

### The Monocots

Basal Angiosperm Phylogeny APGII - 2003 but updated

We will finish our survey of angiosperms by going back to the basal angiosperms and take a look at the **monocotyledons** - those possessing one seed leaf.

The other main features of the monocots separating them from all other flowering plants are:

1. 3 merous flowers

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The other main features of the monocots separating them from all other flowering plants are:

1. 3 merous flowers
2. Parallel-veined leaves
3. Absence of woody tissue

### Alismatales and Acorales - the aquatic monocots

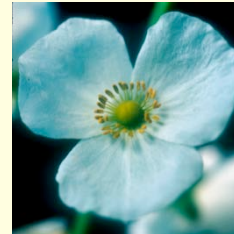


Emergent, floating, or submerged aquatic group of monocots

These are the first diverging monocots



### Alismatales and Acorales - the aquatic monocots



Showy flowers, insect-pollinated

Associated with the aquatic habit is the trend from insect-pollinated, showy flowers to water-pollinated, reduced flowers

The group shows increasing effort to vegetative reproduction over sexual reproduction



Reduced unisexual flowers, water-pollinated

### Butomaceae - flowering rush family



Emergent aquatic family  
Leaves show no obvious blade and petiole differentiation

CA 3 CO 3 A 9 Q 6

Flowers in umbels, unsealed carpels at top form follicles



*Butomus umbellatus* - flowering rush

### Alismataceae - water plantain family



Aquatic or wetland family, especially in north temperate regions


Leaves long petioled, often with sagittate-shaped leaves

Tubers starchy, often edible



*Sagittaria* - arrowhead

### Alismataceae - water plantain family




CA 3 CO 3 A 6-∞ G 6-∞

Calyx of 3 green sepals,  
corolla of 3 white petals


Carpels apocarpic

1-seeded achenes

Flowers can be unisexual



Head of achenes



*Sagittaria* - arrowhead

### Alismataceae - water plantain family







Similar to *Sagittaria*, but with carpels in one ring rather than globose head

*Alisma plantago-aquatica* - water plantain

### Juncaginaceae - arrowgrass family





CA 3 CO 3 A 6 G 3,6

Aquatic plants of swamps, bogs, or lake edges


Leaves basal, fleshy

Inflorescence terminal spike or raceme

Both species in Wisconsin are considered "special concern" but are often overlooked because of size; this species has 6 carpels, the other 3

*Triglochin maritima* - arrowgrass


### Hydrocharitaceae - frog bit family




Submersed or floating aquatic plants  
Various forms of water pollination present

Our native species of *Elodea* have whorl of 3 leaves; cultivated and escaped *E. densa* from Argentina has whorl of 6 leaves

Pollen explodes out and floats





*Elodea canadensis* - waterweed




### Hydrocharitaceae - frog bit family




*Vallisneria americana* - tapegrass (with floating flowers)

*Vallisneria* (tapegrasses, celgrasses) are composed of two species, one New World, one Old World



*Vallisneria americana* - tapegrass (with *Hydrilla verticillata*)

### Hydrocharitaceae - frog bit family




*Vallisneria spiralis* - tapegrass (OW)

Note the floating male flowers and one large female with 3 stigmatic areas on a long peduncle


Male flower in clusters; female flower single

Pollen water boat floats and attaches to 3 broad stigma of the female flower; flower retracts and forms fruit under water




*Vallisneria americana* - tapegrass

### Potamogetonaceae - pondweed family




Aquatic plants with dimorphic leaves

25 species in Wisconsin difficult to identify, hybridize, and some are troublesome weeds



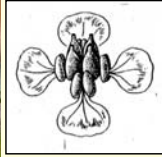

*Potamogeton* sp. - pondweed

### Potamogetonaceae - pondweed family



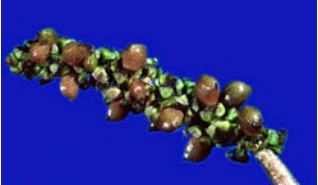


CA 0,4 CO 0 A 4 G 4

Perianth of 4 clawed segments if present  
Gynoecium typically of 4 free, 1-ovuled carpels  
Fruit drupe-like

### Potamogetonaceae - pondweed family

*Potamogeton nodosus* - pondweed

Flowers (top) and fruits (bottom)


### Araceae - jack-in-the-pulpit family

Large family primarily of the tropics  
Mainly epiphytic, others terrestrial, a few aquatic

Vegetative parts often containing **raphides** in the vacuoles with mucilage; raphides often **calcium oxalate** - an irritant

Inflorescence a fleshy **spadix**, surrounded by bract called the **spathe**


CA 0 CO 0 A 6-∞ G (2-3)



spadix  
Spathe (cut away)

*Symplocarpus foetidus* - skunk cabbage



Flowers unisexual or perfect  
Fruits berries clustered on spadix




*Arisaema triphyllum* - jack-in-the pulpit

### Araceae - jack-in-the-pulpit family


Rotting flesh odor, mottled purple and yellow-green coloration indicate specialized pollination syndrome

flesh flies - *Sarcophagidae*





gnats - *Mycetophilidae*




carrion flies - *Calliphoridae*

*Symplocarpus foetidus* - skunk cabbage

### Araceae - jack-in-the-pulpit family

urban legend!



