Flowering Plant Reproduction at the Tallgrass Prairie National Preserve

Date: July, 2016

Overview:

In this lesson, students explore the reproductive functions of flowers by participating in a flower dissection lab. Students will then apply their knowledge to flowering plants at the Tallgrass Prairie National Preserve or other natural area.

Suggested Time Allowance: 1 hour – in class work (more with extensions), 1-2 hours field work.

Flowering Plants - Background Information

The different parts of flowers are specialized to help plants reproduce as efficiently as possible. There is a female part of the flower, and a male part of the flower. The female part of the flower is in the center (point), and is made up of the ovary, the style, and the stigma. The stigma is sticky and captures the pollen from other flowers (sometimes carried on the legs and abdomen of pollinators such as bees, butterflies, hummingbirds etc.). The pollen germinates on the stigma and travels down the inside of the style, toward the ovary. Once the pollen reaches the ovary, it combines with the female gamete to make a seed, or ovule. The male part of the flower is the anther, stamen and filament. The anther carries the pollen, which fertilizes the female parts of the flower. The stamen and the filament hold up the anther. The petals are the colorful structures that help the flower to attract pollinators. Sepals are like petals, usually attaching below the petals on the receptacle. The receptacle is the part of the flower that is left once the flower has been fertilized, and the petals fall off. This part of the flower swells as the seeds develop. The peduncle is the junction between the receptacle and the stem of the flower.

Vocabulary :

Anther – Forms pollen grains.

Filament – Supports the anther.

Ovule – Found inside the ovary and after fertilization develop into seeds.

Ovary – The lower, often times enlarged part of the pistil, which contains the egg cells and produces the seeds. The ovary becomes the fruit.

Petals – Leaf-like, often colorful part of the plant that surrounds the reproductive parts of the flower and make the flower conspicuous to pollinators. Petals collectively form the corolla.

Pistil – The female part of the flower, which is comprised of three parts – stigma, style, and ovary.

Pollen – Fine powder dust that contains the sperm from a male plant.

Pollination - Transfer of pollen from the anther of a stamen to the ovule of a flower.

Sepals – Green leaf-like structures that protect the flower bud. Collectively sepals are referred to as the calyx. Sometimes sepals are colorful like the petals.

Stamens – The male parts of the flower that produces pollen grains. Stamens consist of a filament and an anther.

Ovary – The lower, often times enlarged part of the pistil, which contains the egg cells and produces the seeds. The ovary becomes the fruit.

Stigma – Where pollen grains land on the pistil.

Style – Connects the stigma and ovary. Pollen grains travel to the ovary via the style.

Subject/grade level:

Science/grades 4-12

Materials: (one per pair)

- Dissection microscope (optional)
- Hand lens
- Computer/device with internet access
- Flowers with simple structures (lilies, tulips, irises, daisies, carnations, pansies, violets, daffodils, hibiscus, gladioli, petunias etc.). A variety for comparison is good.
- dissection pan
- Scissors
- Scalpel
- Tweezers
- Rulers
- Flower Parts Handout
- Flower drawing data sheet
- pens/pencils/colored pencils
- Reference materials: books and encyclopedias
- Copy of Classroom Activity Sheet: Flower Investigation
- List of regional native plant and animal species. This link takes you to an excellent website of Kansas wildflowers and grasses by Mike Haddock: http://www.kswildflower.org/

Extensions/Resources:

An excellent PowerPoint slide show on pollinators and their importance:
"Power of Pollinators" by Lindsay Rogers, Nebraska Game & Parks Commission
Nebraska Project WILD is found at this link: Power-of-Pollinators.pdf

A detailed "Pollinator Syndrome" table with many examples and information on plant/pollinator interactions from the North American Pollinator Protection Campaign can be found at this link: Pollinator_Syndromes.pdf

An interactive webpage from the United States Department of Agriculture Forest Service on pollination and pollinators: http://www.fs.fed.us/wildflowers/pollinators/index.shtml

Next Generation Science Standards:
4-LS1-1, MS-LS1-4, HS-LS1-2

Common Core State Standards Connections:
ELA/Literacy – W.4.1, WHST.6-8.1, WHST.9-10.1, WHST.11-12.1

Lesson objectives:

Students will:

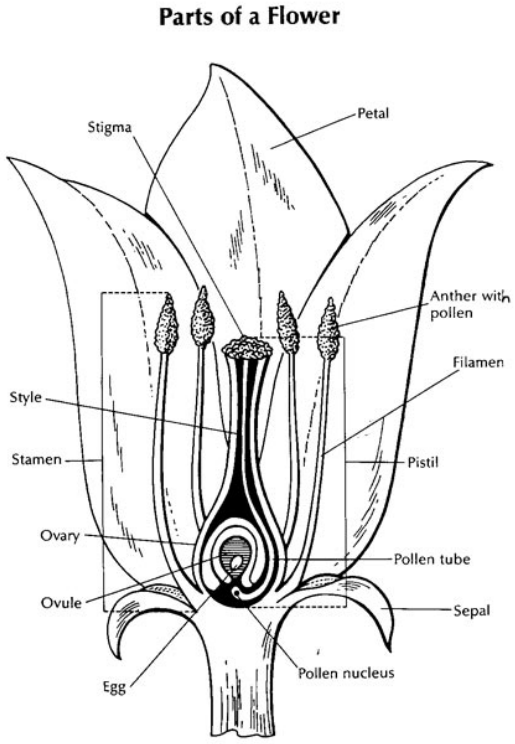
1. Identify the different parts of a flower and understand their functions in pollination.

