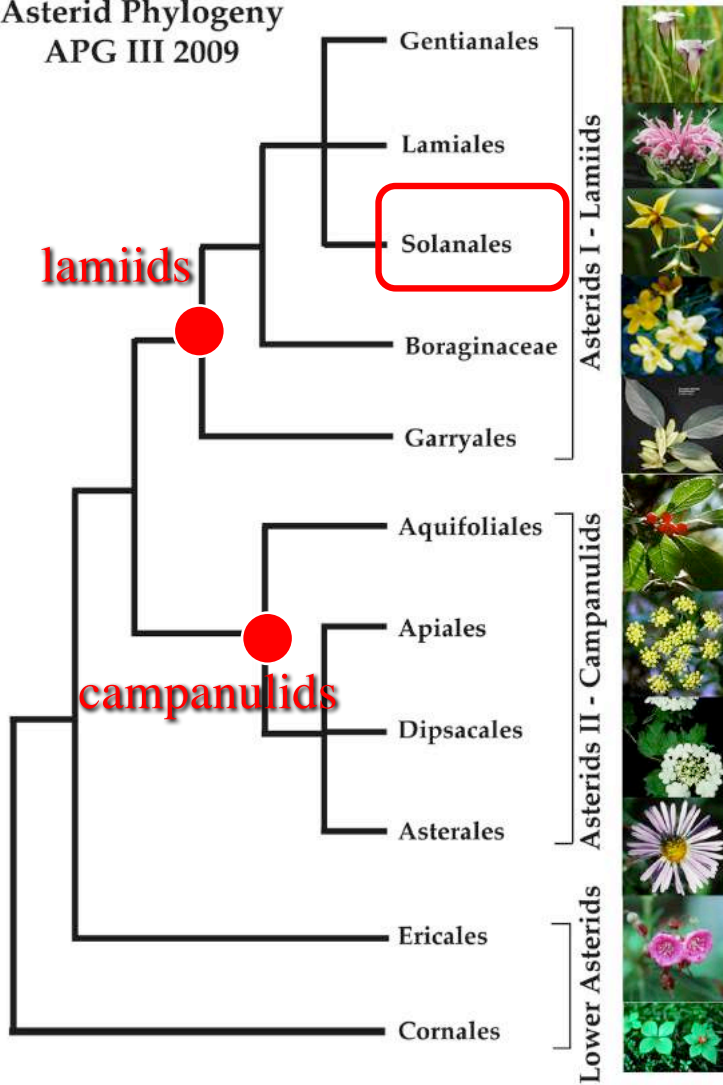
Diversity and Evolution of Asterids

. . . morning glories, mints, and
snapdragons . . .

Solanales

- order within ‘lamiids’ or Asterid I group
- 5 families and nearly 5,000 species dominated by **Solanaceae** (nightshade) and **Convolvulaceae** (morning glory)
- no iridoids, alternate leaves, plicate corolla, calyx persistent in fruit

Asterid Phylogeny
APG III 2009



Solanaceae



Convolvulaceae



*Convolvulaceae- morning glory

Largely tropical family of 57 genera and 1600 spp. Twining herbs or woody with alternate leaves.



Calystegia sepium
Hedge bindweed



Ipomoea purpurea
Morning-glory

*Convolvulaceae- morning glory

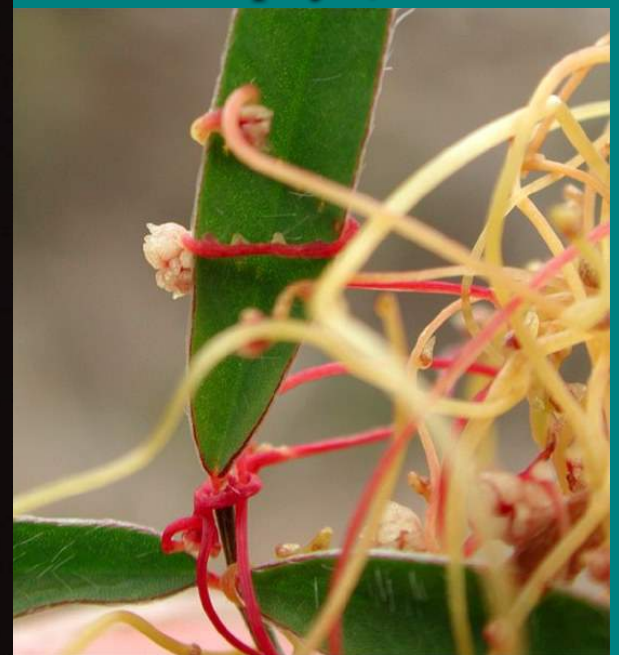
Cuscuta (Cuscutaceae) is actually part of the Convolvulaceae!



