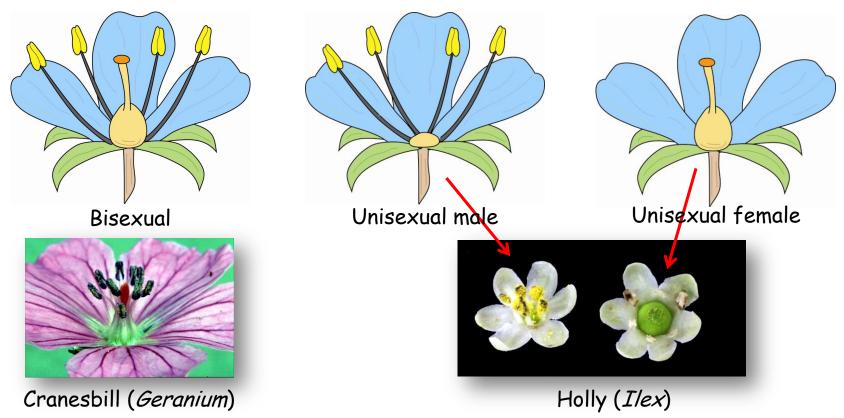
#### **Flowers**

Flowers are the sexual organs in angiospermic plants. They may be bisexual having both male and female parts in the same flower (perfect flower) or unisexual with each flower being male or female only (imperfect flower).

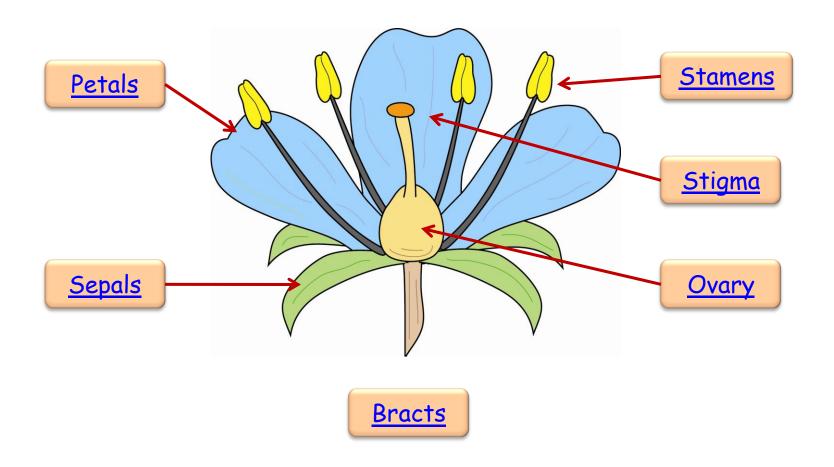








#### Typical parts of an angiosperm flower



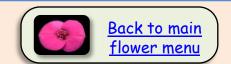




### Sepals (Calyx)

Sepals are the first whorl of floral appendages connected to the flower stem (pedicle or peduncle). They are often green, leaf-like and protect the flower in bud.











#### Sepals (Calyx)

Sepals are the first whorl of floral appendages connected to the flower stem (pedicle or peduncle). They are often green, leaf-like and protect the flower in bud.



Gentian (Gentiana)



Asia bell (Condonopsis)



Trillium (Trillium)











#### Sepals (Calyx)

In some plants, sepals either fuse with the petals or replace the petals as the showy part of the flower. In the examples below, the sepals have replaced the petals.



Dutchman's pipe (*Aristolochia*)



Windflower (Anemone)



Clematis (Clematis)









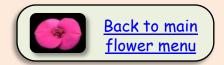


#### Sepals (Calyx)

In hydrangea, the showy outer flowers are sterile with pigmented sepals. The inner flowers are fertile and lack the showy sepal.















#### Sepals (Calyx)

When the sepals and petals are both pigmented and indistinguishable from each other they are called tepals.



Tulip (Tulipa)



Glory of the snow (Chionodoxa)



Bellwort (Uvularia)











#### Sepals (Calyx)

Although tepals are very common in monocots like the lily (Liliaceae), and (Amaryllidaceae) familes, they also appear in docots.



Cactus (Mediolobivia)



Sweetshrub (Calycanthus)











#### Sepals (Calyx)

Sepals usually persist under the petals in an open flower. However, in some plants like poppy (*Papaver*) the sepals fall off as the flower opens.













#### Petals (Corolla)

The petals are the whorl of floral appendages between the sepals and stamens.

They are usually showy and either pigmented or white.



Lotus (Nelumbo)



Magnolia (Magnolia)









#### Petals

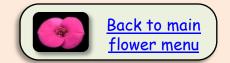
Dicot flowers often have petals in multiples of four or five.



Hawthorn (Crataegus)



Bluets (Hedyotis)











#### Petals (Corolla)

Monocots usually have petals in multiples of three.



Trillium (Trillium)



Spiderwort (Tradescantia)











#### Petals

Petals may be fused and appear to be a single joined petal. However, you can identify the segments in the petunia and moon flower that are five fused petals.



Petunia (Petunia)



Moonflower (*Ipomoea*)



Closed gentian (Gentian)











#### Petals (Corolla)

Through petal and sepal fusion and specialization there is a wonderful diversity of flower forms.



























#### Petals (Corolla)

Many petal modifications are designed to interact with insect pollinators.



Petal marking on phlox to direct insects to the sexual organs.

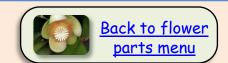


The petals change color in borage to signal insects that the flower is already pollinated.



Nectar in the spur of nasturtium entices the insect to enter and pollinate the flower..

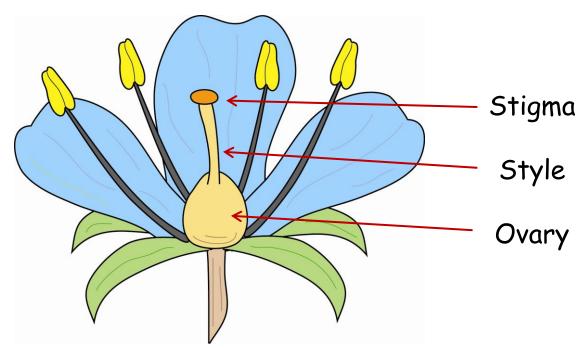


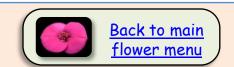




#### Ovary

Collectively the ovary, style and stigma make up the female parts of the flower. This is variably called a carpel, pistil or gynoecium.









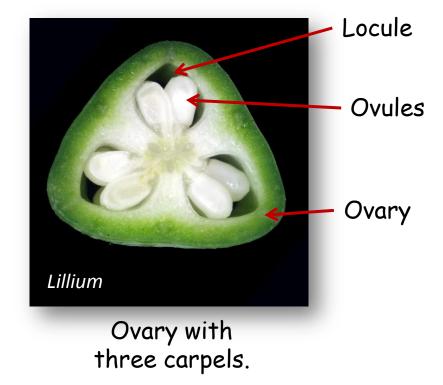


#### Ovary

The ovary is derived from one to many carpels that contain the ovules. The ovary becomes the fruit, carpels are usually indicative of the number of locules in the fruit and the ovules become the seeds within the locules.



Ovary with five carpels.







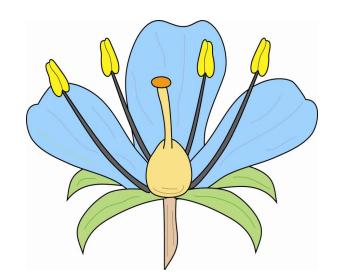




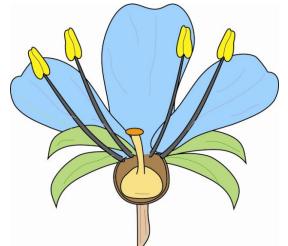


#### Ovary position

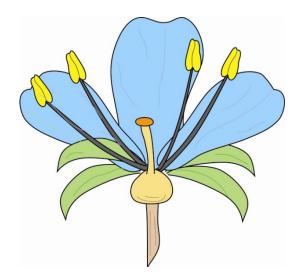
The position of the ovary is characteristic of different plant families. The ovary can be above the other flower parts, below the flower parts or held up on a special structure called a hypanthium.



