

Ranunculaceae - buttercup family



Herbs, sometimes woody or herbaceous climbers or low shrubs. Leaves, alternate sheathing, usually basal and cauline, often divided or compound, or palmately lobed. No stipules.

Flowers very variable: except many stamens and many free carpels (apocarpic). Floral shape varies: some actinomorphic/zygomorphic and some have spurs. Mostly insect and animal pollinated group. Mostly bisexual flowers, but some species dioecious.

CA 3+ CO (0)5+ A ∞ G 3+



Ranunculaceae - buttercup family



Fruits:

Follicles = seeded dehiscent fruit

Caltha - marsh marigold



Berries = seeded fleshy fruit

Actaea - baneberry



Achenes = 1 seeded indehiscent, dry fruit

Ranunculus - buttercup

Caryophyllaceae - pink family

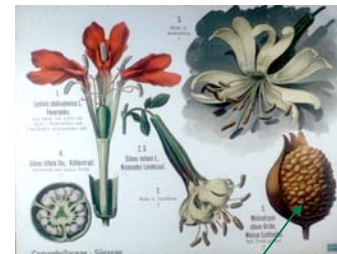
- Mostly herbs with simple, opposite, entire leaves; nodes usually swollen
- Inflorescence a **dichasium** - determinate inflorescence - or **cyme** (compound dichasium)



Note 3 way split, middle branch is oldest flower

Caryophyllaceae - pink family

CA 5, (5) CO 5 A 5, 10 G (2-5)

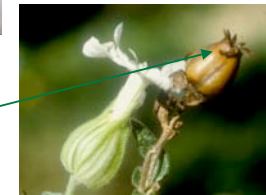


- Important diagnostic character in the family is whether or not the sepals are fused

- Petals often differentiate into a limb and claw, the apex is often notched or deeply cut, producing more or less bilobed petals

Free central placentation = free standing placental column in single locular pistil on which ovules are attached, or **axile**, or both at same time!

Capsule opens by valves or teeth



Rosaceae - rose family

Rosaceae is a large family of nearly 100 genera and almost 3000 species distributed worldwide but most common in the north temperate regions - important fruit family

Comprise herbs, shrubs, or trees and with simple, pinnately compound or palmately compound leaves



Stipules well developed in compound leaves

Rosaceae - rose family

CA 5 CO 5 A ∞ G [variable!]

Flowers are showy, 5 merous, with numerous stamens

Gynoecium is variable and used to define subfamilies

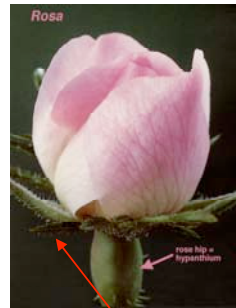


Rosaceae - rose family

CA 5 CO 5 A ∞ G [variable!]

Flowers are showy, 5 merous, with numerous stamens

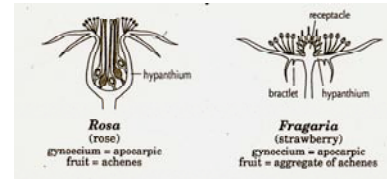
Gynoecium is variable and used to define subfamilies



Hypanthium is present to some degree in all these forms
Bracts on calyx (epicalyx) often present

Rosaceae - Rosoideae subfamily

CA 5 CO 5 A ∞ G _

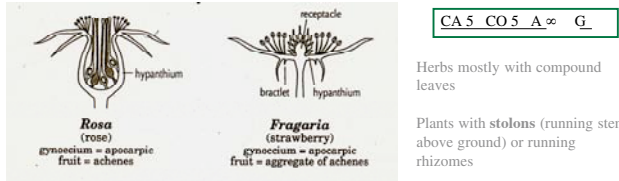


Herbs mostly with compound leaves

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



Rosaceae - Rosoideae subfamily



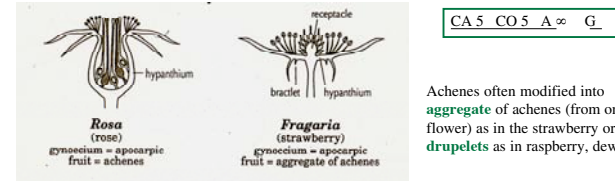
Flowers apocarpic with many carpels

Hypanthium well-developed or **receptacle elongated**

One-seeded **achenes**



Rosaceae - Rosoideae subfamily



Rubus idaeus - American raspberry



Fragaria sp. - strawberry

Legume families



3 families produce specialized foliicles - **legumes** - that open along two lines of dehiscence

