Unit B: Plant Anatomy

Lesson 4: Understanding Fruit Anatomy

Terms

- achene
- aggregate fruits
- berry
- capsule
- caryopsis
- cytokinins
- dehiscent fruits
- disseminated
- drupe
- endocarp
- exocarp
- follicle
- fruit
- gibberellins
- hesperidium
- indehiscent fruits
- legume
- mesocarp
- multiple fruits
- nut
- nutlet
- pepo
- pericarp
- pome
- pyxis
- recepticle
- samara
- simple fruits
- uricle

Functions of Fruit

- Many times a vegetable will be confused with a fruit. Technically, a ***fruit*** is a mature, ripened ovary.
  - After the fertilization of flowering plants, the ovule develops into a seed. The surrounding ovary wall enlarges and forms a fruit around the seeds.
  - 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.

Major Types of Fruits

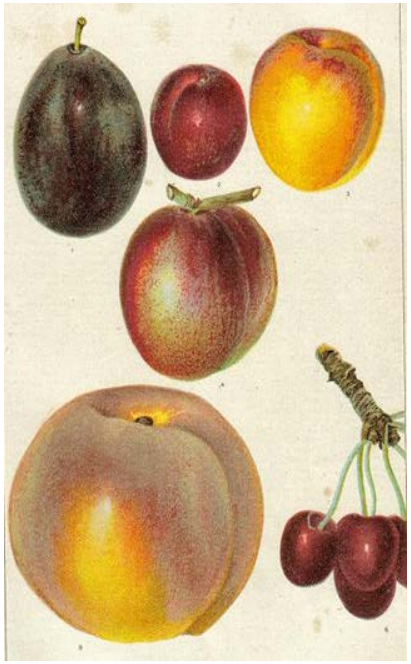
- There is great diversity of fruits. Three major divisions include simple fruits, aggregate fruits, and multiple fruits.
  - ***Simple fruits*** are defined as having developed from a single ovary of a single pistil. Simple fruits are often classified as being fleshy or dry.

- 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.

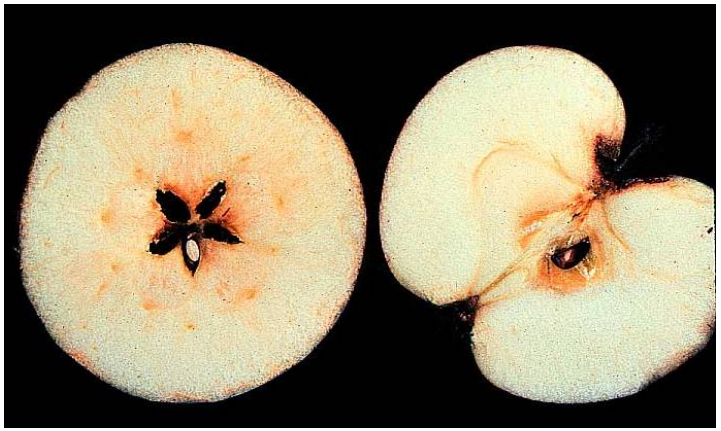
- A ***hesperidium*** fruit has a leathery rind. Examples include oranges, grapefruits, lemons, and limes.

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

- 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.

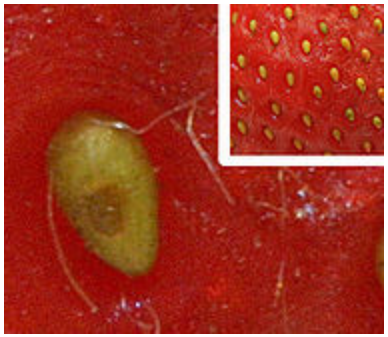


- A ***pome*** has a fleshy exterior and a center with papery carpels. Apples and pears are pomes.