Cuscuta spp. -
dodder



- **Twining habit** (for support) has gone one step further and species are now **parasitic** (support + food + water; no chlorophyll)



*Convolvulaceae- morning glory



Cuscuta gronovii
Common dodder

Cuscuta glomerata
Rope dodder



*Convolvulaceae- morning glory

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

Flowers strongly **funnelform** with **plicate corolla** tube (with fold lines). Calyx often unfused.

Calystegia sepium
Hedge bindweed



Convolvulus

*Convolvulaceae- morning glory



Calystegia sepium
Hedge bindweed
Note: 2 large bracts

Convolvulus arvensis
Field bindweed
Note: no floral bracts



*Convolvulaceae- morning glory



Ipomoea - morning glory



Ipomoea pes-caprae



Ipomoea stolonifera



*Ipomoea batatas -
sweet potato*

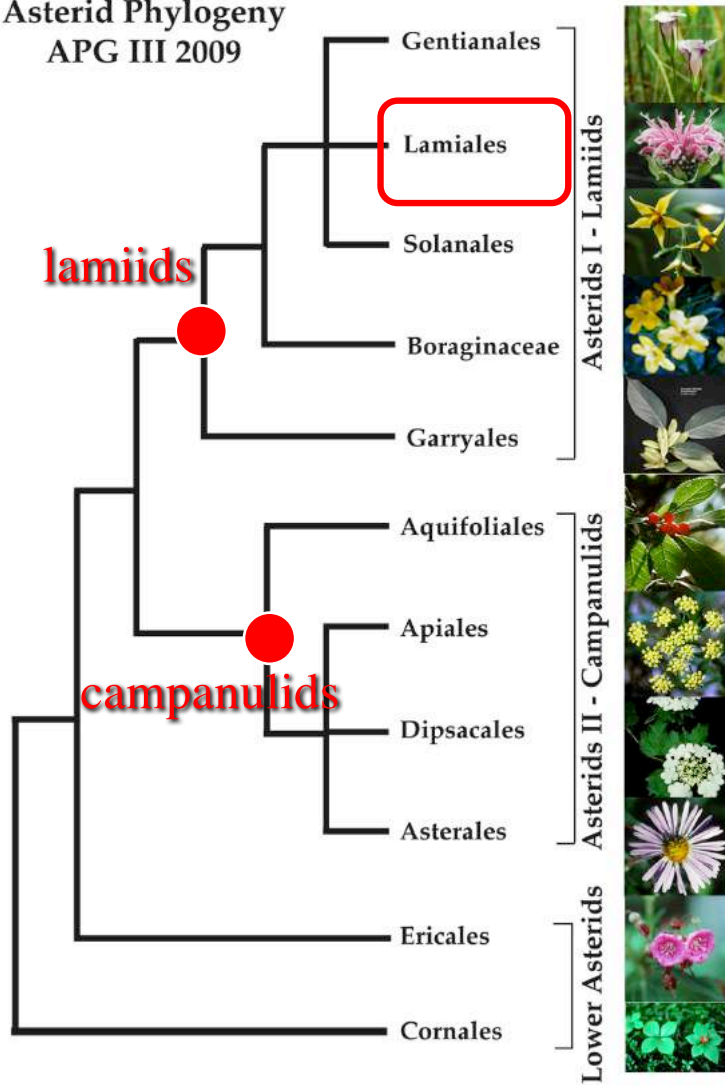
Lamiales

- large order (23,000+ species) within ‘**lamiid**’ or **Asterid I** group - 12% of all eudicots

- 22 families - dominated by the **mints** - **Lamiaceae**

- **iridoids**, **opposite leaves** common, **zygomorphic bilabiate flowers** common, **4 stamens** common

