

Assignment Discovery Online Curriculum

Lesson title:

Plant Pollination

Grade level:

6-8, with adaptation for older students

Subject area:

Life Science

Duration:

One to two class periods (one period to discuss the structure and function of flowers and their parts and a second period to dissect the flowers and complete the data chart)

Objectives:

Students will

1. identify the different parts of a flower and understand their functions and
2. understand the importance of pollen for plant reproduction and diversity.

Materials:

- For the class: Dissecting microscope
- Computers with Internet access (optional but very helpful)
- Reference materials: books and encyclopedias

Each student will need the following:

- One flower from a school garden, a market, or donated from a florist. Good examples include daisies, carnations, lilies, pansies, violets, daffodils, tulips, hibiscus, gladioli, or petunias. Be sure to offer an assortment of flowers so that students can compare different species.
- Magnifying glass
- One copy of Classroom Activity Sheet: Flower Investigation
- One copy of Take-Home Activity Sheet: Pollen Counts (pages 1 and 2)

This lesson plan can be enhanced by purchasing a copy of the documentary *The Private Life of Plants: The Birds and the Bees* from our School Store. This documentary airs on the Discovery Channel on February 20, March 27, May 1, and June 5, 2001.

Procedures:

1. Discuss with students the structure of flowers. Begin by making a list of all the flower parts they know. Then show students a diagram of a flower and discuss the locations of the parts of the plants and their functions. The following parts should be included in this discussion: pistil, stigma, ovary, ovule, stamen, anther, petal, and sepal.

2. Once students are familiar with the different flower parts, have each student select a flower to study. Ask students to observe the flower with their eyes and with a magnifying glass. Make sure each student has a copy of the Classroom Activity Sheet: Flower Investigation on which to record observations. First, have them answer the following questions on their sheets:
 - How big is the flower?
 - What is the shape of the flower?
 - Does the flower have a color?
 - Does the flower have an odor?
 - What flower parts can you see?
3. As a class, brainstorm ways that plants are pollinated. Discuss how the structure of plants contributes to pollination. Ask students to consider whether they think insects, other animals, or the wind are involved in pollination. Then, on the basis of their observations and the class discussion, ask students to develop their own hypothesis about the mechanism of flower pollination. Have them write their hypothesis on their observation sheets.
4. Have students dissect the flower they chose. Although each student has his or her own flower, students can dissect their flowers in small groups so that they can share ideas and problem solve together. Each student should dissect his or her flower by carefully removing each part, starting from outside the flower and working inward, counting how many of each part is present on the flower. If a dissecting microscope is available, have students look at each part under the microscope.
5. Students should record their data on the Classroom Activity Sheet: Flower Investigation. Students could include a sample of the flower part on their chart by taping or gluing it in place. After students have identified all the flower parts, discuss the similarities they found among all the flowers. How were the female parts of each flower similar? How were the male parts similar? Based on this information, challenge students to conclude how each flower is pollinated.
6. If students need more information to determine how their plant is pollinated, suggest that they use reference materials available at school or visit the following Web site:
 - <http://www.bbg.org/gardening/botany/reproduction/pollinators.html>
7. After doing the necessary research, have students address their hypotheses. Were they correct, or did the experimentation and research prove otherwise? Have students write a conclusion to the activity on their Classroom Activity Sheet: Flower Investigation.

8. Assign the Take-Home Activity Sheet: Pollen Counts for homework. After five days, have students bring in their sheets and compare their findings. What did students learn about pollen in their area?

Adaptation for older students:

Have students prepare thin tissue samples to study under a dissecting or compound microscope. Students should be able to identify the ovules in an ovary and the pollen sacs in an anther. Estimate how many seeds the flower could produce by counting the number of ovules in the ovary.

Questions:

1. Compare and contrast the structure and function of the flower parts studied. What is similar in each flower? What varied? What functions do they have in common?
2. Explain how each flower studied would be pollinated. Which flowers would be best pollinated by a bee? Which would be best pollinated by the wind? How did the stigma of each flower adapt to trap pollen? Is one method of flower pollination more common among the flowers studied than another? Why?
3. The angiosperm (flowering) group is the largest, most successful plant group on Earth. Angiosperm species are also the youngest, evolving 125 million years ago. Debate possible reasons for their success. Provide a number of examples to support your hypothesis.
4. Compare the number of each flower part among the flowers studied. Was a pattern evident? Classify each flower as a monocot or a dicot. (Monocots have floral parts in multiples of three, and dicots have floral parts in multiples of four or five.)
5. Consider how the flowers you studied ensure that pollen grains reach the stigma, which is a necessary process for fertilization. Compare each flower's method of pollination. How successful is each method?
6. Discuss the benefits of animal pollination for both flowers and their animal pollinators. Explain how this codependence influences diversification. What disadvantages can be attributed to the mutual dependence of plants and animals?