Superior (Hypogynous)



Intermediate (Perigynous)



Inferior (Epigynous)





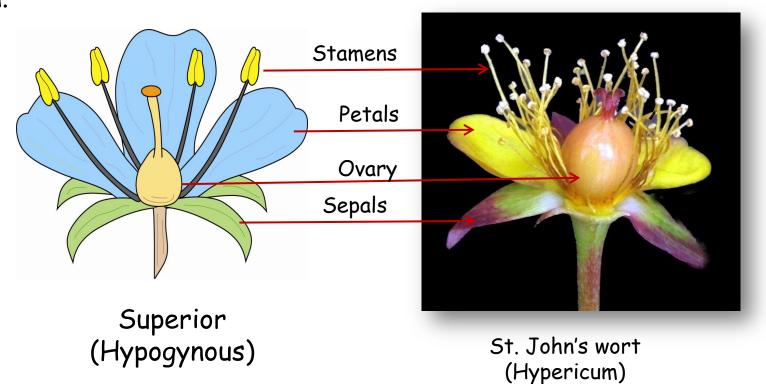






#### Ovary position

A hypogynous flower has a superior ovary that is above the other flower parts. St. John's wort is a good example of this type of ovary position.









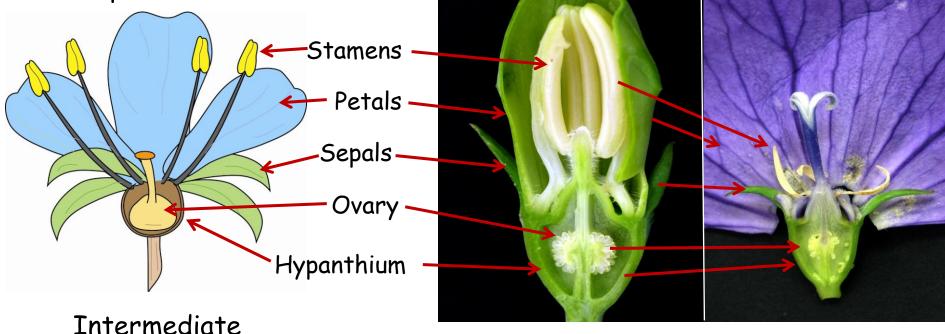




#### Ovary position

A perigynous flower is characterized by having a receptacle cup (hypanthium) that surrounds the ovary. The floral parts initiate from





Intermediate (Perigynous)

Flower in the bud Open flower

Balloonflower (Platycodon)





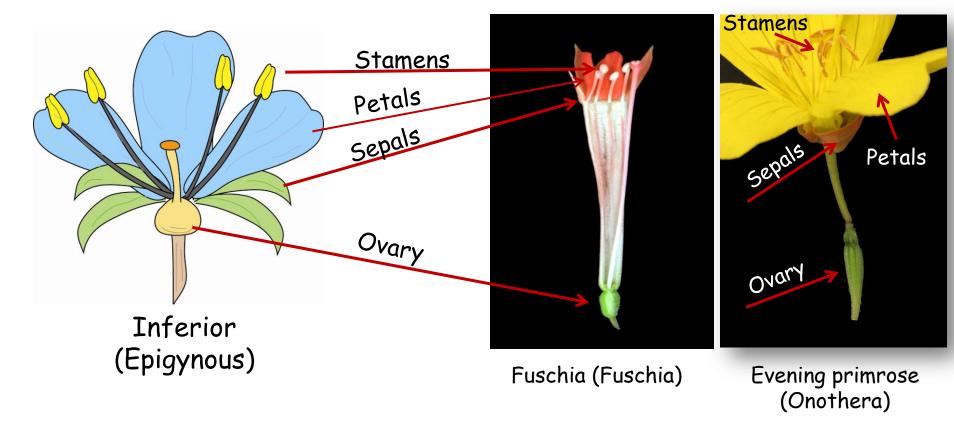


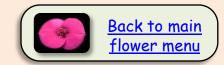




#### Ovary position

A epigynous flower has an inferior ovary. Evening primrose nicely shows the separation between the ovary and the other flower parts.











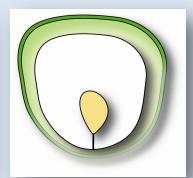


### Ovary placentation

Ovules are arranged in patterns within the ovary on placental connections.

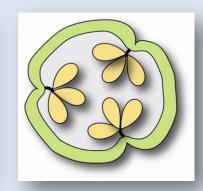
#### Basal





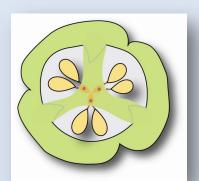
Parietal





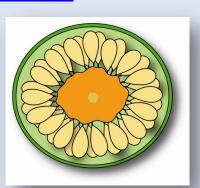
#### Axile





Free central

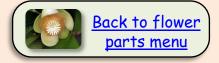








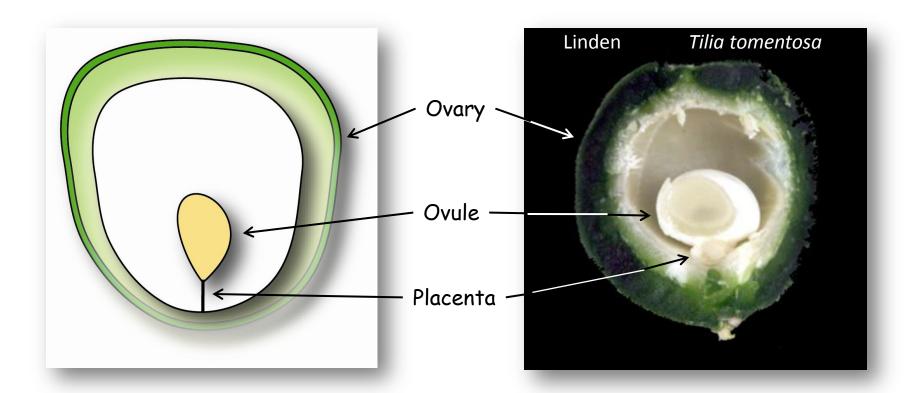






#### Basal placentation

In basal placentation, the ovule is located at the base of the ovary. The ovary often comprised of a single chamber called a locule.













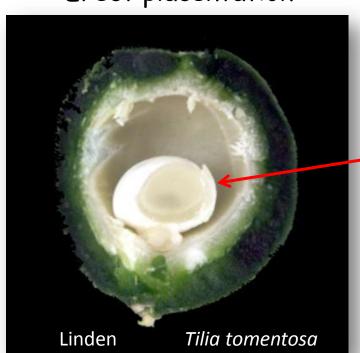


#### Basal placentation

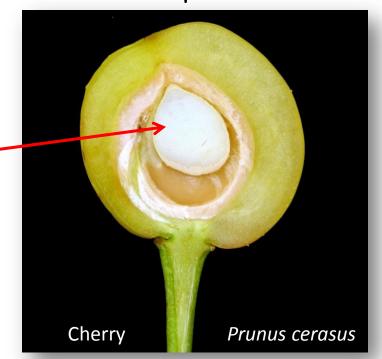
When the ovule is located at the pedicel end of the ovary it is termed erect and when the ovule is located at the opposite end of the ovary it is termed pendulous.

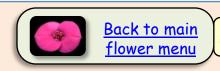
Ovule

#### Erect placentation



#### Pendulous placentation









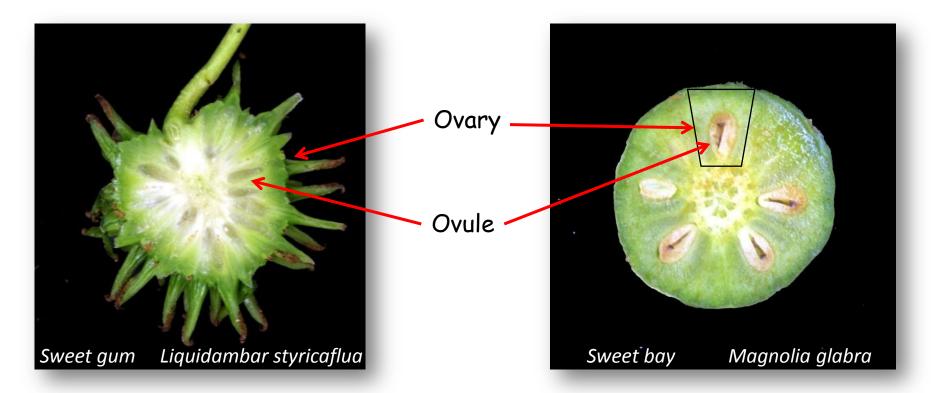






#### Basal placentation

At first glance, many aggregate fruits appear to have free central or axial placentation. However, aggregate fruits are actually groupings of attached individual ovaries usually with a single ovule often with basal placentation.









