



ovary. The two main functions of fruit are to prevent the seeds from drying and to disperse the seed. The fruit may be either fleshy or dry.

Fleshy fruits, like the tomato or apple, hold juices that prevent the seeds from drying until they are mature. Fleshy fruits also serve to help disperse the seeds. For example, some animals are attracted to the nutritious fruit and eat the seeds along with the fleshy fruit. The seeds pass through their digestive tract and are dispersed or **disseminated** away from the parent plant. This dissemination of seed is an important evolutionary trait for the survival of the plant species.

Although dry fruits are not fat and juicy like the tomato, they do help prevent the seed from drying. Dry fruits have other means of dissemination. For instance, the dandelion has evolved a dry, feathery fruit to take advantage of the wind for dissemination.

There is great diversity of fruits. Three major divisions include simple fruits, aggregate fruits, and multiple fruits.

## SIMPLE FRUITS

**Simple fruits** are defined as having developed from a single ovary of a single pistil. Simple fruits are often classified as being fleshy or dry.

### Fleshy Fruit

Fleshy fruits are juicy. Berries, hesperidium, pepo, drupes, and pomes are categories of fleshy fruits.

A **berry** has an entirely fleshy ovary. Tomato, date, blueberry, banana, pepper, and cranberry are examples of berries.

A **hesperidium** fruit has a leathery rind. Examples include oranges, grapefruits, lemons, and limes.

A **pepo** is a type of fruit defined by a hard rind and a fleshy inner matrix. Watermelons, cantaloupe, squash, and pumpkins are pepos.

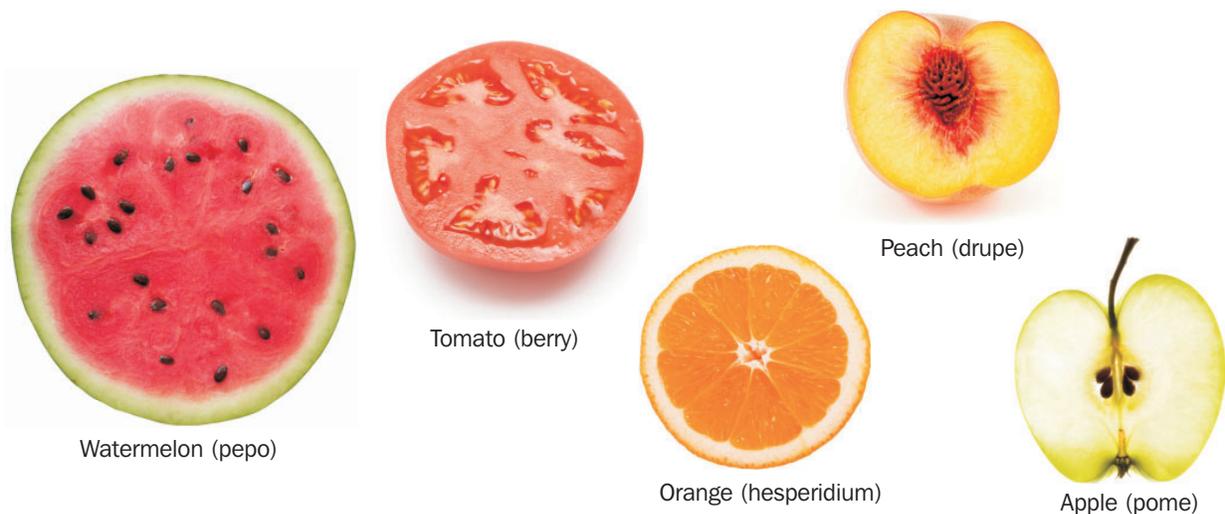


FIGURE 1. Examples of various types of fleshy fruits.

A **drupe** is a fruit with a fleshy exterior and a single hard, stony pit surrounding the seed. Cherry, peach, olive, and plum are examples of plants with drupes.

A **pome** has a fleshy exterior and a center with papery carpels. Apples and pears are pomes.

## Dry Fruit

Dry fruits may be indehiscent or dehiscent.

**Indehiscent fruits** or those that do not split open at maturity and usually contain one or two seeds. Some types of indehiscent fruits are achene, caryopsis, samara, nut, uricle, and nutlet.

