



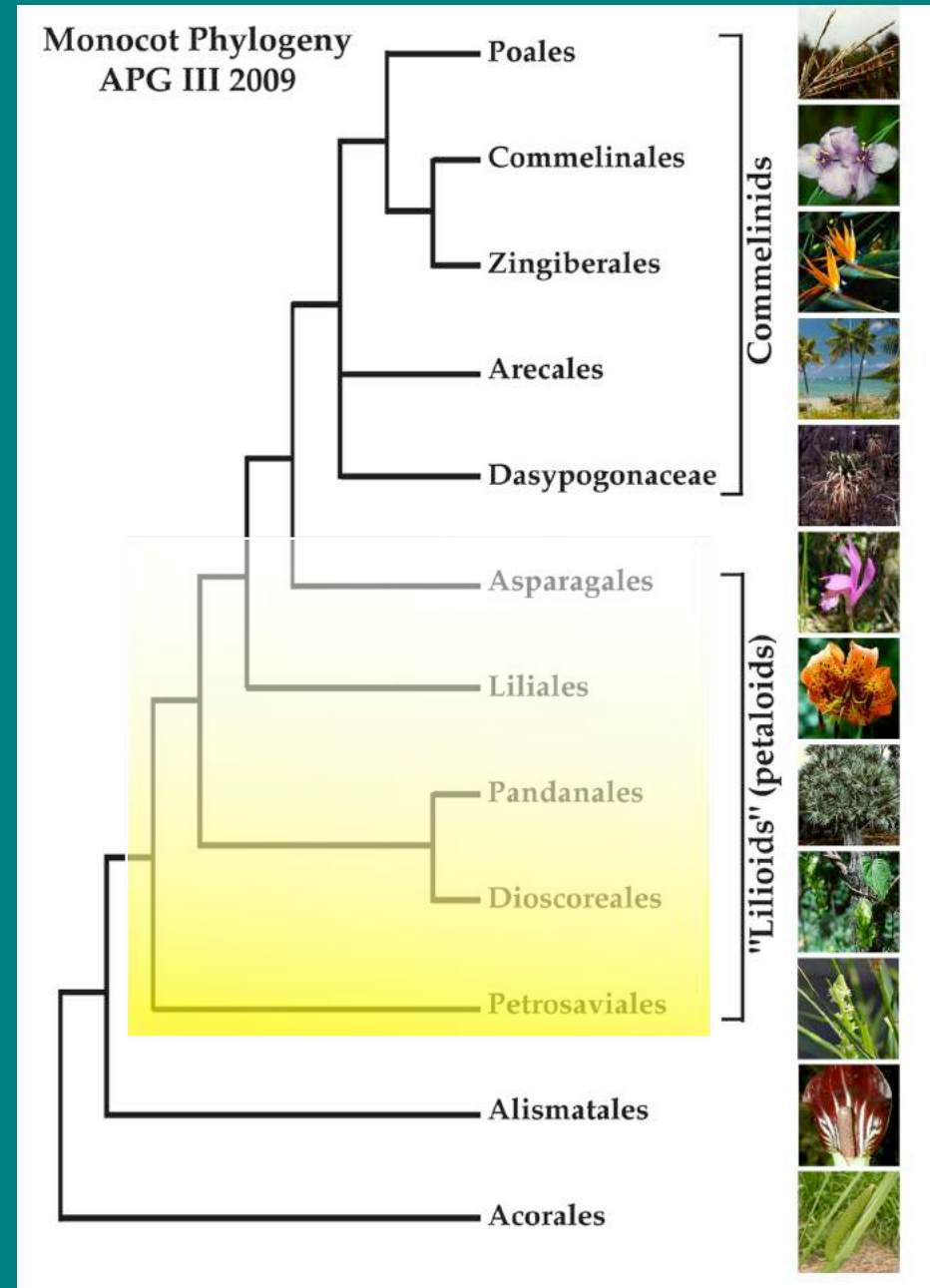
# Diversity and Evolution of Monocots

. . . petaloid monocots . . .

# Lilioids - petaloid monocots

## 4 main groups:

- Acorales - sister to all monocots
- Alismatids
  - inc. Aroids - jack in the pulpit
- “Lilioids” (lilies, orchids, yams)
  - grade, non-monophyletic
  - petaloid
- Commelinids
  - Arecales – palms
  - Commelinales – spiderwort
  - Zingiberales – banana
  - Poales
    - pineapple
    - grasses & sedges





# Lilioids - petaloid monocots



The lilioid monocots represent five orders and contain most of the **showy monocots** such as lilies, tulips, blue flags, and orchids

Majority are defined by 6 features:

1. **Terrestrial/epiphytes**: plants typically not aquatic

# Lilioids - petaloid monocots



The lilioid monocots represent five orders and contain most of the showy monocots such as lilies, tulips, blue flags, and orchids

Majority are defined by 6 features:

2. **Geophytes**: herbaceous above ground with below ground modified perennial stems: bulbs, corms, rhizomes, tubers



# Lilioids - petaloid monocots



... thus common in two biomes

- **temperate forest** understory (low light, over-winter)
- **Mediterranean** (arid summer, cool wet winter)

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Majority are defined by 6 features:

3. **Leaves without petiole:** leaf blade typically broader and attached directly to stem without petiole



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Majority are defined by 6 features:

4. **Tepals**: showy perianth in 2 series of 3 each; usually all petaloid, or outer series not green and sepal-like & with **no bracts**

# Lilioids - petaloid monocots

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Majority are defined by 6 features:

5. **Nectaries**: usually well-developed nectar tissue at the base of ovary or stamens; insect or bird-pollinated





# Lilioids - petaloid monocots



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Majority are defined by 6 features:

6. **Capsule/berry**: fruit a 3-parted capsule or berry



# Lilioids - petaloid monocots

Systematic issues with this group:

Exceptions abound! - most people have classified Pontederiaceae with lilioids (tepals, nectar)



*Pontederia cordata* - Pickerel weed [Commelinid]