Caesalpinaceae

Mimosaceae

Fabaceae

These are often treated as one family called the Fabaceae or Leguminosae with 3 subfamilies

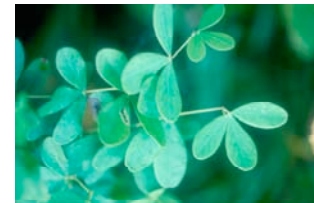
Legume families



Most of the legumes are compound leaved - pinnately, palmately, trifoliolate - a few are simple leaved

Stipules are usually well developed

Petiole bases typically swollen and called the **pulvinus**



Fabaceae - legume family

CA (5) CO 3+(2) A (9)+1 G 1



80 species in Great Lakes region; many with root nodules for N₂ fixation

Calyx often fused

Banner petal behind **lateral** petals

Bottom **keel** petals often fused

Stamens **diadelphous** = 9 fused + 1 separate

banner petal

2 keel petals 2 lateral petals

Violaceae - violet family

A tropical to temperate family of 800 species in about 20 genera. They comprise herbs (ours) to vines and trees. Over 200 are violets (*Viola*). Great Lakes region has around 28 species of *Viola* and 1 member of *Hybanthus*.



Viola - dooryard violet



Hybanthus
Green violet

Violaceae - violet family



Viola are more herbaceous and either basal leaved or caulined leaved. Leaves are often heart shaped and palmately veined or lobes, and sometimes palmately compound.

Stipules are well developed.



Violaceae - violet family

CA 5 COZ 5 A 5 G (3)



- Flowers insect pollinated, with nectar guides, and strongly zygomorphic
- Perianth 5 merous
- Lower petal spurred, 2 lower stamens have spurs going back into the petal spur
- 5 stamens form extensions of connective around style
- Pistil 3 carpellate with parietal placentation

Violaceae - violet family



Pistil forms 3 parting capsule in **chasmogamous** flowers (open flowers) from out-crossing



Cleistogamous, or closed flowers, form small capsules via self-pollination (note the **parietal** placentation in upper capsule)

Euphorbiaceae - spurge family



A large cosmopolitan family of trees, shrubs, and herbs of 300 genera and 5000 species. Latex bearing and filled with nasty chemicals (source of rubber, castor oil, tapioca, poinsettia).

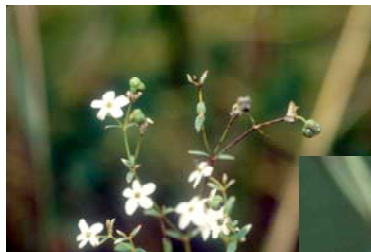
Leaves alternate, simple (often palmately lobed) or palmately compound.

| | | | | | | | |
|----|---|----|---|---|---|---|-----|
| CA | 5 | CO | 0 | A | ∞ | G | 0 |
| CA | 5 | CO | 0 | A | 0 | G | (3) |

Majority of the family has unisexual flowers, 5 sepals, no petals, numerous stamens, 3 fused carpels, and capsules

Ricinus - castor oil bean

Euphorbiaceae - spurge family



Euphorbia corollata - flowering spurge

A quite different arrangement of unisexual flowers is seen in many of our spurges of the genera *Euphorbia* and *Chamaesyce*. The "flower" of our flowering spurge is actually a highly modified inflorescence = **cyathium**



Shown here are 3 cyathia; the whole unit here is one **cyathium**

Euphorbiaceae - spurge family



Cyathium is composed of:
glands



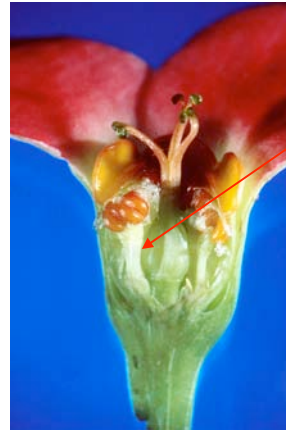
Euphorbiaceae - spurge family



Cyathium is composed of:
glands
appendages of glands



Euphorbiaceae - spurge family



Cyathium is composed of:
glands
appendages of glands
1-stamened male flowers (no perianth)



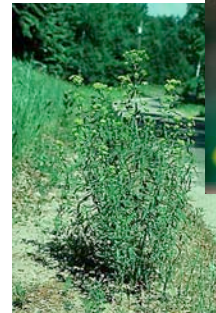
Euphorbiaceae - spurge family



Cyathium is composed of:
glands
appendages of glands
1-stamened male flowers (no perianth)
one 3-carpellate female flower (no perianth)



