

## 2018 Investigation Teacher Instruction Sheet

**INVESTIGATION TITLE:** Pollinators and Plants, Perfect Partners

**Investigation Designers:** Kate Narita and Tiffany Davis

**Grade level:** 4

**Time Required:** five, 45-minute class periods.

- Day 1: engagement activities (pollinator game, class discussion, and pre-assessment)
- Day 2: begin investigation (review protocol, collect data, analyze and interpret data)
- Day 3: finish investigation (construct explanations and draw conclusions)
- Day 4: present findings
- Day 5: wrap-up and post-assessment

**Unit Context:**

This investigation is part of a larger unit called Operation Welcome Mat, an effort to welcome more pollinators to our schoolyard. The unit will culminate with students planting a pollinator garden on school grounds. The Perfect Partners investigation takes place in the middle of the unit.

Sequence	Investigation or Activity
1	Plant Detectives: how do you tell the difference between two plants? Students will observe plants that grow in the schoolyard, analyze plant structures and compare different classification schemes.
2	<b>Pollinators and Plants, Perfect Partners</b>
3	Home Sweet Home: what do plants look for in a home? Students will collect and analyze data on abiotic factors in the schoolyard ecosystem, including: soil moisture, soil pH, air temperature, soil temperature, and sunlight.
4	How Does Your Garden Grow: create a garden to attract a diverse group of pollinators to our schoolyard. Students will use data from all three investigations to choose site-appropriate plants, create a planting map, and plant the garden.

**Investigation Focus:**

Students will observe plant-pollinator interaction in the schoolyard and record data on the number and type of pollinators visiting specific plants. After drawing conclusions about how plants use different flower structures to attract different types of pollinators, students will apply what they have learned to a design challenge: can you “create” a plant that will attract a new pollinator to the schoolyard?

**State Learning Standards:**

- MA Science and Technology/Engineering Standards: 4-LS1-1: construct an argument that animals and plants have internal and external structures that support their survival, growth, behavior, and reproduction.
- MA Digital Literacy and Computer Science Standards: 3-5.CT.c.2 Collect and manipulate data to answer a question using a variety of computing methods (e.g., sorting, totaling, averaging) and tools (such as a spreadsheet) to collect, organize, graph, and analyze data.

**Learning Outcomes:**

- Use observation to collect and record qualitative and quantitative data.
- Graph and analyze which pollinators are attracted to which plants.
- Explain why specific pollinators are attracted to specific plants.
- Identify plant structures and how different plants use different structural elements to attract pollinators.
- Draw and label a plant that will attract a new pollinator to the schoolyard.

**Materials List:**

For the Pollination Game (engagement activity), you will need:

- Timer
- Two beach balls
- Colored, mini-post-it notes—white plus three other colors;
  - For round 1 of the game you will number post-its of one color: use numbers up to half of the total number of students and create two post-its for each number. For example, if you have 24 students you will need 24 post-its, use the numbers 1-12, and create two post-its for each number.
  - For rounds 2 of the game you will need three, different colored post-it notes; one post-it per student, and give a third of the class each color. For example, if you have 24 students, eight students will get pink post-its, eight students will get yellow post-its, and eight students will get blue post-its.
  - For round 3 of the game you will need white and more of the colored post-it notes; one post-it per student, hand out a mix of colors with fewer white post-its than colored post-its. For example, if you have 24 students, seven students will get pink post-its, seven students will get yellow post-its, seven students will get blue post-its, and three students will get white post-its.

Before beginning the investigation, explore the schoolyard to identify a good location for students to collect data. You want a sunny area with a variety of flowering plants. Also, wait for a warm day when pollinators will be active—60°F or warmer. Organize students into groups of three. The teacher will need a timer. Each student group will need one:

- Clipboard with one copy of the Student Instruction/Data Sheet
- Regular pencil or pack of colored pencils
- iPad or Chromebook (to video pollinator-plant interactions)

For optional finished early/extension activities:

- Device with an Internet connection for the NOVA Interactive: Pick the Pollinator, available at <http://www.pbs.org/wgbh/nova/nature/pollination-game.html>. Note: you must enable pop-ups and Flash for the game to work.
- Copies of the Chicago Botanical Garden Pollinator Match-Up activity, available at [https://www.chicagobotanic.org/sites/default/files/images/titan/Pollinator\\_match\\_up.pdf](https://www.chicagobotanic.org/sites/default/files/images/titan/Pollinator_match_up.pdf). Note: you might want to cover the answer key on the bottom before making copies.

