

Topic 13: **Angiosperms: Flowers, Inflorescences, and Fruits**

**A. Flower and Inflorescence Structure**

Angiosperms are also known as the Flowering Plants. They have flowers. Flowers are often arranged into group structures called inflorescences.

**A1. The flower**

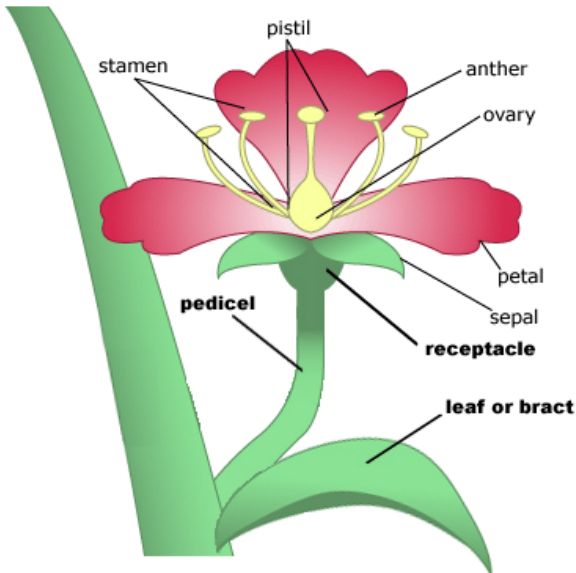


Fig. 1. Basics of flower structure and position.

**The Perianth.** Sepals are the leafy organs that comprise the outermost whorl called the calyx. The petals are the leafy organs that comprise the next whorl in, the corolla. Collectively, sepals and petals comprise the perianth. The perianth is sterile (i.e., non-fertile) in that they do not bear sporangia, seeds or pollen.

Sometimes, the sepals are not very sepal-like (i.e., are not green, but rather colored and textured like the petals). In this case, some botanists refer to these not as sepals or petals, but as tepals. This is common in monocots, for example (see Figure 2 below).

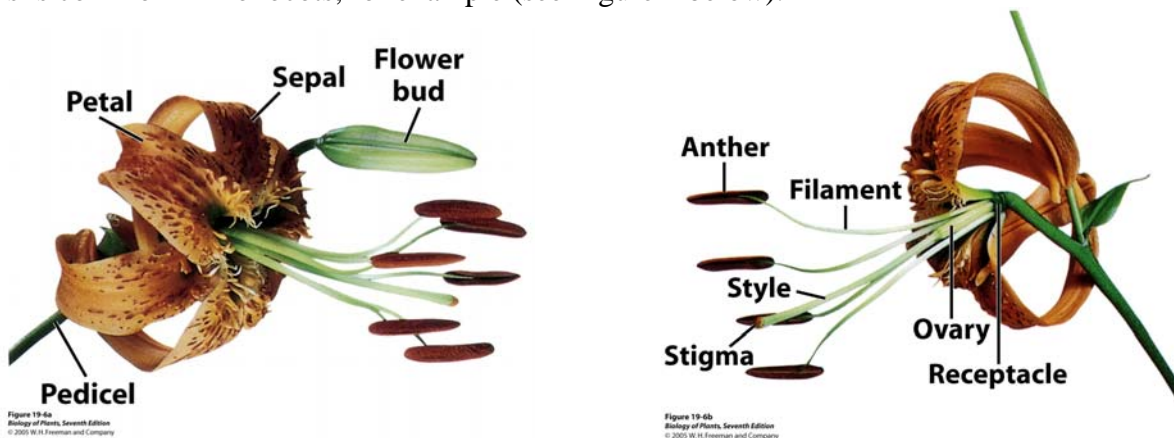


Fig. 2. Flower structure and morphology in a lily. Perianth of right flower partially dissected to expose ovary and receptacle. Contrast the morphology of the outer whorl sepals here with those in Figure 1.

**Androecium.** The first fertile whorl is the androecium (with male function) and is made up of stamens. Each stamen is comprised of filament and anther. Pollen is made in the anther (the anther typically has four sporangia or, more specifically, microsporangia, in which first the microspores.

**Gynoecium.** The second, last, and innermost fertile whorl is the gynoecium which is made up of one or more carpels. Carpels are the modified leaves that make up what we call in common language the pistil. There can be more than one pistil per flower. Pistils are often differentiated into ovary, style, and stigma. Ovaries contain the ovules. The placentation (attachment) of these ovules varies with the species (Fig. 3). Ovules will develop into seeds and the ovary will develop into a fruit. Because fruits are derived from ovaries, the placentation of seeds in fruit will be the same as the placentation of ovules in the unripened ovary.