Euphorbiaceae - spurge family



Euphorbia esula - leafy spurge

One of several species
labelled "obnoxious weed"
by state law



Clonal growth, out-competes range plants as it spreads westward, and avoided by cattle and other animals

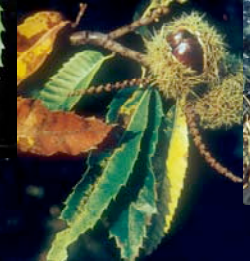
Fagaceae - beech family



Fagus - beech

Similar to Juglandaceae, except simple leaves and nut enclosed by subtending bracts; comprise 8 genera and about 1000 species in north temperate regions.

In Great Lakes we have beech, oaks, and chestnut

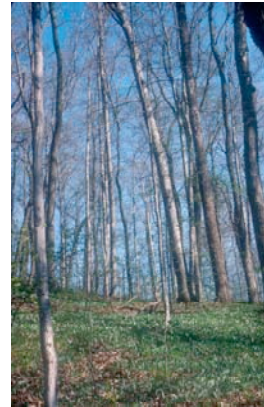


Castanea - chestnut



Quercus - oak

Fagaceae - beech family



American beech is characteristic of mesic forests in southern beech/maple forests and Northern Hardwood Forests

Easy to recognize with gray bark



Fagus grandifolia - American beech

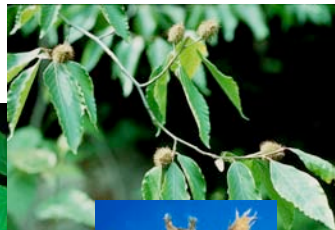
Fagaceae - beech family

Branches are flattened, leaves with toothed edges

2 pistillate flowers (2 nuts) surrounded by one set of bracts



Fagus grandifolia - American beech



Fagaceae - beech family



Quercus, the oaks, have bracts below female flower that coalesce into a woody cup of the acorn fruit (nut)

Quercus usually separated into two groups

White oaks - rounded leaf lobes, thinner walled xylem of summer wood, fruit matures in 1 yr

Red oaks - bristle tipped leaf lobes, thicker xylem, fruit matures in 2 yrs

Aceraceae - maple family

Small but important north temperate family of trees. The family is now included in the much larger and mainly tropical *Sapindaceae*. The family includes 2 of the most important or dominant tree species in many of our forest types - sugar maple and red maple. Easily recognized by simple, palmately lobed and veined leaves that are opposite in arrangement. Only boxelder has compound leaves.



Acer saccharum - sugar maple

Acer rubrum - red maple

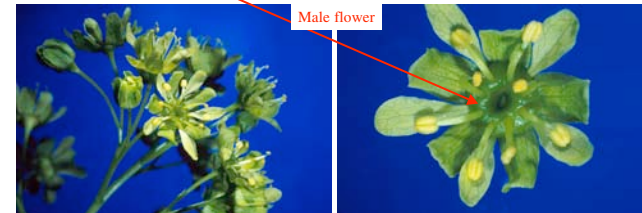
Aceraceae - maples

CA 4-5 CO 0 or 4-5 A 8

CA 4-5 CO 0 or 4-5 G (2)

Flowers typically unisexual with other sexual part aborted. Perianth often 5 merous in our species, but petals lacking in sugar and silver maples and boxelder.

A nectariferous **disk** is often present in the whorl associated with stamens.



Acer platanoides - Norway maple
Introduced ornamental

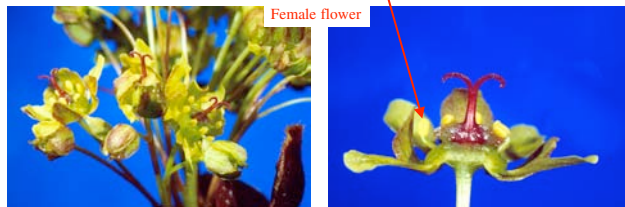
Aceraceae - maples

CA 4-5 CO 0 or 4-5 A 8

CA 4-5 CO 0 or 4-5 G (2)

Superior pistil composed of 2 carpels and 2 extended styles.