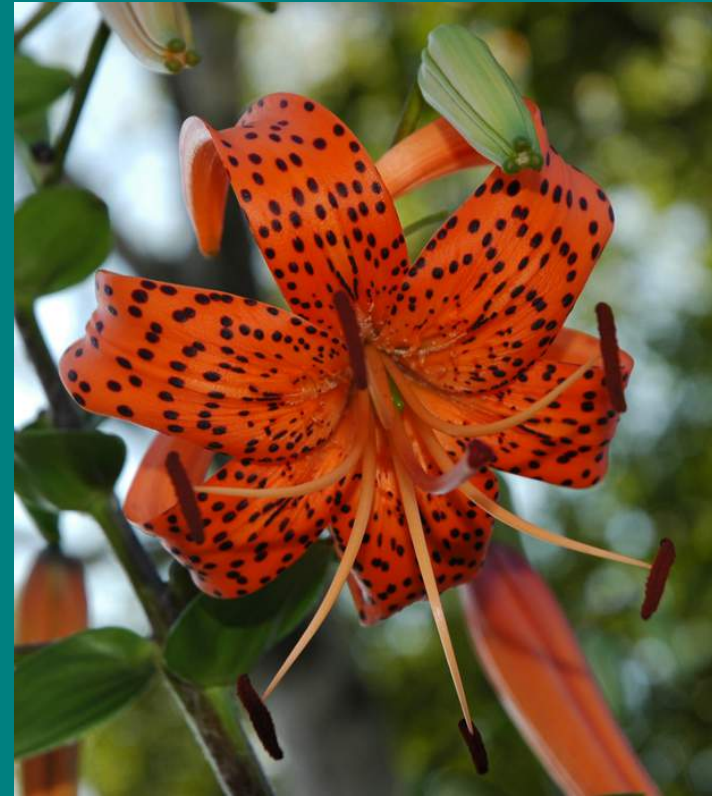
# Lilioids - petaloid monocots

Systematic issues with this group:

Will the real “**Liliaceae**” please stand up!

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The floral pattern in “**Liliaceae**” is **plesiomorphic** (primitive) for the entire group of petaloid monocots



*Lilium* - lily (Liliaceae)

# Lilioids - petaloid monocots

Systematic issues with this group:

Will the real “**Liliaceae**” please stand up!

. . . and anything deviating from the generalized form has been placed in separate families



*Trillium - trillium*

e.g., **Trilliaceae** for flowers with 3 green sepals



# Lilioids - petaloid monocots

Systematic issues with this group:

Will the real “**Liliaceae**” please stand up!

. . . and anything deviating from the generalized form has been placed in separate families

e.g., **Amaryllidaceae** for flowers with inferior ovary



*Eucharis*

# Lilioids - petaloid monocots

Systematic issues with this group:

Will the real “**Liliaceae**” please stand up!

. . . and anything deviating from the generalized form has been placed in separate families

e.g., **Smilacaceae** for viney plants with petioled leaves



*Smilax - catbriar*



# Lilioids - petaloid monocots

Systematic issues with this group:

Will the real “*Liliaceae*” please stand up!

. . . and anything deviating from the generalized form has been placed in separate families

e.g., many families that are “woody”



*Dracaena* - dragon tree

# Lilioids - petaloid monocots

Systematic issues with this group:

Will the real “Liliaceae” please stand up!

Liliaceae thus included a lot of unrelated taxa that are now placed in at least three orders

warning: Gleason & Cronquist still use Liliaceae sensu lato (in the broad sense)

warning: the new *Michigan Flora* and *Wisconsin Flora* use lilioid families incorrectly! but the new Wisflora website IS correct



# Lilioids - petaloid monocots

Handout today has correct names and placement of **genera** into **families**:

**Lilioid monocot genera in Wisconsin and their new family placements relative to various keying sources (exclusive of the Dioscoreaceae, Iridaceae, Orchidaceae, and Smilacaceae)**

Genus	APG family - use! Student Herbarium	WI Flora book	Wisflora online	MI Flora	Gleason/Cronquist
<i>Alettris</i>	Nartheciaceae	Liliaceae	Liliaceae	Melanthiaceae	Liliaceae
<i>Allium</i>	Amaryllidaceae	Liliaceae	Liliaceae	Alliaceae	Liliaceae
<i>Anticlea</i>	(= <i>Zigadenus</i> )	(as <i>Zigadenus</i> )	(as <i>Zigadenus</i> )	Melanthiaceae	(as <i>Zigadenus</i> )
<i>Asparagus</i>	Asparagaceae	Liliaceae	Liliaceae	Asparagaceae	Liliaceae
<i>Camassia</i>	Asparagaceae	Liliaceae	Liliaceae	Hyacinthaceae	Liliaceae
<i>Clintonia</i>	Liliaceae	Liliaceae	Liliaceae	Convallariaceae	Liliaceae
<i>Convallaria</i>	Asparagaceae	Liliaceae	Liliaceae	Convallariaceae	Liliaceae
<i>Erythronium</i>	Liliaceae	Liliaceae	Liliaceae	Liliaceae	Liliaceae
<i>Hemerocallis</i>	Xanthorrhoeaceae	Liliaceae	Liliaceae	Hemerocallidaceae	Liliaceae
<i>Hypoxis</i>	Hypoxidaceae	Hypoxidaceae	Liliaceae	Hypoxidaceae	Liliaceae
<i>Lilium</i>	Liliaceae	Liliaceae	Liliaceae	Liliaceae	Liliaceae
<i>Maianthemum</i>	Asparagaceae	Liliaceae	Liliaceae	Convallariaceae	Liliaceae
<i>Medeola</i>	Liliaceae	Liliaceae	Liliaceae	Convallariaceae	Liliaceae
<i>Muscari</i>	Asparagaceae	Liliaceae	Liliaceae	Hyacinthaceae	Liliaceae
<i>Narcissus</i>	Amaryllidaceae	Liliaceae	Liliaceae	Amaryllidaceae	Liliaceae
<i>Ornithogalum</i>	Asparagaceae	Liliaceae	Liliaceae	Hyacinthaceae	Liliaceae
<i>Polygonatum</i>	Asparagaceae	Liliaceae	Liliaceae	Convallariaceae	Liliaceae
<i>Scilla</i>	Asparagaceae	Liliaceae	Liliaceae	Hyacinthaceae	Liliaceae
<i>Smilacina</i>	(= <i>Maianthemum</i> )	(as <i>Maianthemum</i> )	(as <i>Maianthemum</i> )	(as <i>Maianthemum</i> )	Liliaceae
<i>Streptopus</i>	Liliaceae	Liliaceae	Liliaceae	Convallariaceae	Liliaceae
<i>Tofieldia</i>	(= <i>Triantha</i> )	(as <i>Triantha</i> )	(as <i>Triantha</i> )	(as <i>Triantha</i> )	Liliaceae
<i>Triantha</i>	Tofieldiaceae	Liliaceae	Liliaceae	Melanthiaceae	Liliaceae
<i>Trillium</i>	Melanthiaceae	Liliaceae	Liliaceae	Trilliaceae	Liliaceae
<i>Uvularia</i>	Colchicaceae	Liliaceae	Liliaceae	Convallariaceae	Liliaceae
<i>Yucca</i>	Asparagaceae	Liliaceae	Agavaceae	Agavaceae	Agavaceae
<i>Zigadenus</i>	Melanthiaceae	Liliaceae	Liliaceae	(as <i>Anticlea</i> )	Liliaceae