Evaluation

Students should be able to label a diagram showing the parts of a flower, observe and describe their flowers using appropriate language, develop their own hypothesis based on their observations, create a detailed data chart, and verify their hypotheses based on class discussions and research. Use the following three-point rubric to evaluate students' work during this lesson:

Three points: labeled an accurate diagram of a flower, observed their flower, wrote detailed descriptions, completed all parts of the recording sheet, developed an hypothesis, performed the necessary research to verify the hypothesis, and wrote a complete conclusion to the investigation

Two points: identified, diagrammed, and labeled at least eight parts of a flower; observed their flower; wrote an adequate description; completed most of the recording sheet; developed an hypothesis; performed enough research to at least partially explain the hypothesis; and wrote an adequate conclusion to the investigation

One point: identified, diagrammed, and labeled at least five parts of a flower; observed their flower; wrote short descriptions; completed approximately one-half of the recording sheet; developed an hypothesis; performed some research about the hypothesis; and wrote a short paragraph or an outline summarizing the investigation

Extensions:

Dissect a Fruit

After studying a number of different flowers, have students study fruits. What part of the fruit was the ovary? What part of the fruit were the ovules? Compare the fruit structure of apples, berries, and olives (or other one-seeded fruits).

Design a Flower

Have students work in groups to design models of flowers that are pollinated various ways. One flower could mimic an insect to attract other insects for pollination. Another flower could rely on humans for pollination. Still another flower could be pollinated by the wind. Display the designs in the classroom with small captions describing the flower's unique characteristics.

Sex in your Garden

Angela Overy. Fulcrum Publishing, 1997.

With a touch of humor and more than 250 color photographs, the author of this appealing and entertaining book describes the reproductive processes of garden plants. She pays special attention to the ways plants attract pollinators, paralleling their activities with those of flirtatious humans, and relates how a variety of common pollinators accomplish their tasks.

The Forgotten Pollinators

Stephen L. Buchmann & Gary Paul Nabhan., Island Press, 1996.

The authors, one, a leading authority on plant pollination, and the other, an award-winning writer, provide an in-depth exploration of the relationships between plants and the animals and insects they depend upon for reproduction. Descriptions and detailed illustrations of their observations around the world make their discussions of ecology and botany come to life.

Web Links:

The Great Plant Escape

This site covers everything educators would want to teach their students about plants. Students are able to read information about plants and take a quiz at the end of the activity.

<http://www.urbanext.uiuc.edu/gpe/>

Pollination Adaptations

This site has a lot of information to support the content of the clip. The information is well presented graphically with pictures to hold the attention of the students.

http://koning.ecsu.ctstateu.edu/Plants_Human/pollenadapt.html

The Pollination Scene

This site illustrates the process of pollination by bees. It explains the difference between good pollination and bad pollination.

<http://users.aol.com/pollinator/polpage1.html>

Partners in Pollination

This site is provided by the Smithsonian Center for Education and Museum Studies. It is composed of many reproducible pages for use in the classroom

<http://educate.si.edu/resources/lessons/sjyc/pollen/start.html>

Vocabulary:

angiosperm

Definition: A class of vascular plants having seeds enclosed in an ovary.

Context: Angiosperms are in class of seed plants that produce flowers that become fruits.

anther

Definition: The part of the stamen that develops and contains the pollen.

Context: The stamen on a flower consists of a four-chambered sac called the anther in which pollen is produced.

dicot

Definition: A subclass of angiosperms with an embryo that contains two cotyledons, branching leaf veins, and flower parts in multiples of four or five.

Context: Dicots are angiosperms, such as dandelions, carnations, and most deciduous trees, that have flower parts in multiples of four or five.

monocot

Definition: A subclass of seed plants with an embryo that contains one cotyledon, parallel leaf veins, and flower parts in multiples of three.

Context: Monocots are angiosperms, such as tulips and daffodils, that have flower parts in multiples of three.

nectar

Definition: Sweet liquid secreted by flowers that bees use to make honey.

Context: A sweet-smelling substance, called nectar, is produced in some flowers to attract insects, which help pollinate the flower.

ovule

Definition: The outgrowth of the ovary of a plant that encloses an embryo sac; the part of the plant that is pollinated and grows into seeds.

Context: After being pollinated, many of the small ovules in the flower's ovary will become seeds, which, when planted, can grow into new flowering plants.

petal

Definition: One of the modified leaves of a flower that protects its reproductive organs.

Context: The petals of a flower enclose and protect the flower's reproductive organs.

pistil

Definition: The seed-bearing organ of a plant that consists of the ovary and its appendages.

Context: The pistil of a flower encloses the ovary, the part of a flower that produces seeds.

pollen

Definition: Fine powder dust that contains the sperm from a male plant.

Context: Male flower parts, called stamens, produce pollen in sacs in the anther. The anther bursts open and releases many pollen grains, which contain a sperm nucleus for fertilization.

pollination

Definition: Transfer of pollen from the anther of a stamen to the ovule of a flower.

