Flight of the Pollinators


Photo Credit: Kenneth Spencer

Grade Levels
6-8

Overview
This activity is designed to help participants experience the importance of plant phenology from a pollinator's perspective. Participants learn why pollinators visit flowers and what color, shape, and size of flowers their pollinator prefers to visit. Once familiar with their adopted pollinator's preferences for flower visitation, participants "fly" around the activity area to identify, quantify, and record how many of their preferred flowers are open for their visitation.

Background
A pollination syndrome is, thechnically, a suite of flower traits such as size, shape, color, and scent that, together, tend to attract and to offer rewards to a partilucalr pollinator or suite of pollinators. For example, hummingbirds tend to be attracted to red, tubular flowers with lots of nectar; this is a "humminbird pollination syndrome."

Real-world Connection
Local phenologies differ: The new student from another county or state may hold a different set of phenology facts in mind. This need not be a problem; it can spark a good discussion about why phenologies will vary from place to place. For example, latitude, altitude, and/or nearness to large temperature-moderating bodies of water can all affect local phenology.

Citizen Science Connection
This activity can be completed without a *Nature's Notebook* account. However, the visualization tool can be used to examine phenology data, and exemplify the value of citizen science.

Estimated Time
60 minutes

Learning Objectives
Participants will be able to:

- Learn to recognize the sequence of reproductive events that lead to seed production in most species of flowering plants: opening of floral buds, dispersal of pollen, swelling of the stigma, pollination (deposition of pollen on "receptive" stigmas), wilting of petals and anthers, expansion of ovaries, ripening of fruits, and dispersal of fruits or seeds.
- Identify pollinator syndromes and to predict which pollinator(s) are likely to visit the flowers of any plant species they come across.
- Identify simple methods for helping to conserve local pollinator diversity across the seasons.
- interpret the ecological significance of plant reproductive phenology for the plants themselves, for the pollinators who visit their flowers, and for the animals that consume the resulting fruits and seeds from pollinated flowers.

Next Generation Science Standards

LS: Life Science			
	Grades 6-8		Grades 6-8
MS-LS2-2	Construct an explanation that predicts patterns of interactions among organisms across multiple ecosytems	MS-LS1-4	Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively.

Conducting the Activity

Materials

Resources needed

- Felt balls in 3 colors - red, pink, and yellow
- Construct a central, oversized graph that all students will use That displays the "number of flowers" on the y-axis and "seasons" (divided into spring, summer, fall, winter categories) on the x-axis. In the photo on page 3, notice the vertical white Velcro strips that represent each season. Observe how one to several colors of felt balls (representing the number of open flowers for each pollinator type in each season) are stacked vertically within each season once the activity has been completed. For example, the two tallest columns in the photo each contain red (hummingbird), pink (butterfly), and yellow (bee) felt balls affixed to the Velcro strips; the number of felt balls per color correspond to the number of open flowers that were counted.
- Create three pollinator stations: one station per pollinator, where each station contains a graph of flower counts for each of the four seasons. An example of a hummingbird graph and station is shown on page 3. You may hand---draw these graphs, or create them on a computer. Regardless of the method of creation, the graphs should show changes in the availability of flowers across the four seasons. Care should be taken to make this seasonal trend biologically relevant (e.g., bees should find more flowers in the summer and fewer in the winter; hummingbirds should find more flowers in the spring than in the autumn).

RESOURCES
Adapted from:

Flight of the Pollinators

By: Brian Haggerty, Alisa Hove, Susan Mazer, and LoriAnne Barnett

NOTES ON ACTIVITY

Conducting the Activity

Engage

Connect to prior knowledge

- The educator activates students' awareness of phenology and pollinators by exploring students' own unique connections with the seasons, such as nearby plants, seasonal human health, and sports.
- The seasonal availability of food: What foods are currently in season or ready to harvest locally? Wich foods are you looking forward to in the coming seasons? Which season comes to mind for each of the following fruits: tomatoes, peaches, berries, pumpkins.
- Educator reinforces students' knowledge that fruits and seeds develop from pollinated (and fertilized) flowers.
- The educator introduces the activity by connecting phenology with pollination and phenology from the pollinator's perspective.

