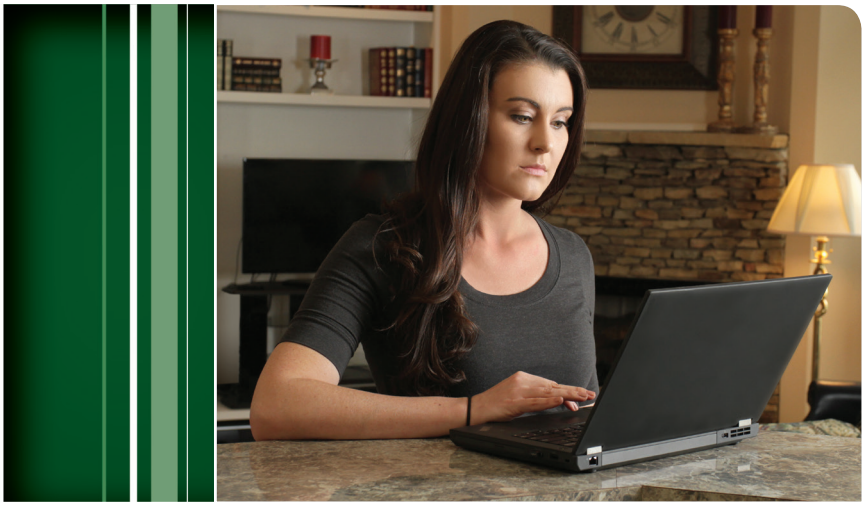
Anatomy of Flowering Plants



Investigation Manual

CAROLINA DISTANCE LEARNING

ANATOMY OF FLOWERING PLANTS

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Overview

Most plants undergo sexual reproduction as part of their life cycle. Pollination refers to the delivery of the pollen grain to the part of the flower containing the egg. Pollination mechanisms are important in plant propagation, adaptation, and evolution. In this investigation, the anatomy of several different flowers will be examined and plant reproduction, flower anatomy, and pollination will be discussed.

Outcomes

- Recognize the reproductive structures of a plant.
- Understand the anatomy of a flower and the function of the flower parts.
- Match flower types with pollination methods.
- Determine flower types.

Time Requirements

Preparation ..... 5 minutes
Activity 1: Flower Identification ..... 20 minutes
Activity 2: Extension Exercise ..... 20 minutes

Key

Personal protective equipment (PPE)


goggles


gloves


apron


follow link to video


photograph results and submit


stopwatch required


warning


corrosion


flammable


toxic


environment


health hazard

Made ADA compliant by
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Background

Plants can reproduce by two general means. **Asexual reproduction** occurs without recombination of genetic material. The most familiar type of asexual reproduction in plants is **vegetative reproduction**. Certain parts of the plant retain the ability to produce unspecialized tissue capable of regenerating all the tissues necessary to form a new, intact, and complete plant. In this regard, plants differ from most animals. An example of vegetative reproduction is the plant *Kalanchoe beharensis*. Leaves of this plant can produce numerous small, root-like structures called rootlets. When the leaf is shed from the "mother" plant, the rootlets will grow into the soil and develop into a new "daughter" plant. Another example is the production of buds in unusual places, sometimes in response to a wound. These are called adventitious buds. In some plants, they develop on roots and mature into **rhizomes**. Since the rhizome is a stem, it has nodes from which roots and shoots can grow and develop into a new plant some distance from the original. Once the new plant is established and capable of photosynthesizing, it is independent, and the rhizome can be severed. Vegetative reproduction enhances the continued success of a species in an environment from one year to the next. Vegetative reproduction is used to propagate a particular plant line that has desirable characteristics.

The second method of plant reproduction is **sexual** reproduction. Plant cells contain two full sets of DNA, or genetic material. Sexual reproduction requires a special kind of cell division called **meiosis** that produces cells with just one (complete) set of genes–**haploid** cells, called gametes. As part of sexual reproduction, male and female **gametes**, sperm and eggs, respectively, will combine to produce an **embryo**. The embryo has a normal, double set of DNA (diploid). The embryo of most plants is contained within a **seed**, which protects, and in some cases nourishes, the embryo.

