Pollinators





This lesson introduces participants to the types of insects that visit flowers, which vegetables require pollination, and why insects are important for pollination.

TEACHING OBJECTIVES: WHY DO THIS?

- Identify insects that commonly visit vegetable crops
- Demonstrate impacts of pollination
- Predict causes for pollination deficiencies
- Suggest steps that can be taken to improve pollination

BEST LOCATION

A vegetable garden

BEST TIME OF YEAR

July-September

IMPORTANCE FOR BEGINNING FARMERS

Beginning farmers will learn the value of sufficient pollination, which is important to maximize yield.

UNIQUE ASPECTS OF THE CURRICULUM

Students will observe insects that visit vegetable plants and conduct an experiment to compare which crops are pollinated by insects.





Facilitator Planning & Preparation

Estimated Instructional Time
Two hours
Four hours
Two hours



Technical Content

KEY WORDS		Flower morphology	The form and structure of a flower, which includes
Pollination	The transfer of pollen to a stigma, ovule, flower or plant to allow fertilization.		reproductive and non-reproductive parts.
Pollinator	An insect or other animal that transfers pollen	Insect	A bug with 6 legs, antennae, and body divided into 3 parts. Many insects that help pollinate can fly.
	another to allow for fertilization.	Pistil	The female reproductive part of a flower, the flower's stigma, style, and ovary
Pollen	A fine powdery substance consisting of microscopic grains discharged from the male part of a flower or from a male cone. Each grain contains a male gamete that can fertilize the female ovule, to which pollen is transported by wind, insects, or other animals.	Stamen Refer to flower pi page to see parts	The male reproductive part of a flower, typically has the flower's filaments and anthers (that has pollen on the surfact.



Technical Content

FACILITATOR BACKGROUND INFORMATION



Pollination is when <u>pollen</u> grains move from the <u>stamens</u> (the <u>flower</u> parts that produce them) to the ovule-bearing organs or to the <u>ovules</u> (seed precursors) themselves. In <u>flowering plants</u>, however, the ovules are contained within a hollow organ called the <u>pistil</u> and the pollen is placed on the pistil's receptive surface, the <u>stigma</u>. There the pollen germinates and gives rise to a <u>pollen</u> <u>tube</u>, which grows down through the pistil toward one of the ovules in its base.



Technical Content

FACILITATOR BACKGROUND INFORMATION (continued)

Review the "Additional Resources" section and other online resources before the class. Focus on:

- Photos of insects, such as bees (including honey bees, bumblebees, and squash bees), flies (especially flower and hover flies), and wasps, that commonly visit vegetable crops.
- Flower morphology and parts related to pollination.
- Which vegetable crops depend on insects for pollination?
- Causes for population deficiencies, including pollinator population and distribution, pollinator health, and weather patterns (e.g., cool temperatures, rain, or excessive wind).



KWL Process

Know, Want to Know, Learn



- What is pollination? Who does it?
- Why is insect pollination so important to certain crops?
- What insects do you see visiting your crops? What are each of them doing?
- Which crops need pollination? How are they getting pollinated?
- If your crops are not getting good pollination, what can you change?
 What can't you change?
- If your crops are well pollinated, why do you think that is? What conditions make for favorable pollination?

Suggested discussion questions to find out what participants want to learn:

- What do you know about bees and pollination?
- What kinds of insects do you see in your garden, and where do you see them? Adult insects usually have three body segments (head, thorax, and abdomen), six legs, and one or two sets of wings.
- How do you know if you do not have good pollination on your crops? What do you see that makes you think there is a lack of pollination?



Primary Activities

Overview of the main activities in this module

Activity 1

Pollinator Introduction

Identify which insects are visiting vegetable plant flowers.

Activity 2

Pollinator Evaluation (Part 1)

Set up an experiment to compare plants that are pollinated by insects, manually pollinated, or not pollinated at all.

Pollinator Evaluation (Part 2)

Check the results of the experiment to compare plants that were pollinated by insects, manually pollinated or not pollinated at all.



1. Pollinator Introduction

OVERVIEW

Use smartphones to identify the insects visiting flowering vegetable species. Note that phone applications may not be entirely accurate, but many are pretty good.

MATERIALS NEEDED

Smartphones with applications that can identify insects (e.g., iNaturalist, Google Lens, etc..)

BEST LOCATION

A vegetable garden

BEST TIME OF YEAR

July-September

PROCEDURE

- 1. Go to a garden or field where there are several flowering vegetable species or flowering plants.
- 2. Have students visit flowers and take notes of which insects they observe.
- 3. Have an insect identification book or use your phone to identify pollinators. Read about them to be sure they are pollinators and not pests.

VARIATIONS

- 1. Before visiting the garden, do an internet search for insect images, such as bees and bee mimics.
- 2. Do this activity in a pollinator flower garden.

