



## The Effects of Fungicides on Bumble Bee Colonies

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Interactive Video  
Educator Materials

### OVERVIEW

This video case study focuses on a real-world problem: declining bee populations. It also provides an example of designing a controlled experiment to collect data for testing a hypothesis and using data from research studies to guide the development of sustainable agricultural practices. As students watch the video, they are prompted to answer questions.

Videos can be used for teaching by stopping at appropriate time points and asking questions to cue student attention, encourage critical thinking, and make the students part of the story. This interactive video, which was created using BioInteractive's [Interactive Video Builder](#) tool, incorporates embedded questions at automatic pause points. Students can answer the questions directly in the interactive video or in the "Student Worksheet."

After finishing the video, students can review their answers and add to their explanations if their thinking has changed.

Additional information related to pedagogy and implementation can be found on [this resource's webpage](#), including suggested audience, estimated time, and curriculum connections.

### STUDENT LEARNING TARGETS

- Define the term fungicide and describe how fungicides can have both positive and negative impacts on the environment.
- Given a scientific question, design an investigation that attempts to answer the question.
- Use scientific evidence from an experiment to identify limitations of a study, draw conclusions, and suggest future studies.

### BACKGROUND

Different types of organisms — referred to as **pests** — attack, damage, and eat crops. Many farmers apply chemicals called **pesticides** to their crops to control pests. But these pesticides can also have negative effects on other species.

Pesticides include **herbicides** to destroy weeds, **insecticides** to control insect pests, **fungicides** to prevent the growth of molds and other fungi, and **disinfectants** to prevent the spread of bacteria.

Bees are important pollinators of many crops and wild plants. Ecologists have observed that some bee populations are declining. There are likely many reasons for these declines, including the use of certain types of insecticides on crops and flowers. In this video, a scientist explores whether fungicides could also be contributing to bee population declines.

### TEACHING TIPS

- Students can work on the questions individually or in small groups.
- Students should type responses into the answer boxes that appear during the interactive video.

- If students are not using the interactive video individually (e.g., you are projecting the video to the entire class), they can write their responses in the “Student Worksheet” instead.
- **The interactive video will not proceed until an answer is submitted.** You must type at least one letter into the answer box to continue.
  - If some questions do not fit the context of your course, you can direct students to skip those questions by typing “I am skipping this question.” in the answer box.
- If students are answering questions within the interactive video, they will be prompted to submit their answers at the end of the video. They will have the opportunity to review and add further explanation to each answer if their thinking has changed.
  - Once they are done, they can download a report of their answers. The report can be saved as a PDF or printed. You can have students submit the PDF or screenshots/photos of the report.
- The original video without embedded questions is available under [The Effects of Fungicides on Bumble Bee Colonies](#).

## SUMMARIES AND QUESTIONS

The interactive video has multiple sections. After each section, the video automatically pauses and prompts students to answer an **embedded question**. This document provides additional **extension questions** that do not appear in the video, which can be used for discussion prompts and written assessments.

Below are summaries of the sections and their associated embedded/extension questions.

### Introduction (0:00–0:10)

#### **Summary**

Before the video, students answer a question that assesses their preexisting knowledge on bee populations.

#### **Embedded Question**

Before you start the video, consider the following statement: People are concerned that bee populations throughout the world are declining. Write down a few sentences that summarize what you know about which factors may be contributing to the decline of bee populations.

### Section 1 (0:11–0:47)

#### **Summary**

This section describes the different chemicals used in agriculture and how they might be affecting bee populations.

#### **Embedded Question**

The narrator is interested in investigating the impact of fungicides on bees. Which of the following best describes a fungicide?

- A type of pesticide that uses toxins extracted from fungi to kill pests.
- A type of pesticide that kills fungi and bacteria.
- A type of pesticide that makes plants resistant to fungal pathogens.
- A type of pesticide that kills fungi or inhibits their growth.