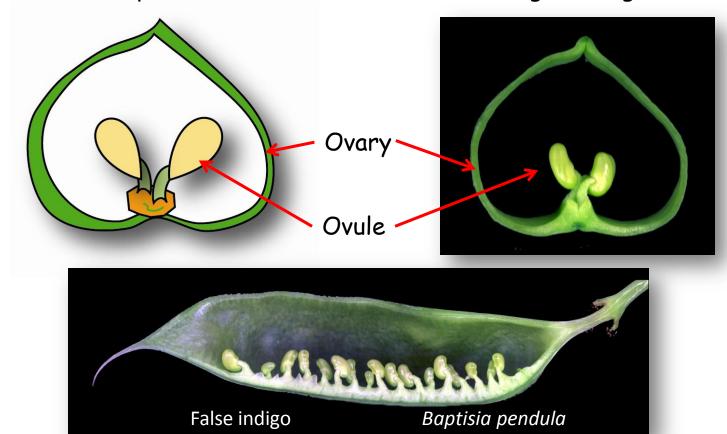


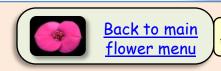




#### Parietal placentation

In parietal placentation, the ovule is attached to the ovary wall. The simplest form is seen in the pod where ovules are attached along one edge of the ovary.









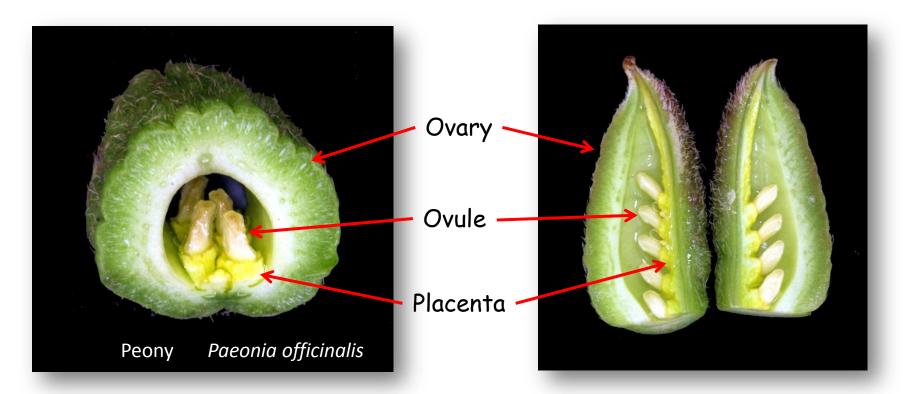






#### Parietal placentation

In a developing peony pod you can clearly see the ovules on short placenta attached in rows on the folded edge of the ovary. You can also clearly see that there are no partitions in the ovary (a single locule).







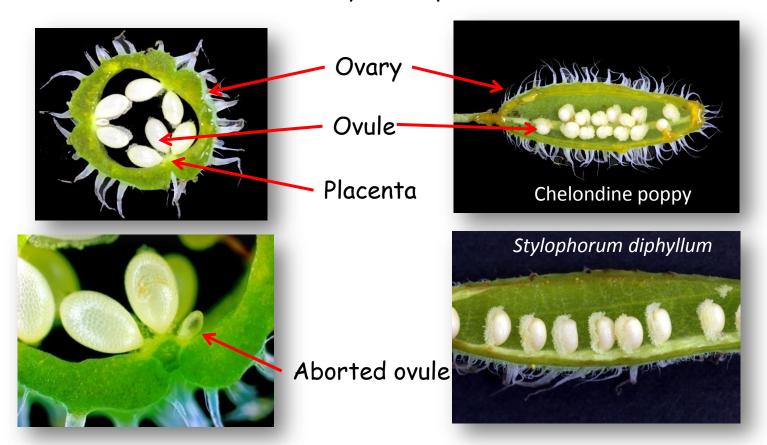






#### Parietal placentation

In the chelondine poppy, three rows of ovules attach at three locations on the ovary. In this case, ovules have a very short placenta.









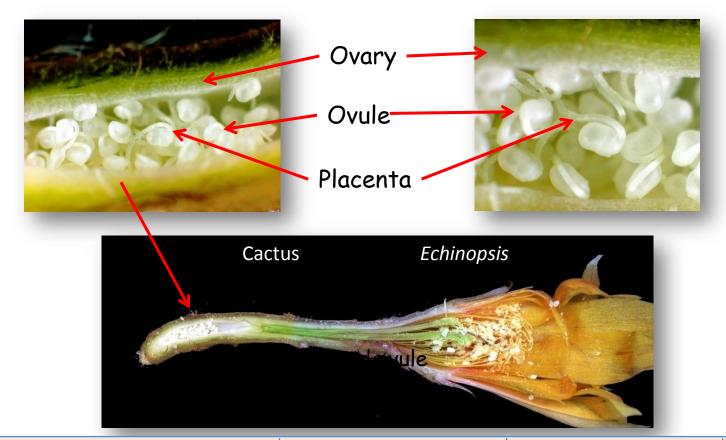






#### Parietal placentation

Cactus can appear to have a riot of ovules in the ovary because they are borne on long placentas. If you look closely, you will see that the placentation is parietal.







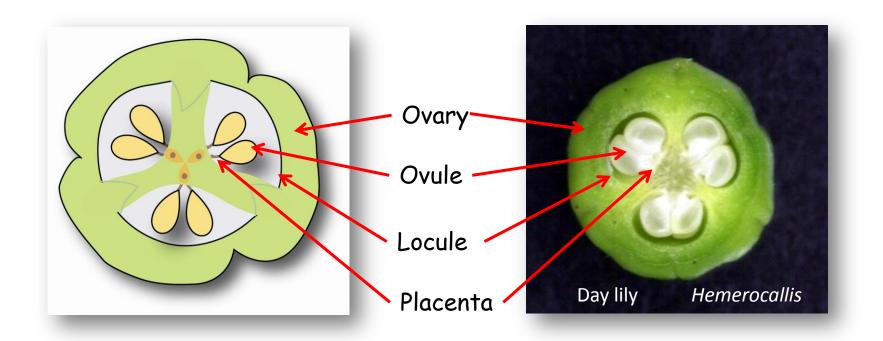






#### Axile placentation

In Axile placentation, ovules are attached to a central axis in an ovary with numerous partitions called locules.







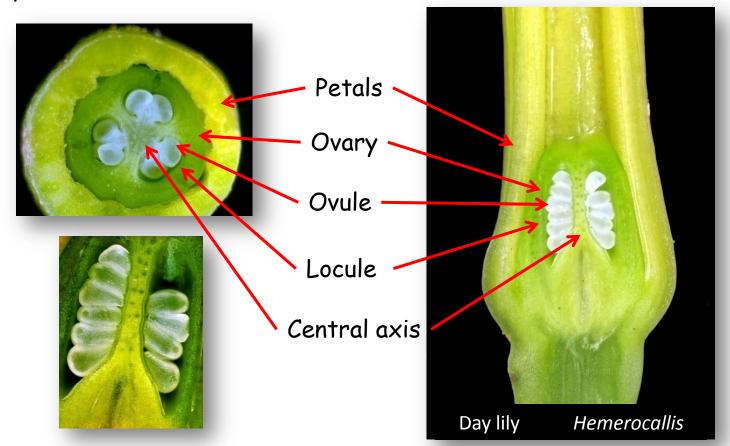


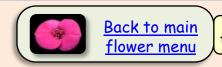




#### Axile placentation

In Axile placentation, ovules are attached to a central axis in an ovary with numerous partitions called locules.