Many of the larger plants in our world are either gymnosperms or angiosperms. These are the only two plant groups that produce seeds. The gametes of angiosperms develop in the **flower**, a specialized structure for sexual reproduction. A diagram of a typical flower can be seen in **Figure 1**. In many plants, one plant can produce both egg and sperm. In some cases, this results in **self-fertilization**, which means that two gametes from one plant can fuse. In most plants, however, two gametes from different plants combine, and the new individual is genetically distinct from either parent. The flower shown below is an example of a "perfect" flower; that is, it can produce both male and female gametes. This is not true for all flowers but is common. Perfect flowers have the potential for self-fertilization.

In the center of the flower is the **pistil**, the part of the flower that produces eggs and protects the developing seed. While this part of the flower is often called "female," the term is not strictly accurate. The **ovary** is the enlarged, lower part of the pistil visible in **Figure 1**. It contains the **ovules**, usually housed within **carpels**. A pistil can contain a single carpel (simple) or several carpels (compound). Each carpel contains a stigma, style, and ovary. Meiosis and egg production occur within the small ovules. The entire ovule will develop into a seed, and the fertilized egg will develop into an embryo. At the

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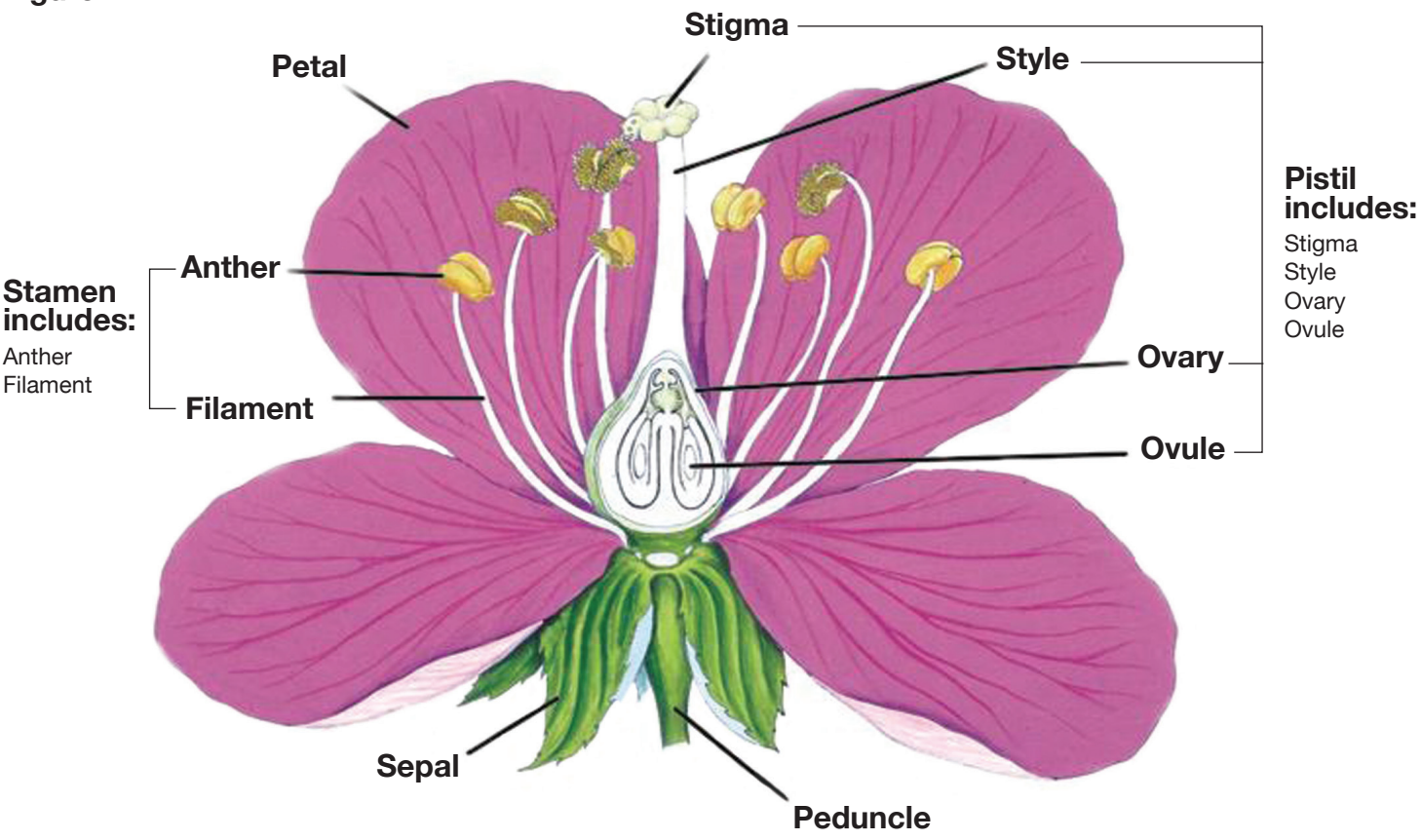
Background continued