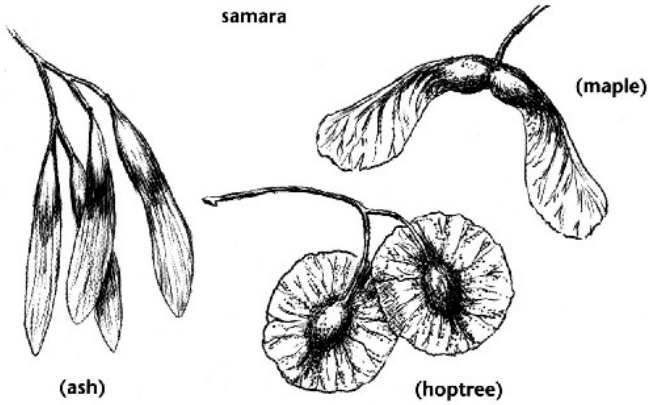
- Dry fruits may be indehiscent or dehiscent.
  - ***Indehiscent fruits*** or those that do not split open at maturity and usually contain one or two seeds. Some types of indehiscent fruits are:
    - Achene
    - Caryopsis
    - Samara
    - Nut
    - Uricle
    - Nutlet.

- An ***achene*** is one-sided fruit with a seed attached at only one place to the pericarp. Sunflowers and strawberries 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, almonds, 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 pecans are examples.

- ***Dehiscent fruits*** are fruits that split open upon maturation.

- Dehiscent fruit types are:
  - Legume
  - Follicle
  - Capsule
  - Pyxis.

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

- F***ollicle*** 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.

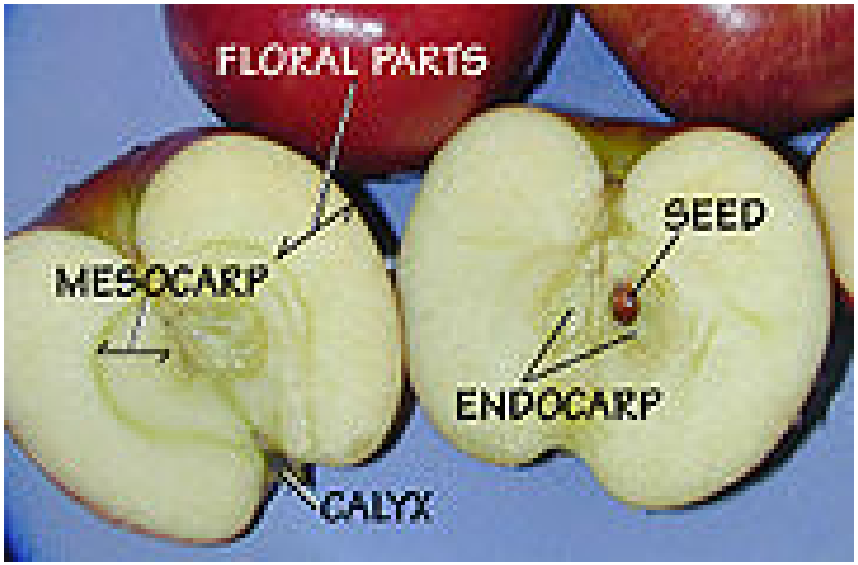
- ***Aggregate fruits*** develop from one flower that contains several ovaries, each of which develops into a small fruit. These small fruits are joined tightly together to make a larger fruit.
  - An example of this is a raspberry. Each fleshy lobe in a raspberry is actually an individual fruit, but they are joined at their bases. Strawberries are an aggregate of achenes.