### **Introduction/Background Information:**

In 2014 a Presidential Memorandum from the Obama White House raised the alarm about a “severe” decline in pollinator populations across the United States, and the threat that decline poses to the sustainability and biodiversity of our environment. In response, Massachusetts generated a Pollinator Protection Plan that details the extent of the problem in the state. The number of managed bees, wild bees, and monarch butterflies in Massachusetts has declined dramatically in the last twenty years. Seven species of wild bees, nineteen species of butterflies and moths, and nine species of beetles are now listed as endangered, threatened or of special concern. Both the Presidential Memorandum and the Massachusetts Pollinator Protection Plan highlight the important role that habitat plays in supporting pollinators.

As teachers, we view this crisis as an opportunity. Most schools include at least some outdoor space—a playground, playing fields, landscaped beds around the school building or parking lot, or strips of grass along a driveway or road. Making these spaces more pollinator friendly offers an opportunity to support pollinators and help our students appreciate their role as stewards of natural ecosystems. Most importantly, creating a pollinator garden gives students a meaningful context for learning NGSS practices and the cross-cutting concept structure and function—“the way in which an object or living thing is shaped and its substructure determine many of its properties and functions.”

Form and structure are key to creating the “match” between plant and animal that enables pollination. For example, plants with long, tube-like flowers attract insects with long tongues that can reach their pollen, like the miner bee. Poor fliers, like beetles, visit large, flat flowers with pollen that is close to the top of the flower. Flowering plants have co-evolved with their pollinators over many years; pollinators help their plant partners reproduce, and plants provide food for their animal partners.

### Engaging Experience:

- Start by playing the Pollination Game from SEP Lessons, available at <http://www.seplessons.org/node/799>).
- Check for understanding with a turn and talk, followed by a class discussion:
  - What is pollination and why is it important? [Answers: most plants can't pollinate themselves, plants that can't reproduce disappear.]
  - Is pollination easy or hard? Why? [Answers: hard, because the pollen must come from another plant of the same species, and not all plants can be pollinated by all pollinators.]
- Ask each student to draw and label a plant that will attract pollinators. This modeling activity will activate students' prior knowledge and provide baseline data for teachers.
- Early finishers? If you have devices that are connected to the Internet in your classroom, students can go online and try the PBS NOVA interactive Pollination Game, available at <http://www.pbs.org/wgbh/nova/nature/pollination-game.html>. If not, use the print Pollinator Match Up activity from the Chicago Botanic Garden, available at [https://www.chicagobotanic.org/sites/default/files/images/titan/Pollinator\\_matchup.pdf](https://www.chicagobotanic.org/sites/default/files/images/titan/Pollinator_matchup.pdf).

### Guiding Question(s):

1. Do plant structures affect the type of pollinator that visit a specific plant?
2. What are the different kinds of structures that plants use to attract pollinators?
3. Which pollinators are attracted to which plant structures and why?

### Investigation:

Divide the class into groups of three students and review the data collection protocol and page one of the Student Investigation Sheet.

- Choose three different plants located within our data collection area to observe. Note the location of each plant so that you can find it again. It may look different in a few weeks.
- Each student will have a different role at each plant: spotter, videographer, or recorder.
- The spotter chooses the plant and calls out the name of the insect and the location of the insect on the plant to the recorder. If the spotter doesn't know the name of insect, the spotter will call out a physical description of the insect for the recorder to note.
- The recorder draws the plant, tallies the insects and records the notes.
- The videographer videos the flower and any pollinators that stop by.
- You will observe each plant for five minutes. When I call time, switch jobs and move to your next plant. Once all groups are ready, I will start the timer again. Wait for the signal from me to begin your next observation.

Once students have collected data outside, head back to the classroom to complete pages two and three of the Student Investigation Sheet. Students will work in the same groups:

1. Analyze and interpret data. Note: students are not expected to identify plant and pollinator species, but should focus on counting pollinators by type (ants, bees, beetles, butterflies, flies and wasps) and analyzing plant structures. Groups should refer to their video recordings to resolve questions or disagreements about observations and data.
2. Construct explanations about why different plants attracted different pollinators.
3. Use evidence from their observations to draw conclusions about the relationship between plant structures and pollinators.

