BIOLOGY 1101
LAB 8: FLOWERS, FRUITS, AND SEEDS

READING: Please read pages 316-327 in your text.

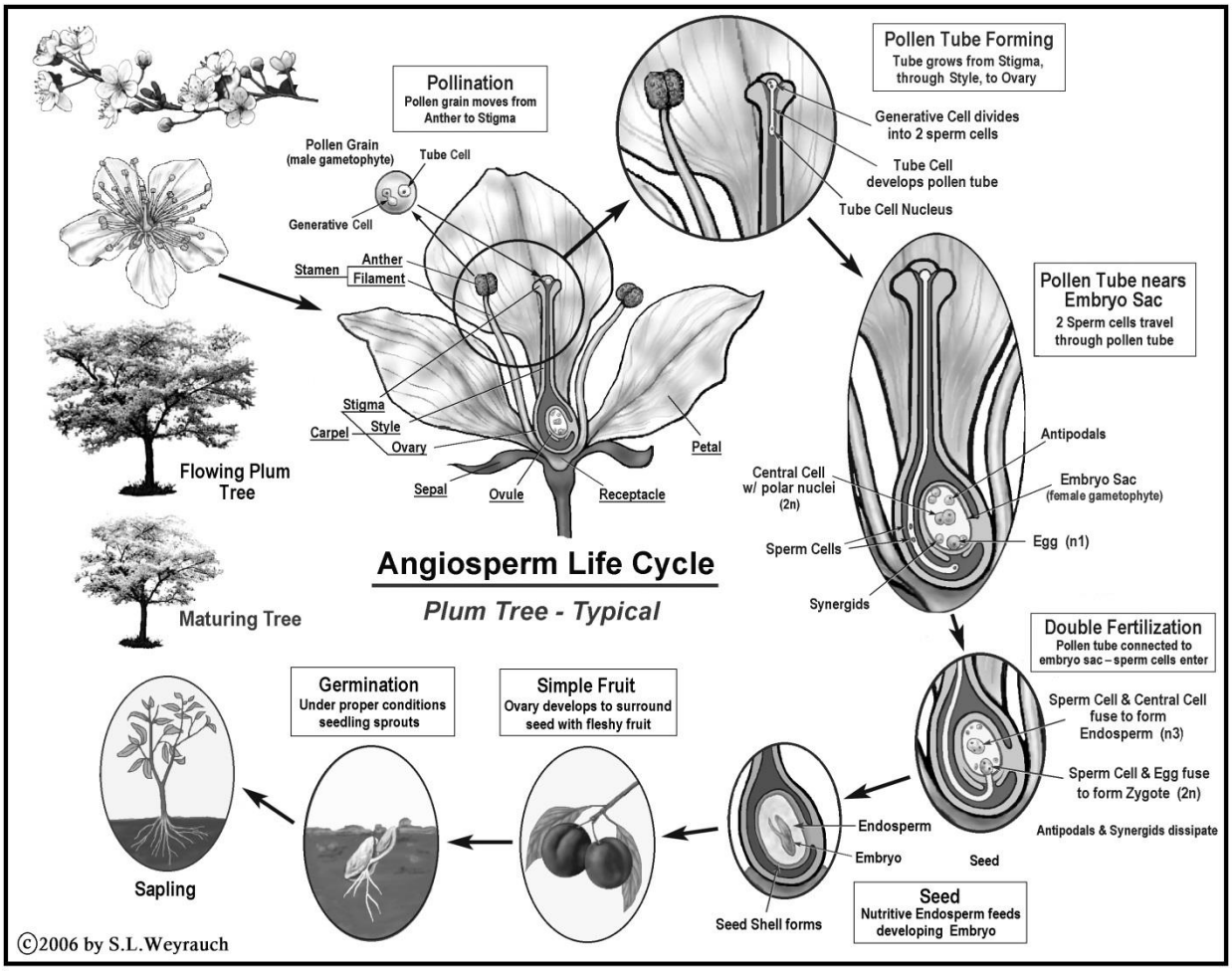
INTRODUCTION: In seed plants (**gymnosperms** and **angiosperms**), **pollination** (note spelling) is the mechanism of sexual reproduction. **Pollen**, or the male gametophyte, is produced by male structures on the plant and has to be transported to the eggs, or the female structures on the plant. When pollen reaches the female structure, sperm are released from the pollen grains and allowed to fertilize the eggs. **Gymnosperms**, the earliest seed plants, were wind-pollinated, as are present day pine trees. Pollen grains released by male pine cones are carried on the wind to the female pine cones where they land on a sticky resin. Insects feeding on the sticky resin discovered the protein-rich pollen and began using it as a food source. The pollen stuck to their bodies as they fed. As the insects moved between female cones, eating pollen, pollination was achieved. This method of pollination was more effective than wind pollination, and those plants that could better attract the insects had a better chance of being pollinated and producing seed. Under these selective pressures, the first flowering plants, called **angiosperms**, evolved.