2. Understand the importance of pollen for plant reproduction and diversity.

3. Dissect a flower, working from the outermost whorl to the innermost whorl.

4. Create and label a cross-section diagram of the dissected flower, including an explanation of how each part of the flower labeled affects flower reproduction.

5. Students will be able to distinguish flowers and their pollinators in the field.



Part 1 – In-class Flower Dissection

ENGAGEMENT

With a partner, *have students brainstorm a list of all the flower parts they know. Have them share with the class and make a classroom list of parts shared. Tell students that they are going to learn flower parts and their function.*

S*how 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.* Students can be given this information and be asked to research, draw, or label a blank flower diagram for further understanding.

EXPLORATION

Once students are familiar with the different flower parts, *have each student, or student pair, select a flower to study.*

Ask students to observe the flower with their eyes and with a magnifying glass only. Make sure each student has a copy of the Classroom Activity Sheet: Flower Investigation, on which to record observations.

Direct them to answer the following questions on their sheets:

- *How big is the flower?*
- *What is the shape of the flower?*
- *What color is the flower?*
- *Does the flower have an odor? Describe it.*
- *What flower parts, discussed earlier, can you see without dissecting it?*

Once they have answered the questions, *have students dissect the flower they chose.* Students can dissect their own flowers or in pairs so that they can share ideas and problem solve together.

Students *should dissect their 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.

Students *should record their data on the "Classroom Activity Sheet: Flower Investigation".*

You may *have students 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?*

Elaboration:

Have students, with a partner, *brainstorm ways that plants are pollinated.*

When they have finished discussing, *have them share their ideas with the class.*

Discuss, using student ideas as a guide, *how the structure of plants contribute to pollination.*

Ask students to consider the role of outside sources (insects, other animals, wind etc.) in pollination.

Then, on the basis of their observations and the class discussion, *ask students to develop their own hypothesis about how flower pollination occurs. Have them write their hypothesis on their observation sheets and be prepared to share and defend their hypothesis with the class.*

Time permitting*, have a class discussion on various student ideas about how flowers are pollinated.*

After discussing their hypotheses*, have students research how their plant is pollinated.*

Suggest that they use reference materials available at school, do an internet search, or visit the following website from the U.S Fish and Wildlife Service for information:

http://www.fs.fed.us/wildflowers/pollinators/What_is_Pollination/syndromes.shtml

After students have noted their research findings, *have them 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".

Extensions:

Dissect plant reproductive parts. *Have students prepare thin tissue samples to study under a dissecting or compound microscope.*

Have them draw and label what they see making sure it include the ovules in an ovary and the pollen sacs in an anther.

Ask students to estimate how many seeds the flower could produce by counting the number of ovules in the ovary.

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 peaches (or other one-seeded fruits).*

Design a Flower

Have students work in groups to design models of flowers that are pollinated various ways. Examples could include mimicking an insect to attract other insects, flowers shaped for hummingbirds, wind pollination, or colors and smell to attract insects and other animals. *Have students display the designs in the classroom with small captions describing the flower's unique characteristics.*

Take-Home or in-class Activity Sheet: "Pollen Counts". *After five days, have students bring in their sheets and compare their findings. Review by asking students what they learned about pollen in their area.*

Evaluation:

Students should be able to (these may be imbedded in the procedure above):

- Label a diagram showing the parts of a flower.
- Observe and describe their flowers using appropriate language.
- Develop their own hypothesis on how pollination occurs based on observations.
- Create a detailed data chart, and verify their hypotheses based on class discussions and research.
- Compare and contrast the structure and function of the flower parts studied. Know what is similar in each flower? What varied? What functions do they have in common?
- Explain different ways flowers can be pollinated. What flowers would be best pollinated by a bee? Which would be best pollinated by the wind? Is one method of flower pollination more common among the flowers studied than another? Why?
- Compare the number of each flower part among the flowers studied.
- Discuss the benefits of animal pollination for both flowers and their animal pollinators.

Activity Sheet: Plant Pollination

Flower Investigation **Name:** _____

I. Initial Observations

Flower: _____

1. What is the width and height of your flower? (Include units)

   Width _____ Height _____

2. What is the shape of your flower?

_____

3. Does your flower have a color?

_____

4. Describe the odor of your flower. Do you consider it pleasant or unpleasant?

_____

5. What flower parts can you see?

_____

II. Hypothesis:

How is your flower pollinated?