Note reduced and probably non-functional stamens



Acer platanoides - Norway maple
Introduced ornamental

Aceraceae - maples



Acer platanoides - Norway maple

Fruit is a **schizocarp** - each carpel separates into a one seeded mericarp

Fruit is also a **samara** - winged achenes; the shape, size, and angle of the wings are important characters separating different species of maple

Brassicaceae - mustard family

Large, complex family of mustard oil producing species
(broccoli, brussel sprouts, cauliflower, kale, cabbage)



Brassicaceae - mustard family

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



Cardamine concatenata - cut leaf
toothwort

Wisconsin has 28 native or introduced
genera - many are spring flowering
Herbs with alternate, often dissected leaves.



Cardamine pratensis -
cuckoo flower

Flowers "cross-like" with 4 petals, six
stamens with 2 outer ones shorter. Old
name for the family is "Cruciferae" or
"cross-bearing". Common name for
some species thus is "cress".

Brassicaceae - mustard family

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

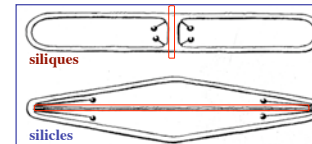


Gynoecium of 2 fused carpels separated by thin
membrane with ovules in a parietal fashion. Fruit is a
special capsule that peels off the two outer carpel walls
exposing the membrane or septum attached to the
persistent **replum**.



Brassicaceae - mustard family

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



siliques

silicles

Two types of flattening of fruits
of the Mustard Family, one
flattened **contrary to the septum**
the other flattened parallel
to the septum.

Fruits are called **siliques** or **silicles** based on how
the fruit is flattened relative to the replum.



Brassicaceae - mustard family



Cardamine concatenata - cut leaf toothwort

Common spring flowering woodland herbs

Cardamine douglasii - purple spring cress

Brassicaceae - mustard family



Arabis laevigata - smooth rock cress



Arabis lyrata - rock or sand cress

Common spring flowering woodland herbs

Brassicaceae - mustard family



Nasturtium officinale - water cress

edible aquatic native with a mustard zing



Brassicaceae - mustard family



Hesperis matronalis - Dame's rocket



Barbarea vulgaris - yellow rocket, winter cress

Introduced or spreading

Brassicaceae - mustard family



Alliaria petiolata -
garlic mustard

European invasive - biennial; at a Botany 401 final exam site in Marquette County

Ericaceae - blueberry family

Worldwide family of subshrubs, shrubs, epiphytes, and small trees. Characteristic of nutrient poor soils; in Great Lakes common in bogs, acidic pine dominated forests, or sandy soils. Symbiotic relationship with **mycorrhizal** relationship, forming **haustoria** - root to fungus connection, permits nutrient uptake by plants, carbon uptake by fungus.

Ericaceae now includes the totally fungus dependent **saprotrophs** - non chlorophyllous, all food and water from fungi



Leatherleaf in bog



Pinesap in pine forest

Ericaceae - blueberry family



Ledum
Labrador tea
Note revolute leaves

Plants are generally evergreen, with tough, leathery leaves often **revolute** or inrolled along edge of leaf, with sunken stomata, and bottom of leaves often covered with protective hairs



Arctostaphylos
bearberry

Chimaphila
shinleaf

Ericaceae - blueberry family

CA (4-5) CO (4-5) A 8-10 \overline{G} (4-5)

Calyx and corolla are fused, the **corolla tube** bell or vase shaped - most of our species are 5 merous

Stamens are 2X the number of petals; they often exhibit **terminal pores** for pollen release - rather than slits - for **buzz pollination** by bees



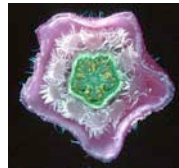
Ericaceae - blueberry family



CA (4-5) CO (4-5) A 8-10 \overline{G} (4-5)



Superior pistil



Inferior pistil

Pistil is superior in most genera, but inferior in blueberries and relatives

Fruit a berry or capsule with 4-5 partitions and many seeds

Cornaceae - dogwood family

CA 4 CO 4 A 4 \overline{G} (2)



bract

Opposite (except for one) leaved shrubs or subshrubs; Flowers small, grouped in tight inflorescences often with 4 inflorescence bracts; 4 merous and with a 2 carpellate inferior ovary; fruit a 1-seeded drupe

Rubiaceae - coffee family



Opposite or whorled leaves
Inter-petiole **stipules**

All species in Great Lakes region are 4-merous; species in the tropics are largely 5-merous

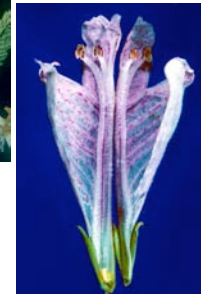


CA (4) CO (4) A 4 G (2)

The family has inferior ovary.

