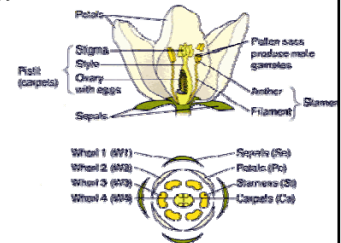


Lecture 23.

Flower

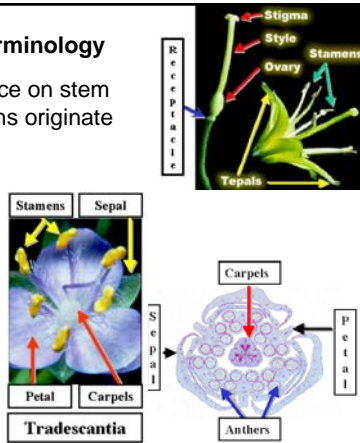
Topics

- 1. Basic flower terminology
- 2. Flower overview
- 3. Flower development
- 4. Female part: gynoecium



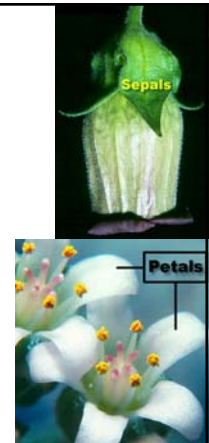
Basic Flower Terminology

- Receptacle = Place on stem where floral organs originate & attach



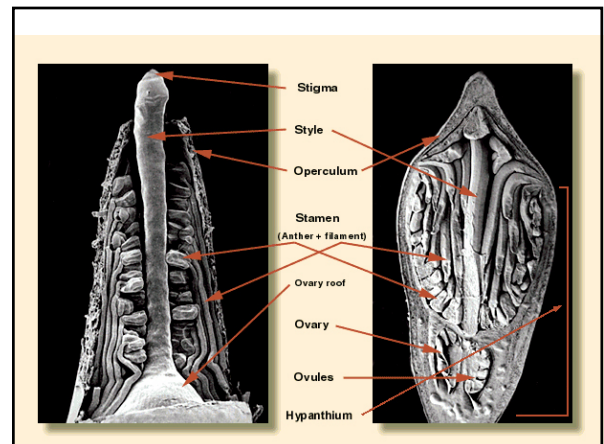
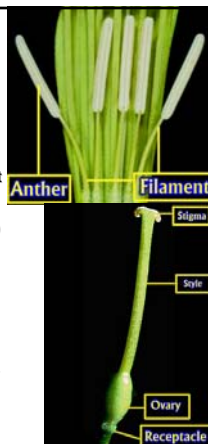
Basic Flower Terminology

- Sepals = Lowest order of floral organs, first to develop, can be green & leaf-like, - Collectively = Calyx
- Petals = Inserted on the Receptacle just above the Sepals, usually brightly colored - Collectively = Corolla
- Tepals = Sepals & Petals alike in color & shape
- Perianth = Collective term for Sepals + Petals



Basic Flower Terminology

- Stamen = Inserted above Petals, consists of the Anther & Filament
 - Collectively = Androecium (Male house)
 - Anther - Part of Stamen that Produces Pollen
 - Filament - Stalk that bears the Anther
- Carpel = Inserted above Stamens, uppermost floral organ, consists of Stigma, Style & Ovary
 - Collectively = Gynoecium (Female house)
 - Stigma - Tip of the carpel, Receptive to Pollen
 - Ovary - Base of the carpel, contains Ovules
 - Style - Connects the Stigma to the Ovary
 - A Gynoecium of a flower may contain 1 carpel, 2 carpels or n Carpels.
 - The Carpels may be free (Apocarpous) or united (Syncarpous)



Flowers Overview

- The Flower represents the most important reproductive adaptation for plants.
- Fruits not only add another protective layer but they also have specific adaptations for seed dispersal by biotic and abiotic agents.



Vegetative and Floral Organs

- Plants contain various organs. These can be divided into vegetative and reproductive.
- The Vegetative Organs are the Root, Stem and Leaf.
- **Floral organs are modified leaves!** They are formed at the shoot apex in the same manner as other leaves, and some floral parts, like sepals and petals, may be clearly leaf-like in their morphology.

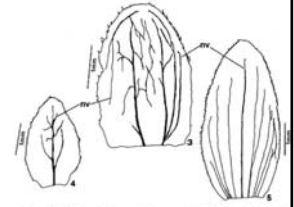


Figure 1-5. 1-2 Female flower of *T. virginica* and male floral bud of *T. pallida* in longitudinal section, respectively; 3-5 Cleared petals of *T. cutipes*; *T. virginica* and *T. pallida*, respectively. (abscissa: anther, anther, anther; ovary, ovary; style, style; sepal, sepal; petal, petal; stamen, stamen; carpel, carpel; flower bud, flower bud; flower, flower)

How are floral organs formed?