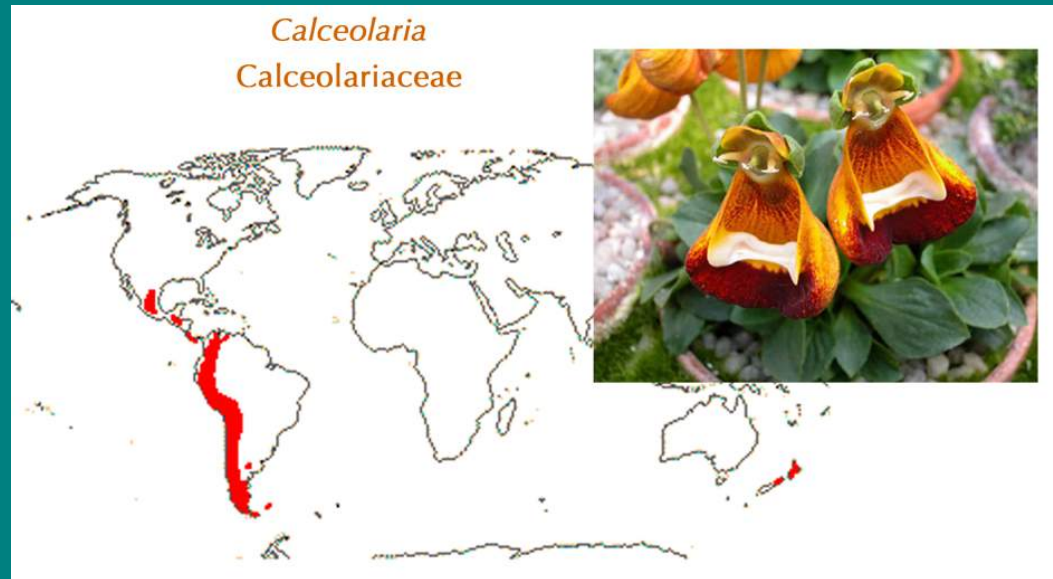
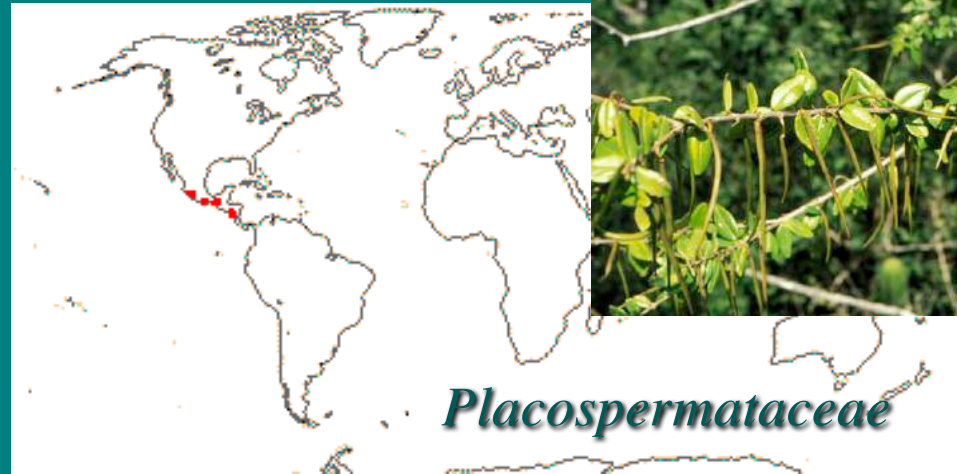
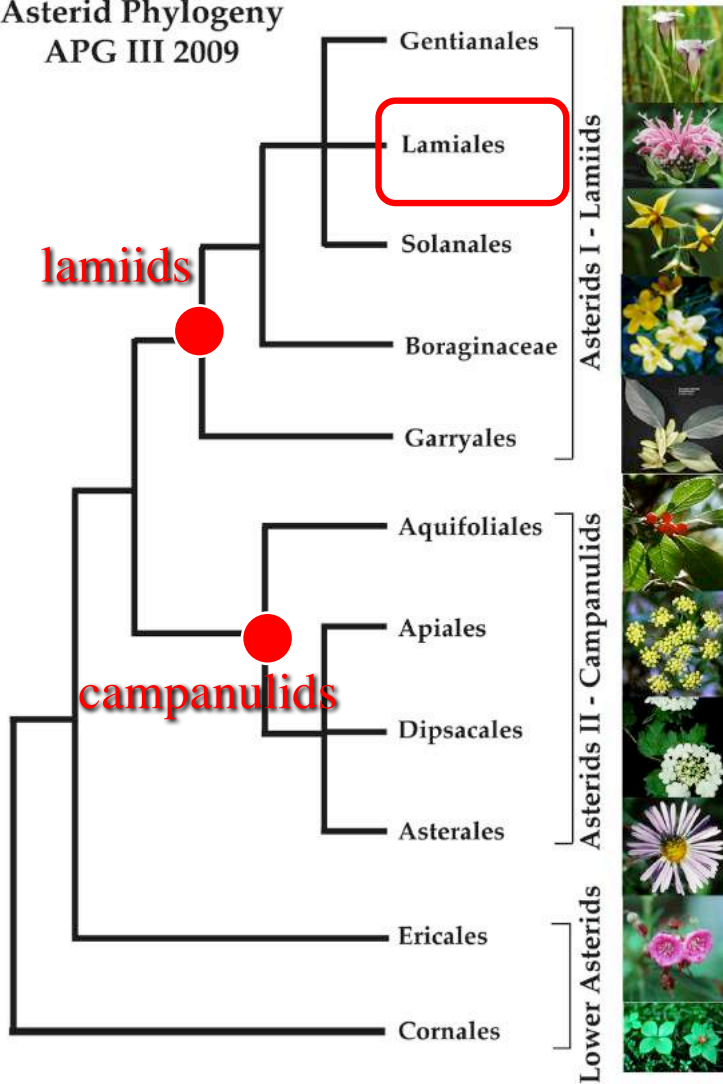
Asterid Phylogeny
APG III 2009