An **achene** is one-sided fruit with a seed attached at only one place to the pericarp. Sunflowers and buckwheat have achene type fruit.

A **caryopsis** is similar to an achene. However, the pericarp sticks or clings to the seed. Corn, rice, barley, rye, amaranth, sorghum, oat, and wheat have caryopsis fruit.

A **samara** is usually single seeded with a membranous wing. Examples are maple, elm, and ash.

A **nut** is a hard, one-seeded fruit. Oak, walnut, filbert, and hickory produce nuts.

A **uricle** is like an achene, but the ovary wall fits loosely around the seed. Examples are finger millet and pigweed.

A **nutlet** is a small version of a nut. Birch and hornbeam are examples.

**Dehiscent fruits** are fruits that split open upon maturation. Dehiscent fruit types are legume, follicle, capsule, and pyxis.

A **legume** (pod) is composed of a single carpel and has two longitudinal sutures. Soybeans, green beans, and peas are legumes.

A **follicle** is composed of a single carpel and splits open along one suture. Milkweed fruit is a follicle.

A **capsule** is composed of more than one carpel that are united and form many-seeded fruits. The fruit of okra and cotton are capsules. Plants in the mustard family have a specialized form of capsule called a silique.

A **pyxis** is a type of capsule with a lid that falls from the fruit. An example is purslane.



FIGURE 2. Walnuts are categorized as dry fruits.



FIGURE 3. Soybean pods are also called legumes.

## AGGREGATE FRUITS

---

**Aggregate fruits** develop from a single flower that has many pistils. Multiple, usually fleshy, fruitlets are attached to one receptacle. Raspberries are an aggregate of drupes. Strawberries are an aggregate of achenes.



FIGURE 4. The raspberry is an aggregate fruit.

## MULTIPLE FRUITS

---

**Multiple fruits** consist of a number of flowers that fused to form a mass. Pineapples are considered a multiple fruit.

## PARTS OF A FRUIT

---

A plant fruit has parts with different functions. The tissue that surrounds the seeds is called the **pericarp**, or fruit wall. Three major parts of the pericarp are the exocarp, the mesocarp, and the endocarp. The **exocarp** is the outer wall of the fruit. The exocarp, sometimes called the epicarp, forms the tough outer skin of the fruit. It can be thick and tough, as in the case of oranges, or thin and soft, like a grape. The **mesocarp** is the middle layer of the pericarp. It often makes up the bulk of the fruit and is fleshy. The **endocarp** is the inner part of the pericarp. It surrounds the seed or seeds. It may be hard like a peach or soft like a grape.



FIGURE 5. Because pineapples are made of many flowers, they are categorized as a multiple fruit.

## STAGES OF FRUIT DEVELOPMENT

---

Many things happen between the time of fertilization and the ripening of the fruit. The processes associated with fruit development are dictated by plant hormones.

As seeds develop inside the ovary wall, they produce cytokinins that migrate from the seed and promote cell division in the ovary wall. This results in added thickness to the fruit. The seeds follow up by producing gibberellins. Next, it is exported to the wall of the ovary and

causes rapid expansion of each of the cells. The combination of more cells and expanding cells leads to a tremendous increase in the size of the ovary.

Meanwhile, the plant produces abscisic acid, which causes the embryo in the developing seeds to become dormant. This is significant because it prevents the seed from sprouting inside the moist, unripened fruit.

Fruits that lack seeds can develop if a solution of gibberellic acid is applied to them. An example is Thompson seedless grapes. Thompson seedless grapes are treated about three times in the growing season with a dilute solution of gibberellic acid.

The developing ovules produce cytokinins that cause nutrients to be stored in the endosperm tissues of the developing seed. In many species, these nutrients are later translocated to the cotyledons.

As the ovary wall thickens, the developing seeds begin to produce either gibberellins or auxins, depending on the species. These hormones cause cells to enlarge and the ovary wall to expand. The combination of cytokinins increasing the number of cells and gibberellins increasing the size of those cells leads to spectacular enlargement of the fruit.

At about this stage, the enlarged ovary can be called a fruit, and the ovules have become mature seeds. The seeds have a drying seed coat (the former integument of the ovule) and contain a mature embryo. Abscisic acid causes the seed embryos to remain dormant. The seed embryos are prevented from growing until the seeds have been removed from the fruit or the abscisic acid in the seed breaks down.