# Lilioids - petaloid monocots

Five orders - highlight 3 families:

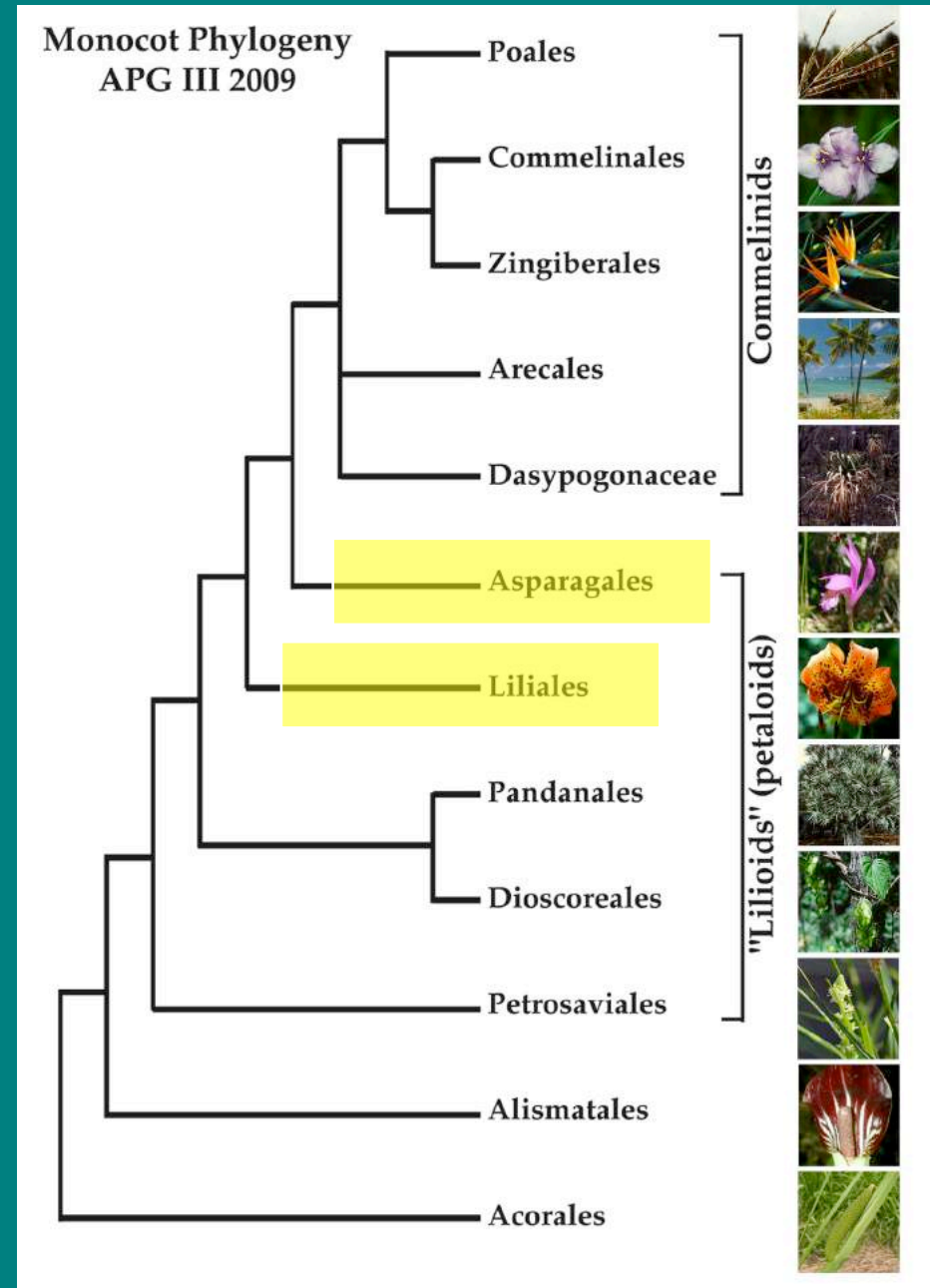
Liliales: \***Liliaceae** s.s. (lilies)

Asparagales: \***Iridaceae** (iris)

Asparagales: \***Orchidaceae**  
(orchids)

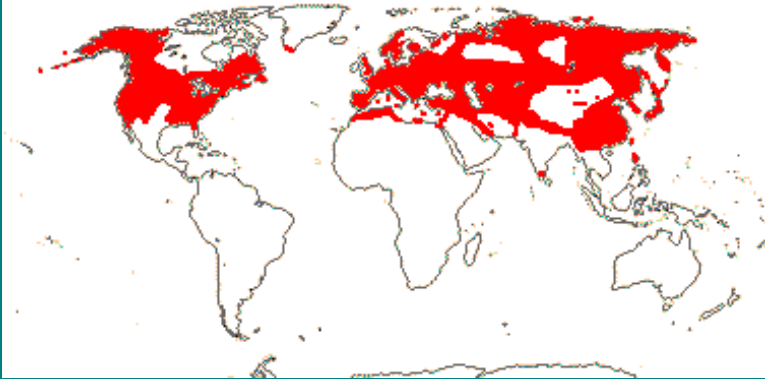
Briefly examine:

- other “Liliaceae” families of these two order
- yams and screw pines of Dioscoreales and Pandanales