Figure 1.



same time, while the seeds are maturing, the ovary matures into a **fruit**. Botanically speaking, many structures commonly called vegetables, such as tomatoes, beans, and cucumbers, are actually fruits.

The **stamens** are arranged around the pistil. Most flowers have one pistil and numerous stamens. Stamens have a long **filament** that supports the **anthers**. The anthers are composed of chambers where meiosis occurs. Meiosis produces the **pollen grain**, which contains the male gametes, or **sperm**.

You can see in **Figure 1** that the pistil contains a tube-like structure, the **style**, with a flat, broad structure on its upper surface called the **stigma**. The stigma will receive the **pollen grains**, which produce a **pollen tube** that grows down the style into the ovary. The sperm travels through this tube into the ovules where they fuse with the eggs.

The stamen and pistil are surrounded by **petals**, collectively called the corolla, usually arranged in a whorl. Beneath the petals, also usually arranged in a whorl, are small, usually green, leaflike structures called the **sepals**. Collectively, the sepals are called the **calyx**, which is Latin for "cup," because it resembles a cup holding the flower. The entire flower structure is located on a specialized branch called the **peduncle**, and the

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flower sits on the **receptacle** of the peduncle.

Some flowers may be associated with leaflike bracts. These are not actually part of the flower. In some cases, such as the common flower Dogwood (**Figure 2**), the bracts can be large and bright white while the petals are small and inconspicuous.

Some plants produce large flower heads that are made up of tiny florets. Sunflowers and other members of the aster family are examples of this kind of **composite flower**. They have an outer ring of ray florets that produce the outer ring of petal-like structures. Ray Florets are sterile. The inner disc florets have both male and female structures. In sunflowers the ovary produces the sunflower seeds. A single composite flower can produce hundreds of seeds.

Delivery of the pollen grain to the stigma is called **pollination**. Pollination can occur by many different mechanisms, and the structure of the stamens and pistils may be modified in ways that accommodate their method of pollination.

Figure 2.

Table 1 on page 6 shows some flower characteristics and how they are related to pollinators. There are a wide variety of colors, odors, shapes, and nectars in flowers to attract the "correct" pollinator. The flower and its type of pollination are finely tuned and specific. A plant's flowering may be timed to coincide with the availability of its insect or bird pollinator. Other plants modify the flower structure to accommodate the pollinator. For example, some flowers have long, narrow petals that are a good fit for the elongated beak of a hummingbird. These specific pollination mechanisms confer certain advantages. They increase the probability that the pollen will be delivered to the correct flower, and the plant may not need to produce as much pollen as a species without these specific mechanisms. Wind-pollinated plants, for example, produce a large amount of pollen, and much of it is delivered to the unintended plant, if it is delivered to a plant at all. Nonspecific delivery of pollen, though wasteful, is not in itself a problem. Different species of plants are not genetically compatible. This incompatibility normally prevents pollination and fertilization.

Insect and bird pollinators can be attracted to the flowers by odor, color, or both. A pollinator that is attracted by nectar will enter the flower to get to the nectar and carry some of the pollen away when it exits. When the pollinator visits another flower, it will pick up new pollen and leave some of the old pollen on the newly visited flower. If genetically compatible, pollination and fertilization may result. As discussed

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Background continued

Table 1. Flower characteristics and the type of pollinator that will be attracted.

