

Lesson Plan: Insect Pollination in a Warming World

Lesson plan developed with contribution from Gargi Khandelwal, St. Xavier's College, Mumbai, India.

As a **high school** or introductory **undergraduate Biological Sciences** teacher, you can use this set of computer-based tools to teach about **insect pollination** and the impact of climate change on pollinators, pollinator systems and food security.

This lesson plan will allow you to teach about insect pollination and various **plant-pollinator** systems. It includes a hands-on activity to teach your students about **plant adaptations** and **nectar guides**, different **types of pollinators**, their role in the natural and man-made world, and the environmental factors that affect **pollinator behavior** and effectiveness. This lesson plan will further explain how warming global temperatures, changes in precipitation patterns, and extreme weather events due to climate change, influence insect pollination.

Thus, the use of this lesson plan allows you to integrate the teaching of a climate science topic with a core topic in **Biological Sciences**.

Use this lesson plan to help your students find answers to:

- What is a plant-pollinator system? Give examples.
- How do environmental changes affect insect pollinator behavior?
- What is the importance of insect pollination for global food security?
- What are the impacts of climate change on insect pollination?

About the Lesson Plan

Grade Level: High School, Undergraduate

Discipline: Biological Sciences

Topic(s) in Discipline: Pollination, Fertilization, Insect Pollination, Pollinators, Plant-Pollinator Systems, Adaptations, Nectar Guides, Types of Pollinators, Pollinator Behavior, Flower Structure, Flower Mechanics, Pollen Viability, Stigma Receptivity, Pollen Tube Growth

Climate Topic: Climate and the Biosphere

Location: Global, USA

Access: Online, Offline

Language(s): English

Approximate Time Required: 2-3 sessions, 45-60 min each.

1 Contents

1. Reading (10 min)

A brief introduction to insect pollination and types of insect pollinators.

This can be accessed at:

[https://bio.libretexts.org/Bookshelves/Introductory_and_General_Biology/Book%3AGeneral_Biology_\(Boundless\)/32%3A_Plant_Reproductive_Development_and_Structure/32.2%3A_Pollination_and_Fertilization/32.2B%3A_Pollination_by_Insects](https://bio.libretexts.org/Bookshelves/Introductory_and_General_Biology/Book%3AGeneral_Biology_(Boundless)/32%3A_Plant_Reproductive_Development_and_Structure/32.2%3A_Pollination_and_Fertilization/32.2B%3A_Pollination_by_Insects)

2. Classroom/Laboratory activities (30-45 min per session)

A set of hands-on classroom/laboratory and field activities to teach about flower mechanics and adaptations for pollination, and the role of insect pollinators in enabling fertilization and plant reproduction.

These can be accessed at:

High School: <https://blogs.cornell.edu/cibt/labs-activities/labs/bouquet-of-flowers/>

High School, Undergraduate: <https://tiee.esa.org/vol/v2/experiments/pollinate/description.html>

3. Video (~5 min)

A video to discuss research on bee data and related satellite imagery that shows that climate change is affecting plants and pollination.

This can be accessed at:

https://climate.nasa.gov/climate_resources/41/video-sting-of-climate-change/

4. Optional: Reading (60 min)

A reading to describe the importance of crop pollination by insects, the factors involved, and the impacts of climate change on them.

This can be accessed at:

<http://www.fao.org/3/a-i2242e.pdf>

5. Suggested questions/assignments for learning evaluation

- What is a plant-pollinator system? Give examples.
- How do environmental changes affect insect pollinator behavior?
- What is the importance of insect pollination for global food security?
- What are the impacts of climate change on insect pollination?

2 Step-by-step User Guide

Here is a step-by-step guide to using this lesson plan in the classroom/laboratory. We have suggested these steps as a possible plan of action. You may customize the lesson plan according to your preferences and requirements.

1. Topic introduction and discussion

Use the reading, '[Pollination by Insects](#)' by LibreTexts™, UC Davis, to briefly introduce the topic of insect pollination to your students. Use this reading to describe the different types of insect pollinators, plant adaptations and nectar guides. Discuss how both insects and flowers benefit from the symbiotic relationship in plant-pollinator systems.

This can be accessed at:

[https://bio.libretexts.org/Bookshelves/Introductory_and_General_Biology/Book%3A_General_Biology_\(Boundless\)/32%3A_Plant_Reproductive_Development_and_Structure/32.2%3A_Pollination_and_Fertilization/32.2B%3A_Pollination_by_Insects](https://bio.libretexts.org/Bookshelves/Introductory_and_General_Biology/Book%3A_General_Biology_(Boundless)/32%3A_Plant_Reproductive_Development_and_Structure/32.2%3A_Pollination_and_Fertilization/32.2B%3A_Pollination_by_Insects)

2. Classroom/Laboratory Activity

Use the hands-on set of classroom/laboratory activities, '[Bouquet of Flowers](#)' by Cornell Institute for Biology Teachers, Cornell University, to extend student understanding about flower design, and plant and vector adaptations for pollination. Use the activities to enable students to learn about and examine pollen grains, pollen tubes, and pollen germination.