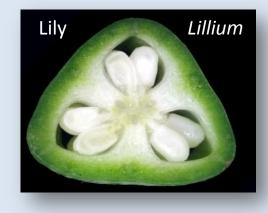


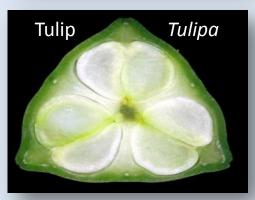
#### Axile placentation

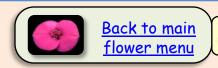
Ovaries with three locules in axile placentation are typical of monocots.















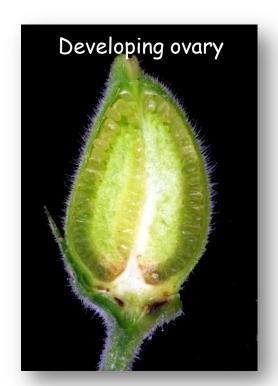


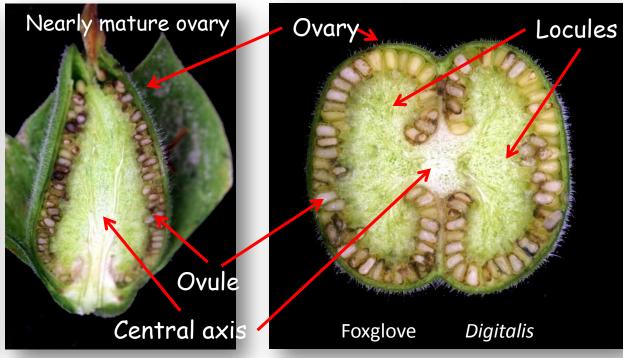




#### Axile placentation

Foxglove is an example of an ovary with two fused carpels and two locules with axile placentation.











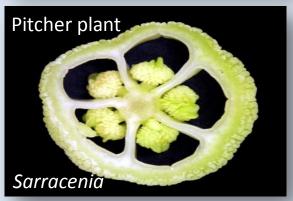




#### Axile placentation

Dicots typically have two, four, five, or more locules within an ovary.













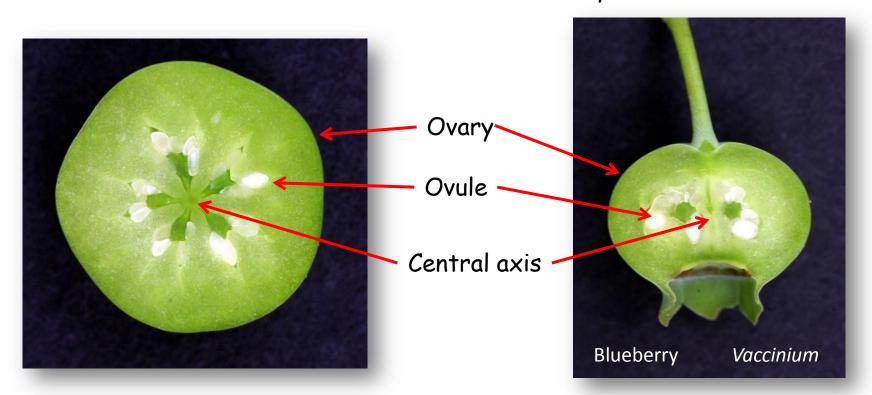


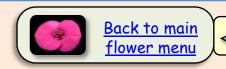




#### Axile placentation

Blueberry shows the typical star-shape seen in many fleshy ovaries that will become berries. The star-shape is created by the axine placentation but the individual locules can be difficult to see in the fleshy fruit.









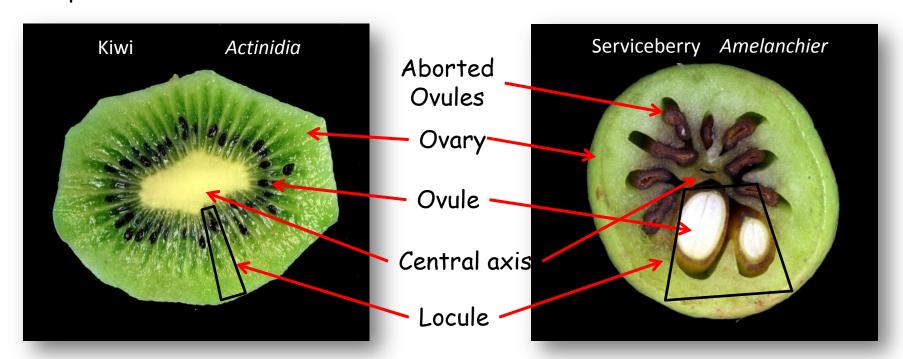






#### Axile placentation

In kiwi fruit there is a high percentage of fertilized ovules with many ovules per locule and many locules. In serviceberry There are only two ovules per locule and most of the ovules have aborted due to lack of fertilization except for a pair in one locule.







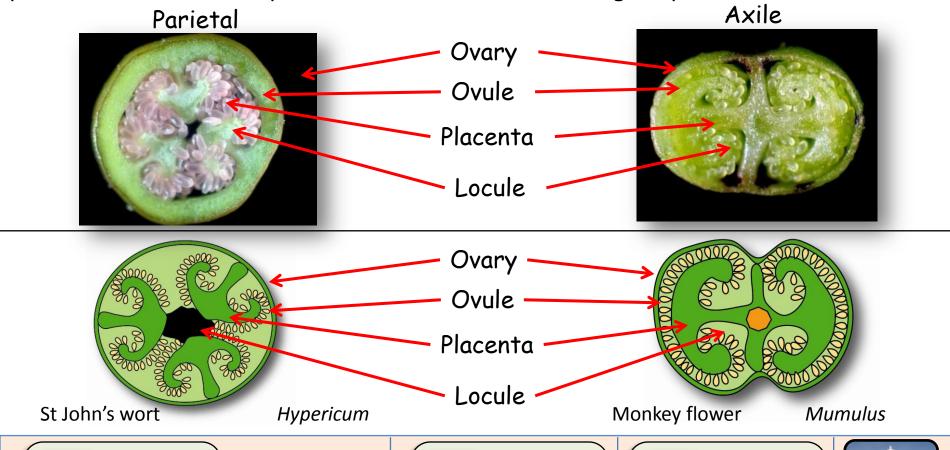






#### Parietal and Axile Placentation

The placenta in some ovaries can be elaborate and extend into the locule. Although similar in appearance St. John's wort ovaries have a single locule with parietal placentation and monkey flower has two locules making its placentation axile.



Back to main

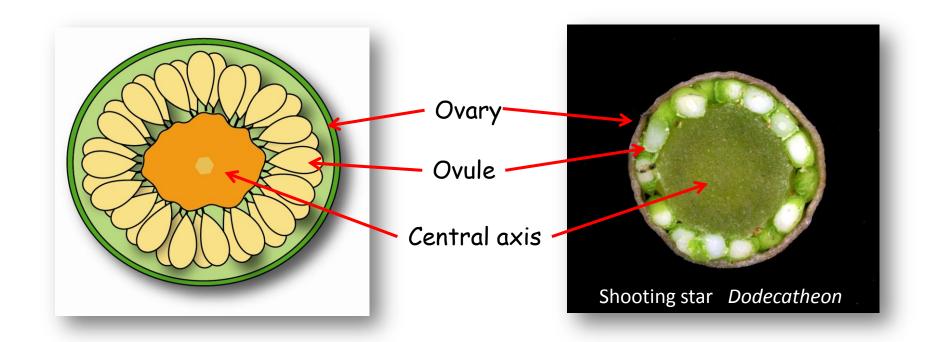
Back to ovary

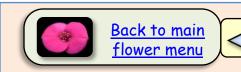
menu

Back to flower

### Free central placentation

In free central placentation, ovules are attached to a central axis in an ovary with only a single locule.