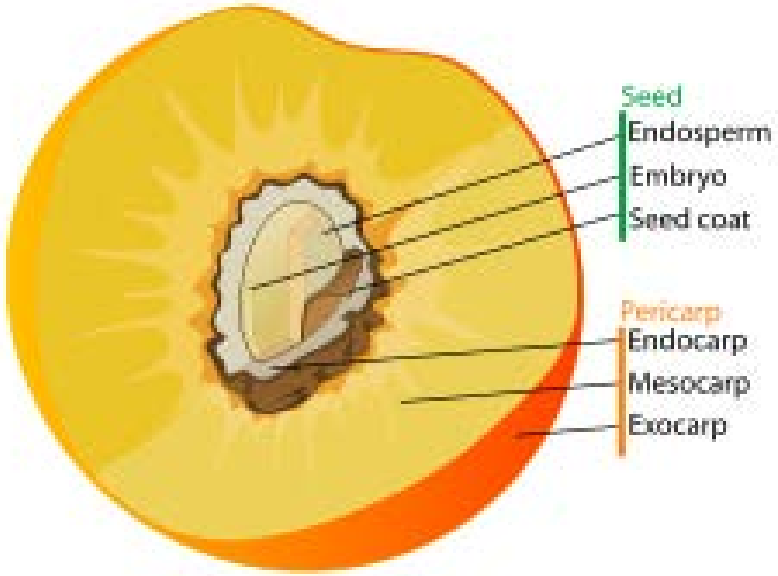
- ***Multiple fruits*** consist of a number of flowers that fused to form a mass.
  - An example of this is a pineapple. Each section of a pineapple was an individual fruit from an individual flower, but they have fused to form the pineapple. Another example is the fig.
  - Many think that grapes are multiple fruits. However, grapes grow in clusters, but they are not compound fruits. Each grape grew from one ovary in one flower, and each grape remains an independent fruit.

Parts of a Fruit

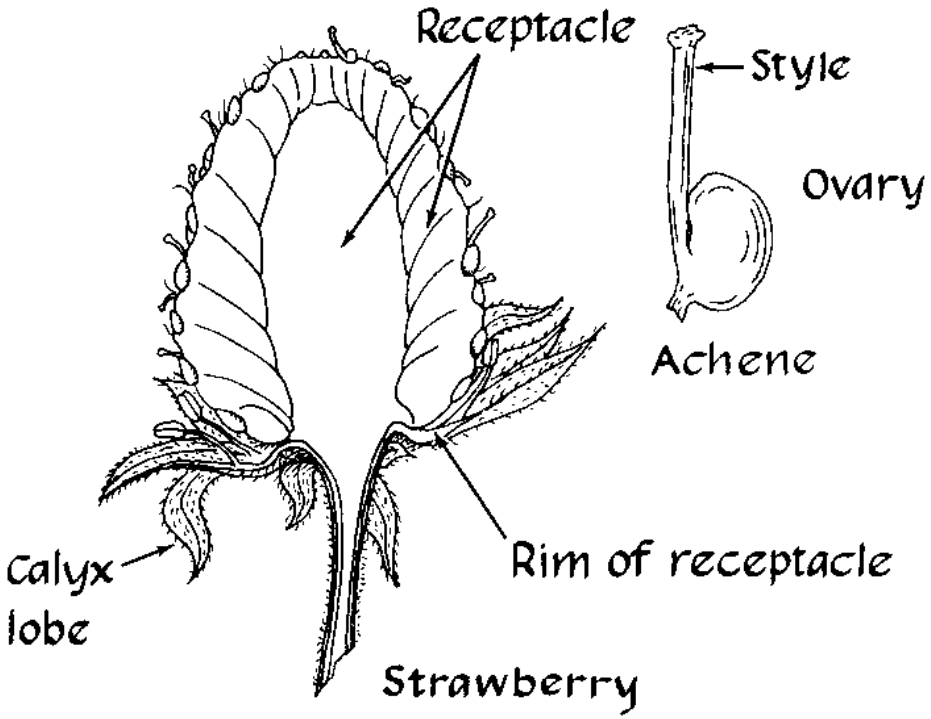
- The tissue that surrounds the seeds is called the ***pericarp***, or fruit wall.
- Three major parts of the pericarp are the exocarp, the mesocarp, and the endocarp.

- 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.


FLORAL PARTS
SEED
MESOCARP
ENDOCARP
CALYX


Seed
Endosperm
Embryo
Seed coat
Pericarp
Endocarp
Mesocarp
Exocarp

- The ***receptacle*** is the thickened part of a stem from which the flower organs grow.
  - In some accessory fruits, for example in pomes or strawberries, the receptacle gives rise to the edible part of the 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. ***Cytokinins*** are hormones which are mostly responsible for cell division and differentiation. This results in added thickness to the fruit.

- The seeds follow up by producing gibberellins. ***Gibberellins*** are hormones which cause internodal elongation and cell division.
- 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.

- 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.