Lamiaceae - mint family

CA (5) CO (2+3) A 4.2 \overline{G} (2)



Opposite leaved, strong odors (mint, peppermint, sage, rosemary)
Squarish stems

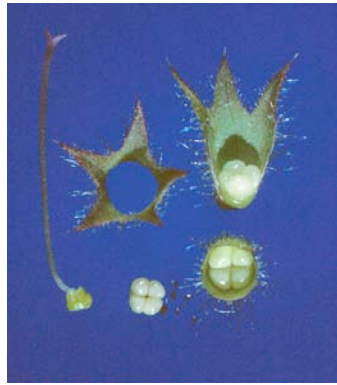
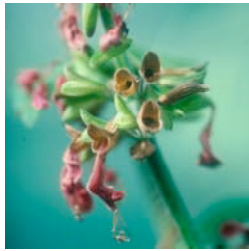
Flowers in **verticils = clustered flowers at a node**
Strongly 2-lipped corollam with 4 or 2 stamens inserted

Lamiaceae - mint family

CA (5) CO (2+3) A 4.2 G (2)

Gynobasic style (as in Boraginaceae)

4 nutlet fruits



Scrophulariaceae - figwort family

Large family of herbs and small shrubs. Many are **hemi-parasitic** = green and photosynthetic but parasitize roots of other plants (these closely related to Orobanchaceae of holo-parasites). Others related to Plantaginaceae (plantains). Leaves opposite or alternate.



Flowers generally zygomorphic and can be confused with mints; sometimes with fusion of two upper petals and appearing 4-petaled.



Scrophulariaceae - figwort family

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

Stamens 5, or 2 sets of 2, or reduced to 2. Gynoecium bi-carpellate, axile placentation, and usually producing many seeded capsules.



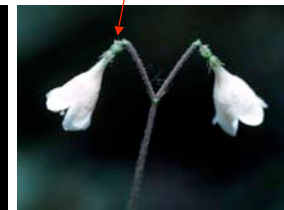
Caprifoliaceae - honeysuckle family

Northern hemisphere family (and tropical mountains) of 15 genera and about 400 species of shrubs or subshrubs

Family (and order) recognized by opposite leaves and **inferior ovary**



Lonicera - honeysuckle



Linnaea - twinflower

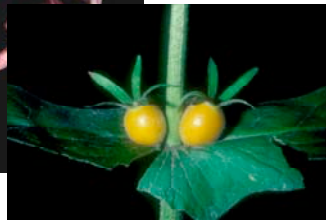
Caprifoliaceae - honeysuckle family

CA (5) CO (5) A 4-5 \overline{G} (2-5)



Flowers are 5 merous and either bell-shaped or strongly zygomorphic

Inferior ovary forms berry



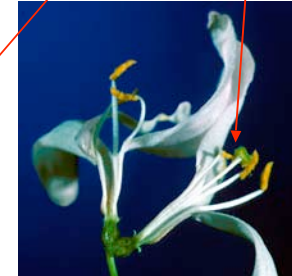
Caprifoliaceae - honeysuckle family

Family is composed of two groups of genera, which are each related to other families

Short-styled flowers vs. long-styled flowers



Viburnum - viburnum



Lonicera - honeysuckle

Apiaceae (Umbelliferae) - carrot family

Large family of 300 genera and over 3000 species most common in north temperate regions. Economically important (carrot, parsnip, parsley, celery, dill, caraway).

Aromatic herbs with hollow stems, dissected or compound leaves that are strongly sheathing, inflorescence umbellate



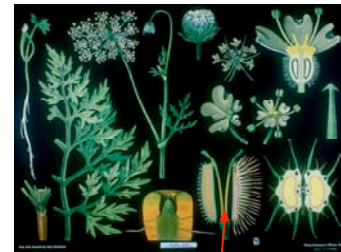
Heracleum lanatum - cow parsnip



sheath

Apiaceae (Umbelliferae) - carrot family

CA 5 CO 5 A 5 \overline{G} (2)



Flowers small, often with female flowers along edge of each umbellate. Flowers 5 merous with no corolla tube. Inferior gynoecium of 2 fused carpels separating at maturity.

Fruit dehiscent, **schizocarp** with 2 dry one-seeded mericarps held together by a **carpopore**, 5 primary ribs are on each mericarp separated by oil canals



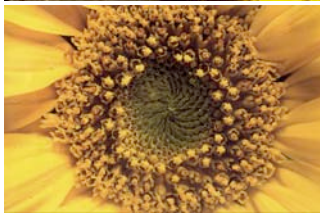
Asteraceae - aster family



One of the most successful of all flowering plant families with over 1500 genera and 23,000 species.