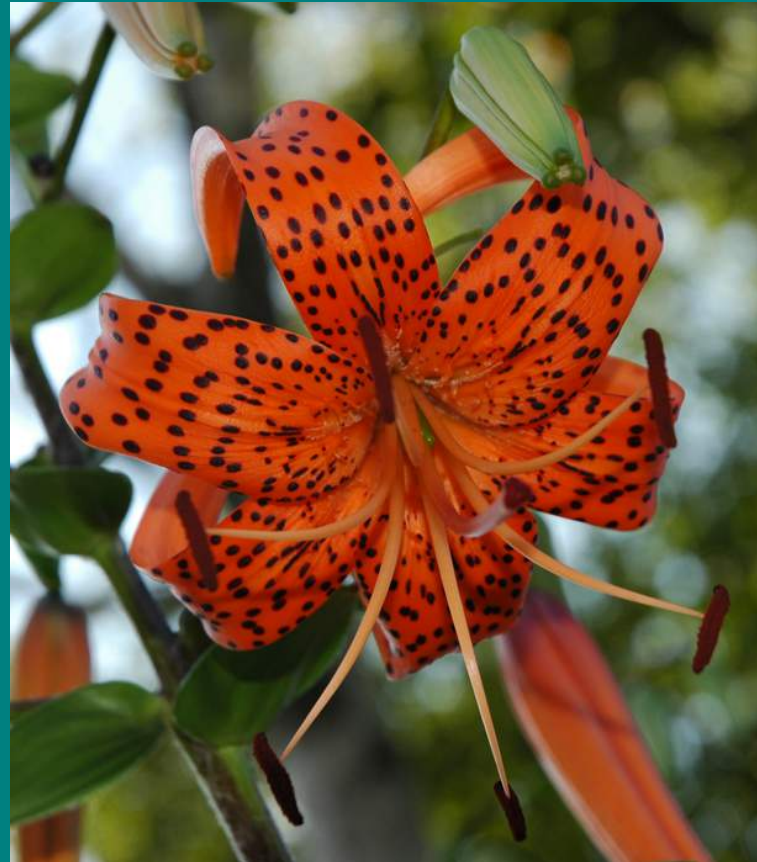


# Liliales: \*Liliaceae s.s. - lilies



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North temperate family of 16 genera  
and 700 species



- bulbed or rhizomatous perennials
- leaves without petioles, stemmed or basal
- “Liliaceae” flower (tepals) but often spotted
- capsule or berry

*Lilium* - lily (Liliaceae)

# Liliales: \*Liliaceae s.s. - lilies



*Medeola virginica* - Indian cucumber root





# Liliales: \*Liliaceae s.s. - lilies



*Clintonia borealis* - Yellow blue-bead lily

# Liliales: \*Liliaceae s.s. - lilies



*Erythronium americanum*  
- yellow trout lily

*Tulipa sp.* - tulip





# Liliales: Smilacaceae - catbriars



Small family, mainly of South Hemisphere, climbers via **tendrils** (modified stipules), starchy tubers, large, net-veined leaves and definite petiole



*Smilax herbacea* - bristly greenbriar

# Liliales: Smilacaceae - catbriars

Flowers unisexual, dioecious plants; carrion flowers are foetid



Male umbel

Female umbel

Fruit an umbel of black berries  
(red berries are from jack-in-the  
pulpit)