- **Image A:** SEM Photo of a Vegetative Shoot Apical Meristem of Pineapple. The primordia differentiate as Vegetative Leaves
- **Image B:** SEM of a Pineapple Flower Apical Meristem. The Flower Primordia resemble Leaf Primordia but the develop into Flowers.



Leaf Origin of floral organs

- While most Stamens and Carpels are not "leafy" in their appearance, some plants, like Paeony, produce leaf-like Stamens and Carpels.
- Careful anatomical studies have shown that all floral organs are modified leaves.

The Stamens in Paeony are decidedly Leaf-Like

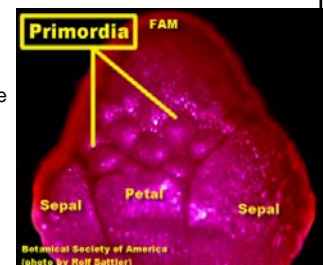


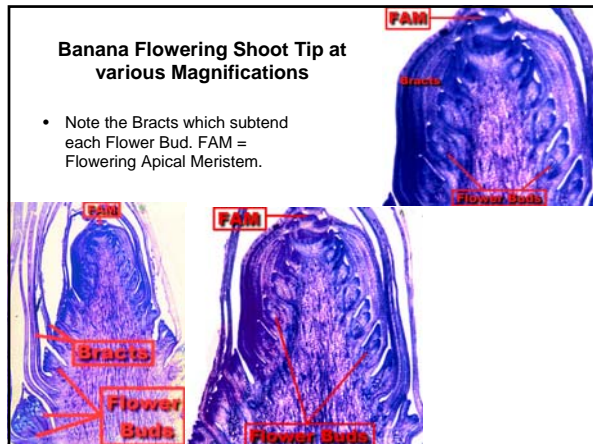
Flower Development-1

- Flowers are modified branches.
- Like vegetative branches they are composed of leaves attached to a stem (Receptacle). In most cases there is little internodal elongation between successive flower parts and they are tightly inserted one above the other.
- Flower parts may have a spiral arrangement. However, they usually occur in whorls.
- A Whorl occurs at a Node when three or more appendages are attached at the same level.

Flower Development-1: Flowering Apex of *Ranunculus*

- The Sepal and Petal Primordia have begun to develop.
- The Stamen Primordia are just visible.
- Carpel Primordia will eventually develop at the summit of the apex.





Flower Development-1

- The next step may be a widening and flattening of the FAM. A thick surface layer of highly meristematic cells develops and produces floral structures in an Acropetal succession.
- (Acropetal = from the Base towards the Tip; *i.e.* [1] Sepals -> [2] Petals -> [3] Stamens -> [4] Carpels).

Flower Development-2
Flower Development in *Potamogeton*

- Note the Acropetal Progression of Flower Development.
- This continues until the entire FAM has differentiated into floral organs. This is called "Determinate" growth because it has a limited growth potential.

Flower Development-2
Flower Development in *Potamogeton*

1. Young Flowering Apex: The Preanths (Calyx & Corolla) are the first primordia produced (FAM = Flowering Apical Meristem)
2. The Perianth Primordia have grown and Stamen
3. Primordia have appeared. Enlarged View of the Carpel Primordia which develop at the Summit of the Flower Apical Meristem.

The Gynoecium

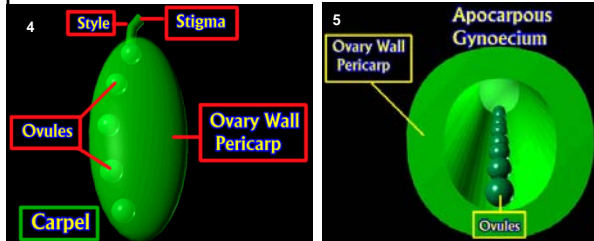
- how could an ancestral carpel have evolved to produce Apocarpous and Syncarpous Gynoecia?