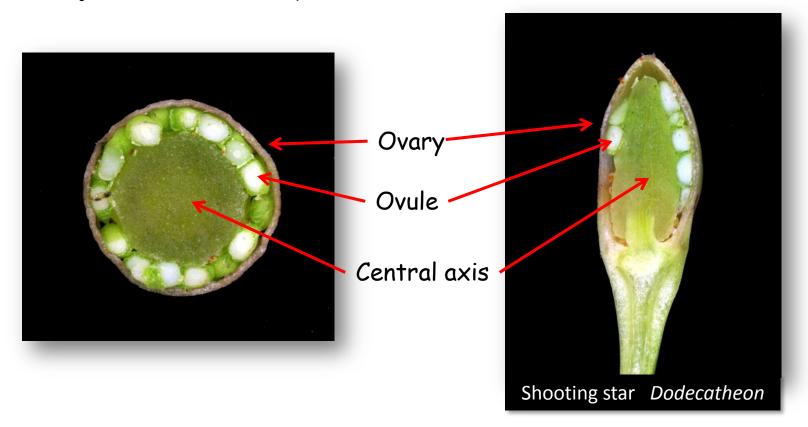


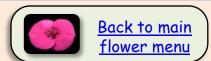




### Free central placentation

Shooting star has an ovary of five fused carpels as a single locule. Ovules are produced just below the ovary wall.







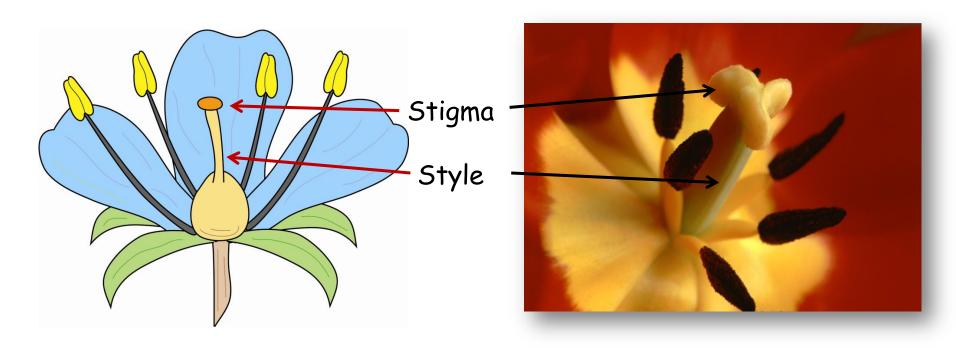


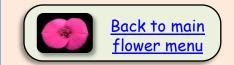




### Stigma and Style

The stigma is at the top of the style and provides the area where pollen germination occurs. Once the pollen germinates, it produces a tube that grows down the style to get to the ovule.







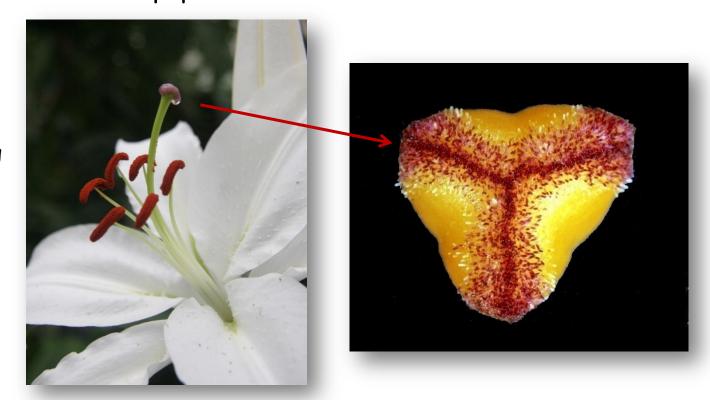




### Stigma and Style

The surface of the stigma can be dry but is more often covered with secreted material from glandular hairs or many elongated cells covering the surface called papillae.

Stigma in lily showing the wet surface and papillae.









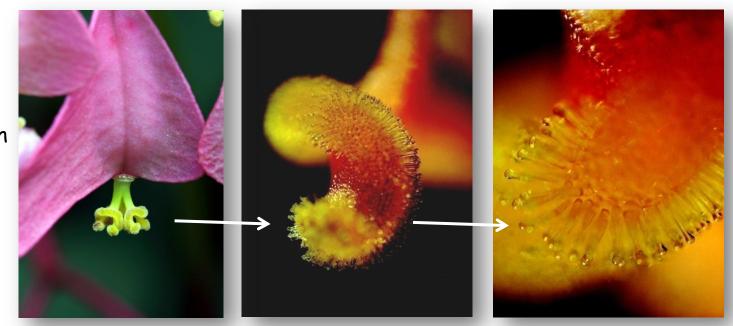


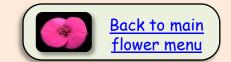


### Stigma and Style

The materials secreted on the stigmatic surface may aid the pollen grain in germination and growth. It may also serve as a chemical recognition system between the pollen and stigma. Only pollen compatible with that stigma will germinate and produce an actively growing pollen tube.

Begonia has wonderfully twisted stigmas covered with secreting papillae.









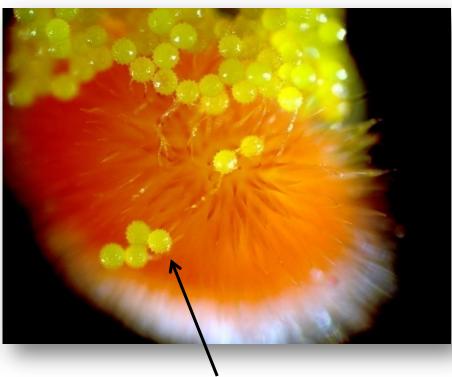




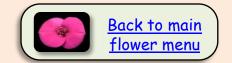
### Stigma and Style

In some plants, the stigma surface is a mass of glandular hairs.





The stigma in hibiscus is covered with hairs where the pollen grains adhere.











### Stigma and Style

Other stigmas have irregular and feathery shapes.



Crocus (Crocus)



Trumpet flower (Campsis)







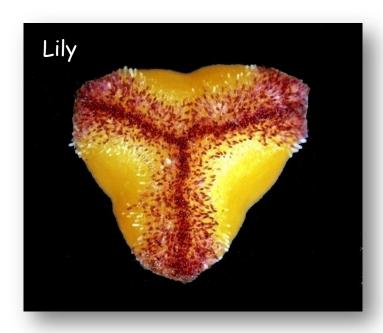




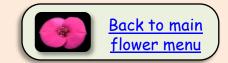
### Stigma and Style

By definition, there is usually one stigma and style for each carpel. However, flowers often have numerous united carpels leading to a diversity of stigma and style types.





In tulip and lily it is easy to see that the flower has three united carpels by the way the stigma is divided into three distinct sections..











### Stigma and Style

Even though the ovary section of the carpel can be united, the stigma

and styles may be multiple but remain separate.



Pawpaw (*Asimina*) can have as many as 15 stigmas and styles.





Soapwort (Saponaria) with half the petals removed shows numerous styles still separate as they enter the ovary.











### Stigma and Style

A single united style can have branched stigmas.



Maple (Acer) has two.



Passionflower(Passiflora) has three.



Evening primgrose (Oenothera) has four.



Balloonflower (Platycodon) has five.



Florida allspice (Illicium) has many.



Toad lily (Tricyrtis) has multiple branches









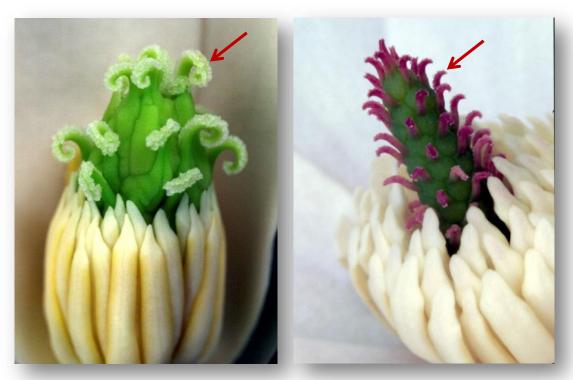


### Stigma and Style

For plants with aggregate fruits like corn or magnolia, there is a single separate stigma and style for each fruit.



Corn (Zea) has a style attached to every corn kernel within the ear.



Magnolia is characterized by an aggregate fruit with many styles and many stamens.