**Present Findings and Draw Conclusions:**

- Each student will create a bar graph of the plant that he/she chose to observe. The bar graph will visually display the number of pollinators found on each plant.
- Each group will partner with another group to share its graphs, arguments and evidence.
- Each group will use feedback from its partner group to improve its argument.
- Each group will present its findings to the class.

**Vocabulary:** definitions from Harcourt Science Dictionary and Enchanted Learning

- Flower—reproductive structures in flowering plants
- Pollination—transfer of pollen from the male part of a flower (stamen) to the female part (stigma)
- Structure—the arrangement of parts in an organism
- Composite Flower—a flower made of many, individual flowers, called florets, arranged around a wide, flat central disk
- Tubular Flower—a funnel-shaped flower that usually contains a lot of nectar
- Pollen—male reproductive cell of flowering plants and cone-bearing plants, produced in the anther of the flower
- Nectar—sweet liquid produced by flowers; provides food/energy for pollinators that drink it
- Insect—an animal that has three body parts and six legs; ants, bees, beetles and flies are all insects

**Assessment:**

- As a pre-activity assessment, students will individually draw and label a plant that will attract pollinators.
- The teacher will review each group's Student Investigation Sheet as an embedded activity assessment
- As a post-activity assessment, students will individually draw and label a plant that will attract a new pollinator to the schoolyard.

**Resources for Educators:**

- SEP Lessons [Pollination Game](#) (engagement activity)
- Finished early/extension activities:
  - PBS Nova Interactive: [Pick the Pollinator](#)
  - Chicago Botanic Garden: [Pollinator Match Up](#)

- *Pollinators of Native Plants: Attract, Observe and Identify Pollinators and Beneficial Insects with Native Plants* by Heather Holm has comprehensive information about plant structure and is a plant/insect guide all in one.

## Resources for Students

- *100 Bugs! A Counting Book* by Kate Narita and Suzanne Kaufman features ten different insects and flowers. The scientific backmatter lends itself to a discussion of the partnership between plants and insects. Students could analyze which pollinator groups are represented in the back matter and which ones are missing.
- *Bugged: How Insects Changed History* by Sarah Albee is an irreverent, historical account of how insects have shaped human's lives.
- *Flowers Are Calling*, by Rita Gray and Kenard Pak highlights the cooperation between plants, animals and insects in a forest ecosystem.
- *Me and Marvin Gardens* by Amy Sarig King is a science fiction novel that highlights how human actions change the environment, and that even small actions such as bringing one's own bags and forgoing plastic bags at the grocery store have a positive impact. In the end, the main character, Obe, convinces his family to create a garden on the remainder of their family land.
- *Moth and Wasp, Soil and Ocean* by Sigrid Schmalzer and illustrated by Melanie Linden Chan tells the story of Chinese scientist, Pu Zhelong, through the eyes of a farm boy who decides to become a scientist himself. Zhelong is known for teaching peasants how to forgo pesticides in favor of parasitic wasp to control the moths that were decimating Chinese crops.
- *Weeds Find a Way* by Cindy Jensen-Elliott and illustrated by Carolyn Fisher is a gorgeous celebration of the tenacity and beauty of weeds. The scientific backmatter includes information on each native plant and why they're an important part of our environment.

## Wrap Up:

Discuss as a class:

1. What are the different kinds of structures that plants use to attract pollinators?
2. Which pollinators are attracted to which plant structures, and why?
3. Which pollinators do we have a lot of in our schoolyard, and why?
4. Which pollinators are missing from our schoolyard, and why?

Following the discussion, students will be asked to apply what they have learned to a design challenge: can you draw and label a plant that will attract a new pollinator to the schoolyard? Students should work alone, so that the teacher can accurately assess each

individual student's mastery of the content. If time allows, students can share their models through a gallery walk.

**Connection:**

In the institute, we explored plant and animal adaptations and analyzed the relationship between form and function in a variety of organisms and ecosystems. We also learned about the important role that native pollinators play in sustaining healthy ecosystems, as keystone species whose survival impacts all trophic levels.