Apocarpous Gynoecium (*Apo* means *Separate*)

1. A Primitive Carpel with Ovules distributed at the Margin of the Leaf
2. The Transparent Blade shows the Midrib.
3. A Primitive Carpel which has become folded but the Ovules are still marginal

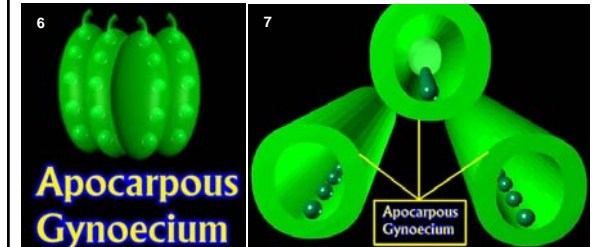
Apocarpous Gynoecium (*Apo means Separate*)

- 4. Primitive Carpel which has folded and fused along the margin so that the Ovules are enclosed & surrounded by the Lamina.
- 5. Cross Section of a Simple Carpel. Some Flowers like Legumes have a Gynoecium of One Simple Carpel



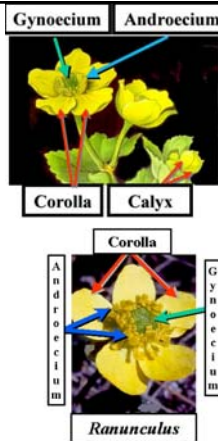
Apocarpous Gynoecium (*Apo means Separate*)

- 6. In some cases the Gynoecium may have several Simple, Free Carpels. This is called an Apocarpous Gynoecium.
- 7. Cross Section for an Apocarpous Gynoecium with 3 Carpels



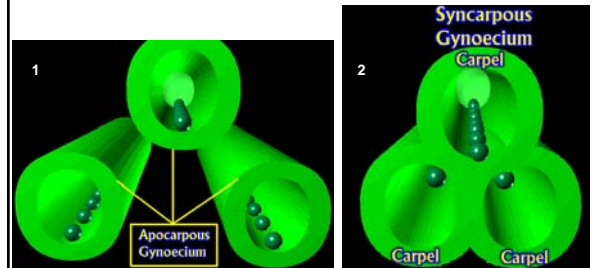
Apocarpous Gynoecium - the Buttercup (*Ranunculus*) as a model of an Apocarpous Flower

- *Ranunculus* flowers showing the progression of flower development from the bud on the right to a mature flower on the left. The Sepals (Clayx) abscise early in development. Compare this to the picture of real flowers. Note the presence of many free carpels in the Gynoecium & the numerous Stamens in the Androecium.
- Carpels contain Ovules in their Ovaries.
- Ovules contain the Megagametophyte which is called the Embryo Sac in angiosperms.



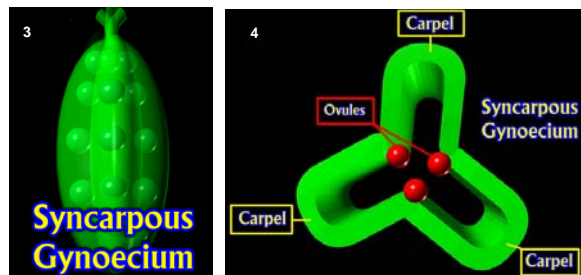
Syncarpous Gynoecium (*Syn means fused*)

- 1. Cross Section of an Apocarpous Gynoecium with three Carpels
- 2. Cross Section of a Syncarpous Gynoecium with Three Carpels.



Syncarpous Gynoecium (*Syn means fused*)

- 3. A Syncarpous Gynoecium of three Carpels.
- 4. Cross Section of a Syncarpous Gynoecium with the Carpels fused at their margins.

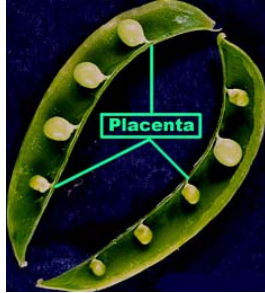


Placentation-1

- **The Placenta is the area of the Carpel to which Ovules are attached.**
 - Marginal Placentation
 - Parietal Placentation
 - Axile Placentation
 - Central Placentation
 - Basal Placentation

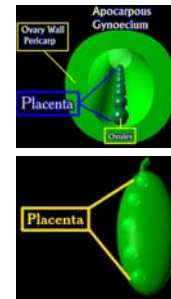
Marginal Placentation

- Legume Fruits have their Ovules attached along the area where the Marginal Traces occur. This is called the Suture because it represents the locus where the Ancestral Carpel fused to create an enclosed space (Locule). This is called Marginal Placentation!



