University of Al-Mustansiriyah/
College of Science/ Department of Biology
Course : Botany
Lecture: 7

Flowers, Fruits, and Seeds

The flowers range in size from 0.5 millimeter to1 meter in Rafflesia flowers (Fig. 8.2A). Flowers may be any color or combination of colors of the rainbow, as well as black or white; they may have virtually any texture, from filmy and transparent to thick and leathery, spongy to sticky, hairy, prickly, or even dewy wet to the touch. Flowers of many trees, shrubs, and garden weeds are quite inconspicuous and lack odor (Fig. 8.3). Flowering plants have been placed in two major classes, the *Magnoliopsida* and *Liliopsida,* previously known as the *Dicotyledonae* and the *Monocotyledonae.* Despite the revised class names, the two groups are still commonly referred to as **dicots** and **monocots.**

STRUCTURE OF FLOWERS

Regardless of form, all flowers share certain basic features. A typical flower develops several different parts, each with its own function (Fig. 8.5). Each flower, occurs as a specialized branch at the tip of a stalk called a **peduncle,** which may in some instances have branchlets of smaller stalks called **pedicels.** A peduncle or pedicel swells at its tip into a small pad known as a **receptacle.** The other parts of the flower, some of which are in *whorls***,** are attached to the receptacle .

The outermost whorl typically consists of three to five small, usually green, somewhat leaflike **sepals.** The sepals of a flower, which are collectively referred to as the **calyx,** protects the flower while it is in the bud. The next whorl of flower parts consists of three to many **petals;** the petals collectively are known as the **corolla.** Showy corollas attract pollinators, such as bees, moths, or Birds. The petals are distinct separate units in peach flowers, but in some flowers (e.g., petunias), the petals are fused together into a single, flared, trumpetlike sheet of tissue (Fig. 8.6). The corolla may not be showy or conspicuous in many tree and weed species and is often missing altogether or highly modified in windpollinated plants such as grasses. The calyx and the corolla together are referred to as the **perianth** Several to many **stamens** are attached to the receptacle around the base of the often greenish **pistil** in the center of the flower. Each stamen consists of a semi-rigid but otherwise usually slender **filament** with a sac called an **anther** at the top. In most flowers, the pollen is released through lengthwise slits that develop on the anthers, but in members of the Heath Family (Ericaceae) and those of a few other groups, the pollen is released through anther pores.

At the top is the **stigma,** which is usually connected by a slender, stalklike **style** to the swollen base called the **ovary**.

The ovary later develops into a *fruit.* There is evidence that ovaries first developed when the margins of leaves bearing ovules rolled inward. Such ovulebearing leaves were called **carpels.** The ovary is said to be **superior** if the calyx and corolla are attached to the receptacle at the base of the ovary, as in pea and primrose flowers. In other instances, the ovary becomes **inferior** when the receptacle grows up around it so that the calyx and corolla appear to be attached at the top, as in cactus and carrot flowers. A cavity containing one or more egg-shaped **ovules** lies within the ovary; ovules are attached to the wall of the cavity by means of short stalks. An ovule, the development of which takes place after *fertilization* has occurred, eventually becomes a **seed.**

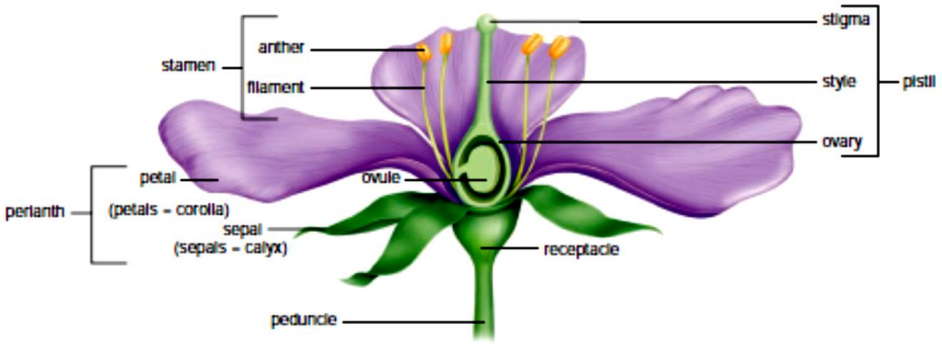


Figure 8.5 Parts of a generalized flower. The interior structure of the ovule and the sexual processes involved are discussed in Chapter 23.