Lamiales

- many small, isolated families

Asterid Phylogeny
APG III 2009



Oleaceae - olive and ash

Cosmopolitan family of **opposite-leaved** shrubs and trees

CA (4) CO (4) or 0 A 2 G (2)

- 4 **merous** flowers
- only 2 **stamens**



Oleaceae - olive and ash



- olives are one-seeded drupes

Olea europea - olive



Oleaceae - olive and ash



Forsythia suspensa
Goldenbell, forsythia

Ligustrum vulgare
European privet



Oleaceae - olive and ash



- Ashes have **compound leaves** and **diamond-furrowed bark**
- Ashes are usually **unisexual**, other genera are bisexual



Male flowers

Female flowers

Fraxinus pennsylvanica -
Red, green ash

Oleaceae - olive and ash



- Ashes have 1-seeded samaras



Fraxinus americana - White ash

*Lamiaceae - mints

Huge cosmopolitan family of 267 genera and nearly 7000 species of herbs and sometimes shrubs or trees

- major family of **Mediterranean climate** regions
- strongly **aromatic** (mint, peppermint, sage, rosemary, thyme)
- **square stems, opposite leaves**
- flowers often congested in **verticels** or **terminal heads**



Satureja in Greece



Mentha longifolia

*Lamiaceae - mints

CA (5) CO (2+3) A 4,2 G (2)

- flowers two-lipped (**bilabiate** - called **Labiatae**)

Stachys palustris -
hedge nettle



Salvia - sage



*Lamiaceae - mints

CA (5) CO (2+3) A 4,2 G (2)

- flowers two-lipped (**bilabiate**)
- **stamens 4** (or even 2)



Salvia - sage

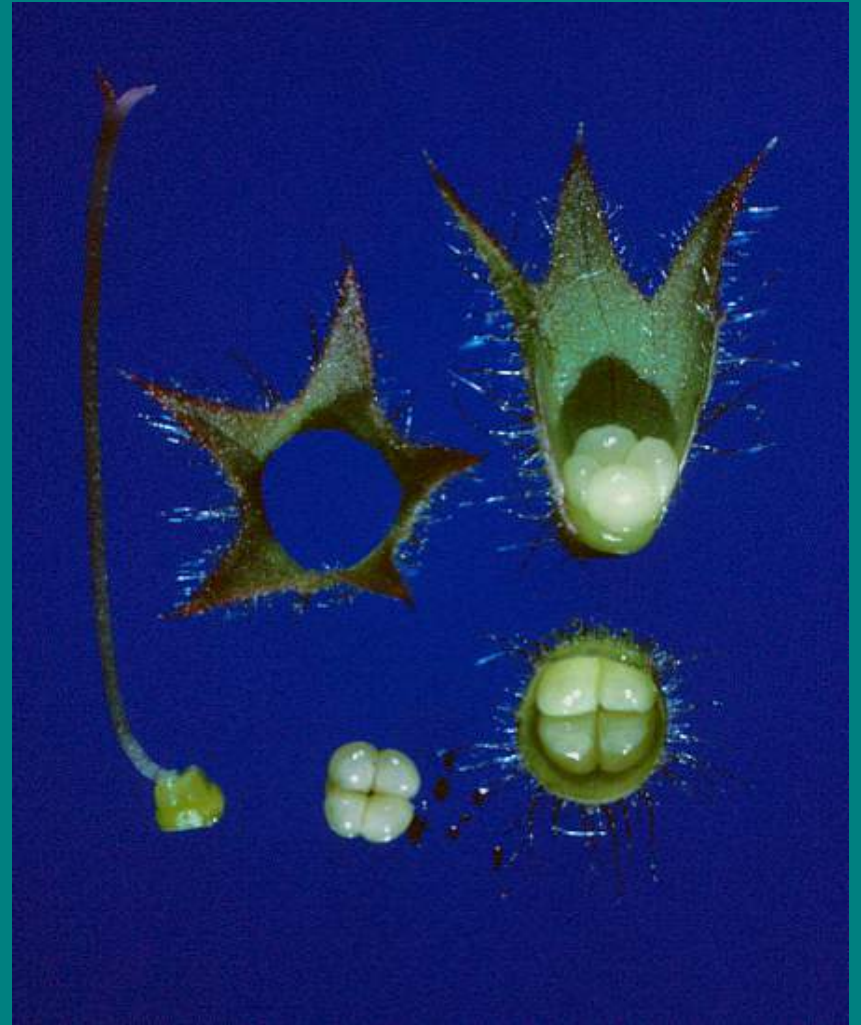


Clerodendrum

*Lamiaceae - mints

CA (5) CO (2+3) A 4,2 G (2)

- flowers two-lipped (**bilabiate**)
- **stamens** 4 (or even 2)
- 2 carpels, **gynobasic**
- fruit - 4 **nutlets**