*Arisaema triphyllum* - jack-in-the pulpit  
[or jill-in-the-pulpit ?]

**Araceae - jack-in-the-pulpit family**

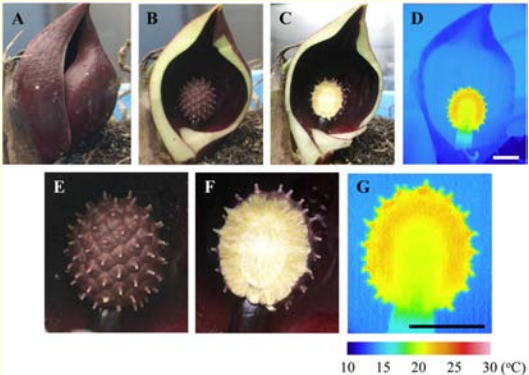


Cabbage-like leaves emerge later in the spring

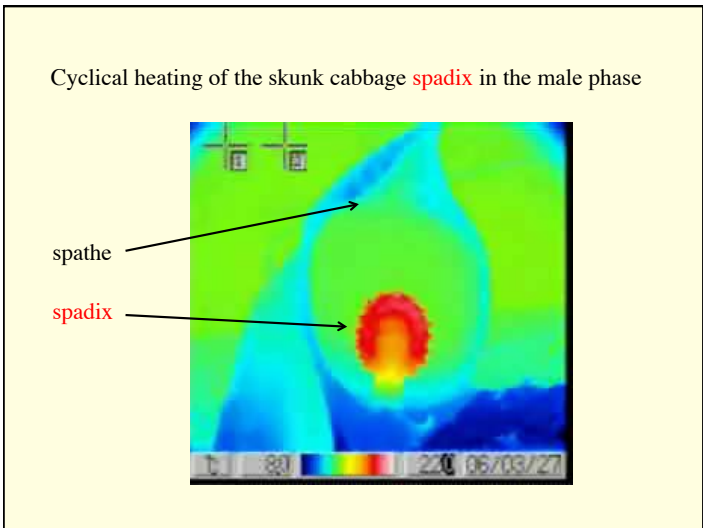
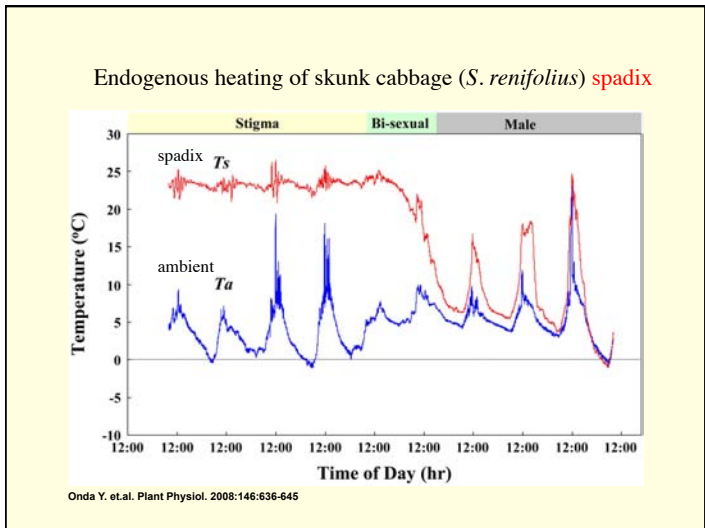
Foetid smelling inflorescence emerges early in spring or late winter; attracts carrion flies by heating up and volatilizing off the odor

*Symplocarpus foetidus* - skunk cabbage

Endogenous heating of skunk cabbage (*S. renifolius*) spadix



Onda Y. et.al. Plant Physiol. 2008:146:636-645





### Araceae - jack-in-the-pulpit family





*Calla palustris* - water arum

Our emergent aquatic member of the family



### Lemnaceae - duckweed family



Floating or submersed aquatic family almost cosmopolitan in distribution; Vegetative reproduction primarily

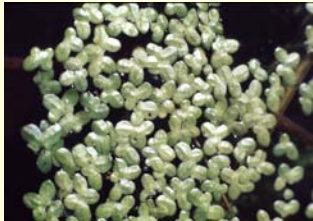
Now known to be derived from within the Araceae

*Lemna minor* - small duckweed

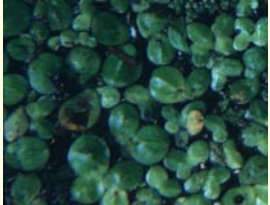
*Lemna turionifera* - perennial duckweed