Family has 3 specialized features important in this radiation:

1. Special inflorescence "head"
2. Pollen presentation
3. Diverse secondary chemistry



Asteraceae - aster family



The **head** or **capitulum** is a cluster of 1 or 2 distinct flower types. The family is also called "Compositae" referring to this clustering.



The head is surrounded by special bracts called the **involucre** or **phyllaries**.

The involucre is important in the classification and identification within the family.

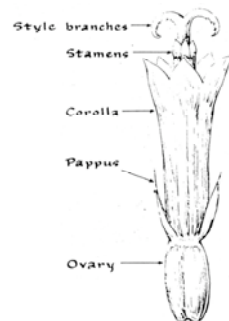
Asteraceae - aster family



Calyx is reduced to a **pappus** of scales, awns, bristles, or absent

Corolla has 5 petals but variously fused or zygomorphic

CA X CO (5) A (5) $\overline{\sigma}$ (2)



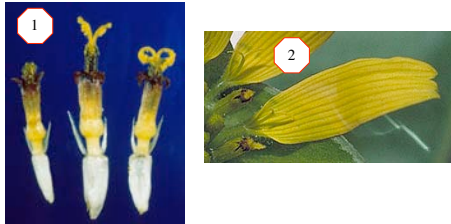
Asteraceae - aster family



Main floret types:

1. **Disk** or **tubular** florets are actinomorphic

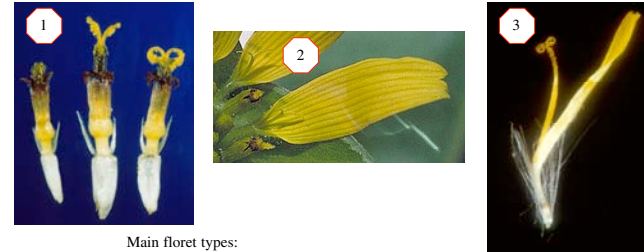
Asteraceae - aster family



Main floret types:

1. Disk or tubular florets are actinomorphic
2. Ray florets are usually 3 long fused petals + 2 short petals

Asteraceae - aster family



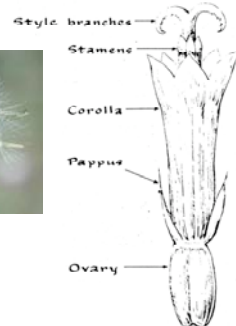
Main floret types:

1. Disk or tubular florets are actinomorphic
2. Ray florets are usually 3 long fused petals + 2 short petals
3. Ligulate florets are 5 fused petals but split open

Asteraceae - aster family



CAX CO (5) A (5) $\overline{\text{G}}$ (2)



The fruit is a one-seeded **achene** with the pappus serving as the fruit disperser (e.g., barbs for animal dispersal, hairs for wind dispersal)

Asteraceae - aster family

These various types of florets come together to form a number of different looking heads. The 3 most important ones are:

Radiate head: disk or tubular florets in the center, ray florets along the edge (these usually pistillate only)

Discoid head: only disk or tubular florets comprise the entire head

Ligulate head: only ligulate florets comprise the entire head (note 5 lobed florets)



Aster - aster

Asteraceae - aster family

These various types of florets come together to form a number of different looking heads. The 3 most important ones are:

Radiate head: disk or tubular florets in the center, ray florets along the edge (these usually pistillate only)

Discoïd head: only disk or tubular florets comprise the entire head

Ligulate head: only ligulate florets comprise the entire head (note 5 lobed florets)



Liatris - blazing star

Asteraceae - aster family

These various types of florets come together to form a number of different looking heads. The 3 most important ones are:

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Ligulate head: only ligulate florets comprise the entire head (note 5 lobed florets)



Taraxacum - dandelion

Liliaceae s.l. - lily family

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

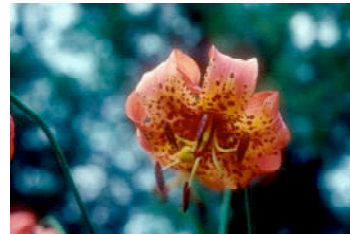
The family Liliaceae s.l. (sensu lato or "in the broad sense") is now broken up into many smaller families belonging to these two orders. As "Liliaceae" of the two floras used in lab reflects this old usage, the genera representing the family are given below but with their new family designation listed in brackets.



