
The \$235 Billion Insect: Why Bees Hold the World Together

Bloom's Level: Analyze

Standard:

NCSS.D2.Eco.10.9-12 — Economic Interdependence

NGSS.HS-LS2-7 — Ecosystem Interactions and Dynamics

TEKS.9.10.B — Analyze Ecological Relationships

STUDENT EDITION



A bee collects pollen from a wildflower. As it moves from flower to flower, it pollinates crops that feed billions of people around the world.

The \$235 Billion Insect: Why Bees Hold the World Together

Imagine walking into a grocery store and finding the produce section nearly empty. No apples, no almonds, no blueberries, no avocados. The shelves where cucumbers and squash once sat are bare. This isn't a scene from a disaster movie — it's what scientists warn could happen if bee populations continue to decline. A creature smaller than your thumb helps sustain a global food system worth hundreds of billions of dollars. So how does something so tiny carry so much weight?

What Is Pollination — and Why Does It Matter?

To understand bees' economic power, you first need to examine what they actually do.

When a bee lands on a flower to collect nectar, tiny grains of pollen stick to its fuzzy body. As the bee travels from flower to flower, it transfers that pollen, fertilizing plants so they can produce fruits, vegetables, and seeds. This process is called **pollination**.

Scientists estimate that bees pollinate roughly **one out of every three bites of food** humans eat. That includes crops like almonds (which depend almost entirely on bees), strawberries, coffee, and chocolate. Without pollinators, these plants cannot reproduce — and without reproduction, there is no harvest.



A bee collects pollen from a wildflower. As it moves from flower to flower, it pollinates crops that feed billions of people around the world.

Breaking Down the \$235 Billion Figure

So where does that staggering number come from? Economists and ecologists calculate the value of what bees provide by examining what farmers would have to spend without them. This is called an **ecosystem service** — a benefit that nature provides for free that would otherwise cost enormous amounts of money to replace.

Compare these two scenarios:

- **With bees:** Crops are pollinated naturally at no direct cost to farmers.
- **Without bees:** Farmers would need to hand-pollinate crops using brushes and human labor, or rent managed hives at high prices — costs that would be passed on to consumers.

When researchers organize all the crops that depend on pollinators and calculate their global market value, the total reaches approximately **\$235 billion per year**. That figure represents economic interdependence in action: farmers, grocery chains, food manufacturers, and consumers across the world are all connected through the quiet work of bees.

What Is Threatening Bee Populations?

Bee populations worldwide are declining, and scientists have identified several interconnected causes. Differentiating between these threats helps us understand why the problem is so complex:

- **Pesticides:** Certain chemicals used to protect crops from insects also harm or disorient bees, making it harder for them to find their way back to the hive.
- **Habitat loss:** As forests and wildflower meadows are replaced by cities and single-crop farms, bees lose the diverse food sources they need to survive.
- **Climate change:** Shifting temperatures alter when flowers bloom, sometimes creating a mismatch between when bees are active and when their food sources are available.
- **Disease and parasites:** A tiny mite called Varroa destructor — a **parasite**, meaning an organism that lives on and harms another living thing — has devastated honeybee colonies worldwide by feeding on bees and spreading viruses.

Each of these threats doesn't work alone — they interact and amplify each other, making bee populations more vulnerable overall.

What Are Scientists and Farmers Doing?

Researchers are actively working to understand and reverse bee decline. Some farmers are planting **wildflower strips** along the edges of their fields to give bees diverse food sources. Others are reducing pesticide use or switching to bee-safe alternatives. Scientists are developing treatments for Varroa mites and studying how to breed more disease-resistant bee colonies.

Governments are also responding. The European Union has banned several pesticides linked to bee harm, and many cities have created "pollinator corridors" — connected patches of bee-friendly plants across urban areas.

Your Backyard Is Part of the System

Here's a real-world connection that might surprise you: planting wildflowers in a yard or community garden is not just a hobby — it's a genuine ecological and economic act. Every patch of habitat supports local bee populations, which in turn support local food systems.

Conclusion

Bees reveal something important about how the world works: systems that appear separate are deeply connected. Agriculture depends on pollinators. Food prices depend on agriculture. Communities depend on food. When you examine these relationships carefully, a single bee becomes a thread woven through the entire fabric of the global economy. Protecting bees isn't just an environmental cause — it's an economic one, a food security one, and ultimately, a human one.

Think About It: Compare the four threats to bee populations described above. Which do you think is most difficult to solve, and why? How do these threats interact with each other to make the problem worse?

Lesson Objective

In this lesson, you will explore how bees connect agriculture, food systems, and the global economy through the process of pollination. You will examine the multiple threats facing bee populations and investigate how these threats interact with one another. By the end, you will be able to break down the relationships between ecological health and economic interdependence to explain why protecting bees matters on a global scale.



