

Unit B: Plant Anatomy

Lesson 4: Understanding Fruit Anatomy

Student Learning Objectives: Instruction in this lesson should result in students achieving the following objectives:

1. Describe the functions of a fruit.
2. Describe some major types of fruits
3. Describe the parts of a fruit.
4. Describe the stages of fruit development

Recommended Teaching Time: 3 hours

Recommended Resources: The following resources may be useful in teaching this lesson:

- A PowerPoint has also been developed with use of this lesson plan
- <http://en.wikipedia.org/wiki/Pericarp>
- <http://waynesword.palomar.edu/fruitid1.htm>
- http://plantphys.info/Plants_human/fruittype.html
- <http://theseedsite.co.uk/fruits.html>

List of Equipment, Tools, Supplies, and Facilities

Writing surface

PowerPoint Projector

PowerPoint slides

Transparency Masters

Variety of fruits

Copies of Student Lab Sheet

Apples, Strawberries, and peaches

Cutting board

Paring knife

Index cards

Terms: The following terms are presented in this lesson (shown in bold italics and on PowerPoint Slide #2):

- 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
- receptacle
- samara
- simple fruits
- uricle

Interest Approach: Use an interest approach that will prepare the students for the lesson. Teachers often develop approaches for their unique class and student situations. A possible approach is included here.

Have a variety of plants that we eat sitting on a table. These plants will need to be a mixture of plant roots, stems, leaves, fruits, and flowers. Have the students get into equal size groups and as a group guess which of these are fruits. This should be a little bit easier now that they have covered roots, stems, and leaves. Also they are probably the most familiar with these in general. Lead into a discussion of why it was easier for them to pick out the fruits.

**** Use this activity to lead into what is actually considered a fruit.**

Summary of Content and Teaching Strategies

Objective 1: Describe the functions of a fruit.

(PowerPoint Slide # 3)

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

B. The two main functions of fruit are to prevent the seeds from drying and to disperse the seed.

(PowerPoint Slide # 4)

C. The fruit may be either fleshy or dry.

1. 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.

(PowerPoint Slide # 5)

2. 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.

****Have the students get into small groups. Have them brainstorm and write down as many fleshy and dry fruits in your area. Make sure they specify which group the fruit belongs in. Discuss their answers when everyone is done.**

Objective 2: Describe some major types of fruits

(PowerPoint Slide # 6)

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

- A. **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.

(PowerPoint Slide # 7)

1. Fleshy fruits are juicy. Berries, hesperidium, pepo, drupes, and pomes are categories of fleshy fruits.
 - a. A **berry** has an entirely fleshy ovary. Tomato, date, blueberry, banana, pepper, and cranberry are examples of berries.

(PowerPoint Slide # 8)

- b. A **hesperidium** fruit has a leathery rind. Examples include oranges, grapefruits, lemons, and limes.
 - c. A **pepo** is a type of fruit defined by a hard rind and a fleshy inner matrix. Watermelons, cantaloupe, squash, and pumpkins are pepos.

(PowerPoint Slide # 9)

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

(PowerPoint Slide # 10)

- 2. Dry fruits may be indehiscent or dehiscent.
 - a. **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.

(PowerPoint Slide # 11)

- 1. An **achene** is one-sided fruit with a seed attached at only one place to the pericarp. Sunflowers and strawberries have achene type fruit.
- 2. 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.

(PowerPoint Slide # 12)

- 3. A **samara** is usually single seeded with a membranous wing. Examples are maple, elm, and ash.
- 4. A **nut** is a hard, one-seeded fruit. Oak, walnut, almonds, and hickory produce nuts.

(PowerPoint Slide # 13)

- 5. A **uricle** is like an achene, but the ovary wall fits loosely around the seed. Examples are finger millet and pigweed.
- 6. A **nutlet** is a small version of a nut. Birch and pecans are examples.

(PowerPoint Slide # 14)

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

(PowerPoint Slide # 15)

- 1. A **legume** (pod) is composed of a single carpel and has two longitudinal sutures. Soybeans, green beans, and peas are legumes.
- 2. A **follicle** is composed of a single carpel and splits open along one suture. Milkweed fruit is a follicle.

(PowerPoint Slide # 16)

- 3. 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.
- 4. A **pyxis** is a type of capsule with a lid that falls from the fruit. An example is purslane.

(PowerPoint Slide # 17)

- B. **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.
1. 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.

(PowerPoint Slide # 18)

- C. **Multiple fruits** consist of a number of flowers that fused to form a mass.
1. 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.
 2. 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.

****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. When finished go through and say the definitions of each type of fruit again. Have the students tell you which type you are talking about. Because there are a lot of terms in this section, this will help them retain the information better**

Objective 3: Describe the parts of a fruit.

(PowerPoint Slide # 19)

III. A plant fruit has parts with different functions.

- A. 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.