# Liliales: Melantheriaceae



*Trillium grandiflorum*  
- large flowered trillium

*Trillium recurvatum*  
- prairie trillium





# Liliales: Melanthiaceae



*Xerophyllum*  
beargrass

*Anticlea/Zigadenus*  
death camas





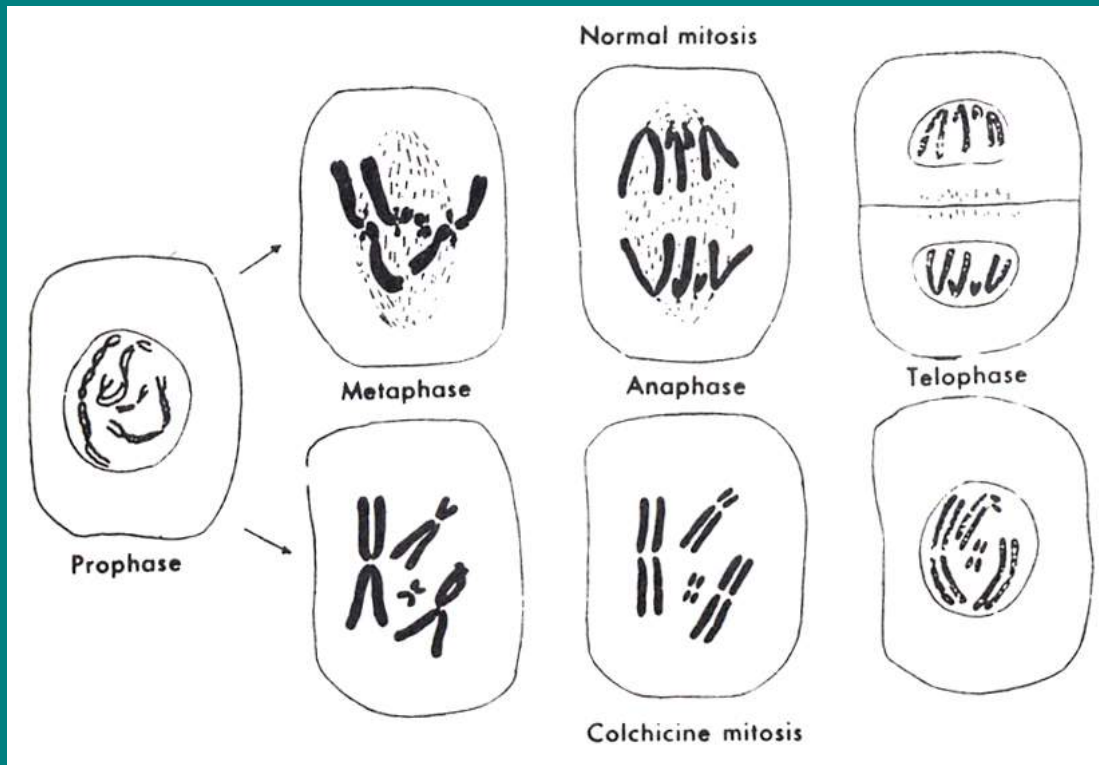
# Liliales: Colchicaceae



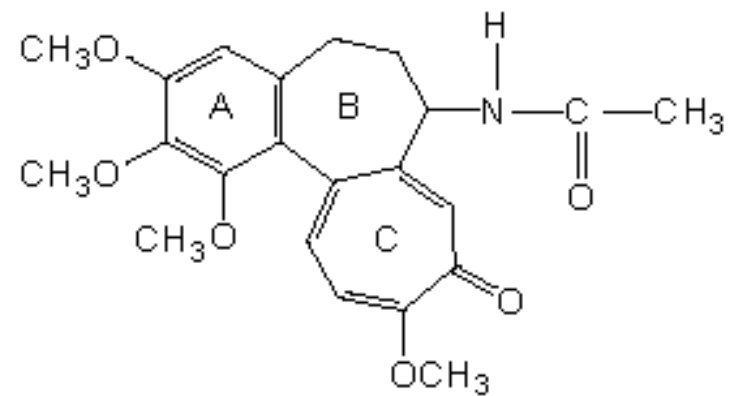
*Uvularia grandiflora* - bellwort



# Liliales: Colchicaceae



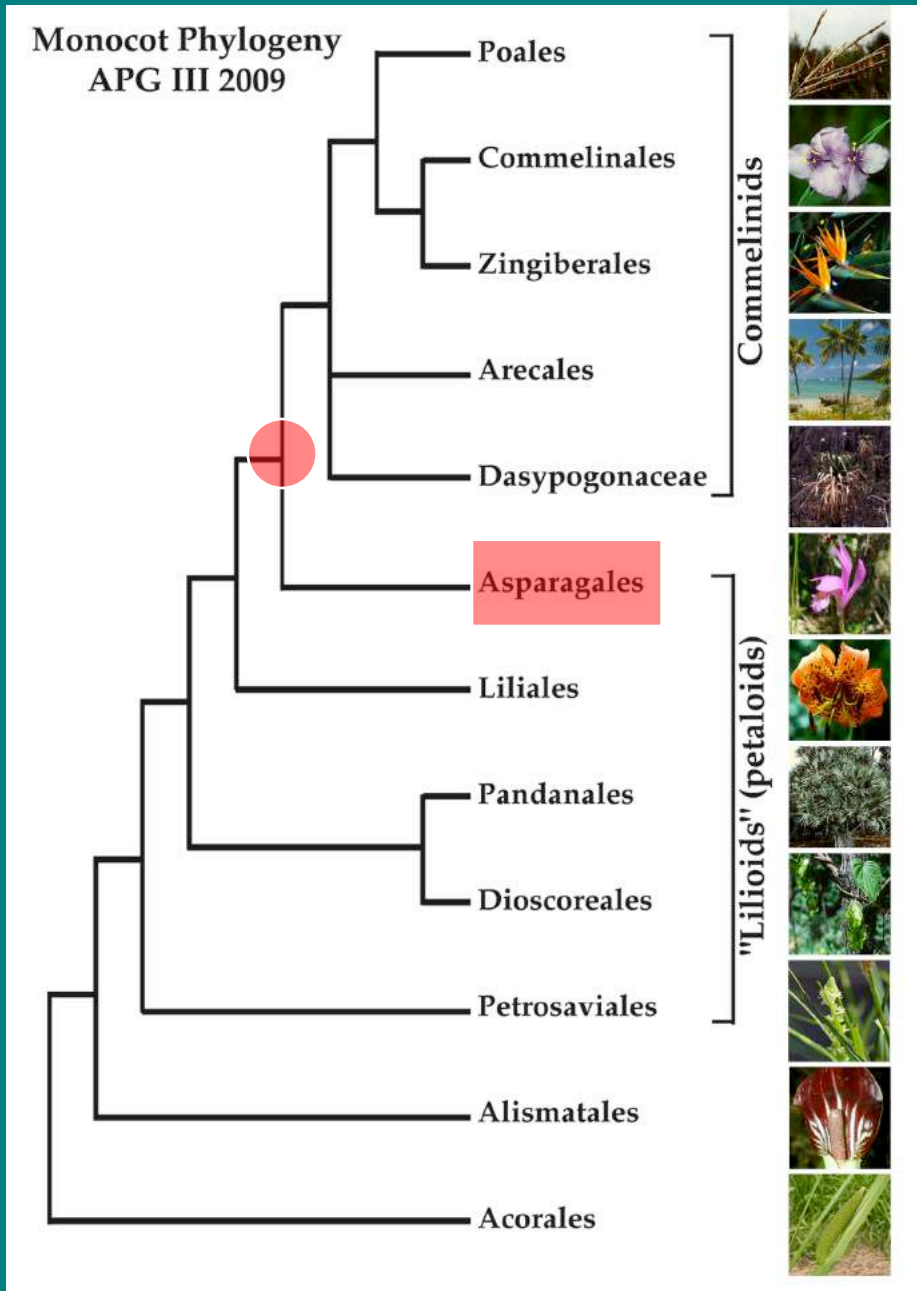
*Colchicum autumnale* -  
meadow saffron