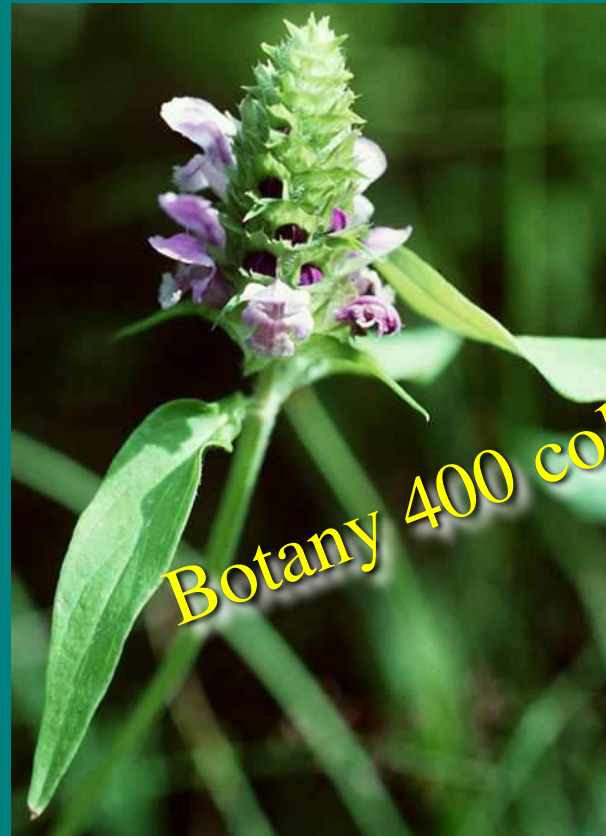
Galeopsis

*Lamiaceae - mints

Prunella vulgaris -
selfheal

Nepeta cataria -
catnip

Glechoma hederacea -
creeping charlie



Botany 400 collections species!



*Lamiaceae - mints



Leonurus cardiaca -
motherwort



Lycopus americanus
Water horehound

*Lamiaceae - mints



Monarda punctata -
horsemint

Monarda fistulosa -
wild bergamot



Botany 400 collections species!

*Lamiaceae - mints

Clerodendrum thomsoniae
Lamiaceae / Verbenaceae
© G. D. Carr



Clerodendrum

- some woody members formerly placed in Verbenaceae now are mints

Tectona grandis - teak



Vitex

Verbenaceae - vervains

34 genera and 1175 species of aromatic herbs, vines, trees

- square stems
- opposite, serrate leaves
- flowers not lipped
- fruit often 1-2 seeded drupe, not gynobasic

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



Lantana camara - sage



Verbena gracilencens

Verbenaceae - vervains



Verbena hastata - Blue vervain



Verbena stricta - Hoary vervain

Botany 400 collections species!

* “Scrophulariaceae”

CA (4-5) CO (2+3) A 2+2 G (2)

The ‘old’ family is similar to mints, but . . .

- alternate **or** opposite leaved
- round **or** squarish stems
- **terminal style, many seeds, capsules**



Bellardia



Aureolaria - false foxglove

* “Scrophulariaceae”

. . . and included normal as well as **hemiparasitic** species (green but with attachment to plants for additional food)



Pedicularis canadensis -
wood betony



Castilleja coccinea -
Indian paintbrush

* “Scrophulariaceae”

Status of 3 “old” unrelated families

1. Plantaginaceae – wind pollinated
2. Orobanchaceae – holoparasites
3. Scrophulariaceae – the rest + hemiparasites

Plantago-
plantain



Conopholis-
cancer-root



Verbascum-
mullein



Linaria-
butter-eggs



Castilleja-
paintbrush



* “Scrophulariaceae”

Status of 3 “new” unrelated families – DNA story!

1. **Plantaginaceae** – wind pollinated + most genera
2. **Orobanchaceae** – holoparasites + hemiparasites
3. **Scrophulariaceae** – only *Scrophularia* + *Verbascum*

Plantago-
plantain



Linaria-
butter-eggs



Conopholis-
cancer-root



Castilleja-
paintbrush



Verbascum-
mullein



Scrophulariaceae - figworts



Verbascum thapsus -mullein

New Scrophulariaceae is small with 24 genera but retains type genus

Scrophularia marilandica -
figwort, carpenter's-square



Scrophulariaceae - figworts



Botany 400 collections species!

Verbascum thapsus - common mullein weedy biennial (1st year as a rosette)

Plantaginaceae - plantains



Plantago lanceolata -
English plantain



Plantaginaceae includes *Plantago*
(plantains) - **wind pollinated** derivatives
of snapdragons . . .

Plantaginaceae - plantains



Botany 400 collections species!

Plantago major - common plantain



Plantago patagonica-
wooly plantain

Plantaginaceae includes *Plantago*
(plantains) - **wind pollinated** derivatives
of snapdragons . . .

