Teacher Guide: Pollination: Flower to Fruit

Learning Objectives

Students will …

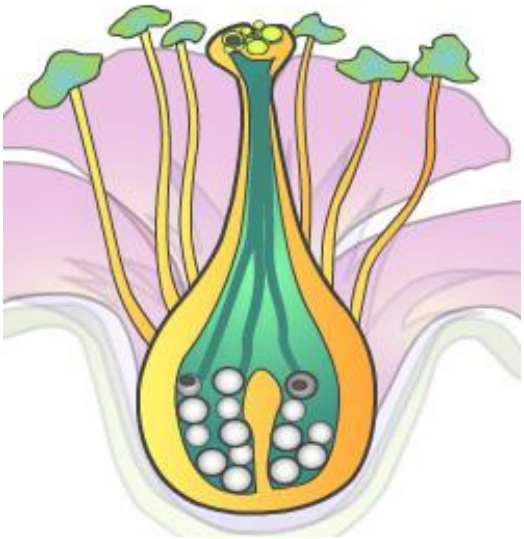
- Identify the parts of a flower and explain their functions.
- Describe the steps of plant reproduction.
- Explain the function of a fruit.
- Explain how pollen can get from one flower to another.

Vocabulary

anther, cross pollination, filament, fruit, nectar, ovary, ovule, pedicel, petal, pistil, pollen, pollen tube, pollination, receptacle, self pollination, sepal, stamen, stigma, style

Lesson Overview

The *Pollination: Flower to Fruit* Gizmo™ allows students to examine the processes of self pollination and cross pollination in flowering plants. Students discover the parts of the flower that are involved in reproduction as well as the role that each part plays in reproduction.



(Note: The related *Flower Pollination* Gizmo covers similar topics at a more basic level.)

The Student Exploration sheet contains two activities:

- Activity A – Students label a diagram and match flower parts to their functions.
- Activity B – Students explore the processes of pollination and fertilization.

Suggested Lesson Sequence

1. **Pre-Gizmo activity: Flower dissection** (15 – 30 minutes)
   Bring a variety of flowers for students to examine. Tulips and lilies are good choices because they have large, easily-identifiable pistils and stamens. Students can count the petals and observe the leaves to determine if the flower is a monocot or a dicot. (See the **Scientific Background**.) Students can dissect the pistil of each flower to find the ovary and ovules. The stickiness of the stigma can be tested by using it to lift a small piece of tissue paper. Students can collect pollen from the anthers to view under a microscope.

2. **Prior to using the Gizmo** (10 – 15 minutes)
   Before students are at the computers, pass out the Student Exploration sheets and ask students to complete the Prior Knowledge Questions. Discuss student answers as a class, but do not provide correct answers at this point. Afterwards, if possible, use a projector to introduce the Gizmo and demonstrate its basic operations. Demonstrate how to take a screenshot and paste the image into a blank document.

3. **Gizmo activities** (10 – 15 minutes per activity)
   Assign students to computers. Students can work individually or in small groups. Ask students to work through the activities in the Student Exploration using the Gizmo. Alternatively, you can use a projector and do the Exploration as a teacher-led activity.

4. **Discussion questions** (5 – 15 minutes)
   As students are working or just after they are done, discuss the following questions:
   - What is the function of flowers?
   - Why are flowers often brightly colored, fragrant, and full of sweet nectar?
   - What animals serve as pollinators?
   - What part of the flower eventually becomes a fruit?
   - Why is it helpful for a plant to have its fruit eaten by animals?
     - How does this process ensure that seeds are planted in a fertile environment?
   - How is plant reproduction similar to animal reproduction? How are they different?

5. **Follow-up activity: Plant a butterfly garden** (8 – 10 weeks)
   After bees, the most important pollinators are butterflies and hummingbirds. You can create a butterfly garden by using plant varieties that are preferred by butterflies. Choose plants that are utilized by adult butterflies for their nectar as well as other plants whose leaves are eaten by caterpillars. See the **Selected Web Resources** on the next page for helpful websites.

   While planning the garden, students can first find out which species of butterflies are common in your region. Appropriate plants can then be chosen and planted. Once the plants are established, students can observe the garden and gather data on which butterflies visit the garden.

