

Fruit Types and Classification of Fruits

Although most of us have a good idea what fruits and vegetables are when we eat them, it is difficult to provide a definition for the convention of just what makes one food a vegetable and another a fruit. For a botanist, the definitions are easier; a fruit is the structure of an angiosperm that develops from the ovary and accessory tissues and surrounds and protects the seed(s). Fruits are also important in seed dispersal. A vegetable is a part of one of the vegetative organs of the plant: roots, stems or leaves, or shoot systems. There are a few "vegetables" that are difficult; broccoli and cauliflower are inflorescence buds, and an artichoke is the entire inflorescence. Since flowers, the reproductive organ of the plant produce fruits and seeds, perhaps those vegetables that are inflorescences are more similar to fruits than they are to vegetables. The pineapple is an example of an inflorescence that we call a multiple fruit. No matter what we call our nutritious dietary components, in botany what constitutes a fruit is straightforward, and this exercise looks at the structure and classification of fruits.

The process of fertilization initiates both seed and fruit development. While seeds are developing from the ovules, the ovary tissue undergoes a series of complex changes that results in the development of the fruit. Many fruits are "fleshy" and contain sugars that attract animals who disperse the enclosed seeds to new locations after successfully passing through the digestive system of the animal. Non-fleshy, fruits use other mechanisms for seed dispersal. In some plants, fruits can develop without fertilization. This is called parthenocarpy, and such fruits are typically seedless.

As the ovary develops into a fruit, its wall often thickens and becomes differentiated into three, more or less distinct, layers. The three layers together form the pericarp, which surrounds the developing seed or seeds.

The three fruit layers are:

- Exocarp, the outermost layer often consisting of only the epidermis
- Mesocarp, or middle layer, which varies in thickness
- Endocarp, which shows considerable variation from one species to another

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Classifying Fruits

All fruits may be classified into three major groups on the basis of the number of ovaries and the number of flowers involved in their formation. The following outline includes most of the common types of fruits. A simple key to classifying fruits is provided here. Use these descriptions and the "Key to Fruit Types" provided to identify the types of fruits you observe today.

A. Simple Fruits.

Simple fruits develop from a single matured ovary in a single flower.

1. **Fleshy Fruits**, pericarp fleshy at maturity

- a. **Berry**, consisting of one or more carpels with one or more seeds, the ovary wall fleshy

- (1) **Pepo** (an accessory fruit), a berry with a hard rind, the receptacle partially or completely enclosing the ovary
- (2) **Hesperidium**, a specialized berry with a leathery rind

- b. **Drupe, a stone fruit**, derived from a single carpel and containing (usually) one seed. Exocarp a thin skin
- c. **Pome** (an accessory fruit), derived from several carpels, receptacle and outer portion. of pericarp fleshy, inner portion of pericarp papery or cartilaginous, forming a core
- d. **Hip** (an accessory fruit), several separate carpels enclosed within the fleshy or semi-fleshy receptacle

2. **Dry Fruits**, pericarp dry at maturity

- a. **Dehiscent fruits**, those which dehisce or split open when fully mature
 - (1) **Follicle**, composed of one carpel and splitting along a single suture
 - (2) **Legume**, composed of a single carpel and splitting along two sutures
 - (3) **Capsule**, composed of several carpels and opening at maturity in one of four ways:
 - (a) Along the line of carpel union (septicidal dehiscence)
 - (b) Along the middle of each carpel (loculicidal dehiscence)
 - (c) By pores at the top of each carpel (poricidal dehiscence)
 - (d) Along a circular, horizontal line (circumscissile dehiscence)
 - (4) **Silique**, composed of two carpels which separate at maturity, leaving a persistent partition between them
- b. **Indehiscent fruits**, those which do not split open at maturity
 - (1) **Achene or akene**, a one-seeded fruit with the seed attached to the fruit at one point only
 - (2) **Caryopsis or grain**, a one-seeded fruit in which the seed is firmly attached to the fruit at all possible points
 - (3) **Samara**, a one- or two-seeded fruit with the pericarp bearing a wing like outgrowth. A modified achene
 - (4) **Schizocarp**, consisting of two carpels which at maturity separate along the midline into two one-seeded halves, each of which is indehiscent
 - (5) **Loment**, having several seeds, breaking into one-seeded segments at maturity
 - (6) **Nut**, a hard, one-seeded fruit, generally formed from a compound ovary, with the pericarp hard throughout

B. Aggregate Fruits.

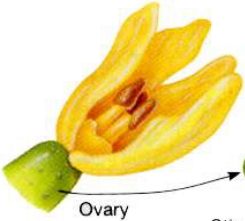



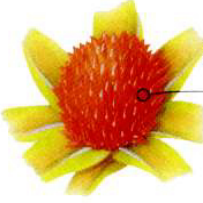



Aggregate fruits consist of a number of matured ovaries formed in a single flower and arranged over the surface of a single receptacle. Individual ovaries are called fruitlets.

