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# K-12 Partnership Lesson Plan

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# *Pollination: what’s on your flowers?*

# *Observing and quantifying pollinator visitation*

## Overview

Students explore mutualistic interactions by focusing on pollination. Do flowers attract specific or a variety of pollinators? Students hear a presentation on mutualism and pollination in particular, and the go outside and use actual observations and data collection to discover what types of pollinators visit flowering plants in their vicinity. The lesson is adaptable to multiple topics, grade levels, and habitats.

**Objectives**

At the conclusion of the lesson, students will be able to:

* Explain the major kinds of interspecific interactions
* Explain what pollination is and how it works
* Identify one or more species of local flowering plants
* Identify pollinators by broad or narrow group, depending on age of students
* Collect pollinator visitation data in a scientifically rigorous way
* Discuss some of the ecological factors affecting composition and abundance of pollinator communities

**Length of Lesson**

Introduction: 20 minutes

Field: 30 minutes (plus time to get there and back)

Data collation and recap: 20 minutes

**Grade Levels**

K-8; through 12 if instructor’s insect identification and statistical analysis skills are up to the challenge.

**Standards covered**

Disciplinary Core Ideas:

 *Kindergarten*

* **K-LS1-1**: use observations to describe patterns of what plants and animals (including humans) need to survive

*Middle School*

* **MS-LS2-2:** construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems
* **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

Cross Cutting Concepts:

* Patterns

Science and Engineering Practices

* Planning and carrying out investigations
* Analyzing and interpreting data
* Engaging in argument from evidence

***Previous Michigan Standards Met:***

* **Inquiry process**: make purposeful observation of the natural world
* **Inquiry process**: plan and conduct investigations
* **Inquiry process**: construct charts
* **Organization of living things**: identify that living things have basic needs
* **Inquiry analysis and communication**: summarize information from charts and graphs to answer scientific questions
* **Inquiry analysis and communication**: compare and contrast sets of data from multiple trials of a science investigation to explain reasons for differences
* **Inquiry analysis and communication**: explain reasons for differences
* **Ecosystems**: identify organisms as part of a food chain or web
* **Inquiry process**: identify patterns in data
* **Ecosystems**: describe common patterns of relationships between and among populations (competition, parasitism, etc.)
* **Ecosystems**: explain how 2 kinds of organisms can be mutually beneficial and how that can lead to interdependency

**Materials**

* Data sheet for each student
* 1 m square quadrat (or hula hoop) for every 3-4 students (alter size according to abundance of flowers- how large a space can students reliably watch for pollinators?)
* A clipboard and pencil for each student

**Background**

“Interspecific interaction” is a broad term for any way that two different species come into contact in nature. This includes relationships where one party lives at the expense of the other (predation), one damages but does not kill the other (parasitism), both species benefit from the interaction (mutualism), and a whole continuum of interactions that fall in between. Even mutualistic relationships can operate as a sort of mutual parasitism, in which each partner works (or evolves) to maximize what it gets from, and minimize what it gives to, its partner.

Animal pollination is an interaction that generally operates as a mutualism (although there are notable exceptions, including bee-mimic orchids and nectar-robbing bees). Most pollination relationships involve an animal getting pollen or nectar to eat, and a plant getting its pollen (male sex cell) deposited on the stigma (from whence it proceeds to fertilize the ovule, the female sex cell). The pollinator gets food, the plant gets to reproduce.

Plant-pollinator relationships are a great example of species webs in nature, and are generally available for observation in Michigan from April through October.

### Activities of the session

Start with a short presentation introducing the information in the background above. Use photos of diverse plant-pollinator systems: there are a lot of them and they are cool. Also introduce the different groups of pollinators you want the students to be able to distinguish in the field.

Before going outside, explain to students what you are going to do in the field and how you are going to do it.

First walk out to the chosen site and show students how to identify the flowers of the plant species (one or more) you want them to observe. Then have them distribute the sampling quadrats or hula hoops. This can be done randomly (by flinging in a direction chosen by spinning a compass) or systematically (every X meters along a measuring tape). Encourage the students to think about why you wouldn’t want to just pick the biggest, most beautiful bunch of flowers to observe.

For younger students, give them several minutes to fill out a worksheet with various questions about the plot and plants: how tall are they? How many stems in the plot? How many other species of plant can then identify in the plot? How do the leave and flowers look? How do they smell? Can then identify the pollen? Is there any nectar?

Then start the 10 minute observation period. Students should record the number and type of pollinators that enter the plot and visit at least one flower – no matter how many flowers they visit, only record an individual pollinator once. If it leaves the plot and re-enters, count it again (this is because we as human observers can’t be expected to distinguish one fly or bee from another – better to standardize sampling around that.) If you are interested in observing multiple species of plant simultaneously, be sure students record which species are visited. If you have time and students have focus, you can repeat or lengthen the observation times.

Once the data is collected, return to the classroom and combine the students’ data. Depending on the level of the students, this can be done with a tally on a whiteboard or using Excel and producing pie charts, bar graphs, or bipartite interaction graphs. The class should then discuss their conclusions together. Which species was the most common pollinator? If you studied multiple plant species, did the pollinators differ between them? This can segue into a discussion about ecological factors that may affect pollinators. What if the weather had been warmer/colder, sunnier/cloudier, windier/more still? What if there had been water/no water nearby? What if there was a different soil type, one that pollinators could/couldn’t utilize for nesting? The possibilities for discussion are endless, and can lend themselves to forming hypothesis and designing experiments to test them.

**Resources**

* Data sheet available on the “Pollination: what’s on your flowers” lesson page on the KBS GK-12 website
* Pollinator identification key: <https://www.buglife.org.uk/sites/default/files/Pollinator%20identification%20chart.pdf>
* Additional resource on pollinator observations and identification: <http://www.xerces.org/download/pdf/PA_Xerces%20Guide.pdf>
* For information on encouraging pollinators in your backyard: <http://msue.anr.msu.edu/news/how_to_protect_bees_in_my_yard_and_garden>

**Extensions and Modifications**

Extensions are one of the strengths of this lesson. It can be a very simple, kindergarten-level lab, or it can be complicated enough to challenge an AP Biology student. This can all be controlled by the amount and detail of data collected, the number of plants and fineness of pollinator identification involved, and the complexity of data analysis. Another excellent extension would be comparing data from past years, if the lesson can be taught annually.