Flowers, unique to angiosperms, are an adaptation for attracting insects and achieving pollination. The diversification of angiosperms and of insect pollinators such as bees and butterflies occurred, not surprisingly, during the same period of evolutionary history. The figure at the top of the next page shows the life cycle of angiosperms. After fertilization, the egg and the associated tissues develop into a seed while the ovary walls mature into a fruit. The term angiosperm means “seed container”. Gymnosperms are also seed plants, but their seeds are not contained in the ovary. Gymnosperm actually means “naked seed”. Angiosperm fruits may be dry, like a peanut shell, or fleshy, like an orange. Besides offering protection, the fruit may have special modifications that help the seeds disperse to a suitable habitat.

OBJECTIVES: In this lab you will learn to recognize the different parts of flowers. You will learn about floral characteristics that attract different kinds of pollinators. In addition, you will learn to identify types of fruits and examine the characteristics of fruits and seeds associated with different mechanisms of seed dispersal.

1. Learn to identify the parts of flowers and fruits and describe their functions
2. Understand where flowers and fruits fit into the life cycle of plants.
3. Discuss flowers as adaptations for effective pollination and fruits as adaptations for effective seed dispersal.

EXERCISES: In today’s lab, we will first learn about the anatomy of a flower by dissecting some complete and/or incomplete flowers, as available. We will prepare a slide of pollen producing structures for closer observation. In the second section, we will observe various fruits and learn how to identify them to botanical category using a dichotomous key. We will also look briefly at seed dispersal.



A. Flower Structure. Flowers are leaves that have been modified in various ways for reproduction. The fertile parts are the **stamens** and the **carpel**. The sterile parts consist of the **sepals** and **petals**. You will learn more about these in a moment. All of these parts are attached to a **receptacle**, a platform at the top of the flower stalk. Some flowers have all parts (stamen, carpel, sepals, and petals) and are called **complete**. However, the structure of these parts can be quite different for different species of flowers. Flowers lacking one or more of these basic parts are called **incomplete**. The parts of flowers are arranged in concentric rings or **whorls** around the receptacle. From the outside to the inside the whorls are the sepals, petals, stamens, and carpels. In this activity, you will dissect a flower and identify its parts. You may want to get out your dissecting microscope to see the individual structures in more detail as you dissect.