_____

_____

III. Conclusion:

Was your hypothesis correct? If not, how is your flower pollinated?

_____

_____

IV. 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)

Part 2 – Flowering Plant Exploration at

Tallgrass Prairie National Preserve

Field trip to Tallgrass Prairie National Preserve in Chase County, Kansas (or other local prairie or natural area with flowering plants). Note: This activity must be done while flowers are blooming. This will vary with location but plants go dormant during winter on the Tallgrass Prairie National Preserve. The best time to observe flowering plants is early fall or late spring in Kansas and may vary from year to year. Call the preserve to ask if there are flowers blooming before you finalize a date. Please note that everything at the preserve is protected and must stay in place. No picking of flowers, plants, or removing anything from the site.

Please educate yourself and your students on the venomous, poisonous and allergy inducing plants and animals that may be encountered on your trip and be prepared for contact (rattlesnakes, poison ivy, ticks, mosquitos, bees etc.) with them. Be prepared for any allergic reaction and bring a first aid kit. Please identify students with severe bee sting allergies and make sure there is an Epipen close by. Also note: Please call ahead and schedule a time for your field trip at 620-273-8494 ext. 0. Bus tours of the prairie and tours of the historical and cultural landmarks (ranch house, barn, and outbuildings) located at the preserve may be able to be scheduled with prior arrangement. Rangers will be able to answer any questions you may have as well as recommend other activities/events located here and in the area.

Materials:

- Clipboards/pencils
- Field Trip Activity Sheet: Plant Pollination
- Hand lens
- ruler
- Reference materials/books, list of regional native plant and animal species. This link takes you to an excellent website of Kansas wildflowers and grasses by Mike Haddock: http://www.kswildflower.org/

Lesson Objectives:

Students will hypothesize and identify ways tallgrass prairie flowering plants are pollinated. Students will also reflect and communicate observations from the field trip.

Exploration

1) Using the Kansas Wildflower and Grasses website by Mike Haddock: http://www.kswildflower.org/ , or other resources, *have students pick 5 – 10 plants that will be flowering during your trip. Have students fill out Part I (hypothesis) of the Field Trip Activity Sheet: Plant Pollination, for each flower.* You may also assign flowers to each group to ensure that the flowers to be observed will be found on your trip. Note: if possible, hike the area or check with rangers/caretakers to ensure the flowers will be present to observe.

2) *Instruct students to spend 10 minutes observing a flower or group of flowers of each type that they (you) have chosen while hiking one of the trails.* The Southwind Nature Trail at the preserve offers easy accessibility, a variety of habitats and is near the preserve visitor center but there are others to choose from. *They should document the flower and animal (insect) types. Have them note types, numbers, and characteristics of pollinators that visit their flowers on the Field Trip Activity Sheet. Tell students to stay on the trail and to not disturb the pollinators they see. They should also note what the pollinators hang on to while feeding and if a flower was visited by more than one type of pollinator. You can also have students infer as to why a certain pollinator prefers a particular plant.*

3) When students are finished with the Field Trip Activity Sheet, *instruct them to reflect on their time and experiences on the field trip. Have them answer the questions on the Reflection worksheet.* This can be done at the park, on the bus ride home, or upon returning to the classroom.

Field Trip Activity Sheet: Plant Pollination

Flower Investigation **Name:** _____

I. Hypothesis:

How is your flower pollinated?

_____

_____

II. Observations

Flower: _____ Pollinator(s): _____

1. What is the width and height of your flower? (Include units)

Width _____ Height _____

2. What is the shape of your flower?

_____

3. What is the color of your flower?

_____

4. Describe the odor of your flower. Do you consider it pleasant or unpleasant?

_____

5. What flower parts can you see?

_____

III. Conclusion:

Was your hypothesis correct? If not, how is your flower pollinated?

_____

Field Trip Reflection

1. Having visited the Tallgrass Prairie National Preserve, or other natural area, note below, things you noticed with your senses.

2 things I saw _____ _____

2 things I heard _____ _____

2 things I smelled _____ _____

1 thing I touched _____ _____

Did you taste anything? _____

2. Draw a picture of something you saw today in the space below.

Extension Activity

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.

Review

• 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.

Procedure:

1. 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.

2. 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 answer the following questions.

1. How does your pollen count compare to that of your classmates?

   _____

   _____

2. How does your pollen count compare to that of the published site? Explain any differences.

   _____

   _____

   _____

   _____

3. Did the pollen count change with different weather conditions? Explain your observations.

   _____

   _____

   _____

   _____

Pollen Counts: Pollen Recording Chart

Name: _____

For five days, record the pollen count from www.pollen.org or other website or 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 relationships between pollen count and weather.

Date	Temp. (C)	Weather Conditions (Precip.)	Pollen Count (from website) published	Pollen Count (from pollen catcher) estimate	Difference between published and estimate
Day 1					
Day 2					
Day 3					
Day 4					
Day 5					