The family comprises herbaceous perennials common in the north temperate forests

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

Liliaceae s.l. - lily family



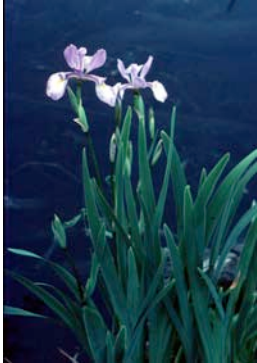
CA 3 CO 3 A 6 \bar{C} (3)

Flowers are showy and 3 merous with 6 tepals

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

Iridaceae - iris family

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



Iris sp. - from Costa Rica

Iris virginica - Blue flag, iris

Iridaceae - iris family

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"
Note the nectar guides for insects

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

Orchidaceae - orchid family

CA 3 COZ 2+1 A 3,2,1 \overline{G} (3)

The lower petal is elaborated into the **labellum** - the landing platform



Cypripedium acaule - stemless lady's-slipper

Orchidaceae - orchid family

CA 3 COZ 2+1 A 3,2,1 \overline{G} (3)

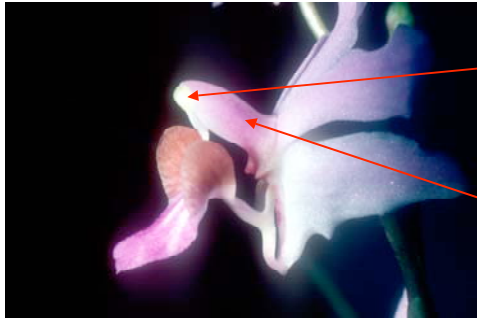
The lower petal is elaborated into the labellum - the landing platform

Lady's-slippers have two functional stamens with pollen masses



Cypripedium acaule - stemless lady's-slipper

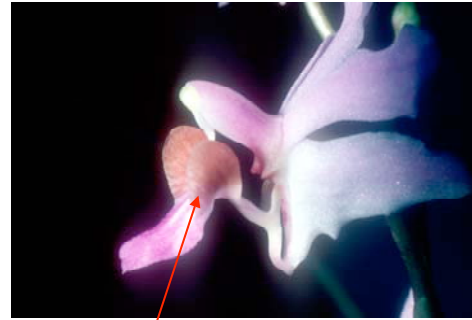
Orchidaceae - orchid family



All our other orchids have only 1 functional stamen with one or two pollinia

The stamen is situated on a **column** formed by fusion with the top of the inferior gynoecium

Orchidaceae - orchid family



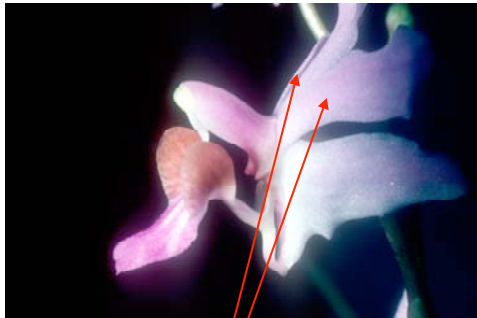
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labellum Other petals sepals (one behind)

Other floral parts . . .

Orchidaceae - orchid family



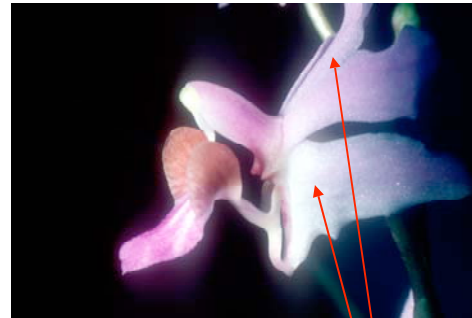
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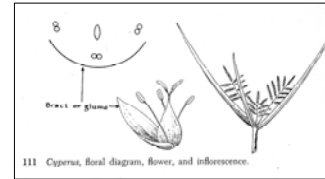
Cyperaceae - sedge family

A graminoid family of about 100 genera and 4,500 species primarily of moist habitats. *Carex* with 2,000 species is one of the largest of all angiosperm genera. Most species have triangular stems in cross section - "sedges have edges" - and thus leaves are 3-ranked.



Cyperus rotundus
Cyperaceae
G. D. Carr

Cyperaceae - sedge family



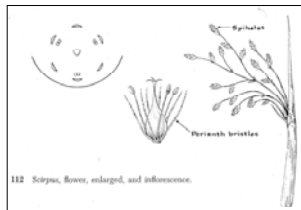
111 *Cyperus*, floral diagram, flower, and inflorescence.