Includes the smallest angiosperm, and the smallest flower

Inflorescence reduced to 1 female and 1-2 male flowers



### Lemnaceae - duckweed family



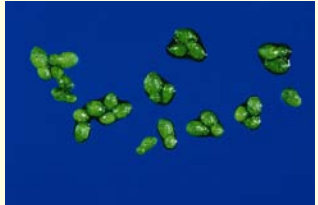


*Spirodela polyrhiza*  
great duckweed

Largest member of the family

Smallest member of the family and the angiosperms

*Wolffia columbiana* - water meal



### Acoraceae - sweetflag family



Emergent aquatic plants with ethereal oils and no raphides – first diverging monocot!

2 species, one in both the old world and new world; both are in Wisconsin

Inflorescence with spathe and spadix, flowers bisexual

*Acorus americanus* - sweet flag



### Lilioid Monocots (Liliales + Asparagales)



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

They are defined by 3 features:

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

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2. **Tepals:** showy perianth in 2 series of 3 each; usually all petaloid, or outer series not green and sepal-like
3. **Nectaries:** usually well-developed nectar tissue at the base of ovary or stamens; insect or bird-pollinated

### Liliaceae s.l. - lily family

The orders of Liliales and Asparagales contain 15 families in the new classification system, but these are not well demarcated based on morphological features.

Liliaceae s.l. (sensu lato or "in the broad sense") = many of these families

"Liliaceae" of the two floras used in lab reflects this old usage which we will use



The family comprises herbaceous perennials common in the north temperate forests

Leaves usually do not have a well-developed petioles and leaves are either sessile or basal



Liliaceae s.l. - lily family



CA 3 CO 3 A 6  $\overline{G}(3)$

Flowers are showy and 3 merous with 6 tepals

3 fused carpels (either superior or inferior) form capsule or berry with numerous seeds



Liliaceae s.l. - lily family

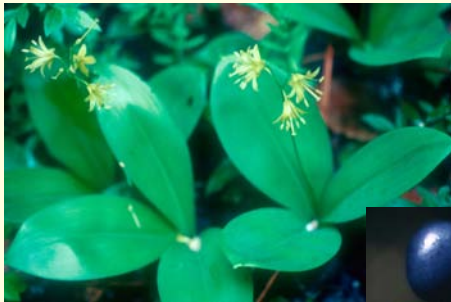


*Lilium michiganense* - Turk's cap lily  
[Liliaceae]



*Medeola virginica* - Indian cucumber root  
[Liliaceae]

Liliaceae s.l. - lily family



*Clintonia borealis* - Yellow bead lily  
[Liliaceae]



Liliaceae s.l. - lily family



*Erythronium americanum*  
- yellow trout lily  
[Liliaceae]



*Tulipa* sp. - tulip  
[Liliaceae]

Liliaceae s.l. - lily family



*Trillium grandiflorum*  
- large flowered trillium  
[Melanthiaceae]



*Trillium recurvatum*  
- prairie trillium  
[Melanthiaceae]

Liliaceae s.l. - lily family



*Uvularia grandiflora* - bellwort  
[Colchicaceae]



Liliaceae s.l. - lily family



*Asparagus officinalis* - asparagus  
[Asparagaceae]



Liliaceae s.l. - lily family



*Maianthemum canadense* -  
wild lily of the valley  
[Convallariaceae]



Liliaceae s.l. - lily family



*Smilacina racemosa* -  
False Solomon's-seal  
[Convallariaceae]

[= *Maianthemum racemosum*]

*Smilacina stellata* -  
Starry false Solomon's-seal  
[Convallariaceae]

[= *Maianthemum stellatum*]



Liliaceae s.l. - lily family



*Polygonatum pubescens* -  
Solomon's-seal  
[Convallariaceae]



Liliaceae s.l. - lily family



*Allium tricoccum* -  
Wild leek  
[Alliaceae]

Liliaceae s.l. - lily family



*Narcissus sp.* - daffodil  
[Amaryllidaceae]  
Cultivated, note corona

*Scilla sibirica* - English bluebell  
[Hyacinthaceae]  
cultivated





### Liliaceae s.l. - lily family



*Hemerocallis fulva* - day lily  
[Hemerocallidaceae]  
cultivated

### Smilacaceae - catbriar family



Small family, mainly of South Hemisphere  
Climbing via **tendrils** (modified stipules)  
Starchy tubers, edible

Often placed within Liliaceae (e.g., *Spring Flora*) but different based on large, net-veined leaves and definite petiole



*Smilax herbacea* - bristly greenbriar

### Smilacaceae - catbriar family

Flowers unisexual, dioecious plants; carrion flowers are foetid



*Smilax herbacea* - common carrion-flower

Male umbel

Female umbel



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