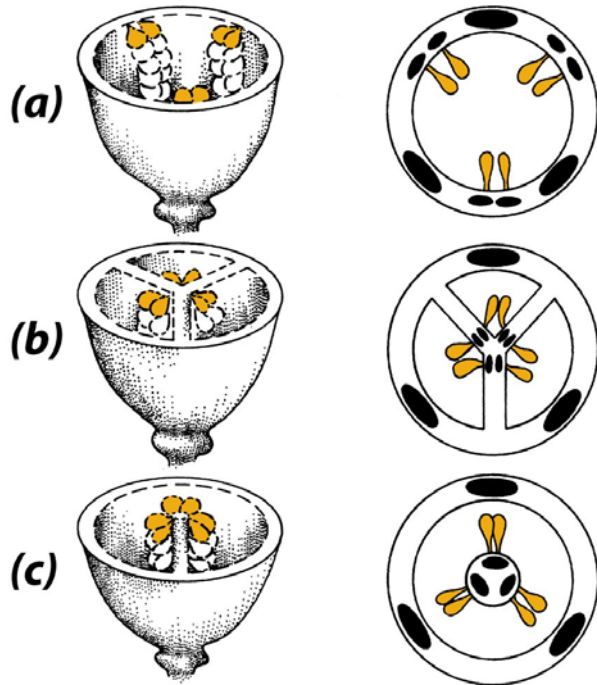


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Fig. 3. Placentation types. Cross-sections through ovaries. A, parietal placentation. B, axile placentation. C, free-central placentation.

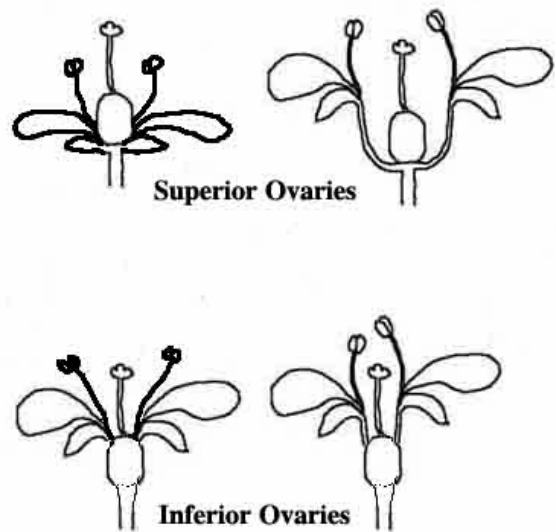


Fig. 4. Ovary position can vary. Superior ovaries sit atop the receptacle to which all other floral organs are inserted. Inferior ovaries sit below the insertion of the other floral organs, and appears to be embedded in the receptacle.

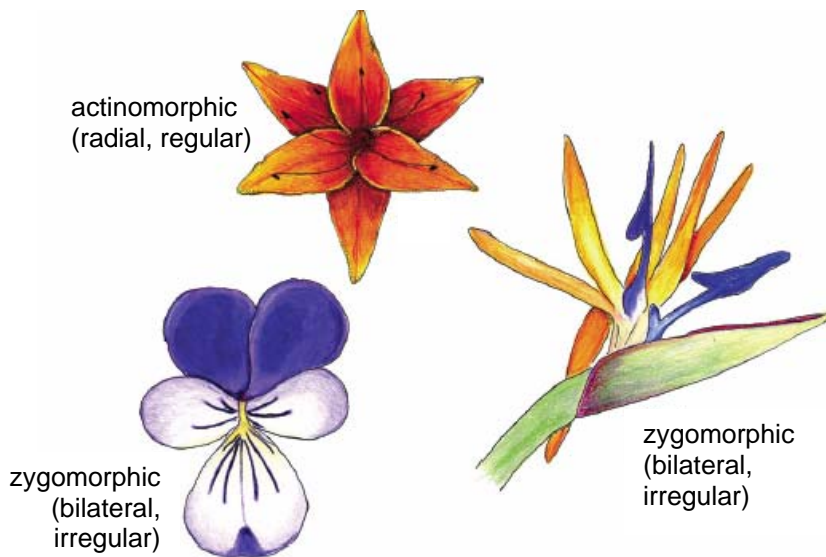


Fig. 5. Floral symmetry varies with the species (illustrations by Jess Landis '08).