C. Multiple Fruits.

Multiple fruits consist of the matured ovaries of several to many flowers more or less united into a mass. Multiple fruits are almost invariably accessory fruits.

D. Accessory Fruits.

Fruits that develop from tissues surrounding the ovary are called accessory fruits. Accessory fruits generally develop from flowers that have inferior ovaries, and the receptacle or hypanthium becomes a part of the fruit. Accessory fruits can be simple, aggregate or multiple fruits.

General Fruit Types				
Type	Characteristics	Example	Flower	Fruit
Simple	Develops from a single ovary, formed from a single carpel or from two or more fused carpels (= compound pistil)	Cucumber		
Aggregate	Develops from fusion of many separate carpels in a single flower	Raspberry		
Multiple	Develops from ovaries of many flowers grouped on same stalk	Pineapple		
Accessory	Develops from ovaries plus nearby tissue	Strawberry		

The Structure of Some Common Fruits

This exercise is designed to help you become familiar with the structure of several common fruit types, such as the legume, the caryopsis, the berry, the drupe, and the pome.

A. Legume: Bean or Pea

Examine the bean or pea pod on your table. Answer the following questions as you observe the legume fruit.

What part of the carpel does it represent?

What happened to the other parts of the carpel?

At which end of the pod were the stamens, petals, and sepals attached? Is there any evidence of any of these parts?

Split the pod lengthwise along both edges. Do all the seeds adhere to one side, or do they alternate from one side to the other?

B. Caryopsis (or Grain): Corn

Examine dry and soaked grains of corn. What part of the carpel do these represent?

Look for a tiny bump on the upper end of the corn grain marking the location where the silk was attached. What is the silk of corn? .

Try to remove the pericarp from a dry grain. Do the same with a grain that has been thoroughly soaked in water. When this skin like structure has been removed, what structures are left? .

C. Berry: Tomato or Grape

Examine fresh tomato fruits or other berry, noting the stalk or pedicel and the green sepals at the basal end. Where do you find the remains the style?_____.

Does the berry develop from a superior or an inferior ovary?

Where were the petals and stamens attached?

Is any other floral part united with the ovary in the formation of this fruit? Is the tomato an accessory fruit? Why or why not?

Examine a cross-section of a tomato. How many locules (chambers) are visible? .

How many ovaries formed the fruit?

D **The Drupe: Peach** (Cherries, plums, or even soaked prunes)
Examine a fresh or preserved peach. Does this fruit come from a superior or an inferior ovary? .

What evidence do you have to support your answer?

Examine a peach that has been cut lengthwise and one that has been cut crosswise. How many carpels are involved in the formation of the peach?

What part of the ovary wall is the rough, fuzzy skin? .

What part of the fruit forms the edible portion of the fruit? .

What part forms the **stone or pit**?

How many seeds does a drupe contain? .

E. **The Pome: Apple** (Crab apple, pear, or quince)
Examine the fruit of the apple. Find the fruit stalk or pedicel, and see whether you find near its upper end any scars that might mark the former location of the other flower parts.

Examine the other end of the fruit. What are the small, pointed structures which you find there?

How many of these structures are there? .

Do you find any evidence of stamens?

Does the pome develop from an epigynous or hypogynous flower? .

Examine the cross-section of an apple, noting the star-shaped core. What are the papery or cartilaginous structures found in this region? . How many of them are there? .

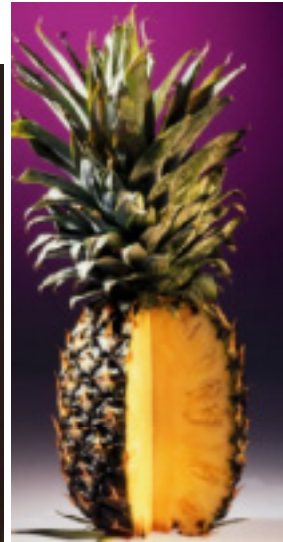
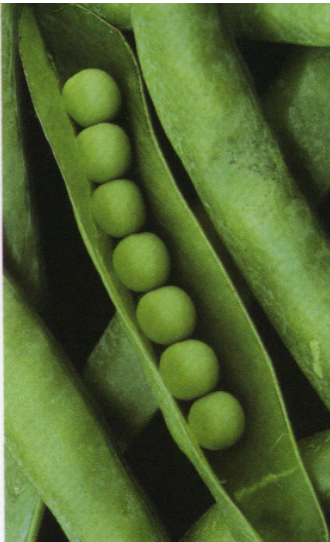
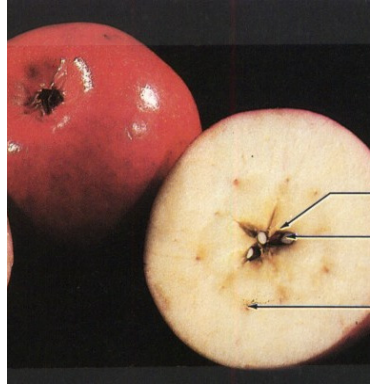
Is the pome an accessory fruit? Why or why not?