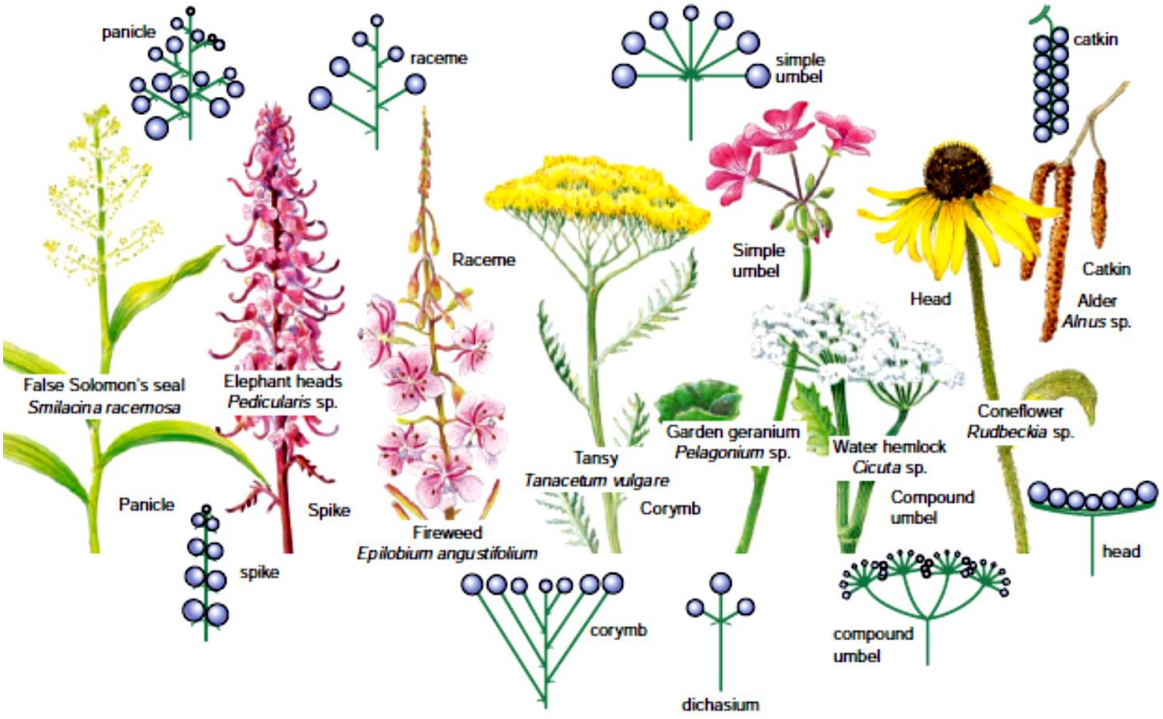


Figure 8.7 Inflorescence types. Each ball represents a flower. In all inflorescences shown, except for the dichasium and catkin, the lowermost or outermost flowers open first. The flowers then open in succession upward or inward. In a dichasium, the central flower opens first, and the side flowers open simultaneously. In a catkin, all the flowers open simultaneously.

FRUITS

a **fruit** is any ovary and its accessory parts that has developed and matured. It also usually contains seeds. By this definition, many so-called vegetables, including tomatoes, string beans, cucumbers, and squashes, are really fruits. On the other hand, vegetables can consist of leaves (e.g., lettuce, cabbage), leaf petioles (e.g., celery), specialized leaves (e.g., onion), stems (e.g., white potato), roots (e.g., sweet potato), stems and roots (e.g., beets), flowers and their peduncles (e.g., broccoli), flower buds (e.g., globe artichoke), or other parts of the plant. All fruits develop from flower ovaries and accordingly are found exclusively in the flowering plants.