This can be accessed at:

<https://blogs.cornell.edu/cibt/labs-activities/labs/bouquet-of-flowers/>

Use the hands-on set of field activities, '[Pollination Ecology: Field Studies of Insect Visitation and Pollen Transfer Rates](#)' by Judy Parrish, Teaching Issues and Experiments in Ecology (TIEE), Ecological Society of America, to enable your students to understand plant-pollinator systems, flowering times, insect visitation rates, and pollen ecology. Use the built-in questions to evaluate student understanding of these topics. Use the tool to design student lab/field experiments to enable them to test various hypotheses related to the topics, analyze data, and prepare a formal report. Finally, discuss the student reports in the context of a changing climate. Encourage your students to comment on how their field observations could be affected by global warming, changing precipitation, and extreme weather conditions.

This can be accessed at:

<https://tiee.esa.org/vol/v2/experiments/pollinate/synopsis.html>

3. Discuss further

Use the video, '[Sting of Climate Change](#)' by NASA (Climate Change and Global Warming) to describe an effect of climate change on plants and insect pollination. Use the tool to talk about NASA scientist Wayne Esaias' research on bee data and related satellite imagery. Discuss the observations that global warming has resulted in early flowering times that may not coincide with bee visitation periods and thereby, impact pollination in flowering plants. Finally, talk about the interdependence of bees and flowering plants and how climate change may affect their survival.

This can be accessed at:

https://climate.nasa.gov/climate_resources/41/video-sting-of-climate-change/

4. Optional Undergraduate Homework Assignment: Reading

Use FAO's 2011 report, '[Potential Effects of Climate Change on Crop Pollination](#)' to enable your students to understand the effects of climate change on pollinators, and the temperature sensitivity of crop pollinators and entomophilous crops. Instruct your students to read the report as a homework assignment and it follow up with a classroom discussion. Use the reading to highlight the different climate variables such as temperature, precipitation, and extreme climate events that affect crop pollination. Further, use the reading to discuss how climate change has affected quality and quantity of nectar and pollen, phenological events, and pollinator behavior, visitation rates, and distribution. Finally, discuss the economic implications of the effects of climate change on crop pollination and thereby, on global food security.

This can be accessed at:

<http://www.fao.org/3/a-i2242e.pdf>

5. Questions/Assignments

Use the tools and the concepts learned so far to discuss and determine answers to the following questions:

- What is a plant-pollinator system? Give examples.
- How do environmental changes affect insect pollinator behavior?

- What is the importance of insect pollination for global food security?
- What are the impacts of climate change on insect pollination?

3 Learning Outcomes

The tools in this lesson plan will enable students to:

- learn about insect pollination, plant-pollinator systems, and types of insect pollinators
- describe factors such as temperature, precipitation, and extreme weather events affecting insect pollination
- discuss the implications of climate change on plants and insect pollination

4 Additional Resources

If you or your students would like to explore the topic further, these additional resources will be useful.

1. Reading; 'Buzzing about Climate Change'

A reading that describes NASA Scientist Wayne Esaias' research using bee data and satellite imagery to make observations on the effects of climate change on plant pollination.

This can be accessed at:

<https://earthobservatory.nasa.gov/features/Bees/bees.php>

2. Reading; 'Pollination & human livelihoods'

A write-up about 'FAO's Global Action on Pollination Services for Sustainable Agriculture', available in 6 languages, to describe how insect pollination is critical for global food production and human livelihoods, and the adaptation strategies against the effects of a changing climate on plants and insect pollinators.

This can be accessed at:

<http://www.fao.org/pollination/background/en/>

5 Credits/Copyrights

All the teaching tools in our collated list are owned by the corresponding creators/authors/organizations as listed on their websites. Please view the individual copyright and ownership details for each tool by following the individual links provided.

We have selected and analyzed the tools that align with the overall objective of our project and have provided the corresponding links. We do not claim ownership of or responsibility/liability for any of the listed tools.

1. Reading; 'Pollination by Insects'

By [LibreTexts™](#), UC Davis.

2. Classroom/Laboratory Activity; ‘Bouquet of Flowers’

[Cornell Institute for Biology Teachers](#), Cornell University.

3. Classroom/Field Activity; ‘Pollination Ecology: Field Studies of Insect Visitation and Pollen Transfer Rates’

By Judy Parrish, [Teaching Issues and Experiments in Ecology](#) (TIEE), Ecological Society of America.

4. Video; ‘Sting of Climate Change’

[NASA \(Climate Change and Global Warming\)](#)

5. Reading; ‘Potential Effects of Climate Change on Crop Pollination’

[Food and Agricultural Organization \(FAO\)](#)

6. Additional Resources

[NASA Earth Observatory](#)

[Food and Agricultural Organization \(FAO\)](#)