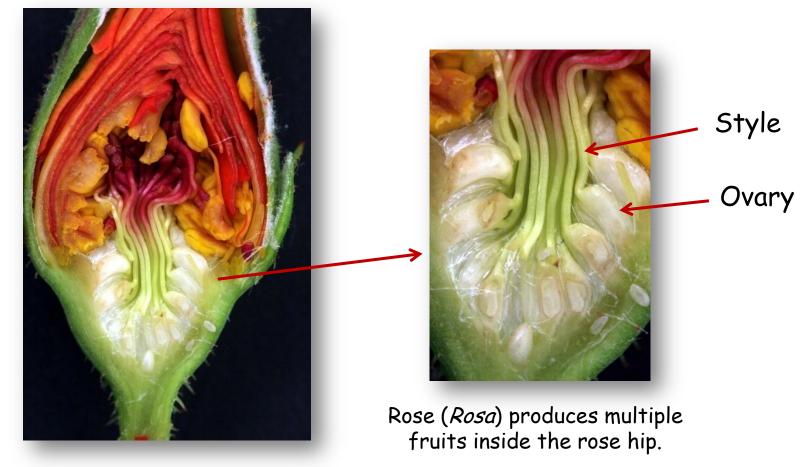






### Stigma and Style

In a rose bud you can easily see that each style is attached to an ovary.





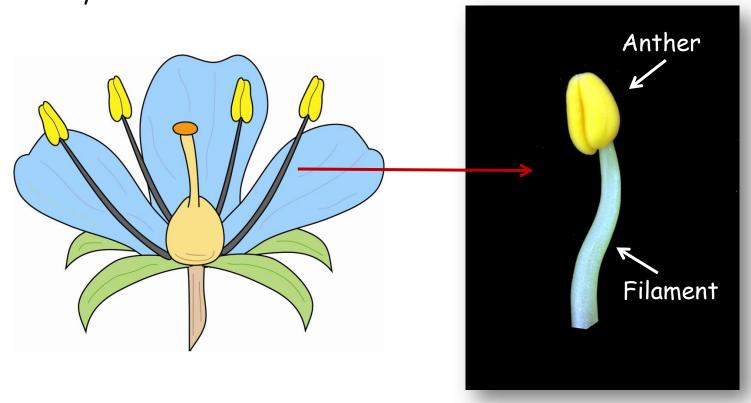


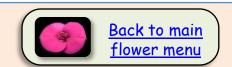




#### Stamens

The stamen is the male reproductive organ of the flower. It consists on the filament and the anther. The anther contains the pollen grains. It is technically called the androecium.





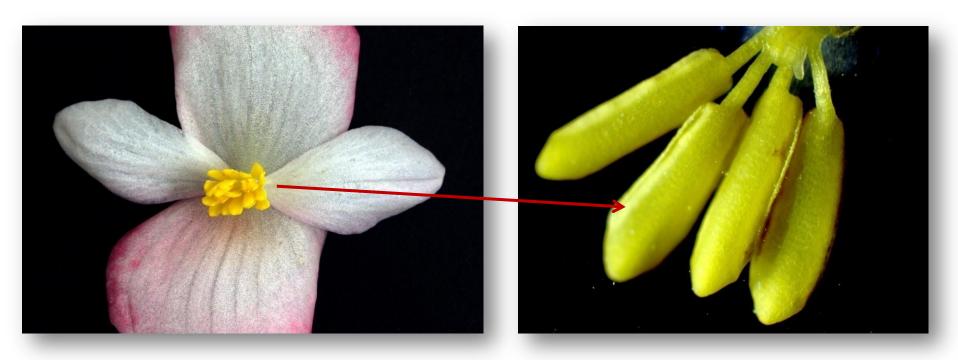






#### Stamens

Filaments are basically the stalk of the stamen that holds the anther. They can vary in length depending on the plant and pollination strategy.



Male flower in begonia showing stamens with short filaments.











#### Stamens

Some filaments are extremely long.



Caper tree (Capparis)



Powder puff tree (Calliandra)











#### Stamens

It is not uncommon for flowers to have filaments of different lengths as in the two long and two short stamens found in trumpet flower.



Trumpet flower (Campsis)











#### Stamens

Mountain laurel flowers have stamens that are held within the folds of the petals under tension. When an insect pollinator visits the flower, the filament snaps the anther against the body of the insect releasing the pollen.



Mountain laurel (Kalmia)





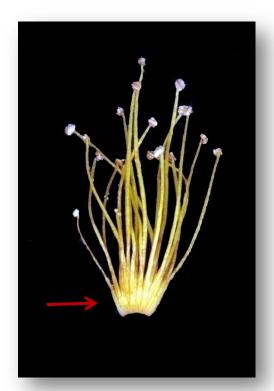




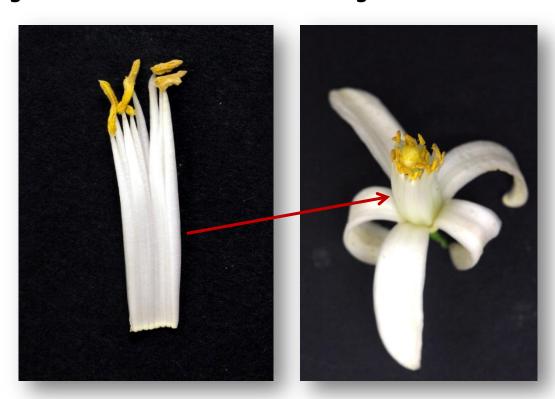


#### Stamens

In some cases the filaments are united into groups as in St. John'swort or can form complete rings around the flower as in orange.



St. John'swort (Hypericum)



Orange (Citrus)







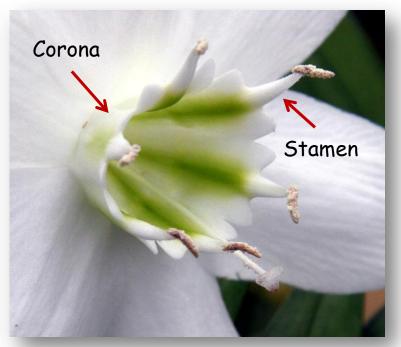




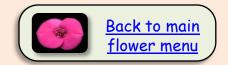
#### Stamens

Some flowers from a crown-like structure between the petals and the stamens called a corona. In the Amazon lily The stamens are fused to the corona.





Amazon lily (Eucharis)







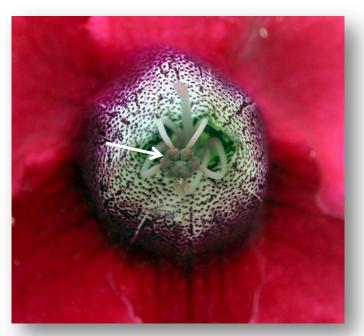




### Stamens

Gloxinia stamens have united anthers.





Gloxinia (Sinningia)











#### Stamens

Filaments may be very short or lacking (sessile).

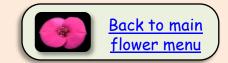


Ardisia (Ardisia)



Tomato (Solanum)

Anthers may also be united to form a cone around the female parts.











#### Stamens

Some filaments are fused to the petals.



Fuchia (Fuschia)



Primrose (Primula)











#### Stamens

Dayflower produces both fertile and sterile anthers (staminoids). The sterile anthers are showy and may attract pollinators to the fertile anthers.



Dayflower (Commelina)











#### Stamens

A common mutation selected for in horticulture is for double flowers. This is most commonly a mutation that causes the stamens to become petals.



Azalea (*Rhododendron*) with most of the stamens converted to petals. This flower will be male sterile.



Begonia (*Begonia*) showing a petaloid stamen. Note the yellow color typical of the anther on the small petal.











#### Stamens

Peony nicely shows the transition from a stamen to a petal that occurs in double flowers.



Peony (Paeonia)











#### Stamens

In some flowers the stamens become the showy part of the flower rather than the petals.



Pineapple guava (*Feijoa*)



St. John'swort (*Fothergilla*)



St. John'swort (*Hypericum*)



Bottlebrush (Callistemon)











#### Stamens

Filaments are sometimes ornamented with stamen hairs (trichomes).