Plantaginaceae - plantains



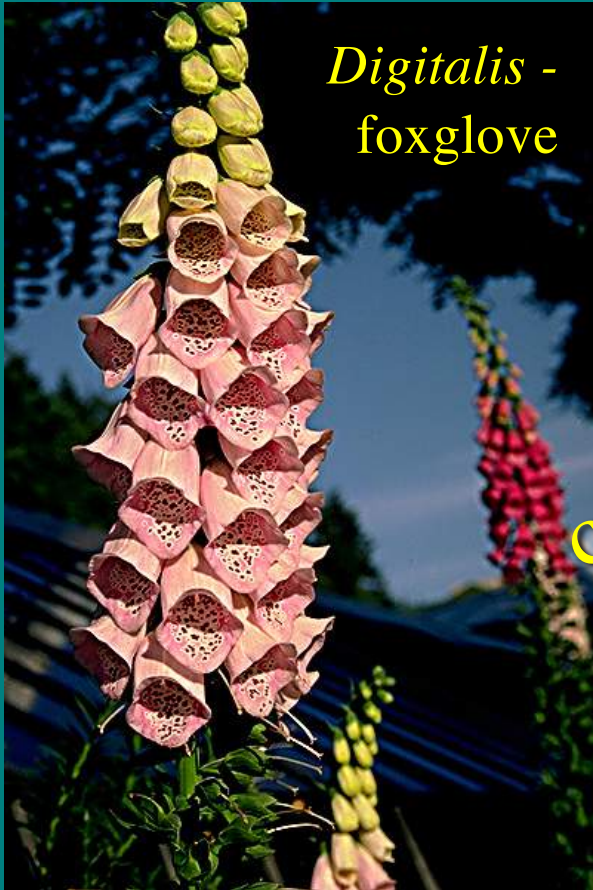
Chelone glabra - turtlehead



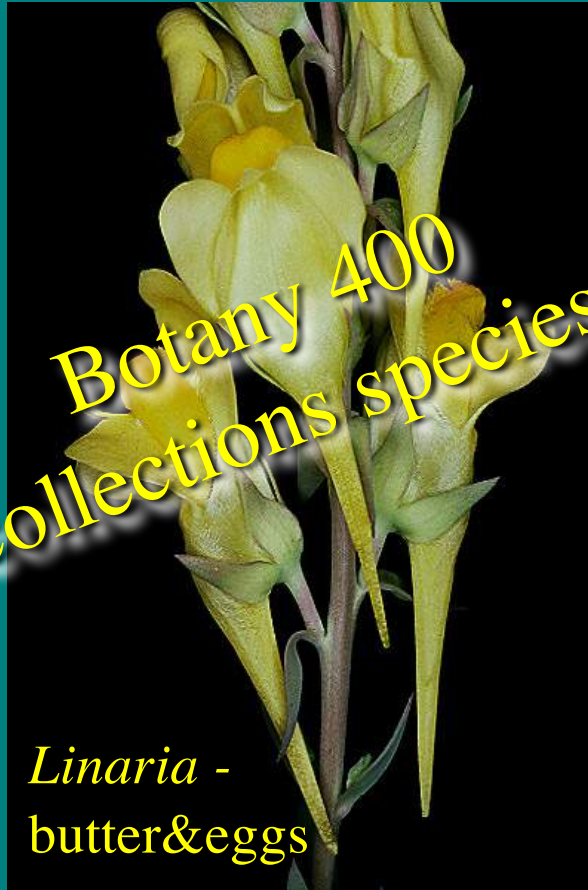
Veronicastrum virginicum
Culver' s-root

... but also most of **non-hemiparasitic**
members of former Scrophulariaceae

Plantaginaceae - plantains



Digitalis -
foxglove



Linaria -
butter&eggs



Antirrhinum -
snapdragon



Veronica

... but also most of **non-hemiparasitic**
members of former Scrophulariaceae

Botany 400
collections species!

Plantaginaceae - plantains



Veronica persica –
Bird's-eye speedwell



Orobanchaceae - broomrape

Orobanchaceae contains holo-parasites (non-green)



Conopholis americana (cancer-root)