(PowerPoint Slide # 20)

1. 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.
2. The **mesocarp** is the middle layer of the pericarp. It often makes up the bulk of the fruit and is fleshy.
3. 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.

(PowerPoint Slide # 21 has a picture of a peach and an apple that has the fruit parts labeled. Have students draw a picture of this, so they can use it as a reference on the lab.)

(PowerPoint Slide # 22)

- B. The **receptacle** is the thickened part of a stem from which the flower organs grow.
 - 1. In some accessory fruits, for example in pomes or strawberries, the receptacle gives rise to the edible part of the fruit.

****Have students complete LS: B4-1. This will give them practice in looking for the main parts of fruits.**

Objective 4: Describe the stages of fruit development

(PowerPoint Slide # 23)

- IV. 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.
 - A. 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.

(PowerPoint Slide # 24)

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

(PowerPoint Slide # 25)

- E. 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.

(PowerPoint Slide # 26)

- F. 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.

(PowerPoint Slide # 27)

G. 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.

(PowerPoint Slide # 28)

1. 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.
2. Warm temperatures also speed the process.
3. The ethylene released by one ripening fruit can cause neighboring fruits to also ripen.

***** Before class break this objective into steps. Write these steps on separate index cards. Place them around the room. When you say “Go,” have the students grab a index card. Once everyone has an index card, have them place the steps of fruit development in order. (If there are more students than index cards, place the students into groups). Once the students think they have the steps in order, you will double check them. Discuss anything that the students may have troubles with.**

Review/Summary: Use the student learning objectives to summarize the lesson. Repeated practice using actual fruits, pictures of fruits, and drawing the fruits are very helpful. Student responses can be used to determine which objectives should be reviewed.

Application: LS: B4-1 can be used to apply objectives to the actual anatomy of a fruit.

Evaluation: Evaluation should be based on student comprehension of the learning objectives. This can be determined using the attached sample written test.

Answers to Sample Test:

Part One: Matching

- | | |
|------|--------|
| 1. d | 7. k |
| 2. g | 8. e |
| 3. h | 9. a |
| 4. b | 10. j |
| 5. i | 11. c. |
| 6. f | |

Part Two: Completion

1. pericarp
2. exocarp
3. mesocarp
4. endocarp.

Part Three: Short Answer

1. The two main functions of fruit are to prevent the seeds from drying and to disperse the seed.

Sample Test

Name_____

Test

Unit B Lesson 4: Understanding Fruit Anatomy

Part One: Matching

Instructions. Match the term with the correct response. Write the letter of the term by the definition.

- | | | |
|---------------------|---------------------|-----------------------|
| a. Pepo | e. Hesperidium | i. Indehiscent fruits |
| b. Aggregate fruits | f. Dehiscent fruits | j. Drupe |
| c. Pome | g. Berry | k. Multiple fruits |
| d. Fruit | h. Simple Fruits | |
- _____ 1. A mature, ripened ovary.
_____ 2. Has an entirely fleshy ovary
_____ 3. Defined as having developed from a single ovary of a single pistil.
_____ 4. These develop from one flower that contains several ovaries, each of which develops into a small fruit.
_____ 5. Those that do not split open at maturity and usually contain one or two seeds.
_____ 6. These are fruits that split open upon maturation
_____ 7. These consist of a number of flowers that fused to form a mass.
_____ 8. A fruit has a leathery rind. Examples include oranges, grapefruits, lemons, and limes.
_____ 9. A type of fruit defined by a hard rind and a fleshy inner matrix. Watermelons, cantaloupe, squash, and pumpkins are examples
_____ 10. A fruit with a fleshy exterior and a single hard, stony pit surrounding the seed. Cherry, peach, olive, and plum are examples.
_____ 12. Has a fleshy exterior and a center with papery carpels. Apples and pears are examples.

Part Two: Completion

Instructions. Provide the word to complete the following statements.

1. The tissue that surrounds the seeds is called the _____, or fruit wall.

2. The _____ is the outer wall of the fruit.
3. The _____ is the middle layer of the pericarp. It often makes up the bulk of the fruit and is fleshy.
4. The _____ is the inner part of the pericarp. It surrounds the seed or seeds.

Part Three: Short Answer

Instructions. Provide information to answer the following question.

1. What are the main functions of fruit?

LS: B4-1

Name_____

Lab Sheet

Procedure:

Look at each longitudinal section and draw what you see. Then label the parts.

Peach:

Type of fleshy fruit: _____

Sketch of section (Label the exocarp, mesocarp, endocarp, & seed,):

Apple:

Type of fleshy fruit: _____

Sketch of section (Label the exocarp, mesocarp, endocarp, seed, and receptacle):

Strawberry:

Type of fleshy fruit: _____

Sketch of section (Label the achene and receptacle):