Eventually, the fruit reaches full size. However, fruit at this stage tends to be sour (acid), mealy (starchy), green, hard, and lack fruity odor. It needs to be ripened before consumption. The ripening process could take a few days after picking or it could depend on an environmental cue.

Most species must produce ethylene in order for the fruit to ripen. Ethylene diffuses throughout the fruit tissue and into the atmosphere around the fruit.

An increase in the rate of cellular respiration in the fruit cells and synthesis of new enzymes usually accompanies the ripening process. Warm temperatures also speed the process. The ethylene released by one ripening fruit can cause neighboring fruits to also ripen.

The manufactured enzymes break down complex cell compounds. Acidic materials are broken down by an enzyme called kinase, so the fruit is no longer sour. Amylase converts starches to sugars and, in the process, the fruit becomes juicier. Hydrolase breaks down chlorophyll and large organic chemicals. With the chlorophyll gone, yellow pigments become visible, and red pigments may develop. Some of the large organic compounds become smaller molecules that give ripe fruit its odor. Pectinase depolymerizes pectin, which is the glue that holds cells together. Without pectin, the fruit becomes soft.



**FIGURE 6.** By placing a ripe apple in a bag next to an unripe fruit, the ripening process will be sped up.

## HOW SEEDLESS FRUIT ARE PRODUCED

---

Seedless fruits can develop by parthenocarpy, stenospermocarpy, and because the plants are triploid.

In a process known as **parthenocarpy**, fruit may develop without fertilization. Seedless pineapples and cucumbers result when pollination fails to occur. Pineapples are self infertile. In other words, pineapples require cross-pollination for seeds to set. Cross-pollination does not occur when a field is planted with all one variety. Many citrus fruits are seedless for the same reason. Cucumbers may produce seedless fruit if not pollinated. If pollination takes place, they produce seeds.

Technically, seedless grapes are not seedless. Normal pollination and fertilization occurs, but the embryos abort when they are young. Often remnants of the seeds can be seen in the fruit. This process is called **stenospermocarpy**.

Bananas and seedless watermelon are seedless because the plants are triploid. Because they have three sets of chromosomes, meiosis fails to take place. The triploid banana varieties are propagated asexually by removing and planting offshoots. Watermelons are produced from seeds obtained by crossing diploid plants with tetraploid plants. The seeds from the cross are triploid. The triploid plants grow and produce fruit after being pollinated but, because they are sterile, fail to produce seed. Triploid plants must be grown near pollen-producing diploid plants.

### Summary:

---



A fruit is a mature, ripened ovary. The two main functions of fruit are to prevent the seeds from drying and to disperse the seed.

Three major divisions include simple fruits, aggregate fruits, and multiple fruits. Simple fruits are defined as having developed from a single ovary of a single pistil. Simple fruits may be fleshy or dry. Fleshy fruit include berries, hesperidium, pepo, drupes, and pomes. Dry fruits may be indehiscent or dehiscent. Some types of indehiscent fruits are achene, caryopsis, samara, nut, uricle, and nutlet. Dehiscent fruit types are legume, follicle, capsule, and pyxis. Aggregate fruits develop from a single flower that has many pistils. Multiple fruits consist of a number of flowers that fused to form a mass.

Three major parts of the pericarp are the exocarp, mesocarp, and endocarp.

The process of fruit development is dictated by plant hormones.

Seedless fruits can develop by parthenocarpy, stenospermocarpy, and because the plants are triploid.

## Checking Your Knowledge:

---



1. What are the functions of fruit?
2. What are the three main divisions of fruit?
3. What are the major parts of a fruit?
4. How do fruit develop?
5. How are seedless fruit produced?

## Expanding Your Knowledge:

---



Obtain a variety of fruits from a store and from a local outside source. Dissect the fruits and determine the different parts. Find out what type of fruit each is.

## Web Links:

---



### Identification of Major Fruit Types

<http://waynesword.palomar.edu/fruitid1.htm>

### Fruits

<http://theseedsite.co.uk/fruits.html>

### Fruit Growth and Fruit Types

[http://plantphys.info/Plants\\_human/fruitytype.html](http://plantphys.info/Plants_human/fruitytype.html)

### Agricultural Career Profiles

<http://www.mycart.com/career-profiles>