colchicine

Disrupts spindle mechanism  
in mitosis

# Asparagales: sister to the Commelinids

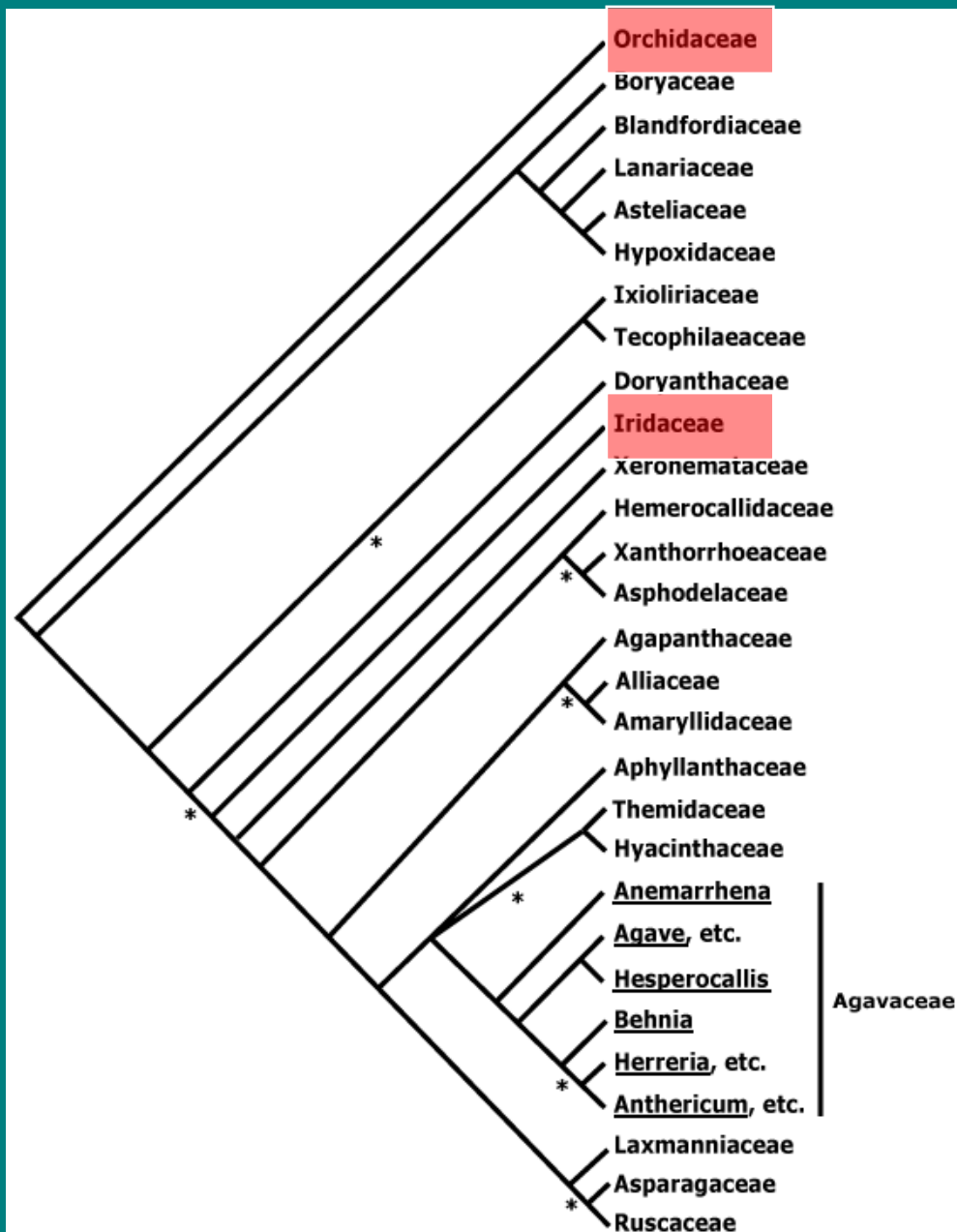


- in the Lilioid grade, Asparagales is **sister to the Commelinids**
- characterized by **phytomelan** in seed coats and **arum-type mychorrizal** connection (vs. Paris-type in Liliales)

(more on Asparagales vs. Liliales in a second)



# Asparagales: sister to the Commelinids



- much of the order Asparagales had been included in “**Liliaceae**”
- **Orchidaceae** is sister to the rest of the order
- **Iridaceae** (iris family) is the other large family



# Asparagales vs. Liliales?

- 3-merous? **Could be either**
- Inferior ovary? **Always Asparagales**
- Spotted, not an Orchid or *Iris*? **Liliales**
- Fruit blackened & crusty (Phytomelan crust)?  
**Asparagales**
- Fruit not with Phytomelan? **Liliales unless Orchidaceae**

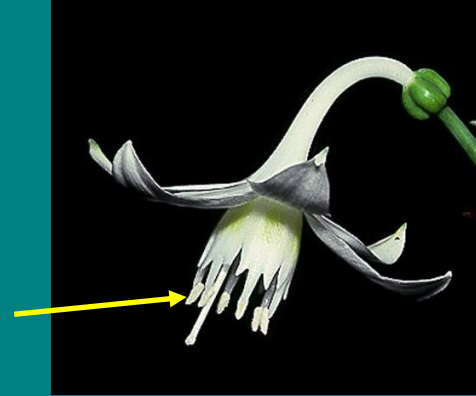




# Asparagales vs. Liliales?

- Extrorse dehiscence of anthers?

Could be either



- Introrse dehiscence of anthers?

Definitely Asparagales

- Nectaries at the base of the tepals or stamens? **Liliales**



- Nectaries on septae of ovary? **Asparagales**

# Asparagales: Asparagaceae



*Asparagus officinalis* - asparagus





# Asparagales: Asparagaceae



*Maianthemum canadense* -  
wild lily of the valley





# Asparagales: Asparagaceae



*Polygonatum*

Solomon's-seal



*Maianthemum (Smilacina)*

False Solomon's-seal





# Asparagales: Asparagaceae



*Dracaena drago* -  
dragon tree of  
Canary Islands



*Dracaena marginata*  
- houseplant from  
Madagascar



*Sansevieria* -  
mother-in-law  
tongue



# Asparagales: Asparagaceae



*Yucca whipplei* (and  
yucca moth)

*Yucca brevifolia* Joshua  
Tree in Mohave



*Agave* - century plant





# Asparagales: Asparagaceae



*Scilla sibirica* - English bluebell



# Asparagales: Amaryllidaceae



*Narcissus sp.* - daffodil

- inferior ovary
- corona (staminal)