Mullein (Verbascum)
Along with the stamen hairs, notice that the three lower stamens are shorter than the upper two.



On close inspection the stamen hairs in spiderwort (*Tradescantia*) resemble strings of pearls.





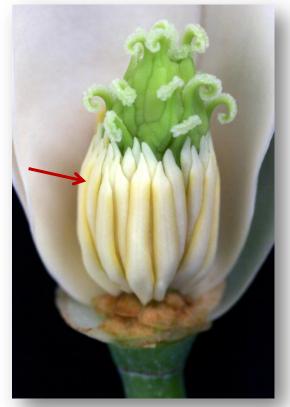




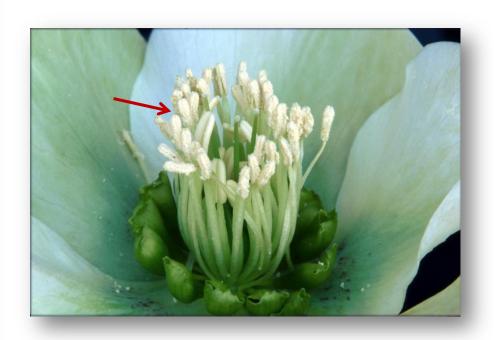


#### Stamens

Having many stamens is often a characteristic of more primitive flowers.



Magnolia (Magnolia)



Lenten rose (Hellaboris)





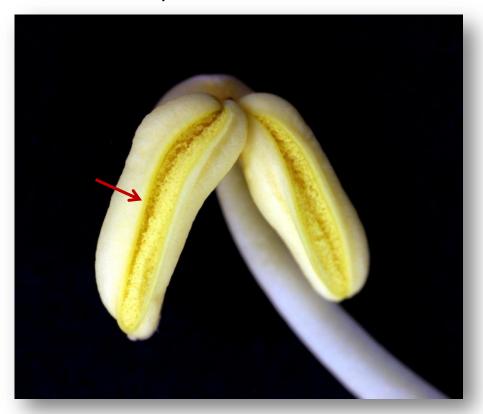




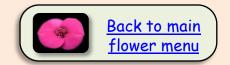


#### Stamens

Usually each stamen consists of two anther parts attached to a single filament. The anther splits (dehisces) to release the pollen.



Trumpet flower (Campsis)





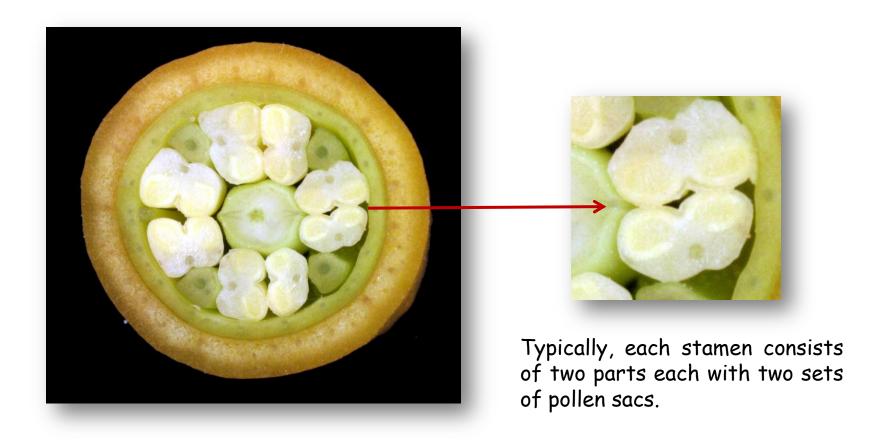


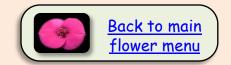




#### Stamens

Cross section of a trumpet flower (Campsis) flower bud through the four stamens.







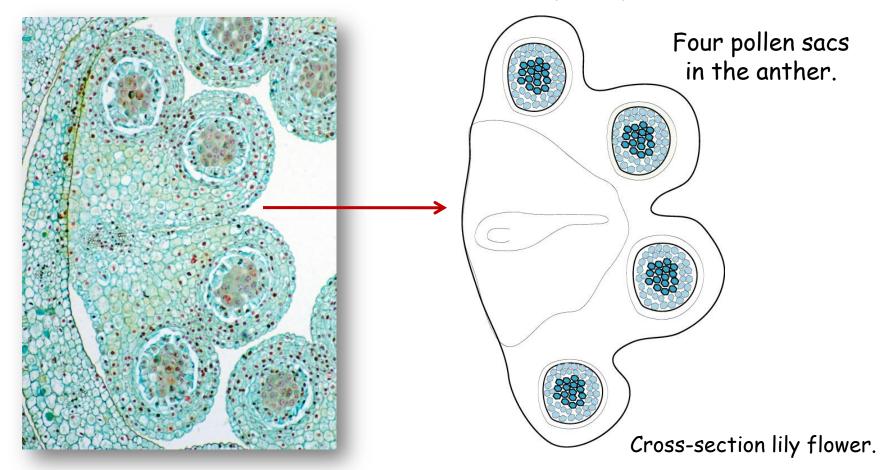






### Stamens

There is a similar stamen anatomy in lily.









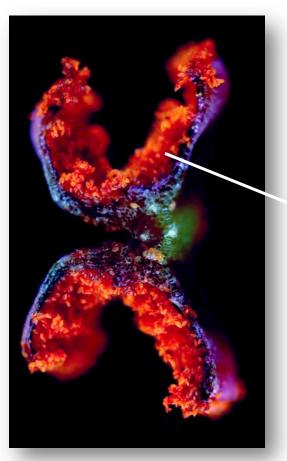




### Stamens

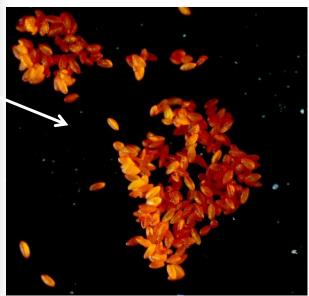


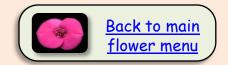
Lily stamens in the bud.



Close up of dehiscing anther.

Pollen release in lily.







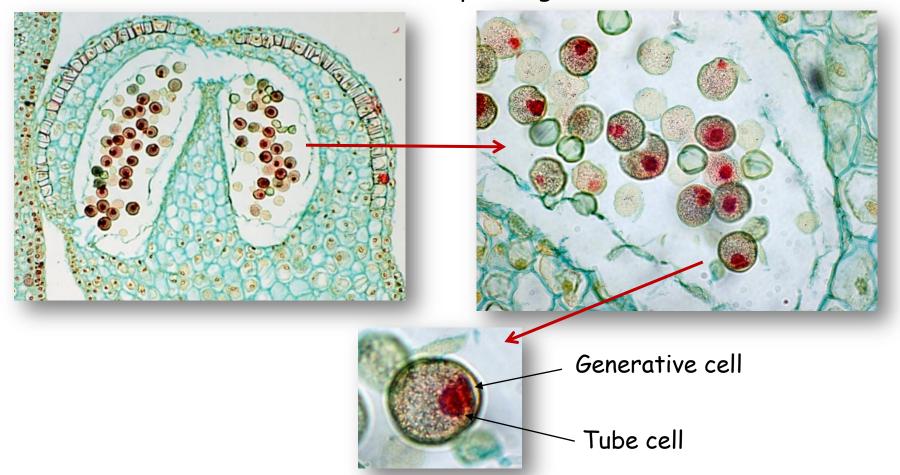






#### Stamens

Pollen sac and pollen grains.









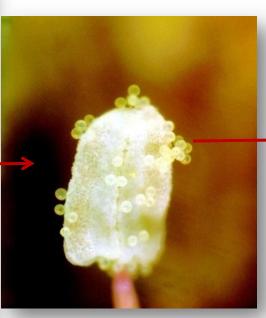


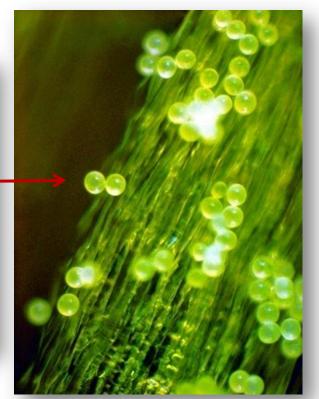


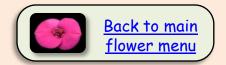
#### Stamens

Cactus pollen is round and has a smooth surface.