Orobanchaceae - broomrape

Orobanchaceae contains **holo-parasites**



haustoria

Epifagus virginiana -
beech drops

Orobanchaceae - broomrape

Orobanchaceae contains **holo-parasites**



Orobanche fasciculata -
fascicled broomrape



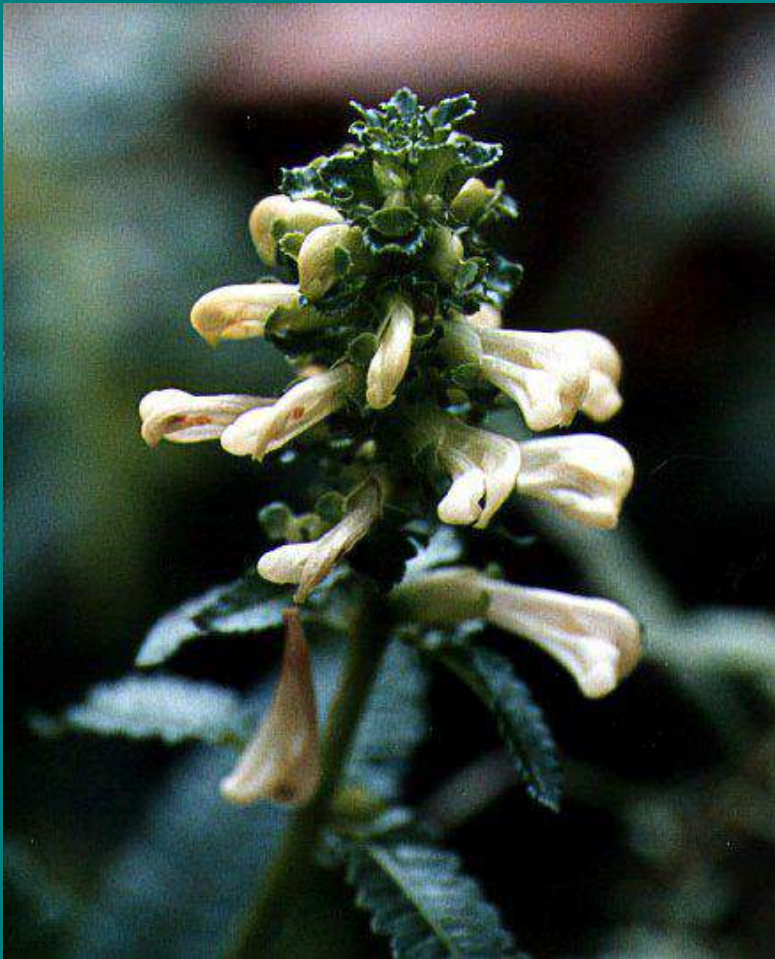
obligate host: *Artemisia
campestris* - wormwood



Orobanche uniflora
One-flowered broomrape

Orobanchaceae - broomrape

. . . and **hemi-parasites** of old Scrophulariaceae



Castilleja sessiflora - downy paintbrush

Pedicularis lanceolata - swamp lousewort

Lentibulariaceae - bladderworts

Cosmopolitan (3 genera/320 species) - vegetatively diverse, **insectivorous** herbs of wetlands



Pinguicula - butterwort



Utricularia - bladderwort



Bignoniaceae - catalpa

Tropical (some temperate) trees and lianas with **opposite, compound leaves** and **large flowers** (bat, bird, bee)

CA (5) CO (5) A 2+2 G (2)

- **long capsule** (berry) with winged seeds



Campsis radicans -
trumpet creeper



Spathodea campanulata



Jacaranda

Bignoniaceae - catalpa



Catalpa speciosa



Catalpa speciosa
Catalpa

Elongated capsules
appearing like
legumes



Acanthaceae - acanths

Tropical (some temperate) herbs, shrubs, lianas with **opposite, simple leaves** and **thick nodes**

CA (5) CO (2+3) A 2+2 G (2)

- **showy bracts**
- **explosively dehiscent capsules**



Aphelandra



Acanthus illicifolius

Acanthaceae - acanths



1 endangered species in Wisconsin prairies

Ruellia humilis - hairy ruellia



Gesneriaceae - African violets

Pantropical herbs and **epiphytes** or weak shrubs

CA (5) CO (2+3) A 2+2 G (2)