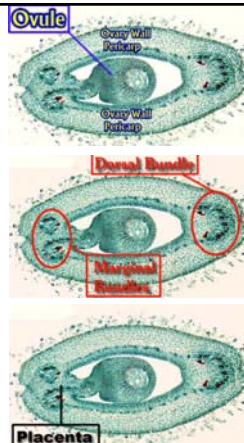
Marginal Placentation

- This Diagram is similar to the single Carpel of a Legume Gynoecium.
- Transparent Model of a Legume Carpel with Marginal Placentation



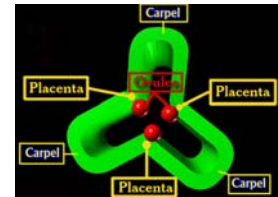
Marginal Placentation

- Cross Section of a Legume Carpel showing the Ovule and Pericarp
- Cross Section of a Legume Carpel showing the Vascular Bundles
- Cross Section of a Legume Carpel showing the location of the Placenta



Parietal Placentation

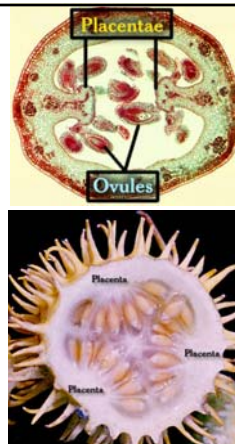
- If two or more Carpels are fused at their Margins such that a Single Locule is created, the Placentae are generally located at the Sutures. This is called Parietal.
- The areas of the Placentae may be enlarged and appear to divide the Locule into Partitions. This resembles Axile Placentation but it is still Parietal.



Model of A Syncarpous Gynoecium with Parietal Placentation.

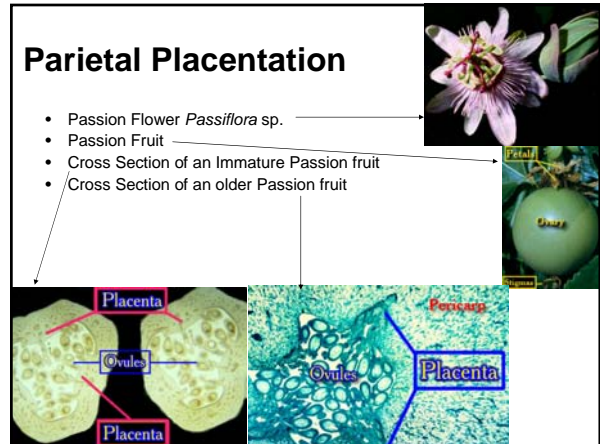
Parietal Placentation

- Cross Section through an Ovary with Parietal Placentation
- Wild Cucumber with Parietal Placentation: The Placental areas have enlarged and create the illusion of a partitioned locule.



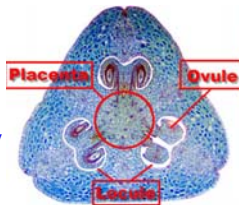
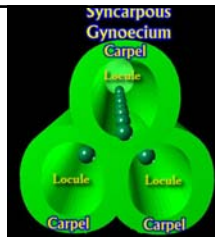
Parietal Placentation

- Passion Flower *Passiflora* sp.
- Passion Fruit
- Cross Section of an Immature Passion fruit
- Cross Section of an older Passion fruit



Axile Placentation

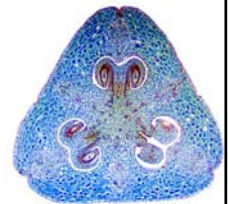
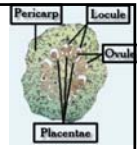
- Axile Placentation occurs when the Ovules of a Syncarpous Gynoecium are attached to a Central Axial Structure and the Ovary is divided into two or more chambers (Locules).



Cross Section of a Lily Ovary which has Axial Placentation with 3 Carpels & 3 Locules.

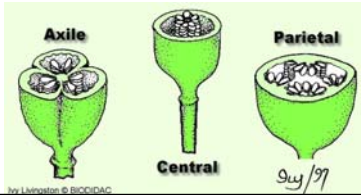
Axile Placentation

- Axile Placentation occurs when the Ovules of a Syncarpous Gynoecium are attached to a Central Axial Structure and the Ovary is divided into two or more chambers (Locules).



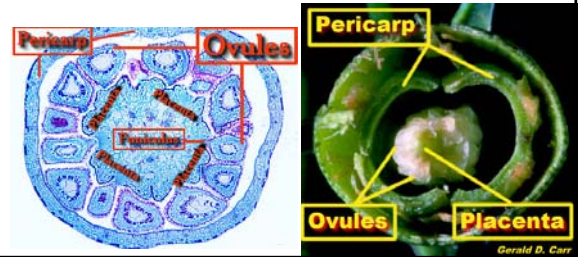
Central Placentation

- Central Placentation is similar to Axile except that there is only One Locule. The Ovules are attached to a central pillar of tissue but there is only one Locule.



Central Placentation

- Cross Sections of an Ovary with Central Placentation



Types of Placentations