Explore

Hands-on learning

- The activity begins with the educator introducing the Flight of the pollinator activity at a central location where there is one large "central graph" that will be completed by the group. The educator assigns pollinator types to participants and they learn pollination syndromes as in the outdoor activity described above. Instead of roaming the area to count flowers, however, each pollinator type flies to a station that the educator has set up in advance anywhere in the area (i.e., indoors or outdoors). This individual pollinator station contains information about the number of flowers available in each season for each pollinator.
- While at their individual pollinator station, pollinators read the graph that depicts the number of open flowers in each of the four seasons. The educator calls out a season (e.g., summer) and students read the graph to determine how many flowers are open. at this point the educator(s) can engage each pollinator group with questions about the prevailing weather conditions during that season and how that might affect the availability of flowers for their pollinator type (e.g., most plants flower during the seasons that are generally both warm and wet: late winter, spring, and early summer).
- Then the pollinators reach into a sack (shown below in the hummingbird station with red felt balls) and pull out the number of felt balls that correspond to the number of flowers open. A pollinator from each group then carries the felt balls over to the central graph and sticks them to the Velcro strips corresponding to the same season. The different pollinator types stack their color---coded felt balls above one another, as in the first photo above.
- Once this "reporting" step is complete, pollinators fly back to their individual station; educators call out another season; and pollinators determine from the graph how many felt balls they should collect and bring to the central graph. Educators can ask participants more questions about the weather conditions for this season before pollinators return to the central graph to deposit the felt balls on the Velcro column corresponding to the correct season. This cycle continues twice more (or for as many seasons as the educator desires).
- Once pollinators have cycled through each season and have deposited the correct number of corresponding felt balls on the central graph, the educator gathers everyone around the central graph. A discussion ensues about the seasonal patterns of flower availability, at two scales: Describe the total flower availability in each season and across the year (regardless of pollinator syndrome); and Describe the flower availability for each pollinator type in each season and across the entire year.

Conducting the Activity (continued)

Explain

Listening and communicating understanding

- Looking at the graphs, think about what they show, vs what students have observed in the world around them lately. Which type of pollinator has the fewest flowers available today? Is this because their plants haven't flowered yet or because their plants have finished flowering?
- How does this compare to the pollinators that you've seen lately around the schoolyard? Have you seen many butterflies, bees, moths, or hummingbirds?
- For each type of living pollinator that you see, are there flowers available that would be appropriate or attractive for it to visit?

Extend

Group projects, real world connections

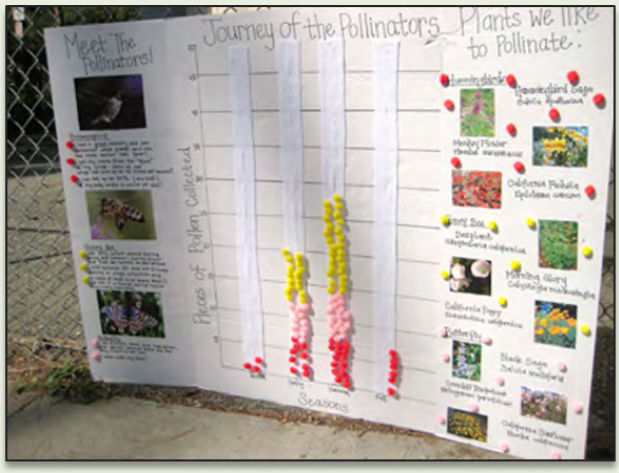
1. This activity can be conducted outdoors where students can act as a specific pollinator and locate flowers collect data on flowers on their campus based on their particular pollination syndrome. Full instuctions for this extension can be found via **this link.**
2. Students can collect phenology data on plants and pollinators on their campus via *Nature's Notebook*. Educators can then use the visualization to to show how their observations compare to what other people are observing through time.