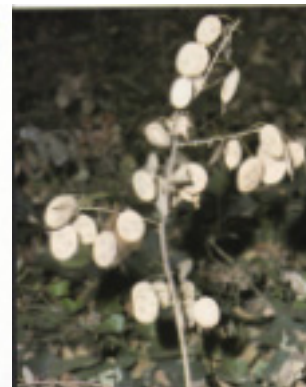
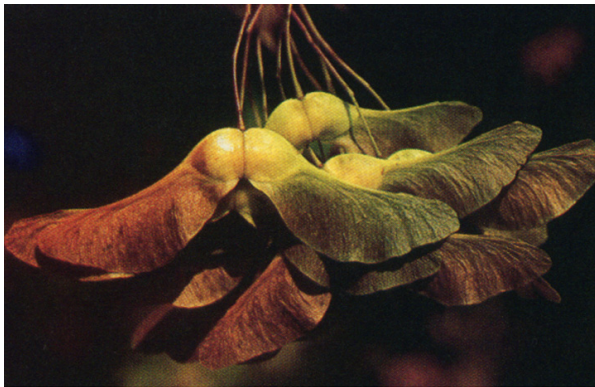
Key to the Classification of Fruits

1.	Simple fruits, formed from a single ovary or carpel	2
1.	Compound fruits, formed from several carpels or ovaries	17
2.	Dry fruits	3
2.	Fleshy fruits	12
3.	Fruit dehiscent	4
3.	Fruit indehiscent	7
4.	Fruit derived from one carpel only	5
4.	Fruit derived from one to several carpels	6
5.	Fruit splitting at maturity along one suture	Follicle
5.	Fruit splitting at maturity along two sutures	Legume
6.	Fruit formed of 2 carpels, separating at maturity, leaving a persistent partition upright between them	Silique
6.	Fruit formed of several carpels	Capsule
7.	Fruit several to many-seeded, breaking at maturity into several one-seeded segments	Loment
7.	Fruit not as above, generally one-seeded	8
8.	Seed coat firmly united with pericarp at all points	Caryopsis
8.	Seed coat not attached to pericarp at all points	9
9.	Pericarp thin, with one or two wings	Samara
9.	Pericarp lacking wings	10
10.	Fruit coat very hard	Nut
10.	Fruit coat not particularly hard	11
11.	Fruit composed of 2 carpels, separating at maturity into two 1-seeded halves or mericarps which are indehiscent	Schizocarp
11.	Fruit coat thin, not separating; fruit small, 1-seeded	Achene
12.	Fleshy part of fruit derived from ovary only	13
12.	Fleshy part of fruit derived, at least in part, from the receptacle	15
13.	Entire ovary becoming fleshy at maturity	14
13.	Outer part of ovary fleshy, inner part stony	Drupe
14.	Fruit fleshy or juicy, composed of several (usually 10) carpels, each with 2 seeds; rind leathery	Hesperidium
14.	Fruit fleshy, of several carpels, each with one to several seeds; leathery rind lacking	Berry
15.	Pistils several, separate, non-fleshy, enclosed by the fleshy or semi-fleshy receptacle	Hip
15.	Ovary compound, carpels united	16
16.	Ovary wall fleshy, berry-like, with hard rind	Pepo
16.	Inner part of ovary wall papery or cartilaginous, outer part fleshy, surrounded by and united with a fleshy receptacle	Pome
17.	Many simple fruits, usually achenes or drupes, derived from separate carpels of one flower, located on a single receptacle	Aggregate Fruit
17.	Many simple fruits derived from the carpels of separate flowers	18
18.	Flowers borne within an enlarged hollow, fleshy receptacle	Synconium
18.	Flowers borne upon the surface of a more or less fleshy receptacle	Multiple Fruit

Identification of Miscellaneous Fruits

Use the Fruit Classification Key above to identify the fruit types of the various fruits available in the laboratory and illustrated below. Have your instructor identify the fruits for you if necessary, and record your information about each one on the Table provided.





Characteristics of Some Common Fruits

Name of Plant	Simple, Aggregate or Multiple	Dry or Fleshy	Dehiscent/Indehiscent	Structures in Fruit	Type of Fruit