



PLANT ORGANS - FLOWERS AND FRUITS

FLOWER

- A flower is the **reproductive structure** found in flowering plants. The biological function of a flower is to provide **reproduction**, a mechanism for the **union of sperm with eggs**. Flowers give rise to fruit and seeds.



FLORAL PARTS

- The essential parts of a flower can be considered in two parts: **the vegetative part**, consisting of **petals** and associated structures in the **perianth**, and the reproductive or sexual parts.
- A stereotypical flower consists of **four kinds of structures attached to the tip of a short stalk**. Each of these kinds of parts is arranged in a whorl on the **receptacle**.



THE FOUR MAIN WHORLS ARE AS FOLLOWS:

- Vegetative (Perianth)
- 1. Calyx and 2. Corolla form the perianth.

1. Calyx: the outermost whorl consisting of units called sepals; these are typically green and enclose the rest of the flower in the bud stage, however, they can be absent or prominent and petal-like in some species.

2. Corolla: the next whorl toward the apex, composed of units called petals, which are typically thin, soft and colored to attract animals that help the process of pollination.

REPRODUCTIVE

- 3. Androecium: the next whorl (sometimes multiplied into several whorls), consisting of units called **stamens**. Stamens consist of two parts: a stalk called a **filament**, topped by an **anther** where pollen is produced by meiosis and eventually dispersed.
- 4. Gynoecium: The gynoecium, innermost whorl (consisting of an ovary, style and stigma) is called a **pistil** and is composed of one or more units called **carpels**. The carpel or multiple fused carpels form a hollow structure called **an ovary, which produces ovules internally**. Ovules are megasporangia and they in turn produce megaspores by meiosis which develop into female gametophytes. These give rise to egg cells.
- The sticky tip of the pistil, the **stigma**, is the receptor of pollen. The supportive stalk, the **style**, becomes the pathway for pollen tubes to grow from pollen grains adhering to the stigma. The relationship to the gynoecium on the receptacle is described as **hypogynous** (beneath a **superior** ovary), **perigynous** (surrounding a superior ovary), or **epigynous** (above inferior ovary).

Inflorescence: It is actually an inflorescence of tiny flowers pressed together on a central stalk that is surrounded by a large petal-like bract.



FRUIT

- A fruit results from maturation of one or more flowers, and the gynoecium of the flower(s) forms all or part of the fruit.
- Inside the ovary/ovaries are one or more ovules where the megagametophyte contains the egg cell. After double fertilization, these ovules will become seeds. The ovules are fertilized in a process that starts with pollination, which involves the movement of pollen from the stamens to the stigma of flowers.



- After pollination, a tube grows from the pollen through the stigma into the ovary to the ovule and two **sperms are transferred from the pollen to the megagametophyte**. Within the megagametophyte one of the two sperm unites with the egg, forming a zygote, and the second sperm enters the central cell forming the endosperm mother cell, which completes the double fertilization process. Later the **zygote will give rise to the embryo of the seed**, and the **endosperm** mother cell will give rise to endosperm, **a nutritive tissue used by the embryo**.



THERE ARE THREE GENERAL MODES OF FRUIT DEVELOPMENT:

- **Apocarpous fruits** develop from a single flower having one or more separate carpels, and they are the simplest fruits.
- **Syncarpous fruits** develop from a single gynoecium having two or more carpels fused together.
- **Multiple fruits** form from many different flowers.



SIMPLE FRUIT

- Simple fruits can be either dry or fleshy, and result from the ripening of a simple or compound ovary in a flower with only one pistil. Dry fruits may be either dehiscent (opening to discharge seeds), or indehiscent (not opening to discharge seeds).



TYPES OF DRY, SIMPLE FRUITS, WITH EXAMPLES OF EACH, ARE:

- **achene** - Most commonly seen in aggregate fruits (e.g. strawberry)
- **capsule** - (Brazil nut)
- **caryopsis** - (wheat)
- **Cypsela** - An achene-like fruit derived from the individual florets in a capitulum (e.g. dandelion).
- **fibrous drupe** - (coconut, walnut)
- **follicle** - is formed from a single carpel, and opens by one suture (e.g. milkweed). More commonly seen in aggregate fruits (e.g. magnolia)
- **legume** - (pea, bean, peanut)
- **loment** - a type of indehiscent legume
- **nut** - (hazelnut, beech, oak acorn)
- **samara** - (elm, ash, maple key)
- **schizocarp** - (carrot seed)
- **silique** - (radish seed)
- **silicle** - (shepherd's purse)



Types of FLESHY, simple fruits (with examples of each):

- Fruits in which part or all of the **pericarp (fruit wall)** is fleshy at maturity are **simple fleshy fruits**.
- **berry** - (redcurrant, gooseberry, tomato, cranberry)
- **stone fruit or drupe** (plum, cherry, peach, apricot, olive)



- An aggregate fruit develops from a single flower with numerous simple pistils.
- Schizocarp fruits form from a syncarpous ovary and do not really dehisce, but split into segments with one or more seeds; they include a number of different forms from a wide range of families. Carrot seed (Apiaceae) is an example.