Evaluate

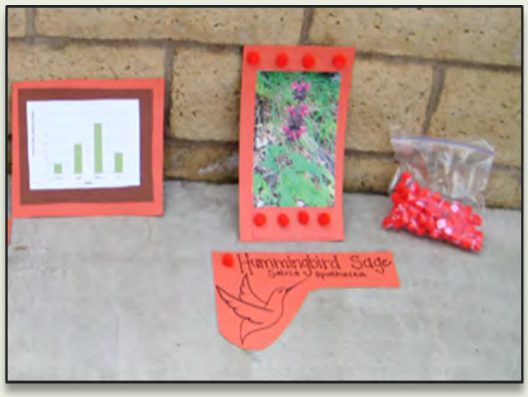
Summarize, check for understanding, assess

- Participation in the activity
- Demonstrate an understanding of pollinators, pollination, and relating to the world around them via discussion.

Reference Images

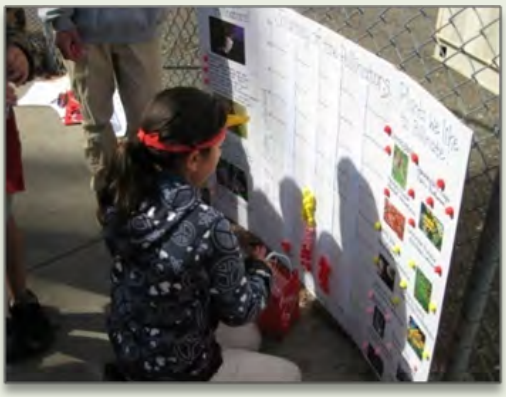


We provided photos of multiple pollination syndromes on each side of the central graph – we discussed pollination syndromes and quizzed students before they took flight. The left side of the board reads "Meet the pollinators!" and offers photos of a hummingbird, a bee, and a butterfly (moth not included in this round). The right side reads "Plants we like to pollinate". Hummingbirds are represented by red felt balls; bees by yellow felt balls; and butterflies by pink felt balls.



The hummingbird pollination station includes:

- A graph of open flowers for each of the four seasons.
- A photograph of a hummingbird pollinated plant (in this case, it's hummingbird sage, Salvia spathacea.
- A bag of red felt balls.



After reading her pollination station's graph to determine the number of open flowers in the summer, a hummingbird reports her observations on the central graph by sticking the correct number of red felt balls to Velcro in the summer column. Other colors correspond to bees (yellow) and butterflies (pink).

NOTES ON ACTIVITY

Flight of the Pollinators

Quick-guide to Pollination Syndromes[1]

Each cell of this table shows the floral features preferred by the pollinator indicated at the top of each column.

	Bats	Bees	Beetles	Birds	Butterflies	Flies	Humming-birds	Moths
Color of flowers or other attractive structures	White, green, or purple	Bright white, yellow, blue, or UV	White or green	Scarlet, orange, red, or white	Bright, including yellow, red, and purple	Pale /dull to dark brown and purple; flecked with translucent patches	Red mostly, but also orange or yelllow	Pale and dull red, purple, pink, or white
Nectar guide	Absent	Present	Absent	Absent	Present	Absent	Absent	Absent
Odor	Strong musty, emitted at night	Fresh, mild, pleasant	None to strongly fruity or foul	None to slight	Faint but fresh	Putrid	None to slight	Strong, fresh, sweet; emitted at night
Nectar	Abundant, somewhat hidden	Usually present	Sometimes present, not hidden	Ample, deeply hidden	Ample, deeply hidden	Usually absent	Abundant, deeply hidden	Ample, deeply hidden
Pollen	Ample	Limited to ample, often sticky, scented	Ample	Modest; anthers dangle outside flower	Limited	Limited	Ample; anthers dangle outside flower	Limited
Flower shape	Bowl-shaped; closed during day	Shallow to tubular, with landing platform	Small to large; bowl-like	Large, tubular to cup; strong perch support	Narrow tube with spur; wide landing pad	Shallow; funnel-like or complex with trap	Large, tubular to bell-shaped; no landing platform	Regular, tubular without a lip

[1]Modified from North American Pollinator Protection Campaign – www.pollinator.org