Materials:

- Basic dissection tools (scalpel, pins, blunt probe, forceps, etc.)
- Dissecting tray
- One flower of each type provided
- A clean slide and coverslip (more than one if you dissected several flower types)

- A compound microscope
- A binocular dissecting microscope (optional)

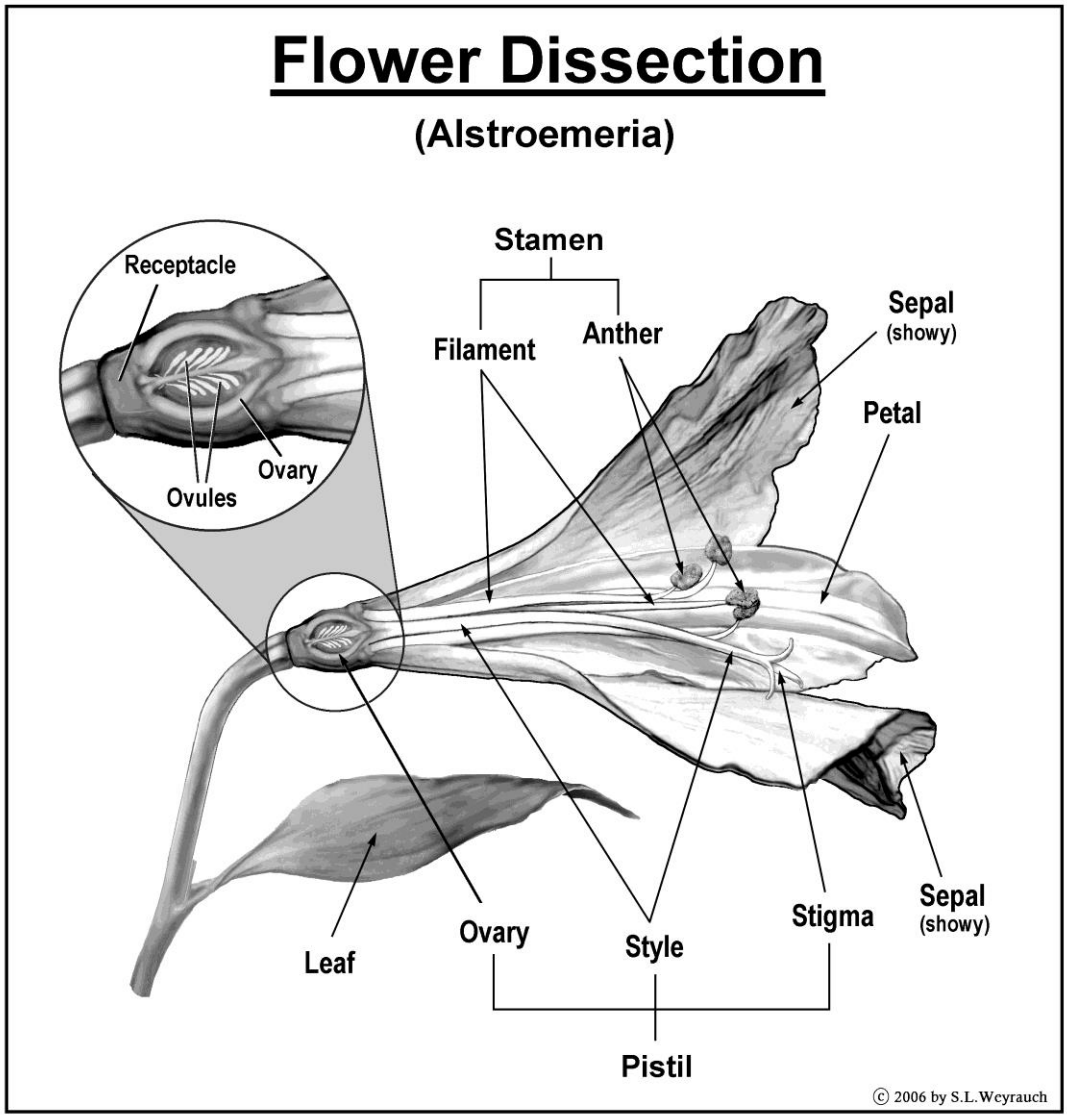
Procedure: (Read the entire section before you start.)