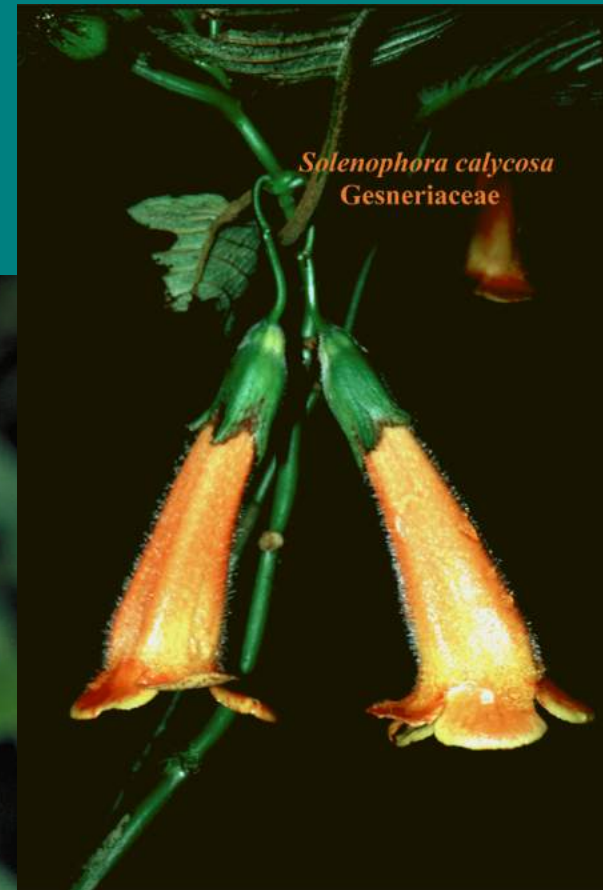
- ovary inferior or superior



Columnea



Saintpaulia - African violet



Solenophora calycosa
Gesneriaceae

Solenophora

Gesneriaceae - African violets

Pantropical herbs and **epiphytes** or weak shrubs

CA (5) CO (2+3) A 2+2 G (2)

- ovary inferior or superior
- **anthers fuse** at maturity



Columnea



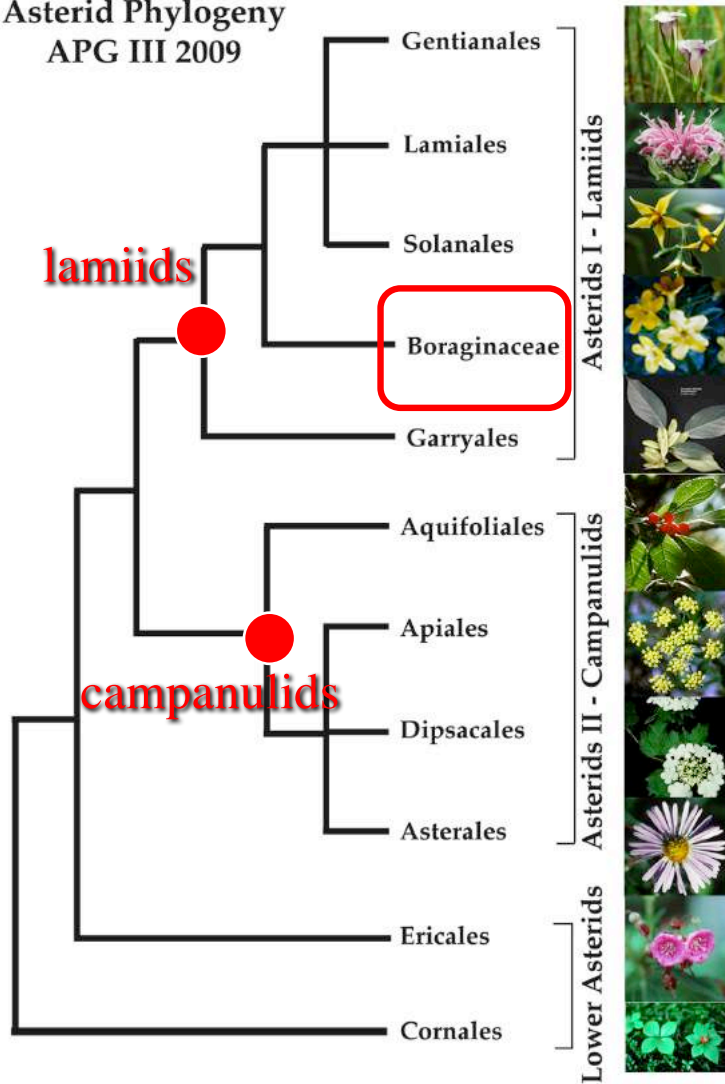
Columnea



Streptocarpus

Boraginaceae - borage

Asterid Phylogeny
APG III 2009



- unplaced family within 'lamiid' or Asterid I group

- large family of herbs to trees, 148 genera and 2740 species



Cordia - geiger tree



Myosotis - forget me not

Boraginaceae - borage

- typically **hairy** plants
- **scirpoid cyme** inflorescences - compound monochasium



Pulmonaria



Borago



Mertensia virginica - Eastern bluebells

Boraginaceae - borage

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

- **Gynobasic style** - independently derived relative to Lamiaceae
- fruit typically 4 **nutlets** or drupe like



Myosotis - forget me not



- *Lithospermum* (puccoon) - classic dimorphic heterostyly

Boraginaceae - borage



Echium vulgare
Blueweed



Echium wildpreti
- tower of jewels
Canary Islands



Boraginaceae - borage



Botany 400 collections species!

Hackelia virginiana
Beggar's-lice

Myosotis scorpioides
Common forget-me-not



Boraginaceae - borage



Lithospermum canescens
Hoary puccoon



Lithospermum incisum
Fringed puccoon

Boraginaceae - borage



Mertensia virginica
Eastern bluebells



Boraginaceae - borage



Hydrophyllum virginianum -
Common waterleaf

- formerly Hydrophyllaceae