# Asparagales: Amaryllidaceae

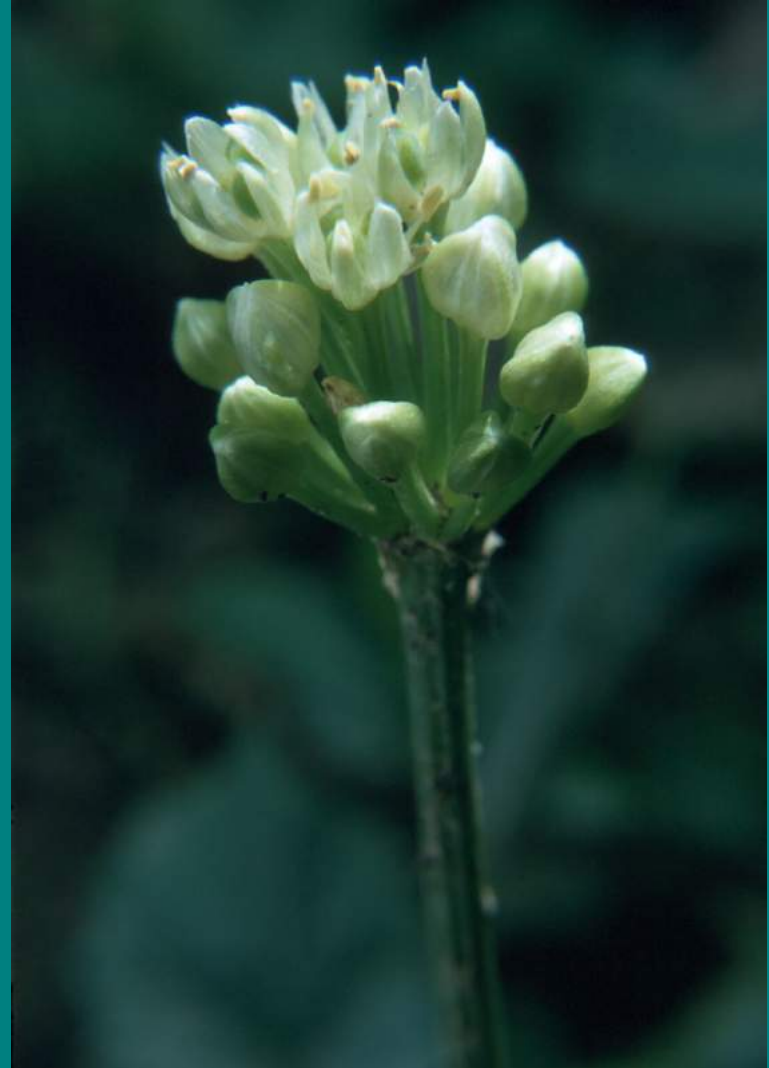


*Hymenocallis* - spider lily



*Eucharis* – Amazon lily

# Asparagales: Amaryllidaceae



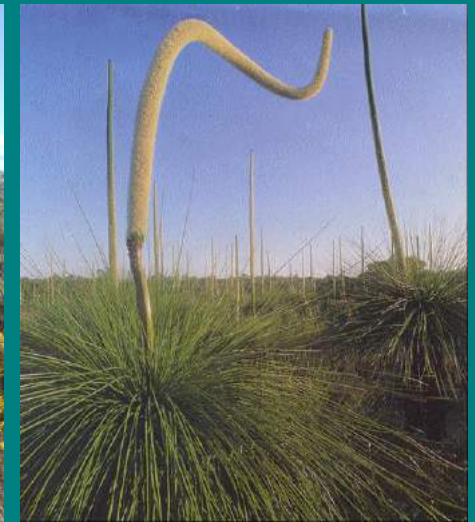
*Allium tricoccum* -  
Wild leek (umbels and S compounds)



# Asparagales: Xanthorrhoeaceae



*Hemerocallis fulva* - day lily



Grass Trees



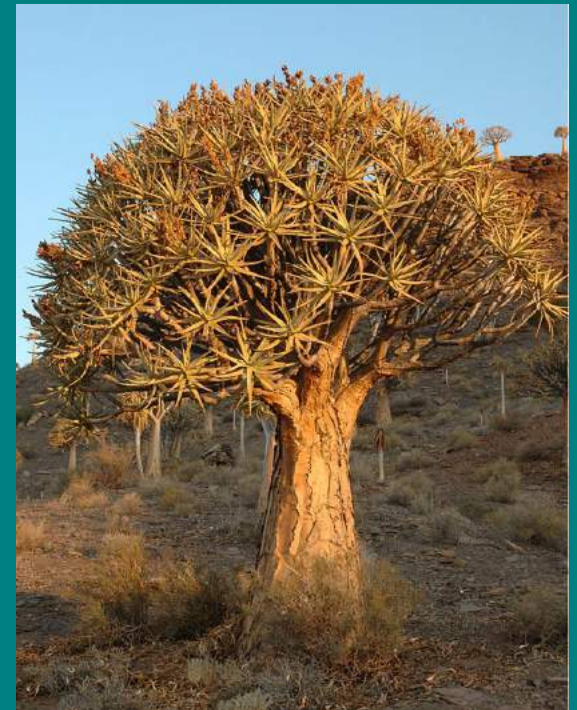
# Asparagales: Xanthorrhoeaceae



*Haworthia* [Asphodelaceae]

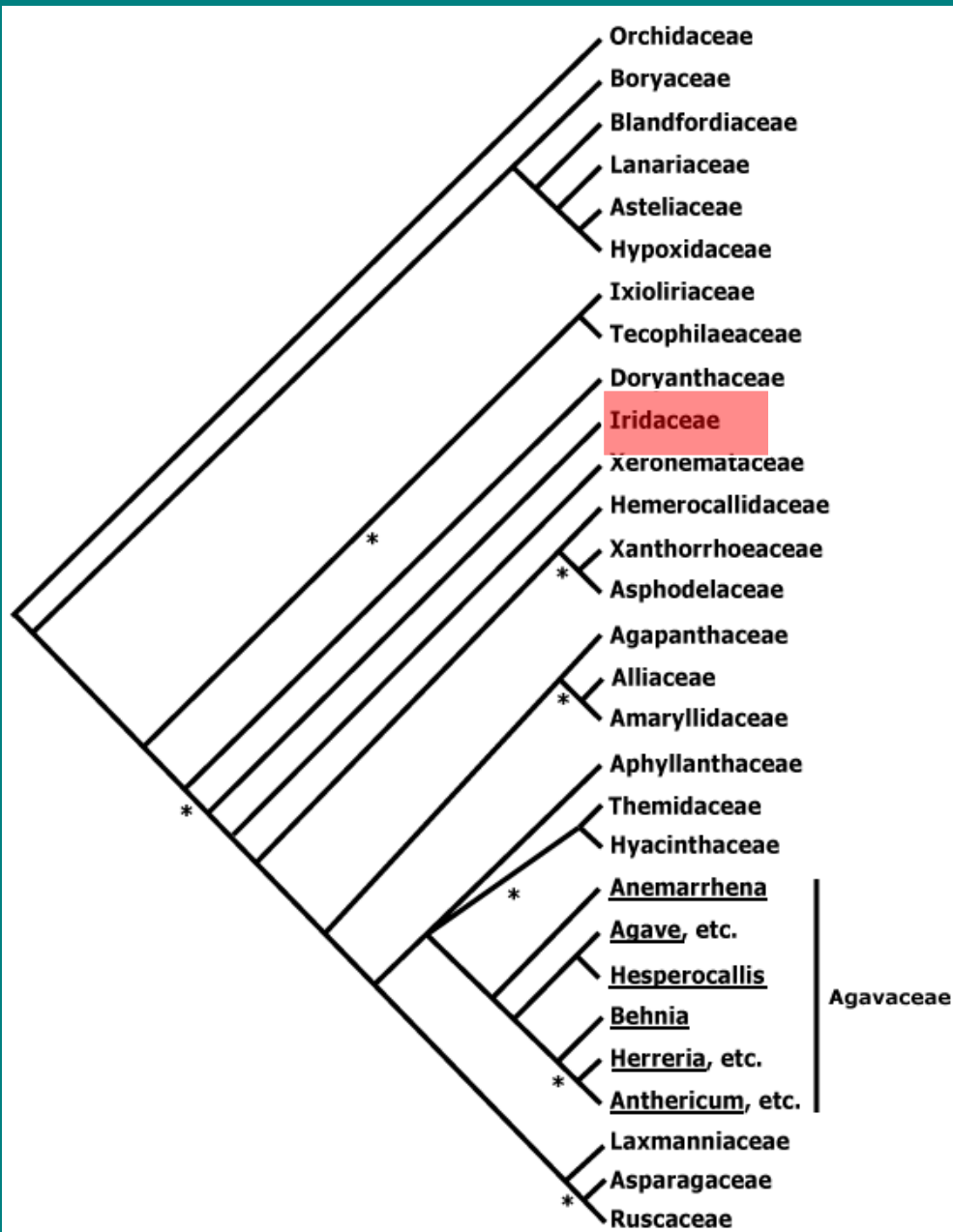


*Aloe dichotomoa*  
[Asphodelaceae]





# Asparagales: \*Iridaceae - iris



Iridaceae always recognized as distinctive family of lilioids



# Asparagales: \*Iridaceae - iris

A family primarily of Mediterranean climate geophytes.  
Leaves are basal and **equitant** - folded and overlapping.



