

Lesson 4 Patient Pollinator Count 1



Unit: Plants, Pollinators & People - Ecosystems

Unit Driving Question: Should we include cultivars in our native pollinator garden?

Unit Anchor Phenomenon/Storyline: Local fire fighters let the milkweed plants grow and the monarchs soon came! (See full story in Unit Overview and Lesson One.)

Overview

This activity provides students with hands-on experience observing pollination in their School's Nativar Gardens or areas around the school (similar to lesson 1) where flowering plants (and pollinators) might be observed. Students will use the Patient Pollinator Count data collection sheet for recording their observations. Students will analyze their data in lesson 8, titled "Plotting Plants & Pollinators." In this activity students will organize, visualize, and present the collected data. On days where students are unable to go outside or if there are no flowers on the plants outside, use the 10-minute [video clip](#) provided. Remind students that research scientists often make video tapes like these and then view and collect data from them at another time. **The Patient Pollinator Count activity may be used multiple times throughout this unit.**

This lesson familiarizes students with the ecological effects of human manipulation of plant characteristics through selection and hybridization. Using a *Budburst Nativars* research garden, students will observe and record pollinator visits to open flowers to help answer the question: **Do pollinators prefer cultivars of native plants species (nativars) or true native plants?** Answering this question has real world implications for pollinator conservation.

Grade(s): Five-Eight	Time Recommendations: 1 – 2 class periods
<p>Central Focus: Central Focus: Recalling the storyline about declining pollinators (specifically the monarch), students will be completing a data collection piece of the scientific protocol for planning and conducting a research-grade investigation to solve the Driving Questions for this unit: Should we include cultivars in our pollinator garden?</p> <p>They will use their data collections to construct an argument in the final research poster that will provide evidence to support their claims.</p>	<p>Student Objectives:</p> <ol style="list-style-type: none"> 1. Explain the role of plants and animals in pollination. 2. Differentiate between cultivars and nativars, and explain how they differ from true native plants. 3. Carry out a scientific protocol collecting research-grade data on plants and pollinators connecting the process to how scientists ask questions and plan and conduct investigations to solve the problems. 4. Explain how environmental conditions (e.g., weather, plant morphology, and flowering phenology) influence pollinator behavior. 5. Identify a cultivar from a native plant using their scientific plant names. <p>Opt: Identify common animal pollinators and compare their anatomies.</p>

<p>Essential Question: How does a change in an ecosystem/habitat (changing weather patterns, human intervention, etc.) impact pollinators like the monarch butterfly or a honey bee? How might we support their needs to ensure places for them to live and thrive?</p>	
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NGSS Alignment: See Unit Overview for list of NGSS standards being addressed.

Vocabulary: Pollination, pollinator, anatomy, plant phenology, environmental conditions, native plant, nativar, cultivar, scientific protocol, research-grade data, and pollinator behavior

Note: Teacher determines when and how to reinforce vocabulary during lesson's implementation. For example, using phenology often during the class lesson will help familiarize students with the terminology.

Materials:

- **Pollinator ID Guide**
- **Observation (Data) Sheets** (Choose the appropriate one for your class from lesson resources; options listed below) **Note:** It is recommended to use the **single plant 3 pollinator groups** worksheet –especially if this is the first time students will be doing this activity.
 - Data Sheets (**English**)
 - Single Plant (3 pollinator groups)
 - Single Plant (7 pollinator groups)
 - Data Sheets (**Spanish**)
 - Single Plant (3 pollinator groups)
 - Single Plant (7 pollinator groups)
- Clipboards (or use their science notebooks as a hard surface to write on)
- Pencils
- Measuring sticks
- Timing device (wristwatch, phone, stopwatch, etc.) Note: The teacher could be in charge of telling all groups when to begin and stop if stopwatches are not available.
- Paper/binder clips, stapler
- Student Notebooks
- Handout titled: A Scientific Protocol – one per student group
- Optional:
 - Skin protection (e.g. hats, sunscreen)

Advance Preparation and Teaching Tips

- **Check to make sure there are flowers blooming in your Nativars Garden.** The numbers of flowering plants may determine how many students you will place in a group. For example, if only 5 plants have flowers on them in the garden, then instead of having students grouped in pairs, you may need to have pairs combined into groups of 4 AND have 2 groups of 4 students around a single flowering plant. Make this group number decision ahead of time. If no flowering plants in the nativars garden, you may use any outdoor area with flowers to make observations, or you may use the [video](#)

clips of pollinators visiting plants for the data collection, and use the actual native and nativar plants the Garden provided to help students learn how to distinguish between them.

