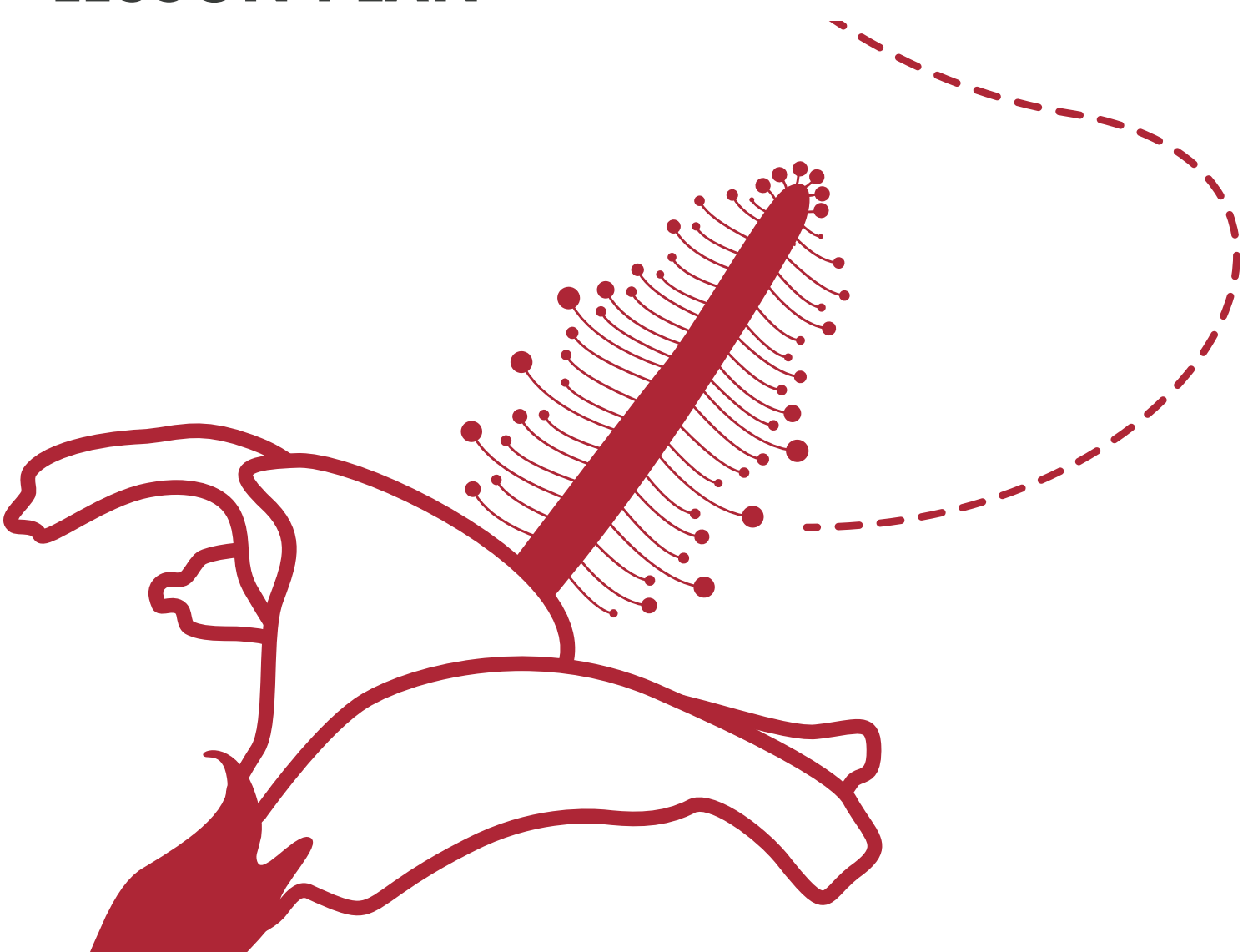


GARFIELD PARK
CONSERVATORY
ALLIANCE 

POLLINATION

LESSON PLAN



The Birds and the Bees

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Topic/Focus: Pollination and plant reproduction; intended for grades 6-8

Lesson Duration: 75 min

Objective(s): SWBAT investigate how pollination works and how plants and pollinators rely on each other for survival.