## A2. Flower exercise

We will look at flowers typical of the three major groups of angiosperms: (1) the primitive dicots, from which all other angiosperms evolved, (2) the monocots, which evolved from a lineage of the primitive dicots, and (3) the advanced dicots (or eudicots), which evolved from another branch of primitive dicots.

The basic distinctions among these three groups are summarized below:

	<b>Primitive Dicots</b>	<b>Monocots</b>	<b>Eudicots</b>
<b>Cotyledons</b>	2	1	2
<b>Leaf venation</b>	reticulate (pinnate or palmate)	parallel	reticulate (pinnate or palmate)
<b>Floral parts</b>	variable (often numerous) to parts in 3's	in multiples of 3's	in multiples of 4's and 5's
<b>Sepal/Petal differentiation</b>	poor to lacking	poor to lacking	strong (i.e., sepals green, petals otherwise colored)
<b>Stamen differentiation into filament and anther</b>	usually poor	good	good
<b>Fusion of parts (e.g., perianth parts)</b>	lacking (i.e., all free)	typically lacking	variable, but many with fused parts.
<b>Receptacle Length</b>	elongate	short and compact	short and compact

Magnolia Flowers: (if there are still magnolia flowers available)

*How many sepals and petals? Or how many tepals?*

*Are the sepals and petals differentiated from one another? What color are they?*

*How many stamens are there? What is the morphology of the stamens?*

*How many pistils are there*

*Make a longitudinal median section through the flower and look at the receptacle and the attachments of all the organs. This will give you a good view of the number of carpels/pistils. Use a dissecting scope. Diagram this.*

*What is the shape or length of the receptacle?*

*Which of the aforementioned three major groups of angiosperms might this species belong to?*

Lily Family flowers (e.g., *Ornithogalum* or star-of-Bethlehem lily):

*How many sepals and petals?*

*Are the sepals and petals differentiated from one another? What color are they?*

*How many stamens are there?*

*How many pistils are there?*

*Is the ovary superior or inferior?*

*With the aid of a dissecting scope, transversely section the ovary, count the number of locules and determine the number of carpels this flower has.*

*Can you see the ovules inside the ovary? What do they look like?*

*Diagram a higher magnification of the pistil/ovary in cross-section.*

*Identify and label the carpels and the rows of ovules attached to each.*

*Which of the aforementioned three major groups of angiosperms might this species belong to?*

Buttercup Family flowers (e.g., *Ranunculus*):

*How many sepals and petals?*

*Are the sepals and petals differentiated from one another? What color are they?*

*How many stamens are there?*

*How many pistils are there?*

*Is the ovary(s) superior or inferior?*

*Make a longitudinal median section through the flower and look at the receptacle and the attachments of all the organs. This will give you a good view of the number of carpels/pistils. Use a dissecting scope. Diagram this.*

*Which of the aforementioned three major groups of angiosperms might this species belong to?*

Additional flowers (if available):

Flower species' name: \_\_\_\_\_

*How many sepals and petals?*

*Are the sepals and petals differentiated from one another? What color are they?*

*How many stamens are there?*

*How many pistils are there?*

*Is the ovary(s) superior or inferior?*

*Which of the aforementioned three major groups of angiosperms might this species belong to?*

Flower species' name: \_\_\_\_\_

*How many sepals and petals?*

*Are the sepals and petals differentiated from one another? What color are they?*

*How many stamens are there?*

*How many pistils are there?*

*Is the ovary(s) superior or inferior?*

*Which of the aforementioned three major groups of angiosperms might this species belong to?*

Flower species' name: \_\_\_\_\_

*How many sepals and petals?*

*Are the sepals and petals differentiated from one another? What color are they?*

*How many stamens are there?*

*How many pistils are there?*

*Is the ovary(s) superior or inferior?*

*Which of the aforementioned three major groups of angiosperms might this species belong to?*

Flower species' name: \_\_\_\_\_

*How many sepals and petals?*

*Are the sepals and petals differentiated from one another? What color are they?*

*How many stamens are there?*

*How many pistils are there?*

*Is the ovary(s) superior or inferior?*

*Which of the aforementioned three major groups of angiosperms might this species belong to?*

### A3. The inflorescence

A flower may be borne solitarily or in clusters or groups called INFLORESCENCES. Either each flower or the entire inflorescence, or both, may be subtended by one or more leaves, which if modified in shape, size, or appearance is (are) called BRACT(S).