1. Refer to the figure on the next page as you proceed with your dissection. The outer ring of **sepals** protects the flower when it is a bud. The sepals are usually green, but in some flowers they have been modified to attract pollinators. In most members of the lily family, for example, the sepals are indistinguishable from the petals except by their position in the outermost ring. Remove the sepals after you have noted their position and set them aside.

2. The next ring consists of the **petals**, which are generally colorful to attract pollinators. We will discuss petals in more detail later. Remove the petals after you have noted their position and set them aside.

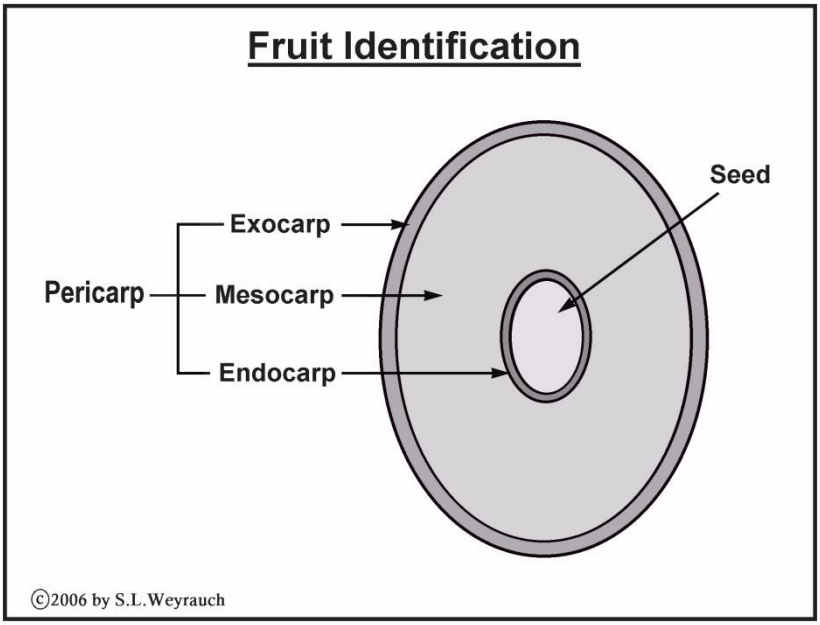
3. The male sexual structures are called **stamens**. The stamens consist of two parts: an **anther** (pollen-producing structure) at the tip, and a **filament** which attaches the anther to the receptacle. **Pollen** is the immature male gametophyte. Remove the stamens after you have noted their position and set them aside. Pick one or two for use in preparing a wet mount.
   a. Make a wet-mount slide of **pollen** from your anthers. As anthers age, they begin releasing their pollen and take on a dusty appearance. Find an anther that appears to be releasing its pollen (if all of your anthers are smooth, borrow one from another group). Add a drop of water to a slide and dip the anther into the water to wash off some of the pollen. Add a cover slip, and view the slide to see the grains of pollen. Have your instructor check your slide. _____