*Iris virginica* - Blue flag, iris



# Asparagales: \*Iridaceae - iris

CA 3 CO 3 A 3  $\overline{G}$  (3)

Tepals 6, the 3 inner (petals) forming the “flags or standards”

The 3 outer (sepals) forming the “falls” with nectar guides

The 3 stamens are positioned under the 3 **petal-like styles**



*Iris virginica* - Blue flag, iris

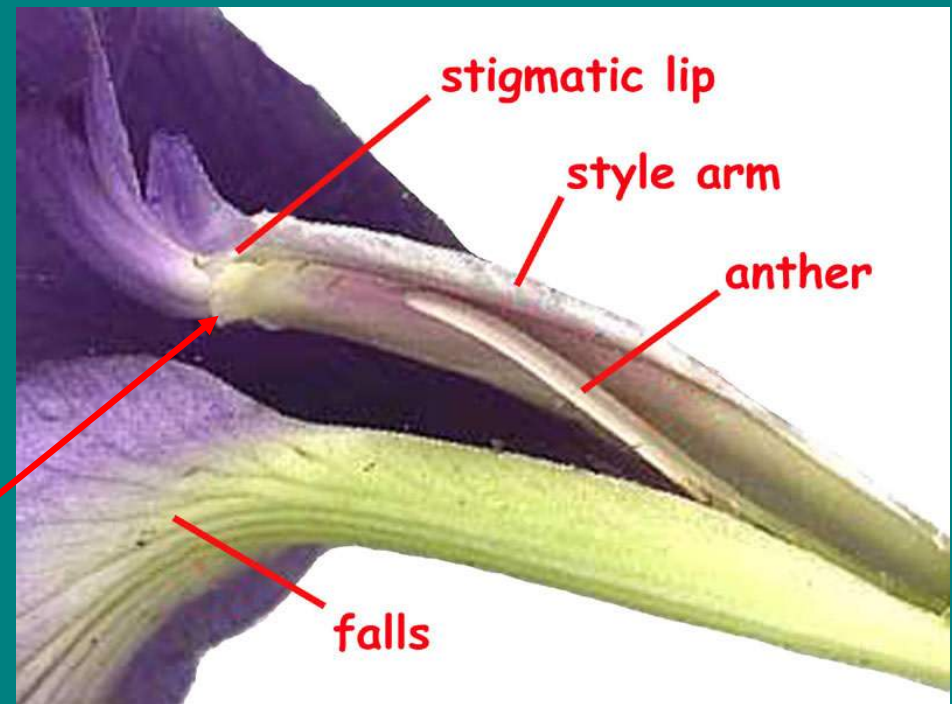
# Asparagales: \*Iridaceae - iris

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*Iris virginica* - Blue flag, iris



# Asparagales: \*Iridaceae - iris

CA 3 CO 3 A 3  $\overline{G}$  (3)

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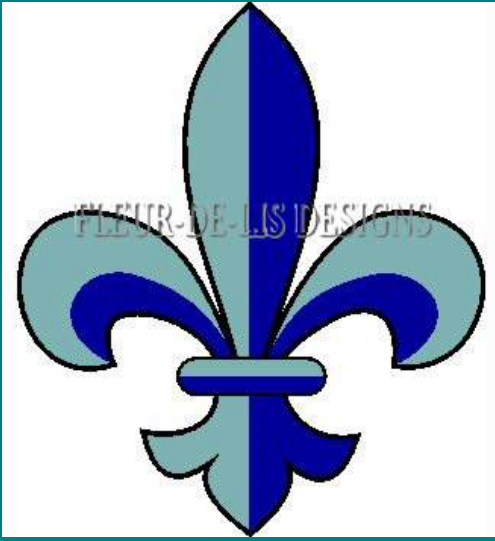
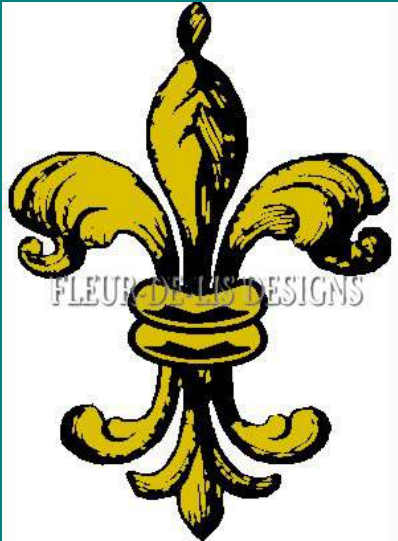
The gynoecium is inferior and forms a 3-parted capsule



*Iris virginica* - Blue flag, iris

# Asparagales: \*Iridaceae - iris

CA 3 CO 3 A3  $\bar{G}$  (3)



Fleur-de-Lis



*Iris virginica* - Blue flag, iris



# Asparagales: \*Iridaceae - iris



*Iris versicolor*

*Iris versicolor* - Blue flag



*Iris pseudacorus* - Yellow flag  
Introduced and potentially invasive



# Asparagales: \*Iridaceae - iris



Endangered species  
restricted to fringe areas  
of northern Great  
Lakes; clonal growth

*Iris lacustris*

Dwarf lake iris





# Asparagales: \*Iridaceae - iris



*Sisyrinchium campestre* - blue-eyed grass



# Asparagales: \*Iridaceae - iris



*Crocus vernalis* - crocus  
cultivated

Crocuses are all introduced but are some of the earliest flowering plants in the spring.





# Asparagales: \*Iridaceae - iris



The dried styles of *C. sativus* yields the expensive **saffron**





# Asparagales: \*Iridaceae - iris



*Geissorhiza* South Africa

Large radiations occur in several genera in Mediterranean climate regions of South Africa



*Moraea* - peacock lily



# Asparagales: Hypoxidaceae - star grass



*Hypoxis hirsuta* - Yellow star grass

CA 3 CO 3 A 3+3  $\overline{G}$  (3)

Family has been placed in Liliaceae or Amaryllidaceae but is now known to be near Iridaceae