DIVE DEEPER

1. Observe which insects appear to be doing the best pollination and which insects have the most pollen on their bodies.

2.Research which pollinators are best for pollinating specific crops

3. Print "<u>Using Native Plants to Attract</u> <u>Beneficial Insects</u>" to held find useful plants.



2. Pollination Evaluation: Part 1

Set up an experiment to compare plants that are pollinated by insects, manually pollinated, or not pollinated at all.

OVERVIEW

Evaluate what happens to plants that are visited by insects, not visited by insects, or manually pollinated. Observe and discuss the differences you find.

BEST LOCATION

A vegetable garden

BEST TIME OF YEAR

July-September

MATERIALS NEEDED

- Paint strainer bags or cheesecloth (for netting flowers)
- Twist ties for attaching nets to flowers
- Flagging tape or tags with strong for marking flowers
- Watercolor brush for manually moving pollen.
- Rubbing alcohol to clean brush between pollinating different flowers.

PROCEDURE

- 1. **Test 1:** Place a net over some flowers that are unopened.
- 2. **Test 2.** Place a net over some flowers that appear to be recently opened.
- Test 3: Manually and gently pollinate a some flowers that are newly open <u>as</u> <u>shown in this video</u>, by transferring pollen from one flower of the same species to another.
- 4. Take the pollen from the anthers of one flower and place on stigma of another flower. If flowers are not full open, gently pull the petals to get the pollen. But do not use flowers that are still growing as pollen will not be ready.
- 5. Net the flowers after pollinating.
- 6. Mark the flowers using the flagging tape or tags. Include date and your initials if more than 1 is doing this.
- 7. Return two weeks later to complete Part 2 of the activity (see pages 11-12).



2. Pollination Evaluation: Part 1

VARIATIONS

- 1. Manually pollinate vegetable flowers with an electric toothbrush.
- 2. Do this activity in a pollinator flower garden.

DIVE DEEPER

- 1. Look up examples and online videos of manual pollination.
- 2. Discuss and compare insect pollination to manual pollination.
- 3. Watch video <u>Hand Pollination</u>: how to pollinate plants by hand.





2. Pollination Evaluation: Part 2

Check the results of the experiment to compare plants that were pollinated by insects, hand pollinated, or not pollinated at all. These would be the flowers that are covered by netting.

OVERVIEW

Return to the vegetable garden from Pollination Evaluation Part 1 to evaluate the seed set of plants that were pollinated by insects, manually pollinated or not pollinated.

MATERIALS NEEDED

- Scissors
- Bag to collect trash (netting, flagging tape or tags)
- Thin water proof marker to label tags
- Small paint brush (as used for water colors)
- Rubbing alchol

PROCEDURE

- 1. Two weeks after doing the Pollination Evaluation Part 1 activity, return to the garden and inspect the plants marked with flagging tape.
- 2. Poorly pollinated fruit may be stunted, misshapen, or have few seeds. Observe the fruit and then cut open fruit to check seeds. Determine whether fruit was well pollinated.
- 3. Remove netting and flagging tape from plants.





3. Pollination Evaluation: Part 2

VARIATIONS

- 1. Facilitator can do Part 1 of this activity a couple of weeks ahead of time so participants can immediately see results.
- 2. Do this activity in a flower garden.
- 3. Do this activity during different times of the day. Pollinator activity and the amount of nectar some plants produce can vary by time of day.
- 4. Do this activity at different times of the season.
- 5. Search for vegetables that appeared to receive insufficient pollination.

DIVE DEEPER

- 1. Research reasons why a plant would not be properly pollinated.
- 2. Look up the consequences of insufficient pollination.
- Grow flowering plants native to your area to attract pollinators. Here are lists of pollinator-friendly native plants:
 - a. In Michigan
 - b. Throughout the United States



Additional Resources/Activities

Resource 1

Vegetable Pollinator Stewardship Guide

by Ana Heck, Ron Goldy, Benjamin Phillips, Benjamin Werling

Resource 2

Insect Pollination of Crops

by John Free

Resource 3

Insect Pollination of Cultivated Crop Plants

by S.E. McGregor, USDA

Resource 4

Pollinator Champions

Online course through Michigan State University

Resource 5

Managing Alternative Pollinators

by Eric Mader, Marla Spivak, Elaine Evans

Resource 6

Five Steps to Protect Bees from Pesticides

by Ana Heck, Andony Melathopoulos



Review and Encouraging Further Learning

Module review and evaluation questions:

- Which crops require insects for pollination?
- What can you do to improve pollination?
- How can you tell if crops did not receive adequate pollination? What are some reasons for reduced insect pollination activity?

Taking Your Knowledge Back to the Farm:

- Do the activities again on your farm!
- Keep a journal of patterns in pollinator flight activity.
- Plant pollinator habitat.
- Take Michigan State University's <u>Pollinator</u> <u>Champions</u> online course.