Fruit Regions

Most of a mature fruit has three regions . The skin forms the **exocarp,** while the inner boundary around the seed(s) forms the **endocarp.** The endocarp may be hard and stony (as in a peach pit around the seed). It also may be papery (as in apples), or it may not be distinct from the **mesocarp,** which is the often fleshy tissue between the exocarp and the endocarp. The three regions collectively are called the **pericarp.**

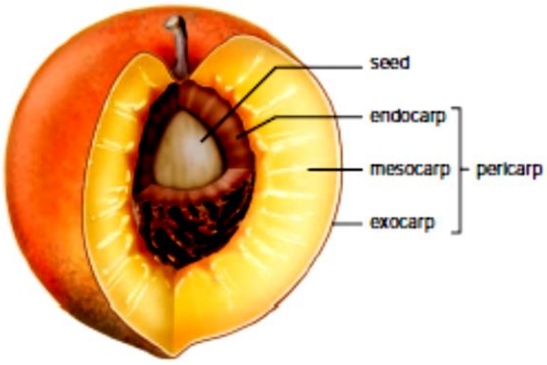


Figure 8.8 Regions of a mature peach fruit.

Kinds of Fruits

1. Fleshy Fruits

Fruits whose mesocarp is at least partly fleshy at maturity are classified as fleshy fruits.

Simple fleshy fruits develop from a flower with a single pistil. The ovary may be superior or inferior, and it may be *simple* (derived from a single modified leaf called a **carpel**), or it may consist of two or more carpels and be *compound* . The ovary alone may develop into the fruit, or other parts of the flower may develop with it.

A. A **drupe** is a simple fleshy fruit with a single seed enclosed by a hard, stony endocarp, or pit (Fig. 8.9). It usually develops from flowers with a superior ovary containing a single ovule. For examples of drupes include the stone fruits (e.g., apricots, cherries, peaches, plums, olives, and almonds).

B. **Berries** usually develop from a compound ovary and commonly contain more than one seed. The entire pericarp is fleshy, and it is difficult to distinguish between the mesocarp and the endocarp (Fig. 8.10). Three types of berries may be recognized.

1- **A *true berry*** is a fruit with a thin skin and a pericarp that is relatively soft at maturity. Although most contain more than one seed. Typical examples of true berries include tomatoes, grapes, persimmons, peppers, and eggplants.

2- ***Pepos*** are berries with relatively thick rinds. Fruits of members of the Pumpkin Family (Cucurbitaceae), including pumpkins, cucumbers are pepos.

3- The ***hesperidium*** is a berry with a leathery skin containing oils. Numerous outgrowths from the inner lining of the ovary wall become saclike and swollen with juice as the fruit develops. All members of the Citrus Family (Rutaceae) produce this type of fruit. Examples include oranges, lemons.

C. **Pomes** are simple fleshy fruits, the bulk of whose flesh comes from the enlarged floral tube or receptacle that grows up around the ovary. The endocarp around the seeds is papery or leathery. Examples include apples, pears. Botany texts often refer to pomes, pepos, some berries, and other fruits derived from more than an ovary alone as *accessory fruits* or as fruits having *accessory tissue.*

2. Dry Fruits

Fruits whose mesocarp is definitely dry at maturity are classified as *dry fruits.*

A. **Dry Fruits That Split at Maturity (Dehiscent Fruits)** The fruits in this group are distinguished from one another by the way they split. The **follicle** splits along one side or seam (*suture*) only, exposing the seeds within (Fig. 8.12). Examples include larkspur, columbine, milkweed, and peony.

1- The **legume** splits along two sides or seams (Fig. 8.13). Legume Family (Fabaceae) produce this type of fruit. Examples include peas, beans. The seeds are usually released in nature by bacterial breakdown of the pericarp instead of through an active splitting action.