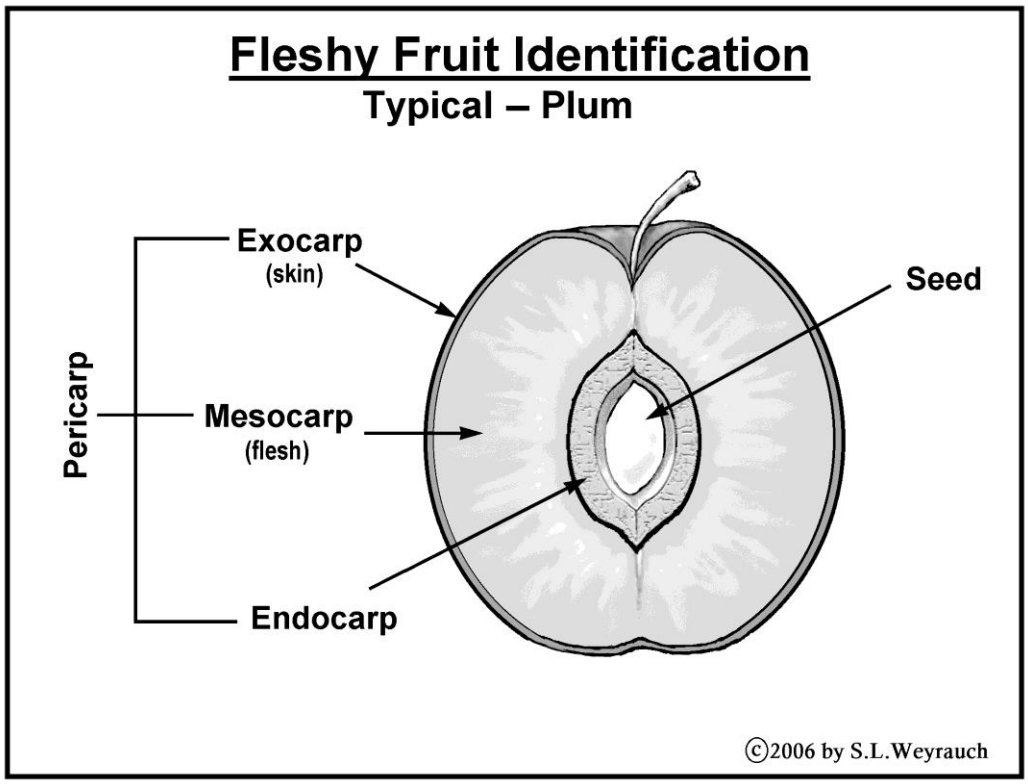
4. The female structures are called **carpels** (or **pistils**). Their function is to produce female gametophytes (**ovules**), which then produce the female gametes (eggs). A flower may have one or more carpels, and they may be either fused or separate. At the top of the carpel is the **stigma**, which receives the pollen. The **ovary**, which encloses the ovules, is at the base of the carpel. Fertilized ovules mature into seeds. The ovary becomes a **fruit**. *For the flower you dissected, approximately how far (in millimeters) will the pollen tube have to grow to reach an ovule?* _____
   a. Cut through the ovary horizontally with a razor blade. The ovules are white and egg shaped*. How many carpels do you see?* _____ *Have your instructor check your answer.*



B. Fleshy fruit identification. A **simple fruit** is formed from a single ovary (either from a single carpel or several united carpels) from a single flower. The fruit may be fleshy or dry, and the ovary may have one or more ovules. For example, you can usually see three rows of ovules in a cucumber slice (there should be some on demonstration, make sure you can see them). A few fruits, such as pineapples and figs, develop from numerous flowers that grow very close together; their ovary walls fusing during maturation. Fruits that develop from multiple flowers are called **multiple fruits**. An **aggregate fruit** is a group of simple fruits that are joined together. Aggregate fruits develop when a single flower has numerous ovaries attached to the same flower. Each ovary develops into a separate fruit, but since the fruits are all attached to a single receptacle (the platform at the tip of the stem) they appear to be a single fruit. Blackberries and raspberries are examples of aggregate fruits. Strawberries are also aggregate fruits where each 'seed' is actually a dry ovary containing a seed.

As the ovary of a fleshy fruit ripens and grows, it also differentiates into three layers. Collectively the layers are called the **pericarp**. “Carp” means fruit, so the outer layer of the fruit is called the **exocarp**. The middle layer the **mesocarp**, and the inner layer the **endocarp**. (See the figure below detailing the parts of a peach fruit). The differences among the pericarps of various fleshy fruits are useful in classifying them.





In this portion of the exercise, you will use a dichotomous key to classify fruits. A **dichotomous key** is a tool developed by biologists to identify organisms into groups. There are keys for all sorts of things like birds, plants, mushrooms, and sea shells. You will use a fruit key (since a mushroom key won't really help you here). A key is constructed to lead you through a series of comparisons. At each step you will choose a statement that best describes the sample you are trying to identify. As this process is repeated, the classification is increasingly narrowed until you obtain the answer.