AGGREGATE FRUIT

- Aggregate fruits form from **single flowers that have multiple carpels which are not joined** together, i.e. each pistil contains one carpel.
- Four types of aggregate fruits include **achenes, follicles, drupelets, and berries**.
- The raspberry, whose pistils are termed drupelets because each is like a small drupe attached to the receptacle. In some bramble fruits (such as blackberry) the receptacle is elongated and part of the ripe fruit, making the blackberry an aggregate-accessory fruit. The strawberry is also an aggregate-accessory fruit, only one in which the seeds are contained in achenes. **In all these examples, the fruit develops from a single flower with numerous pistils.**



MULTIPLE FRUITS

- A multiple fruit is one formed from a cluster of flowers (called an inflorescence). Each flower produces a fruit, but these mature into a single mass. Examples are the pineapple, fig, mulberry.
- After fertilization, each flower develops into a drupe, and as the drupes expand, they become connate (merge) into a multiple fleshy fruit called a syncarp.



Berries

- Berries are another type of fleshy fruit; they are simple fruit created from a single ovary. The ovary may be compound, with several carpels.



- **Pepo** - Berries where the skin is hardened, cucurbits
- **Hesperidium** - Berries with a rind and a juicy interior, like most citrus fruit



Accessory fruit

- The fruit of a **pineapple** includes tissue from the sepals as well as the pistils of many flowers. It is an **accessory fruit** and a **multiple fruit**.
- **Accessory fruit** can be **simple**, **aggregate**, or **multiple**, i.e., they can include **one or more pistils** and **other parts from the same flower**, or the **pistils** and **other parts of many flowers**.



EXAMPLES FOR EACH GROUP:

- **True berry:** Blackcurrant, Redcurrant, Gooseberry, Tomato, Eggplant, Guava, Lucuma, Chili pepper, Pomegranate, Kiwifruit, Grape, Cranberry, Blueberry.
- **Pepo:** Pumpkin, Gourd, Cucumber, Melon.
- **Hesperidium:** Orange, Lemon, Lime, Grapefruit.
- **Aggregate fruit:** Blackberry, Raspberry, Boysenberry.
- **Multiple fruit:** Pineapple, Fig, Mulberry, Hedge apple.
- **Accessory fruit:** Pineapple, Apple, Strawberry, Stone fruit.



SEED

- A seed is an embryonic plant enclosed in a protective outer covering known as the **seed coat (=testa)**.
- It is a characteristic of spermatophytes (gymnosperm and angiosperm plants) and the product of the ripened ovule which occurs after fertilization and some growth within the mother plant. The formation of the seed completes the process of reproduction in seed plants (started with the development of flowers and pollination), with the embryo developed from the zygote and the seed coat from the integuments of the ovule.



- Seeds have been an important development in the reproduction and spread of gymnosperm and angiosperm plants, relative to more primitive plants such as **ferns** and **mosses**, which do not have seeds and use other means to propagate themselves. This can be seen by the success of seed plants (both gymnosperms and angiosperms) in dominating biological niches on land, from forests to grasslands both in hot and cold climates.
- Many structures commonly referred to as "seeds" are actually dry fruits.



OVULE

Plant ovules: Left: Gymnosperm ovule;
Right: angiosperm ovule (inside ovary)

After fertilization the ovules develop into the seeds. The ovule consists of a number of components:

The **funicle** (**funiculus**, **funiculi**) or **seed stalk** which attaches the ovule to the placenta and hence ovary or fruit wall, at the pericarp.

The nucellus, the remnant of the megasporangium and main region of the ovule where the megagametophyte develops.

The micropyle, a small pore or opening in the apex of the integument of the ovule where the pollen tube usually enters during the process of fertilization.

The chalaza, the base of the ovule opposite the micropyle, where integument and nucellus are joined together).



EMBRYO

- The main components of the embryo are:
- **The cotyledons**, the seed leaves, attached to the embryonic axis. There may be one (Monocotyledons), or two (Dicotyledons). The cotyledons are also the source of nutrients in the non-endospermic dicotyledons, in which case they replace the endosperm, and are thick and leathery. In endospermic seeds the cotyledons are thin and papery. Dicotyledons have the point of attachment opposite one another on the axis.
- **The epicotyl**, the embryonic axis above the point of attachment of the cotyledon(s).
- **The plumule**, the tip of the epicotyl, and has a feathery appearance due to the presence of young leaf primordia at the apex, and will become the shoot upon germination.
- **The hypocotyl**, the embryonic axis below the point of attachment of the cotyledon(s), connecting the epicotyle and the radicle, being the stem-root transition zone.
- **The radicle**, the basal tip of the hypocotyl, grows into the primary root.