NGSS Standards: MS-LS1-4, MS-LS1-5, MS-LS2-1, MS-LS2-2

Vocabulary: Anther, filament, stamen, pollen, stigma, style (pollen tube), carpel (pistil), egg, ovule, ovary, seed, fruit, co-evolution; **Optional:** petal, sepal, receptacle

Materials: Flowers (lilies work well), dissecting materials, toothpicks, plant diagrams, gallery walk materials, powdered and plain doughnuts, paper towels

Advance Prep: Make sure copies are made, doughnuts are set up, gallery walk is prepared, flower dissection is ready (it might be helpful to dissect a flower on your own first)

TEACHER BACKGROUND INFO

The flowers of angiosperms (flowering plants) contain both male and female anatomy with both male and female gametes. The stamen, which contains the anther and the filament, is the male anatomy. The pollen, which contains the sperm, is produced in the anther. The stigma, style (pollen tube), ovule, and ovary are all the female anatomy. The eggs are produced and contained in the ovule. When pollinators, such as bees, visit a flower for its nectar, the bees inadvertently brush up against the anthers of the flower, picking up pollen. When the bees then travel to a different flower for more nectar, they (also inadvertently) deposit that pollen onto the new flower—we can now say that this new flower has been pollinated. When the pollen is on the stigma, it will travel down the pollen tube into the ovule, where it can fertilize the eggs. This will now become the seed. In order to protect the seeds, the ovary of the flower will become fleshy and meaty—this is what we know as fruit!

Birds, bees, butterflies, and flies are some of the world's most common pollinators. Pollinators are attracted to the flowers of a particular plant (usually through scent and/or attractive visual color). It is important to recognize that pollinators are not actually interested in pollinating plants – they are actually only interested in the flowers' nectar. Plants and their pollinators co-evolve; in other words, pollinators evolve better ways to access the nectar from the plant, while the plant evolves better ways of exposing its pollen to its pollinators.

ENGAGE (5 MIN)

- The Garfield Park Conservatory houses plants from all over the world in its 8 glass greenhouses. What are some obstacles you think these plants might face and how might Conservatory staff overcome them? Students can brainstorm independently, in pairs or small groups, or as a class.
 - ▶ Pollination is an obstacle for some plants. All of these plants live inside, but need pollinators in order to produce fruit. Some plants also have very specific pollinators that only live where the plants are naturally found.
 - ✧ Often, insects and other pollinators will be able to get inside the Conservatory through open windows, doors, etc. For plants with specific pollinators that only live where the plants are originally from, Chicago Park District staff can hand-pollinate these flowers.

The Birds and the Bees

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EXPLORE (15 MIN)

- What do you already know about how plants reproduce?
 - ▶ The first crucial step for most plant reproduction is pollination.
 - ✧ Have students do the Donut Pollination activity in pairs or groups.

EXPLAIN (15 MIN)

- After bees and insects inadvertently pick up pollen, when they fly to a different flower, what happens?
 - ▶ Pass out flowers. Which parts do you think are male? Which parts do you think are female?
- Talk through what pollination is. See if your students can model how it works by “pollinating” each others’ flowers: using a toothpick, take the pollen from the anther of one flower and put it on the stigma of the other flower. Connect back to the “Engage” exercise—this is how we can pollinate plants at the Conservatory whose natural pollinators live elsewhere!
 - ▶ How do you think the sperm in the pollen can fertilize the egg, which is contained in the ovule? Dissect the flowers and have students trace the path of the pollen. They can record this on the Parts of a Flower handout.
 - ✧ When the pollen, which contains the male gametes (sperm) lands on the stigma, it travels down the pollen tube down to the ovule, where it fertilizes the female gametes (eggs). The fertilized egg(s) now becomes the seed(s) and the ovaries become the fruit—the fleshy meat protects the developing seeds!

EXTEND (30 MIN)

- How do pollinators know which flowers to go to? What strategies do flowers have to attract the most pollinators?
 - ▶ Flowers can be particular colors or give off particular scents to attract pollinators, or grow in a shape that fits with the pollinator (i.e. hibiscus and hummingbird), though not all plant-pollinator relationships are so specific. This is why many plants in the Conservatory are pollinated naturally—when insects/birds get in, they can pollinate many flowers that are non-native to Chicago.
 - ▶ Students will participate in the Plant-Pollinator Stories gallery walk, filling out the template as they go. Alternatively, you can assign students/groups of students to a particular plant-pollinator story. Have them research the relationship and put together a poster displaying their findings. Students can then gallery walk each others’ posters.

The Birds and the Bees

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EVALUATE (10 MIN)

Students will complete exit ticket.

RESOURCES

Doughnut Pollination Activity
Parts of a Flower
Plant-Pollinator Stories Gallery Walk
Exit Ticket

Supplement this lesson plan with a visit to the Garfield Park Conservatory, where you can learn about different pollination stories and see these plants firsthand, with the help of our amazing resources! Register your group at <https://garfieldconservatory.org/group-visits/school-field-trips/>.

Name: _____

Date: _____

Donut Pollination

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Lab Activity:

In this activity, you will be a pollinator. Instead of pollinating flowers, you will be pollinating donuts!

Materials:

- 1 powdered donut
- 2 plates (1 for each donut)
- 1 plain donut

Directions:

Step 1: Make sure you have a powdered donut and a plain donut in front of you.