- Assign plant nicknames to each plant in the Budburst Nativars garden to differentiate among replicates of the same plant type. For instance, the three replicates of black-eyed Susan ‘American Gold Rush’ could be nicknamed “Gold Rush 1”, “Gold Rush 2”, and “Gold Rush 3”. If desired, make tags to attach to the plants or a map to label plants with their nicknames. A day or two before, or the day of, determine if plants are flowering in the *Budburst Nativars* garden.
- Print **Pollinator Observation Data Sheets** (one for each student) and the **Pollinator ID Guide** (one for every student group). Gather materials. Review background.

Pre-teaching/Background Knowledge/Misconceptions

If students have not been introduced to the storyline yet, share it (or review it) with them. Connect the plight of their highlighted insect, the monarch butterfly, to the observations they will be making to help real scientists solve the Driving Question of the Unit.

Activities

Engage (Inquiry/Anticipatory Hook/Opening/Activate Prior Knowledge/Create Interest/Orient to Content)

1. Announce to the class that today we will be scientists collecting data on pollinators to help answer the important research question: **Do pollinators prefer cultivars of native plants species (nativars) or true native plants?** Answering this question is important because in order to plant gardens that support pollinators we need to know what plants they like best.
2. Discuss or review the following:
 - What is pollination?
 - Describe the different ways plants are pollinated (i.e., wind, water, self, animal). Ask students to list some of the most common animal pollinators (e.g., honeybees, other bees, flies, beetles, wasps, moths, butterflies, hummingbirds).
 - What environmental factors influence pollinator behavior? (e.g. weather, availability of flowers)

Explore (Conceptualizing Concepts/Student Activities/Instructional Strategies and Learning Tasks/Development of the Concept)

3. Break the students into groups of two. Give each group one clipboard or other hard writing surface like their student notebooks, one pencil, two data sheets (one for each group member), one pollinator guide, and one measuring stick.
4. Have the students observe the flowering plants and pollinators unstructured for a few minutes. Remind students to stay a reasonable distance away from pollinators (~2-5 ft.) and not to touch them. Reassure students that insects will not hurt them. Honeybees and other insect are not aggressive when they are foraging for nectar and pollen.
5. Ask students to describe some physical characteristics of pollinators they are observing (size, color, striped, antenna length, etc.). Using the **Pollinator ID Guide**, have the students identify a few pollinators. Depending on the data sheet you are using (3 or 7), make sure the students can tell the difference between the *Budburst Nativars* pollinator groups.

6. Have each pair of students identify an initial data recorder and observer. Explain that they will switch roles and start a new data sheets after 10 minutes (each student will have an opportunity to be both observer and data recorder).
7. Recommended: As a class, complete the first section of the data sheet (location, date, temperature, cloud cover).
8. If you have a copy of the school's Nativars Research Garden plot where specific names of plants are specified showing where they are in the garden, then that can be used indoors to assign specific plants to student groups. Anything done ahead of time in the classroom will make time outdoors go more smoothly.

Explain (Checking for Understanding/What the students are doing to construct meaning and what the teacher is doing to facilitate the process)