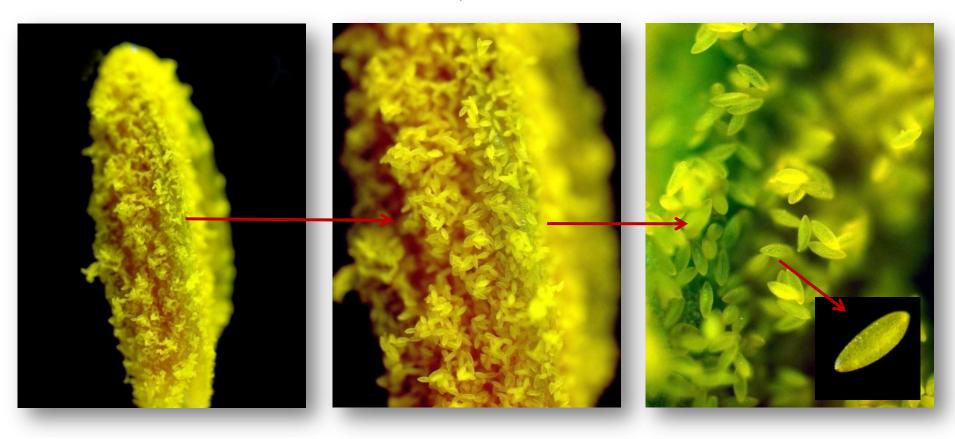






#### Stamens

Daylily (*Hemerocallis*) pollen has some surface texture and resembles grains of rice.







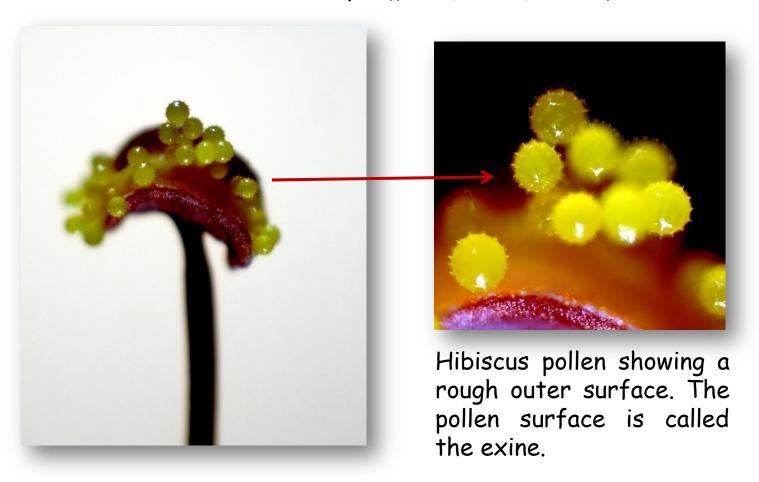


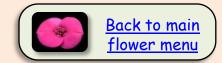




#### Stamens

Pollen released from anther in hibiscus.







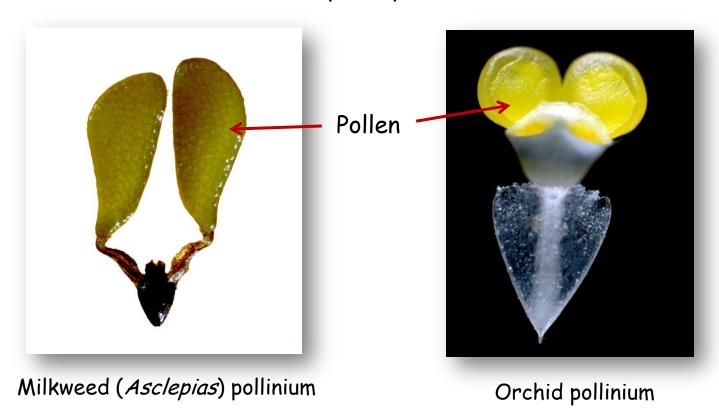






#### Stamens

Some advanced flowers have evolved specialized packets of solid pollen called pollinia that must be extracted from the flower by the insect pollinator and reinserted into another flower to complete pollination.











### **Bracts**

Bracts are modified leaves that subtend a flower or group of flowers (inflorescence).



Bougainvillea (Bougainvillea)



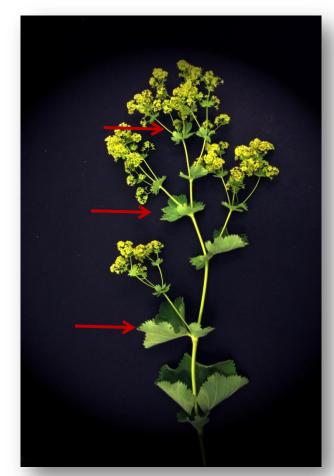




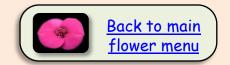


### **Bracts**

Bracts are common features of flowers. They may be showy or simply smaller green leaves. Those smaller bracts within the flower group (inflorescence) are called bractlets or bracteoles.



Lady's mantel (Alchemilla)





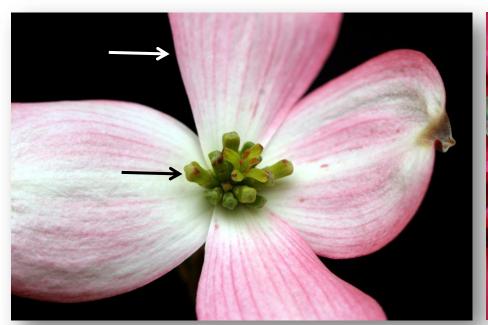






#### **Bracts**

In many cases, the bracts replace the showy function of the petals and the actual flowers are small and often non-pigmented.





Dogwood (Cornus)

Pointsettia (Euphorbia)

White arrow indicates the bract; Black arrow indicates flowers.











### **Bracts**

Bracts can act as hoods or backgrounds that can guide pollinators to a flower.



Bells of Ireland (Moluccella)



Clary sage (Salvia)











### <u>Bracts</u>

Bracts can act as hoods or backgrounds that can guide pollinators to a flower.



Bat flower (Tacca)











### **Bracts**

Often the persistent bracts are more colorful than the petals.



Shrimp plant (*Polystachys*)



Barbados ginger (Costus)









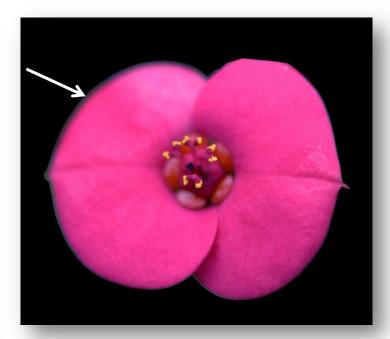


### **Bracts**

Many members of the Euphorbia family have showy bracts.



Bowtie vine (*Dalechampia roezliana*)



Crown of thorns (Euphorbia millii)









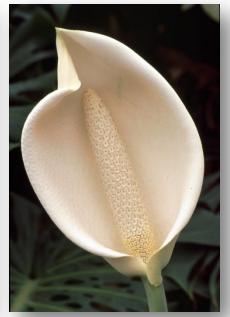


#### **Bracts**

Members of the aroid family produce a specialized bract called a spathe that forms a hood or base for the inflorescence (spadix).



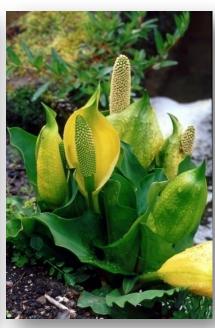
Jack-in-the-pulpit (*Arisaema*)



Swiss cheese plant (*Monstera*)



Jack-in-the-pulpit (*Anthurium*)



Skunk cabbage (Lysichiton)











#### **Bracts**

Plants in the composite family often have bristly bracts that subtend the flower head called involucre bracts.



Sunflower (Helianthus)



Coneflower (Echinacea)







