Diversity and Evolution of Monocots

...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
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)
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:

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

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

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:

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

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!

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

<table>
<thead>
<tr>
<th>Genus</th>
<th>APG family - use</th>
<th>WI Flora book</th>
<th>Wisflora online</th>
<th>MI Flora</th>
<th>Gleason/Cronquist</th>
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<tr>
<td><em>Aleuris</em></td>
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</tbody>
</table>
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

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
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: Melanthiaceae

Trillium grandiflorum
- large flowered trillium

Trillium recurvatum
- prairie trillium
Liliales: Melanthiaceae

Anticlea/Zigadenus
dearth camas

Xerophyllum
beargrass
Uvularia grandiflora - bellwort
Liliales: Colchicaceae

Colchicum autumnale - meadow saffron

Disrupts spindle mechanism in mitosis

Colchicine
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
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 leak (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

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

*CA 3 CO 3 A 3 G (3)*

_Iris virginica_ - Blue flag, iris
**Asparagales: *Iridaceae - iris**

**CA 3 CO 3 A 3 \( G (3) \)**

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CA 3  CO 3  A 3  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

The gynoecium is inferior and forms a 3-parted capsule

*Iris virginica* - Blue flag, iris
Asparagales: *Iridaceae - iris

CA 3   CO 3   A 3   G (3)

Fleur-de-Lis

Iris virginica - Blue flag, iris
Asparagales: *Iridaceae - iris

*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
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*
Large radiations occur in several genera in Mediterranean climate regions of South Africa.
Hypoxis hirsuta - Yellow star grass

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