Scientific Background

The *angiosperms*, or flowering plants, first appeared in the Cretaceous period, about 140 million years ago. Although they were relative newcomers in the 470-million-year history of land plants, angiosperms spread quickly and today represent the most common and diverse group of plants on the planet. Angiosperms include most deciduous trees, flowers, shrubs, and grasses. (Other major groups of plants include mosses, lichens, ferns, and *gymnosperms*—a group that includes conifers.)

The angiosperms are divided into two groups, *monocots* and *dicots*. Monocot flowers have petals in multiples of three. They also have leaves with parallel veins and a single seed leaf upon germination. Grasses (including grains such as corn and wheat), palms, and garden flowers such as tulips, irises, and lilies are monocots. Dicots have petals in multiples of four or five, branching veins, and two seed leaves during germination. Dicots include hardwood trees, shrubs, berry bushes, many vines, and garden flowers such as sunflowers, violets, and roses.

Like animals, flowering plants reproduce sexually by uniting sperm and egg cells. Sperm cells are contained within *pollen* grains. Egg cells are found within the *ovules*. The pollen grains are produced in the *anthers* that are located at the top of a long *filament*. The anther and filament

together comprise the *stamen*, which is the male sex organ of the flower. The *pistil*, or female sex organ, is composed of a sticky top surface called the *stigma*, a neck called the *style*, and an ovary that contains ovules. Many flowers contain both male and female organs, but others contain only male or female organs.

During *pollination*, pollen grains are transferred from the anther to the stigma. A tube grows from each pollen grain, penetrating the style and conveying the sperm cell to the ovule. Fertilization takes place when the nuclei of the sperm and egg unite within the ovule.

The vast majority of flowering plants undergo *cross pollination*, in which pollen is transferred from one flower to another. Bright colors, distinctive petal shapes, attractive scents, and stores of nectar within flowers attract pollinators such as bees, butterflies, hummingbirds, and even bats and lizards. Pollen from one flower sticks to the body of a pollinator and is transferred to another flower. Honeybees have special structures on their hind legs, called *pollen baskets*, that collect pollen and aid in this process (bees also use the pollen as a food source).

After fertilization, the ovary develops into a *fruit*. The purpose of the fruit is to protect the maturing seeds and aid in the dispersal of the seeds. This can be accomplished in several ways. Some fruits develop "wings" or fiber "parachutes" that help the seed travel through the air. Other fruits are covered with tiny spines that adhere to the fur or feathers of animals. Some fruits, such as coconuts, are adapted to float in the ocean for great distances. Many fruits consist of sweet flesh that is eaten by animals. The hard seeds embedded within the flesh pass through the digestive tract of an animal and eventually are eliminated. This has the dual advantage of dispersing the seed and planting it in a fertile pile of animal feces.

Biology Connection: One stinky flower

The world's largest single flower is *Rafflesia arnoldii*, nicknamed the "corpse flower" because it emits the stink of rotting flesh. *Rafflesia* is native to the jungles of Southeast Asia and is rarely seen in the wild.

In many ways, *Rafflesia* is more similar to a fungus than a plant. *Rafflesia* is a parasite that spends most of its life cycle embedded within the tissue of its host vines. *Rafflesia* has no roots, stems, leaves, or chlorophyll. On rare occasions, a bud will form and mature over the course of several months. When the flower appears, its odor attracts flies. Pollination only will occur if male and female flowers are close to one another for the few days that the flowers are viable. After this time the flowers rot and *Rafflesia* returns to its hidden lifestyle.

Selected Web Resources

Flower dissection: http://www.middleschoolscience.com/flower.pdf
Butterfly gardens: http://www.thebutterflysite.com/gardening.shtml
Angiosperm evolution: http://tolweb.org/angiosperms
Monocots vs. dicots: http://www.ucmp.berkeley.edu/glossary/gloss8/monocotdicot.html
Rafflesia sp.: http://homepages.wmich.edu/~tbarkman/rafflesia/Rafflesia.html

Related Gizmo:
Flower Pollination: http://www.explorelearning.com/gizmo/id?635