Below is a key to botanical names of some fleshy fruits (dry fruits like peanuts not included). To use the key, examine a fruit and select the better of the two alternatives for number 1. Is the fruit best described by 1a or 1b? Continue with the choices listed below the alternative that you selected. For example, if you selected 1a, your next choice is between 2a and 2b below 1a. A plum would key out as follows: The endocarp is not fleshy since it is a stony pit, choose 1b (Go to 4). The endocarp is stony rather than papery: under 4, choose 4a. Plums are drupes. Another example: a pumpkin. The endocarp is fleshy (when you scoop out the inside of a pumpkin, the seeds are not separated from the rest of the fruit by a stony or papery tissue): choose 1a. The exocarp is thickened: Choose 2b. The exocarp is not easily peeled away from the rest of the fruit (ever tried to peel a pumpkin?): choose 3b. The pumpkin is a Pepo.

Key out some of the fruits provided by your instructor and write your answers in the table at the top of the next page. Make sure you can do this; you may have to demonstrate on an exam.

Key to simple fleshy fruits

1. How would you describe the endocarp?
   a. The endocarp is fleshy or pulpy……..Go to 2
   b. The endocarp is not fleshy……Go to 4

2. How would you describe the exocarp?
   a. The exocarp is thin and skin-like……..…….....**Berry**
   b. The exocarp is thickened…….....Go to 3

3. Describe the exocarp in more detail.
   a. The exocarp and mesocarp are leathery and easily peeled away from the rest of the fruit. The carpels contain large, juice-filled hairs.....**Hesperidium**
   b. The exocarp is thick, but not leathery, and cannot easily be separated from the rest of the fruit……..**Pepo**

4. How would you describe the endocarp?
   a. The endocarp is stony……**Drupe**
   b. The endocarp is a tough papery membrane……...**Pome**

Common name	Endocarp	Exocarp	Mesocarp	Botanical term
Plum	stony	Skin-like, thin	fleshy	drupe

You should be able to answer the following questions.

1. Some of the fruits that you keyed out are better known to you as “vegetables”. There is no botanical definition of a vegetable. Write out your definition of a vegetable, and list some vegetables according to your definition.

2. Based on the botanical definition of a fruit, what is the best way to distinguish a fruit from a vegetable?

C. Seed dispersal. Many fruits and seed coats (the layer of tissue covering the seed) are adapted for ensuring that the seeds are carried away from the parent plant, a process known as **seed dispersal**. The modifications for seed dispersal parallel the modifications of flowers for pollination. Animal agents may be employed, and plants use color and nutritional rewards to attract the animals to their fruits. Fleshy fruits, such as peaches, are meant to be eaten. The animal digests the fleshy part, the seed, in this case protected within the endocarp, passes unharmed through the gut and is deposited some distance from the parent plant. In other fruits, animals may consume some seeds while others are buried and forgotten. Animals are more passive participants in another scheme of seed dispersal, in which the seed coats are adapted to latch onto the fur of passing animals. These plants have names that describe the seed coats, such as burrs, sticktights and beggar-ticks. Some plants depend on dispersal by the wind. Typically they produce many light seeds and the seed coat forms a structure that can be picked up easily and carried along by the breeze.

Follow the procedure below and then answer the questions in italics.

1. Examine the seeds of dandelion flowers and maple trees. Both are wind-adapted in different ways. Try dropping them both from high places. *Which do you think would travel farthest in still air? Which in a strong wind? Why?*

2. Now observe the fruits and seeds on display. Discuss with your group or as a class the likely dispersal mechanism of each type. *In the table below, record the name and probable dispersal agent of each plant and list the characteristics that helped you decide on the dispersal mechanism.*

Plant	Dispersal mechanism	Characteristics

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