Step 2: Put your hands behind your back.

Step 3: Take a bite of your powdered donut without using your hands!

Step 4: Without wiping your mouth, take a bite of your plain donut...still don't use your hands!

Step 5: Look at your plain donut! What happened?

Questions:

1. What do you observe about your plain donut?

2. Let's compare this exercise to how actual pollination works with insects and flowers. Draw lines to match what happens in real pollination with what happened in this donut activity!

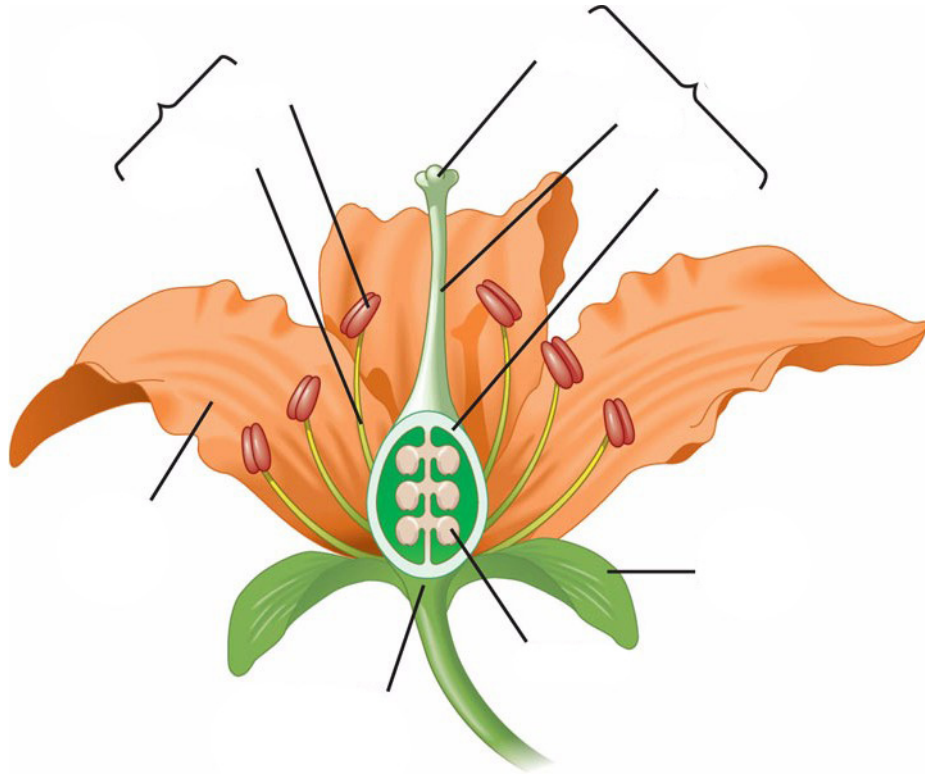
- | | |
|--|---------------------------------------|
| a. Pollen | e. You! |
| b. Pollinator | f. The powdered donut |
| c. The first flower visited by the pollinator | g. The plain donut |
| d. The second flower visited by the pollinator | h. The powder from the powdered donut |

Why do pollinators visit flowers? (Hint: it is not so that they can pick up pollen to spread around to other flowers!)

Parts of a Flower

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1. Label the diagram below!



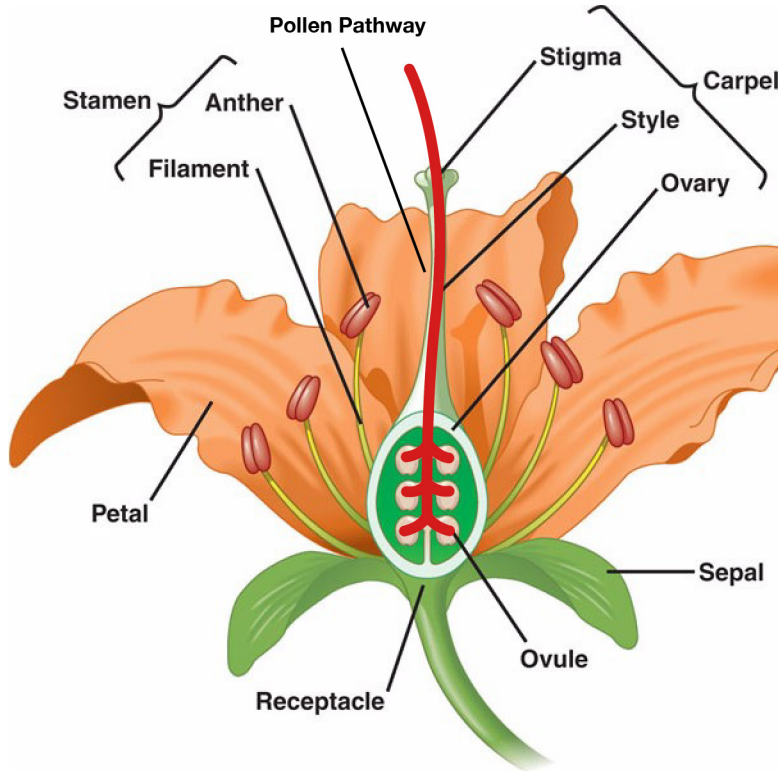
2. Let's say that this flower has just been pollinated. Where does the pollen go? Trace the pathway of the pollen and describe the pathway in words:

3. What happens when the pollen reaches its destination? Why is this important for the plant?

4. How is the structure of a flower suited for pollination and reproduction?

Teacher Key

1. See diagram:



2. Let's say that this flower has just been pollinated. Where does the pollen go? Trace the pathway of the pollen and describe the pathway in words:

The pollen will travel from the stigma down the style into the ovules that are inside the ovary.

3. What happens when the pollen reaches its destination? Why is this important for the plant?

When the pollen reaches the ovules, it will fertilize the eggs contained in the ovules. Once fertilization happens, seeds and fruit will develop. If dispersed properly under the right conditions, new plants will grow from these seeds!

4. How is the structure of a flower suited for pollination and reproduction?

The anther extends up from the flower, making it easier for pollinators to pick up pollen. The style is a straight, long pathway, which ensures the pollen will reach the ovary. The ovules are protected within the ovary, allowing for developing seeds to be protected.

Vanilla Vine



The Melipona bee is the only pollinator of the vanilla vine. Melipona bees live in Mexico near vanilla vines so they can be close by to get vanilla flower nectar. The plant's flowers only bloom for one day—since the Melipona bee lives close to vanilla, the plant “knows” the bee will be there to pollinate its flowers! When humans first tried to grow vanilla outside of Mexico, they did not succeed because there were no Melipona bees to pollinate the flowers. The only way to pollinate the vanilla vine outside of Mexico is by hand. This is a very delicate process that takes a lot of work, which is why vanilla is so expensive at the grocery store!

Chocolate Tree



The midge is the pollinator of the chocolate tree. This very tiny insect (nicknamed "no-see-um") is the only insect that has evolved to reach the nectar inside the complex, small chocolate tree flowers. Furthermore, they are most active at dusk and dawn, which is exactly when the flowers of the chocolate tree are in bloom. Finally, the flowers on the chocolate tree grow directly on the trunk of the tree so that the midges, which mostly live on the ground, do not have to travel as far to pollinate the flowers.

Hanging Lobster Claw



The lobster claw is a sneaky plant! It does not constantly produce nectar for pollinators. Instead, it only makes pollen at certain times for hummingbirds, the pollinator. Once a hummingbird drinks nectar from one hanging lobster claw, it will guard that plant from other hummingbirds while it waits for the plant to produce more nectar. These hummingbirds are extremely territorial, but the hummingbird's reliance on the plant's nectar ensures that the hanging lobster claw will be pollinated.

Gardenia



The gardenia's flowers are extremely fragrant, which serves to attract its main pollinator: moths. In fact, the gardenia smells even sweeter at night, which is when moths are the most active! The flowers are also a bright white color, which is attractive to moths. Additionally, moths are the perfect size for the gardenia's leaves, making it easy for moths to land on the plant to drink nectar.

Calabash Tree



The flowers of the calabash tree only bloom at night. They do this because bats, which are nocturnal, are the primary pollinators of the calabash tree! The flowers are cup-shaped, which is a good shape for the bats; if the flowers were long and tubular, the bats would not be able to reach the nectar. Finally, the calabash flowers emit a stinky smell...fortunately, bats are attracted to that stench!

Name:

Date:

Plant Pollinator Stories

We know that pollinators help plants by spreading plant pollen from one plant to another. We also know that plants help pollinators by giving them nectar to drink! Plants and pollinators have adapted, or co-evolved, to make the most of this partnership. Learn about some examples of this by completing your gallery walk! Take notes in the table below. Then, come to the Garfield Park Conservatory so you can see these plants for yourself!

Plant	Pollinator	What does the plant do to make sure it gets pollinated by its pollinator (shape, color, smell, or something else)?	How has the pollinator adapted to make sure it gets enough nectar (i.e. visits flowers at a certain time, has a body part that is shaped in a particular way)?

Which plant-pollinator relationship do you think is most interesting? Why?

Name:

Date:

Exit Ticket

1. Explain the following statement using an example: Pollination is helpful for both the plant and the pollinator.

2. Most of the gardens at the Garfield Park Conservatory are enclosed under glass. How do you think pollination happens at the Garfield Park Conservatory? Suggest at least 2 different ways in which pollination can occur.