Flower Characteristics	Pollinator						
	Wind	Birds	Butterflies	Bees	Flies	Beetles	Bats
Time when blooming	Day & night	Day	Day	Day	Day & night	Day	Night
Shape of flower	Small with no or small petals	Large funnel shaped with strong foundation	Narrow, large petal for landing	Shallow, large petals for landing	Shallow with funnel	Large, bowl-shaped	Bowl-shaped
Color	Green or brown	Orange, red, or white	Orange, red, or purple	Yellow, blue, or white	Dark brown or purple	Green or white	Green, white, or purple
Odor	None	None	Spicy or none	Mild and fresh	Putrid	Fruity or spicy	Strong fruity
Nectar	None	Deep inside flower, abundant	Deep inside flower, abundant	Commonly present	None	Some-times	Commonly present

earlier, many flowers produce both male and female gametes. These plants would be capable of self-pollination, depositing the pollen from the flower on the stigma of the same flower, which could then result in self-fertilization. Although this does occur, self-fertilization is believed to circumvent one of the major functions of sexual reproduction: to enhance genetic recombination and permit adaptation and evolution. Plants have developed a variety of different mechanisms to limit self-pollination. One mechanism is to make the stigma receptive to pollen at a different time from when the pollen is shed. Other plants have developed self-incompatibility mechanisms, in which a pollen protein is recognized as "self," and pollination is prevented.

Safety

There are no safety concerns for this lab.

Materials

Needed but not supplied:

- Pen or pencil
- A variety of flowers from outside or a local florist shop

ACTIVITY

ACTIVITY 1

A Flower Identification

1. Read all instructions.

Flower Characteristics	Pollinator						
	Wind	**Birds**	**Butterflies**	**Bees**	**Flies**	**Beetles**	**Bats**
Shape of flower	Small with no petals or small petals	Large, funnel-shaped with strong foundation	Narrow, large petal for landing	Shallow, large petals for landing	Shallow with funnel	Large, bowl-shaped	Bowl-shaped
Color	Green or brown	Orange, red, or white	Orange, red, or purple	Yellow, blue, or white	Dark brown or purple	Green or white	Green, white, or purple

2. For the following flowers, use the table above to identify the pollinator as well as the characteristic you used to base your choice.

Flower 1

Flower 2

Flower 3

continued on next page

ACTIVITY 1 continued

Flower 4

Flower 5

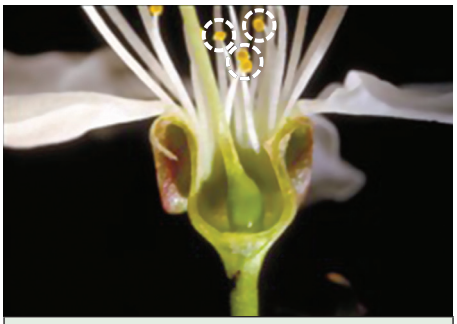
Flower 6

Flower 7

Flower 8

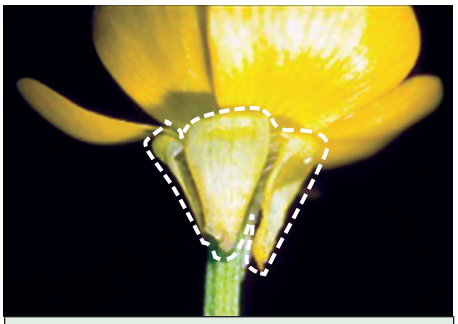
Flower 9

3. Identify the parts of the following flowers (found within the dotted lines):



Flower 10

Flower 11



Flower 12

continued on next page

4. Using the pictures of the flowers 1–12, fill in **Data Table 1**. Write "N/A" if a structure is not visible in the picture.

Data Table 1.

Flower Number	Number and color of petals	Flower shape	Stamen number	Pistil number
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				

ACTIVITY

ACTIVITY 2

A Extension Exercise

1. Collect several flowers from outside or a flower shop.
2. Clean and sanitize the work area.
3. Put the flowers on a paper towel.
4.  Take a picture of the flowers.
5. Pick up each flower and examine its exterior. Note the position of the flower, the number of flowers per receptacle, and the number per peduncle.
6. Carefully remove each petal.
7. Compare the number, position, and size of the petals for each plant. Record these data in **Data Table 2**.
8.  Open the flower and spread it out carefully on a new piece of paper towel. Make sure not to damage the stamen or pistil.
9.  Count the number of stamens for each flower. Record these data in **Data Table 2**.
10.  Count the number of pistils for each flower. Record these data in **Data Table 2**.

Disposal and Cleanup

1. Sanitize the workspace with isopropyl alcohol (or other non-bleach disinfectant) and paper towels. If this is insufficient for removing flower debris during cleanup, use soap and water, followed by more alcohol/disinfectant.

Data Table 2.

Flower Number	Number and color of petals	Flower shape	Stamen number	Pistil number

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