Context: For flower reproduction to occur, pollen from the male anther is transferred to the stigma, found in the pistil. Wind, water, and insects can help pollination occur.

stigma

Definition: The part of a flower's pistil where the pollen grains are germinated.

Context: The pollen grains enter the pistil and are germinated in the flower's stigma.

Academic Standards:**Grade level:**

6-8

Subject area:

Life Science

Standard:

Knows about the diversity and unity that characterize life.

Benchmark:

Knows that animals and plants have a great variety of body plans and internal structures that serve specific functions for survival (e.g., digestive structures in vertebrates, invertebrates, unicellular organisms; leaves and stems in photosynthesis and mineral transport in plants).

Grade Level:

6-8

Subject Area:

Life Science

Standard:

Knows about the diversity and unity that characterize life.

Benchmark:

Knows that unity exists among organisms that look very different from one another (e.g., similarity of internal structures in different organisms; similarity of chemical processes in different organisms; evidence of common ancestry).

Grade Level:

6-8

Subject Area:

Life Science

Standard:

Knows the general structure and functions of cells in organisms.

Benchmark:

Knows the levels of organization in living systems, including cells, tissues, organs, organ systems, whole organisms, and ecosystems, and the complementary nature of structure and function at each level.

Credit:

Mary C. Cahill, middle school science coordinator, Potomac School, McLean, Virginia.

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Flower Investigation

Flower: _____

I. Initial Observations

1. What is the width and height of your flower? Measure each with a ruler.
2. What is the shape of your flower?
3. Does your flower have a color?
4. Does your flower have an odor?
5. What flower parts can you see?

II. Hypothesis

How is your flower pollinated?

III. Flower Parts

As you dissect your flower, record your findings here.

| Flower Part | How Many Parts Present | Description of Structure | Description of Function | Sample (glue or tape) |
|-------------|------------------------|--------------------------|-------------------------|-----------------------|
| | | | | |
| | | | | |
| | | | | |
| | | | | |

IV. Conclusion: Was your hypothesis correct? If not, how is your flower pollinated?
(Write your answer on the back.)

Pollen Counts

As you learned in class, pollen is a necessary ingredient in flower reproduction, but this potent powder can be pretty annoying to most people with allergies. That's why scientists keep track of the amount of pollen in the air and report daily "pollen counts" during the pollen season, which runs from late February through the middle of October in most parts of the United States. This information is often included in local weather reports. In this activity, you'll track the pollen counts reported in your area, then take your own pollen counts from around your home. To do this, you'll make your own "pollen catcher" to collect pollen, then (with the help of a magnifying glass or a microscope) count the pollen grain by grain.

1. Review the Facts

- For flower reproduction to occur, pollen grains must be released from the male anther of flowers.
- Many flowers produce hundreds or thousands of grains that are released into the air.
- Each plant produces its own unique pollen grain.
- Grains can vary in shape, size, and the type of extensions off of their walls.
- A pollen count is the number of pollen grains per cubic meter on a given day.

2. Create Five Pollen Catchers (one for each day of your study)

* Use a metric ruler and a black marker to draw a small 1 x 1 cm square in the middle of each of five index cards. Fill in the square with your black marker. You will be counting the pollen in this square area.

* On each index card, completely cover the black square with a piece of double-sided tape. You can also use a loop with regular tape. Just be sure the black square is covered.

* Each day of your study, place a new pollen catcher in the same protected area outside your home, such as a porch. The card should be exposed to wind but not rain. You may want to use a brick or rock to keep your pollen catcher from flying away.

3. Complete the Chart

- For five days, record the following information on your Pollen Recording Chart: date, temperature, weather conditions, published pollen count (from your local paper).
- Next, estimate the number of pollen grains collected in the black square on your pollen catcher. Note: Use a microscope or magnifying glass to count the number of grains on your pollen catcher. Some grains are really small, but others are big enough to see with your eyes.
- Remember, your pollen count will be very different from the official pollen count from your paper. An official pollen count is the number of pollen grains in a cubic meter on a given day. Your pollen count is the number of pollen grains collected on a square centimeter. But you should still notice similar patterns between the two pollen counts.
- After five days, bring your chart to school and compare your count to that of your classmates and to the published pollen count. Did the pollen count change with different weather conditions?

Continued

Pollen Counts: Pollen Recording Chart

For five days, record the pollen count recorded in your local paper, while taking your own pollen count with the pollen catcher you made. Be sure to record the temperature and weather conditions and watch for any patterns between pollen count and weather.

| Date | Temperature | Weather Conditions (Precipitation) | Published Pollen Count (from your local paper) | Estimated Pollen Count (from your pollen catcher) |
|-------|-------------|------------------------------------|--|---|
| Day 1 | | | | |
| Day 2 | | | | |
| Day 3 | | | | |
| Day 4 | | | | |
| Day 5 | | | | |