2- **Siliques** also split along two sides or seams, but the seeds are borne on a central partition, which is exposed when the two halves of the fruit separate (Fig. 8.14A). Such fruits, when they are less than three times as long as they are wide, are called *silicles* (Fig. 8.14B). Siliques and silicles are produced by members of the Mustard Family (Brassicaceae), which includes broccoli, cabbage, radish.

3- **Capsules:** the dry fruits consist of at least two carpels and split in a variety of ways. Some split along the partitions between the carpels, while others split through the cavities (*locules*) in the carpels. Still others form a cap toward one end that pops off and releases the seeds, or they form a row of pores through which the seeds are shaken out as the capsule rattles in the wind. Examples include orchids, lilies.

B. **Dry Fruits That Do Not Split at Maturity (Indehiscent Fruits)**

In this type of dry fruit, the single seed is united with the pericarp.

1- Only the base of the single seed of the **achene** is attached to its surrounding pericarp. Accordingly, the husk (pericarp) is relatively easily separated from the seed. Examples : sunflower "seeds" (Fig. 8.16), buttercup, and buckwheat.

2- **Nuts** are one-seeded fruits similar to achenes, but they are generally larger, and the pericarp is much harder and thicker. They develop with a cup, or cluster, of bracts at their base. Examples include acorns (Fig. 8.16), hazelnuts (filberts), and hickory nuts.

3- The pericarp of the **grain** (**caryopsis;** plural: **caryopses**) is tightly united with the seed and cannot be separated from it (Fig. 8.16). All members of the Grass Family (Poaceae), including corn, wheat, rice, oats, and barley, produce grains.

4- In **samaras,** the pericarp surrounding the seed extends out in the form of a wing or membrane, which aids in dispersal (Fig. 8.17). In maples, samaras are produced in pairs, but in ashes, elms, and the tree of heaven, they are produced singly.

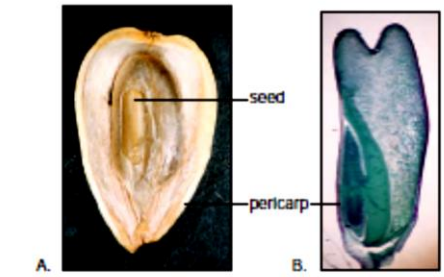
5- The twin fruit called a **schizocarp** (Fig. 8.18) is unique to the Parsley Family (Apiaceae). Members of this family include parsley, carrots, anise, caraway, and dill. Upon drying, the twin fruits break into two one-seeded segments called *mericarps.*

3. Aggregate Fruits

An **aggregate fruit** is one that is derived from a single flower with several to many pistils. The individual pistils develop into tiny drupes or other fruitlets, but they mature as a clustered unit on a single receptacle (Fig. 8.19). Examples include raspberries, blackberries, and strawberries. In

4. Multiple Fruits

Multiple fruits are derived from several to many individual flowers in a single inflorescence. Each flower has its own receptacle, but as the flowers mature separately into fruitlets, they develop together into a single larger fruit, as in aggregate fruits. Examples of multiple fruits include mulberries, Osage oranges (Fig. 8.20), pineapples, and figs. Pineapples, like bananas, usually develop parthenocarpically , and there are no seeds.



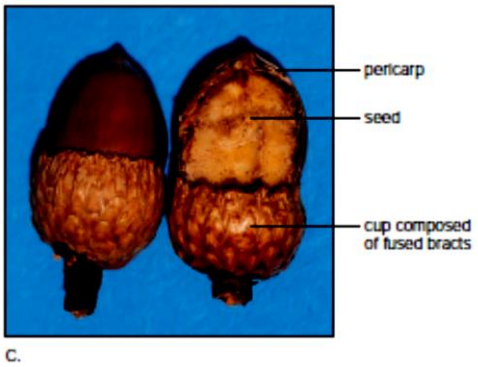


Figure 8.16 Dry fruits that do not split at maturity. *A.* Achene of a sunflower sliced open. *B.* Grain (caryopsis) of corn, cut lengthwise. *C.* Nuts (acorns) of an oak. The acorn on the right was cut lengthwise above the cup.

