

Plant Reproduction

Objectives

- ★ To gain an understanding of how the anatomy of a flower is related to the process of plant reproduction.
- ★ To test which propagule (seed or fruit) characteristics contribute to effective dispersal by wind or animals.

I. Flower Dissection

While there are many types of plants, only **angiosperms** have flowers. Flowers have different adaptations which help increase the chances of the plant reproducing. For instance, some angiosperms, like grasses, are adapted for wind pollination, while others have showy flowers that attract **pollinators**. Wind or pollinators carry **pollen** (containing male gametes) from one flower to another of the same species, which allows the pollen to fertilize egg cells of the ovule to produce an embryo. If this pollen is transferred between flowers on different individual plants, this is known as **cross-pollination**. Some angiosperms may **self-fertilize** if pollen from a flower is transferred to egg cells on the same plant, or even within the same flower.

Many flowers contain both the male and the female sex organs surrounded by petals. If a flower contains both male and female parts, botanists call them **perfect flowers**. Most flowers (roughly 85%) are perfect flowers and are able to self-fertilize. **Imperfect flowers** contain either male or female parts, but not both, and therefore, a single flower cannot self-fertilize.

The floral parts are arranged in whorls or rings. Study the picture below to see this arrangement. Some species of flowers lack one or more of these rings of structures.

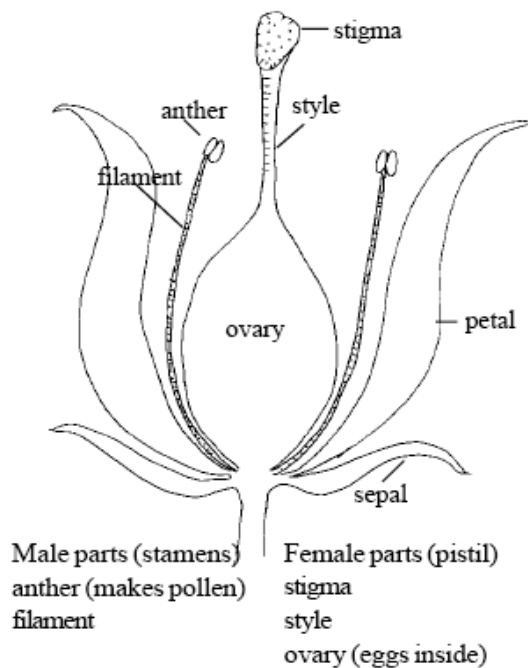


Figure 1

Angiosperms can be either **monocots** or **dicots**, which refers to how many cotyledons (or seed leaves) are found in seed at germination. The seeds in monocots have only one cotyledon (or seed leaf), while dicots seeds contain two cotyledons. Leaf and floral patterns also vary between monocots and dicots.

Procedure

Work individually or in pairs (ask your instructor) for this activity.

As you dissect your flower, you will attach the parts of the flower to your lab report. Each pair will turn in separate lab reports, one of which will have the flower parts, and one will have sketches. Please be sure to indicate who your partner is on your lab report.

1. Obtain a large flower to examine.
2. Look for the **sepals** of your flower.
 - a. The sepals are typically on the outside of the flower and are often green.
 - b. They help protect the bud before it opens.
3. As you dissect from the outside inward, the **petals** compose the next "ring" of flower structures.
 - a. Remove the petals and examine the texture and color of the petals using a microscope.
4. The structures inside of a flower produce the **gametes** (eggs or pollen).
5. Working inwards, the "ring" you encounter will be the **stamens**. Stamens are the male reproductive parts of the flower.
 - a. Removal of the petals will expose the stamens. If necessary, use a razor blade or scalpel to help expose the internal structures.
 - b. How many stamens do you see in your flower?
 - c. The stamens each have an **anther** at the top of the **filament** stalk. Pollen grains are released from the anther. Inside of each pollen grain there are two **haploid sperm** nuclei.
6. Make a wet mount of the *pollen grains from your flower* and view using the compound microscope. Make a second wet mount of *pollen from a pine tree* and view on a second microscope. (You may need to view a prepared slide of pine tree pollen if fresh pollen is unavailable.) Compare the pollen from the flowering plant and the pollen from the pine tree. How do they differ? What can you hypothesize about the method used to move pollen?
7. Making up the innermost ring of structures is one or more **carpels**.
 - a. A carpel is the female reproductive flower part. A flower may have one or more carpels, either single or fused. A single carpel or a group of fused carpels is also known as a **pistil**.
 - b. To see the carpel clearly, make sure the flower is separated from the sepals and base.
 - c. Notice that the carpel has three parts: a sticky **stigma** at the top, a long shaft called a **style**, and an **ovary** at the bottom. Cut open the carpel to see the ovary. The ovary contains ovules, which will develop into seeds. These ovules are made of 8 haploid cells, including two **haploid eggs**. Use the dissecting microscope to see the ovules.
 - d. Why do you think the stigma is sticky?

8. Once a pollen grain has become stuck onto a stigma, it begins to grow a tube through which the sperm nuclei travel down to the ovary. There, one of the haploid sperm nuclei from the pollen fertilizes the haploid egg cells to produce a **diploid zygote**.
9. You can usually characterize your flower as monocot or dicot by looking at its physical characteristics.
 - a. The floral parts in a monocot generally occur in multiples of three and the leaves have parallel veins.
 - b. In dicots, floral parts are usually in multiples of four or five and leaves have branched veins.