9. Travel to a *Budburst Nativars* garden (on site, or at a partner location, or other outside location). Remember to take the measuring tools - meter sticks and timers with you.
10. Gather the students around you and discuss what it means as a community scientist to have a scientific protocol or 'list of procedures' that everyone follows in exactly the same way. Tell students that they are community scientists today, and their observations and recorded data will be important information for the research scientists at the Chicago Botanic Garden's Plant Science Center. Pass out the "A Scientific Protocol" handout to each student group. Tell them they can refer to it while they are making their observations. Go through the protocol (list of procedures) below.
11. Have each student group identify (or find their assigned plant) a single plant with open flowers to observe. If there are fewer plants with open flowers than there are student groups, more than one group can observe the same plant. Ideally, all plants with open flowers will be observed by at least one student group.
12. If they were unable to do this indoors, each student group should record the full plant name (including cultivar, if appropriate) and plant nickname on their data sheet, matching their spelling with the spelling on the plant label. Each row of three plants has one label, but all the plants of that row are the same type and have the same name.
13. Using the measuring sticks, each student group should measure the height of their plant in centimeters (from the soil surface, to the highest point of the plant) and record the height on their data sheet.
14. Each student group should count the number of open flowers on their plant. If there are too many flowers to count (e.g. >100), help students estimate to the nearest 50.
15. Each student group should identify and record the flower stage of their plant as one of the following:
 - Early: few (<5%) flowers open
 - Middle: many flowers open
 - Late: most (>95%) flowers wilted/fallen off
16. Inform students that we will be observing pollinators in 10-minute intervals. Ask the students to come to a comfortable sitting or standing position where they can clearly see their plant (~2-5 feet away). Remind the students that each time the observer sees a pollinator touch an open flower they should tell the recorder, who will mark a tally in the appropriate box. Explain to students that while making observations:

- Only record data on pollinators visiting flowers. Do not record data for pollinators that are only visiting other plant parts (e.g., leaves, stems) or just flying around the general area.
- Be careful not to disturb pollinators before you get a chance to observe them. Avoid moving fast, making sudden movements or talking loudly. Position yourself so that you do not cast a shadow on the plant you are trying to observe.
- You might not observe any pollinators, which is OK. When scientists conduct pollinator observations they often record a lot of zeros, but zeros are still important data!

17. Announce the start time of the observation period for each group to record on their data sheet. Oversee student observations for 10 minutes, providing guidance and encouragement as needed. At the end of the 10-minute period, announce that the observation period is over, and tell them the end time to record on their data sheets. If students did not observe any pollinators, instruct them to place zeros in the appropriate boxes of their data sheet. Instruct students to turn in their first (completed) data sheet to the instructor.

Note: If multiple student groups observed the same plant, compile and attach those data sheets together (e.g. staple, paper clip) and treat as a single observation during data entry to prevent duplicate data. If results differ across data sheets, average results or identify one sheet from which to submit data.

Extend (Applying New Knowledge/Guided Practice/Independent Practice)

18. Instruct the students to switch roles (the observer becomes the recorder, and vice versa). For the second observation period, student groups can observe the same plant, or switch to a new plant. If groups observe the same plant, instruct them to copy the responses to sections 1 & 2 on their data sheet (from “Name of observer(s)” through “Flowering stage”), onto their second data sheet. If groups switch plants, instruct them to copy the responses for section 1 (“Names of observer(s)” through “Cloud cover”) and repeat steps 10 through 14 for their new plant.
19. Announce the start time of the second observation period for each group to record on their data sheet. Oversee student observations for 10 minutes, providing guidance and encouragement as needed. At the end of the 10-minute period, announce that the observation period is over, and tell the students the end time to record on their data sheets. If students did not observe any pollinators, instruct them to place zeros in the appropriate boxes of their data sheet.

Evaluate (Closing/Exit Slip/Wrap Up/Tie Up the Lesson/Provide Cognitive Closure)

20. Gather students and collect the second completed data sheet (see #16 Note regarding duplicate data). Ask them about their observations, e.g.:
- Who saw a pollinator? Who saw more than one? More than two? etc.
 - Who saw no pollinators? Why might we not see pollinators? (Possible answers include: not very many flowers are open, these flowers are less attractive to pollinators than other flowers, we only observed for 10 minutes, etc.)
 - Which plants attracted the most pollinators? Why might those plants be more attractive to pollinators?
 - What types of pollinators did you see?
21. Collect materials and return to classroom.
22. Post class: Instructors can enter the data online at budburst.org under their personal account, or under student accounts in a Budburst Classroom (see **Suggested Activity Extension: Students Submit Data Online**).

Extensions

- **Repeated Observations**
Repeat this activity as often as desired to observe different types of plants and pollinators throughout the growing season. For subsequent observations, review pollinator identification, safety, and protocols only as needed (skip steps 1-2, 5-7, & 15). For Budburst partners, observations should occur once a week while plants are in flower and students are in session.
- **Students Submit Data Online**
If the class has access to tablets or computers and Wi-Fi, students can enter their pollinator observation data directly into the Budburst database online. Instructors will need to create a Budburst account and Budburst Group and provide students with login information (see our page on how to participate in [Budburst Groups](#)). The online data submission form mirrors the paper data sheet.