Developmentally, subtending bracts (and leaves) and flowers are related because the flower is technically an axillary shoot (i.e., a branch), and branch buds always are produced above leaves.

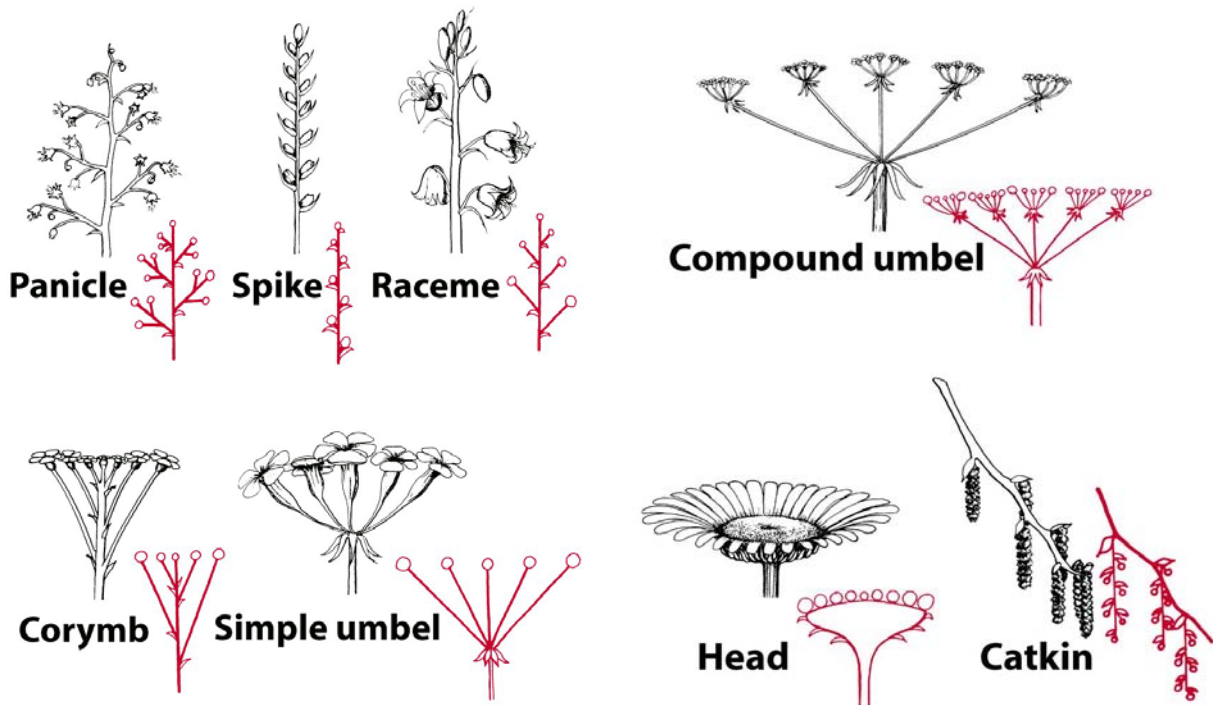


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Figure 19-7 part 2  
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Fig. 6. Some types of inflorescences.

INSTRUCTOR'S CHOICE: Review the inflorescences on the lab bench or at the back of the room. The plants are chosen because their inflorescence type characterizes the plant family to which they belong.

Plant Family Name: \_\_\_\_\_

Infl. Type: \_\_\_\_\_

Plant Family Name: \_\_\_\_\_

Infl. Type: \_\_\_\_\_

Plant Family Name: \_\_\_\_\_

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Plant Family Name: \_\_\_\_\_