II. Seed Dispersal

Angiosperms (flowering plants) and **gymnosperms** (seed plants) both produce seeds. Following pollination, the fertilized egg will develop into an embryo enclosed in a protective seed coat – this is the **seed**. These seeds generally need to disperse to a new place to germinate. In gymnosperms, these seeds are unprotected (gymnosperm means naked seed). In angiosperms (vessel seeds), there is tissue surrounding the seed that protects it and helps it disperse. These tissues can be hard and dry or soft and fleshy. Individual seeds, or entire fruits, are called **propagules**, and show various adaptations for seed dispersal, such as the following--

Wind: Some plants produce propagules that can use the wind to carry the seeds away from the parent tree to a suitable place for germination and growth.

Animals: Animals can help spread seeds in several ways. In some cases, the seeds are surrounded by a fruit. When an animal eats the fruit, it is unable to digest the seeds and the seeds are expelled in the animals' feces. Some animals bury seeds to store them. If these seeds are not eaten, they can germinate. Animals with fur can also help plants disperse their seeds. Propagules may attach to an animal's fur. If the seed falls off in a suitable environment, it will germinate.

Water: Plants that are located near water can use it to spread their seeds. The propagule drops into the water and floats until the water pushes it onto the shore. If the environment is suitable, the seed will germinate.

Procedure

Work in two groups per table for this activity

Wind Dispersal

1. Designate propagules #1, #2, #3, #4 and #5. Sketch each one in your lab report.
2. Set up the fan on the floor blowing horizontally across the room.
3. Establish a standard drop site above the fan and set up a meter stick or tape measure along the floor beneath the fan.
4. Each propagule model should be dropped at least four times from the same point above the fan.

- a. Experiment with your set-up to find the best height, and then use that height consistently for all trials.
5. Carry out four trials for each seed.
6. Record the time aloft and the distance traveled for each trial.
7. Calculate the average distance traveled and time aloft for each propagule.

Animal Dispersal

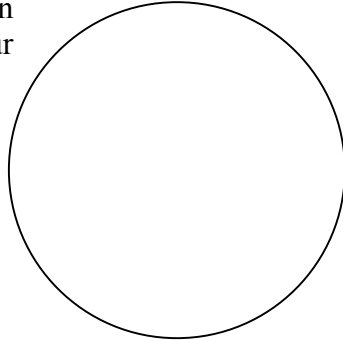
1. Use the same propagules as you used in the wind dispersal experiment.
2. Attach a large piece of felt (~1 m²) to a wall or cabinet door using double-sided tape.
3. Establish a standard distance away from the felt from which you will throw your propagules (~20-30 cm). Use that distance consistently for all trials.
4. Throw your first propagule at the felt with a gentle, underhand toss.
5. Establish a scoring system to quantitate how well the propagule stick to the felt using 1-5. (For example, 0 = no sticking and 5 = maximum sticking)
6. Carry out four trials for each propagule.
7. Record the sticking score for each trial.
8. Calculate the average sticking score for each propagule.

Name _____

Plant Reproduction

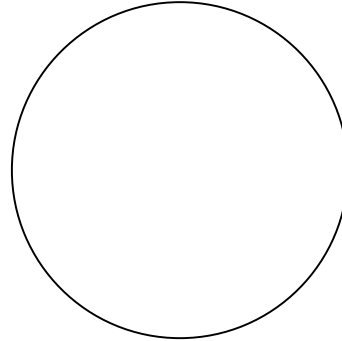
I. Flower Dissection

Sketch the pollen grains from your flower



Total magnification _____

Sketch the pollen grains from the pine tree



Total magnification _____

1. How do the flower pollen and the pine tree pollen differ?
2. Given these differences, what can you hypothesize about the how pollen from one plant travels to another plant in flowers versus pine trees?
3. Is your flower a perfect or imperfect flower? _____
What are the advantages and disadvantages of self-pollination vs. cross-pollination?
4. Is this flower a monocot or a dicot? _____
On what evidence do you base your conclusion?

5. Do some research on pollinators. You can take the “Pick the Pollinator Quiz” to online learn more about pollinators:
(<http://www.pbs.org/wgbh/nova/flower/pollinator.html>)

This table shows some of the co-evolutionary relationships between plants and pollinators:
(<http://www.fs.fed.us/wildflowers/pollinators/syndromes.shtml>)

You can learn more about how important pollinators are by watching this video:
(<http://pollinator.org/multimedia.htm>)

Now, hypothesize what type of animal pollinator most likely visits this flower and explain the evidence supporting your conclusion.
(Hint: Just because your flower is a perfect flower does not mean that it self-pollinates!)

Use clear tape to attach the flower parts in the appropriate squares, or sketch them.
Label each part. (*Make sure that the flower parts are securely attached!*)

Sepals	Petals
Female Flower Parts	Male Flower Parts

II. Seed Dispersal

Sketch the propagules that you have designated #1-#5 as carefully as you can.

Propagule #1 Propagule #2 Propagule #3 Propagule #4 Propagule #5

Enter data from your seed dispersal experiments in the tables below.

Seed Dispersal Data Table - WIND					
	Trial	Time Aloft (s)	Distance Traveled (cm)	Average Time Aloft (s)	Average Distance Traveled (cm)
Seed #1	#1				
	#2				
	#3				
	#4				
Seed #2	#1				
	#2				
	#3				
	#4				
Seed #3	#1				
	#2				
	#3				
	#4				
Seed #4	#1				
	#2				
	#3				
	#4				
Seed #5	#1				
	#2				
	#3				
	#4				



Be sure to check your instructor's website for extra credit questions and announcements.