#### **Extension Questions**

- What kind of chemicals are used in agriculture? Why do we apply them to crops?
- What is the question that the narrator wants to answer?

**Section 2 (0:48–2:05)****Summary**

This section explains the ecological relationship between adult bees, pollen, bee larvae, and yeast. In particular, fungi such as yeast are found in the pollen mixtures eaten by bee larvae.

**Embedded Question**

Shawn wants to determine which species of bacteria and fungi live with bees. In a few sentences, describe a method you might use to identify the microbes.

**Section 3 (2:06–3:28)****Summary**

This section describes a research method for answering the question from Section 2. It shows how Shawn isolated and identified the microbes present in the nest with the bee larvae. He discovered that the larvae of some bee species depend on yeast that grows on pollen for food.

**Embedded Question**

Shawn has a hypothesis that fungicides harm bee development. Using what you now know, describe an experiment to test Shawn's hypothesis. Be sure your response includes which data should be collected and how you would collect it.

**Extension Question**

In your own words, explain the logic behind why the scientists think fungicides are causing bee population declines. Are they concerned that the fungicide is directly harming the bees or bee larvae?

**Section 4 (3:29–3:46)****Summary**

This section describes the experiment the scientist used to test the hypothesis from Section 3.

**Embedded Question**

Shawn plotted the data in a bar graph with two bars: one representing the number of bees per colony in the control cages and the other representing the number of bees per colony in the cages exposed to the fungicide. If the results support the hypothesis that fungicides harm bee development, what would you expect this bar graph to show?

**Section 5 (3:47–4:02)****Summary**

This section shows the results of the experiment from Section 4 as a bar graph. The bars compare the average number of bees per colony in control cages without fungicide (orange) to the average number in cages exposed to fungicide (green).

Note that the error bars (white lines extending above and below each bar) on the bar graph represent 95% confidence intervals. The 95% confidence interval estimates the range of values that is likely to include the true average of the population, with a 95% confidence level. In general, if the 95% confidence intervals for two averages do not overlap, they are statistically different from one another.

**Embedded Questions**

- Are these results consistent with what you expected? (Yes/No)

- What do you conclude from this experiment? Write your conclusion in a few sentences.

### **Extension Questions**

- In the bar graph, the error bars represent 95% confidence intervals. Explain what 95% confidence intervals are and why the scientist may have wanted to show them on this graph.
- Based on the error bars in this graph, are you confident that there is a difference between the control and fungicide plots? Explain your answer.

### **Section 6 (4:03–4:36)**

#### **Summary**

This section summarizes the scientist's interpretation of the experiment's results.

#### **Embedded Questions**

- Shawn explains that many studies have shown that directly spraying bees with fungicides doesn't harm them. Are those results consistent with what Shawn has discovered? Explain your answer in a few sentences.
- Shawn has made progress in understanding how fungicides may impact bee colonies, but there is still work to be done. Can you suggest additional research that you think would help us better understand how fungicides affect bees?

### **Section 7 (4:37–5:19)**

#### **Summary**

This section discusses the applications of the experiment's results and potential limitations, highlighting the need for additional scientific research on the ecological effects of fungicides.

**Embedded Question** How could farmers use the knowledge gained in this study to reduce possible harmful effects of fungicides on bees?

### **Section 8 (5:20–6:05)**

#### **Summary**

This section prompts discussion about society's role in deciding how to regulate which fungicides are applied to crops, as well as how and when these fungicides are applied. It concludes by asking students to think about the broader relevance of this work.

**Embedded Question** Do people have a responsibility to protect bees? Write down a few sentences to capture your thoughts.

#### **Extension Questions**

- Scientists suggest that bee populations could be helped by changes in policy regarding fungicide use and application. How might a change in policy help solve bee population declines?
- Who regulates policies regarding use and application of pesticides?
- If fungicides have harmful effects, why do we continue to use them?

### **CREDITS**

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