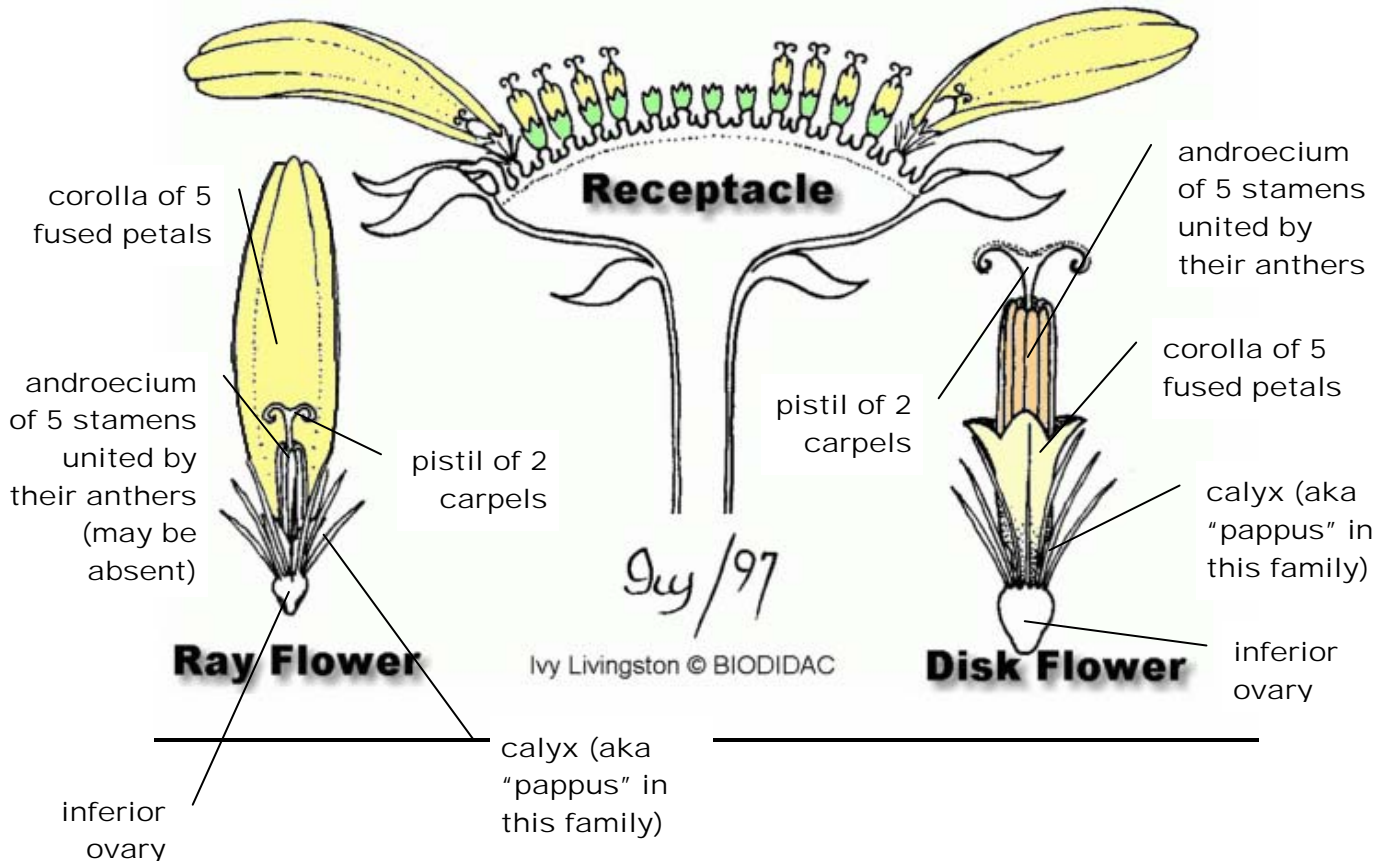
Infl. Type: \_\_\_\_\_

**Focus on Asteraceae Inflorescences:**  
**The Head**

The apparent “flower” of a sunflower or any of its relatives in the same family Asteraceae is actually a composite of many small flowers.

In a typical radiate head such as the sunflower, disk flowers in the center are surrounded by ray flowers around the periphery (see below).

Some heads have only disk-like flowers, and these are called discoïd or disciform heads. Other heads have only ray-like flowers and these are called ligulate heads.







*Is the head pictured above a radiate head or is a discoid, disciform, or ligulate head?*

*Label one or more bracts that “subtend” each flower.*

*Label one or more of the ovaries. Are the ovaries inferior or superior?*

*Label the pistil.*

*Label of the “receptacle” of the inflorescence.*

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*Make a study of each of the other sunflower family representatives in lab today.*



## B. Fruits

Angiosperms not only have flowers, but also fruits.

A fruit develops from the ovary, after pollination and fertilization has been achieved.

Thus, the ovary wall becomes the fruit wall and flesh, the ovules of the ovary become the seeds.