Cyperus has bisexual flowers: 3 stamens and 2 fused carpels. A single bract sits below each floret. The spikelets are generally symmetrically arranged.



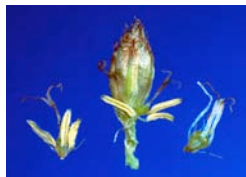
Cyperus lupulinus- Sand cyperus, sand sedge

Cyperaceae - sedge family



112 *Scirpus*, flower, enlarged, and inflorescence.

Scirpus and relatives (bulrushes) often have roundish stems. Florets are bisexual with 3 stamens, 3 fused carpels, 6 perianth bristles, and 1 subtending bract. Florets are generally whorled in the spikelet.



Scirpus validus (*Schoenoplectus tabernaemontani*)
Soft-stem bulrush



Cyperaceae - sedge family



Carex pennsylvanica
Pennsylvania sedge

Carex (sedge) is a large, complex, and difficult to key out genus.

Sedges have unisexual flowers with the male and female florets usually arranged in discrete portions of the spikelets.

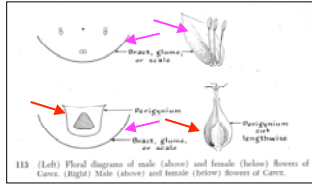
Male florets

Female florets



Carex buxbaumii
Buxbaum's sedge

Cyperaceae - sedge family



113 (Left) Floral diagrams of male (above) and female (below) flowers of Carex. (Right) Male (above) and female (below) flowers of Carex.



Carex blanda - Wood sedge

Both male and female florets are subtended by a **floret bract**.

Female florets are further enclosed by a sac-like bract called the **perigynium** - the achene forms within.



Carex intumescens - Bladder sedge

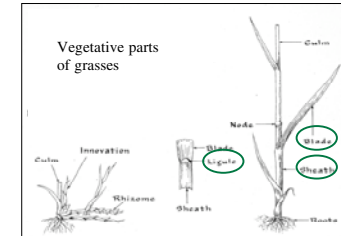
Poaceae - grass family



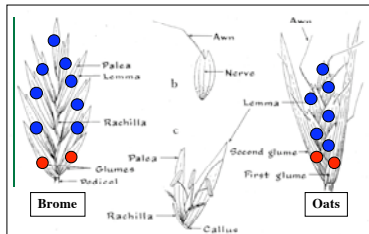
Lolium perenne - Rye-grass

The most important plant family - with about 650 genera and nearly 10,000 species - represents the ultimate in floret reduction and spikelet evolution for wind pollination.

Herbs, often rhizomatous, with 2-ranked leaves on generally hollow stems. The leaves consisting of **sheath, ligule, and blade**.



Poaceae - grass family



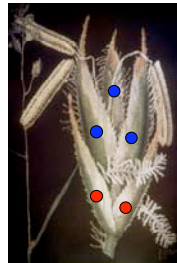
The main unit of the inflorescence is the **spikelet** which is composed of 2 **glumes** (spikelet bracts) and 1 or more **florets**

spikelet

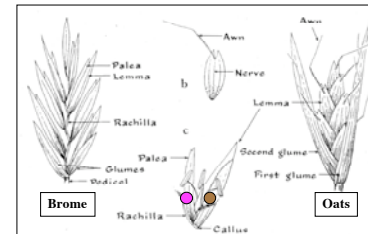
glumes

florets

Dactylis glomerata
Orchard grass



Poaceae - grass family



Each **floret** is additionally surrounded by two floret bracts - the outer **lemma** and the inner **palea** (usually not seen until anthesis - when florets open)

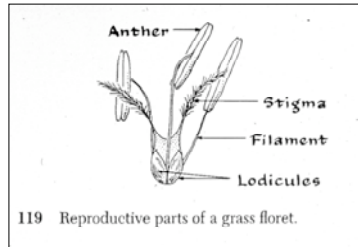
lemma

palea

Dactylis glomerata
Orchard grass



Poaceae - grass family



Although considerable variation occurs in florets (among species or within a spikelet), most of our species have the following floret structure:



Perianth represented by 2 **lodicules**

Stamens 3

Superior gynoecium of 2-3 fused carpels

One ovuled fruits called a **grain** or **caryopsis** =
seed fused to ovary wall

Dactylis glomerata
Orchard grass