Assessments/Evidence of Student Learning

Informal Assessments: Teachers will continually check for understanding of the vocabulary terms. If teachers use a teaching and learning strategy like Kagan’s “Quiz, Quiz, Trade”, they could allow students to play the vocabulary game before or after each class session.

Formal Assessments: Completion of the Pollinator Observation Data Sheet(s) and Notes added to Student Notebooks that can be used for the final research poster at the end of the unit.

Student and Teacher Resources

Background Information

Pollination

Pollination refers to the transfer of pollen grains from the male organs of the flower (anthers) to the female organs (stigma). Pollination is necessary for fertilization to occur, which leads to the production of seeds and fruits. Pollen can move by abiotic means (mostly wind), but the majority of plants need an animal to transport their pollen. Animals that transport pollen are called pollinators and include bees, flies, butterflies, bats, birds, and more! They provide this **ecosystem service** in exchange for a reward from the flowers in the form of pollen and/or nectar. Sadly, many pollinator populations have been declining dramatically in recent years, including the honeybee and the monarch butterfly. These declines have been tied to a variety of drivers including habitat loss, pests & pathogens, changes in climate & weather, and herbicides & pesticides. These declines are alarming for the future of agriculture as well as the health of natural habitats.

Budburst Nativars gardens were designed to compare pollinator preferences for native plants and cultivated varieties of native plants. A **cultivated variety**, or **cultivar**, is a variety of a plant that was selected and cultivated by people. Cultivars can originate spontaneously as mutations, or through breeding, such as plant hybridization. Development of cultivars aims to increase commercial appeal through modifications of plant color, scent, shape, or size. Sometimes cultivars can be hard to differentiate morphologically from the original species, in which cases plant names can provide some

clarification. Both common names (English names) and scientific names (Latin names) will include the name of the plant cultivar. In scientific names, the cultivar is always noted after the two-part species name in single quotes (see #2 below). If a scientific name does not include a name in quotes, that plant is not a cultivar (#1). Example:

	Common Name	Scientific Name
1. Native	Eastern Red Columbine	<i>Aquilegia canadensis</i>
2. Cultivar	Pink Lanterns Columbine	<i>Aquilegia canadensis</i> 'Pink Lanterns'

What is a nativar?

A new term has emerged recently to describe cultivars of plants native to the region— **nativars**. Nativars is a contraction, or combination, of the words “natives” and “cultivars”. **Native plants** grow naturally in the region and coevolved with the other plants and animals living there. Nativars share some traits in common with the original native plants (their “parents”) but also differ in some traits, including leaf size, flower color, plant height, and the number of flowers they produce. To help declining pollinator populations, many people want to plant native plant gardens, since we know that native plants and pollinators evolved together and support each other. However, although nativars are similar to true native plants, they also differ in traits like flower color, number, shape, and smell, all of which can influence pollinator attraction. Because of these trait differences, we do not know if nativars provide the same support for pollinators as true native plant species. So, should nativars be used in pollinator gardens? The first step in the process to answer that question is to document the number of pollinator visits to these different types of plants and compare the results. Through the collaboration of botanic gardens, schools, nature centers, and home gardeners, *Budburst Nativars* is collecting data on pollinator visitation to native plants, and cultivars of those plants, across the country. Taken together, our data will help us answer this critical question for pollinator conservation!

Reference List

Chicago Botanic Garden. (2014). *Make way for monarchs: A Janet Meakin Poor research symposium*. Chicago Botanic Garden, Glencoe.

Illinois Department of Natural Resources. (2018). *Monarch mania!* Accessed on May 3, 2019 at: <https://www.dnr.illinois.gov/education/Pages/monarchgen.aspx>

Note: Parts of this activity were adapted from “Sustainable Agriculture Activity Guide: Community Involvement in Research, UC Davis Agriculture and Sustainability Institute” Accessed July 30, 2019 at: <https://asi.ucdavis.edu/programs/sf/community-engagement/educational-materials>