Figure 8.18 Schizocarps of carrots. A schizocarp separates at maturity into two one-seeded fruitlets.

SEEDS

Seed Structure

The concave side of an ordinary kidney bean (a dicot) has a small white scar called the ***hilum***. The hilum marks the point at which the ovule was attached to the ovary wall. A tiny pore called the ***micropyle*** is located right next to the hilum. If this bean is placed in water for an hour or two, it may swell enough to split the seed coat. Once the seed coat is removed, the two halves, called **cotyledons,** can be distinguished (Fig. 8.28).

The cotyledons are food-storage organs that also function as the first "seed leaves" of the seedling plant. The cotyledons, and the tiny, rudimentary bean plant to which they are attached, constitute **the *embryo***. Some seeds (e.g., those of grasses and all other monocots) have only one cotyledon. The tiny embryo plantlet has undeveloped leaves and a meristem at the upper end of the embryo axis. This embryo shoot is called a **plumule.**

The cotyledons are attached just below the plumule. The very short part of the stem above the cotyledons is called the **epicotyl,** while the stem below the attachment point is the **hypocotyl.** The tip that will develop into a root is called a **radicle.**

In other seeds, the cotyledon(s) may not play a significant role in food storage. In corn, for example, the bulk of the food-storage tissue is ***endosperm***. Corn "seeds" (Fig. 8.29) also display other features not seen in beans. The plumule and the radicle are enclosed in tubular, sheathing structures called the **coleoptile** and the **coleorhiza,** respectively. These protect the delicate tissues within as the seeds germinate.

Dispersal of seed

seeds are transported from one place to another is the subject of the following sections.

1- Dispersal by Wind

In hop hornbeams, the seed is enclosed in an **inflated sac** that gives it some buoyancy in the wind. In some members of Sunflower Families (Asteraceae), the fruits have **plumes**, and in the Willow Family (Salicaceae), the fruits are surrounded by **cottony or woolly hairs** that aid

in wind dispersal. In button snakerootsand Jerusalem sage, the fruits are too large to be airborne, but they are **spherical** enough to be rolled along the ground by the wind. Seeds themselves may be so tiny and light that they can be blown great distances by the wind. In catalpa and jacaranda trees, the seeds themselves are **winged**. Dandelion fruitlets have plumes that radiate out at the ends like tiny **parachutes**.

2- Dispersal by Animals

Birds, mammals, and ants all act as disseminating agents (Fig. 8.23). Shore birds may carry seeds great distances in mud that adheres to their feet. Other birds and mammals eat fruits whose seeds pass unharmed through their **digestive tracts**.

Many fruits and seeds catch in or adhere to the fur or feathers of animals and birds or covered with **small hooks** that catch in fur. Flax have fruits with **sticky appendages** that adhere to fur on contact. Bleeding hearts, trilliums, and several dozen other plants have on their seeds **appendages that contain oils** attractive to ants (Fig. 8.25).

3- Dispersal by Water

Many sedges have seeds surrounded by **inflated sacs** that enable the seeds to float (Fig. 8.26). Others have **waxy material** on the surface of the seeds, which temporarily prevents them from absorbing water while they are floating. Large raindrops themselves may splash seeds out of their opened capsules. Enough fruits are beached before this occurs to ensure the survival of the species.

4- Other Dispersal Mechanisms and Agents

Fruits of some legumes **mechanically eject seeds**. For example, the splitting action of drying witch hazel capsules may fling the seeds over 12 meters (40 feet) away. In manroots and a few other members of the Pumpkin Family (Cucurbitaceae), the seed release resembles a geyser eruption as a frothy substance containing the seeds squirts out of one end of the melonlike fruits. Humans are by far the most efficient transporters of fruits and seeds.

Figure 8.22 Types of seeds and fruits dispersed by wind.