Thus, the ovary (fruit) wall is the vessel that contains the ovules (seeds). In fact, *angios* is derived from Greek for “vessel”, and *sperma* is derived from Greek for “seed”.

The wall of the fruit is called the pericarp. Sometimes the pericarp is differentiated into an exocarp (the outer portion of the fruit wall), a mesocarp (the inner portion of the fruit wall), and an endocarp (the innermost portion of the fruit wall).

Various fruits are available for you to look at. *Using the posters on the wall and the fruit hierarchical classification provided in the back of this lab manual, identify the types (classes) of fruit represented by the following:*

Fruit Species Name	Is this fruit dry or fleshy at maturity?	Is the fruit dehiscent or indehiscent?	Is the fruit a simple, aggregate, or multiple fruit?	Specific Fruit Type

### **C. INSTRUCTOR's choice: Some Important Angiosperm Families**

Here are some important angiosperm families. Compare and contrast them based on the material at hand.

#### Dicots

1. Pea & Bean family (Fabaceae or Leguminosae)
2. Maple family (Aceraceae)
3. Oak, Beech, & Chestnut family (Fagaceae)
4. Sunflower, Aster, or Composite family (Asteraceae or Compositae)

#### Monocots

5. Orchid family (Orchidaceae)
6. Palm family (Arecaceae or Palmae)
7. Grass family (Poaceae or Gramineae)

## A Classification of Common Fruit Types

- I. SIMPLE FRUIT—develops from the single ovary of one flower.
  - A. SIMPLE DRY FRUIT—pericarp becomes leathery, papery, or woody.
    - 1. DEHISCENT—opens when ripe.
      - a. FOLLICLE—develops from a simple pistil, opens along one side only.
      - b. LEGUME—from a simple pistil, opens along two sides.
      - c. CAPSULE—from a compound pistil (i.e., one with two or more carpels). Opens in a variety of ways.
      - d. SILIQUE—from a single pistil, the lateral walls of the flattened fruit opening, leaving behind the seeds attached to a persistent, free-standing partition. Members of the mustard family.
    - 2. INDEHISCENT—fruit does not open at maturity.
      - a. ACHENE—small, one-seeded; seed coat free from pericarp (e.g., dandelion).
      - b. GRAIN or CARYOPSIS—seed coat is fused with pericarp. Members of grass family.
      - c. SAMARA—usually one-seeded, has a wing formed by an extension of the ovary wall.
      - d. SCHIZOCARP—fruit breaks into 1-carpellate seeded units with the seeds inside.
      - d. NUT—a rather large, hard-walled, 1-2-seeded fruit. Bracts usually wholly or partially enclose the hard pericarp.
  - B. SIMPLE FLESHY FRUIT—a portion or all of the pericarp is fleshy at maturity.
    - 1. BERRY—entire pericarp fleshy.
      - a. “HESPERIDIUM”—a special type of berry in which the pericarp is leathery, and the inner wall of the carpels has extra-plump and juicy trichomes. Characteristic of one very important genus from the Mediterranean!
      - b. “PEPO”—a special type of berry in which the pericarp is thick, forming a “rind”. Characteristic of one very important family!
    - 2. DRUPE—pericarp divided into three parts: outer EXOCARP (the “skin”), middle MESOCARP (usually fleshy), and inner ENDOCARP (which is stony). The stony endocarp or “pit” encloses the seed.
    - 3. SIMPLE ACCESSORY FRUIT—from only a single ovary of a single flower: fruit includes ovary wall and other floral parts or nearby structures.
      - a. POME—from an inferior ovary of some members of the rose family: where most of the flesh of the fruit is actually the receptacle and/or fused bases of the sepals, etc. Can usually see remnants of sepals and, in some cases, stamens atop the fruit.
- II. AGGREGATE FRUIT—develops from a number of separate ovaries of one flower. The component fruit-probers are called “fruitlets”.
  - A. SIMPLE AGGREGATE FRUIT—simple fruits from multiple pistils of one flower are loosely aggregated together and, together, separate from the dry receptacle.
  - B. AGGREGATE ACCESSORY FRUIT—receptacle is incorporated into the “fruit”.
- III. MULTIPLE FRUIT—develops from a number of individual ovaries of flowers grouped closely together in an inflorescence. A fruit is produced from each flower, and these fruits remain together (or even fuse) in a single mass. Often, even the bracts subtending the individual flowers are incorporated into the “fruit”!