Many of the fruits and vegetables at a farmers market — from strawberries to avocados — exist because bees pollinated the plants that grew them.

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Bloom's Level: Analyze

Bloom's Goal: Students will analyze how the decline of bee populations disrupts interconnected ecological and economic systems by breaking down the causes, effects, and relationships described in the article.

Explanation: Analyzing requires students to go beyond recalling facts and instead examine how parts of a system relate to and affect one another. In this lesson, students will differentiate between multiple threats to bees, compare their severity and interactions, and draw conclusions about how a single species can hold together a complex global food economy.

Application Questions

Read each question carefully, use evidence from the article to support your thinking, and write a complete response in your own words.

1. The article describes bees as providing an 'ecosystem service' worth \$235 billion per year. Analyze how the loss of this ecosystem service would create a chain reaction affecting farmers, grocery stores, food manufacturers, and consumers. Who do you think would be hurt most, and why?

Think about: Think about how each group in the food system depends on the one before it. What happens to prices, jobs, and food availability when one part of the chain breaks down?

2. The article identifies four threats to bee populations: pesticides, habitat loss, climate change, and parasites like Varroa mites. Analyze how two of these threats interact with each other to make bee decline worse than either threat would cause on its own.

Think about: Consider how a bee colony that is already weakened by one threat might be less able to survive a second threat. Use specific details from the article to explain the connection.

3. The article states that planting wildflowers in a backyard or community garden is 'a genuine ecological and economic act.' Analyze this claim. In what ways is a small local action like planting wildflowers connected to the larger global food economy described in the article?

Think about: Trace the connection from a single wildflower patch all the way to global food markets. How does supporting local bee populations eventually affect things like food prices or crop harvests on a larger scale?

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Hypothesis Builder

Read the context below carefully. Then complete each component to build a scientific hypothesis about bee populations and food production. Use evidence from what you know about pollinators and ecosystem relationships to guide your answers.

Scientists have observed that bee populations are declining in many regions around the world due to threats such as pesticide use, habitat loss, climate change, and parasites. Bees are responsible for pollinating approximately one out of every three bites of food humans eat, contributing an estimated \$235 billion in ecosystem services annually. Researchers want to investigate how reducing pesticide use near farmland affects the health and size of local bee colonies. Understanding this relationship could help farmers protect both their crops and the pollinators those crops depend on.

Independent Variable

What is the ONE factor the researchers will deliberately change or control in this investigation? Identify the variable being tested.

Dependent Variable

What will the researchers measure or observe as a result of changing the independent variable? What outcome are they tracking?

If

Write the 'If' part of your hypothesis by stating what change will be made to the independent variable. Begin with the word 'If...'

Then

Write the 'Then' part of your hypothesis by predicting what will happen to the dependent variable as a result. Begin with the word 'Then...'

Because

Write the 'Because' part of your hypothesis by explaining the scientific reasoning behind your prediction. What do you know about bees and pesticides that supports this outcome? Begin with the word 'Because...'

Claim-Evidence-Reasoning (CER)

Read the phenomenon below carefully. Then complete each component of the Claim-Evidence-Reasoning (CER) framework. Your Claim should answer the question directly. Your Evidence should include specific facts or data from the article. Your Reasoning should explain how your evidence connects to and supports your claim using scientific and economic concepts.

Phenomenon: Bee populations around the world are declining due to multiple interacting threats, including pesticide use, habitat loss, climate change, and parasites like Varroa destructor. At the same time, scientists estimate that bees contribute approximately \$235 billion per year to the global economy through pollination. Researchers and governments are beginning to take action, but the problem continues to grow more complex as these threats reinforce one another.

Claim

Make a claim: How does the decline of bee populations affect both ecosystems and the global economy? Write a clear statement that answers this question without using the words 'I think' or 'I believe.'

Evidence

Provide evidence: What specific facts, data, or examples from the article support your claim? Include at least two pieces of evidence, such as numbers, named threats, or examples of crops affected by pollination loss.

Reasoning

Explain your reasoning: How does your evidence connect to your claim? Use the concepts of ecosystem services, economic interdependence, and the interaction of threats to explain why bee decline creates consequences that extend far beyond the bees themselves.

Data Table & Analysis

Study the data table below, which summarizes the four major threats to bee populations described in the article. Use the information in the table and what you learned from the lesson to answer the three analysis questions that follow. Write your answers in complete sentences.

Experiment: This data set is drawn from ecological research summarized in the lesson article about bee population decline and its economic consequences. Each row describes one identified threat to bee populations, including its primary cause, its direct effect on bees, and whether it interacts with other threats. Use this information to analyze patterns and relationships among the threats.

Threat to Bee Populations (N/A)	Primary Source or Cause (N/A)	Direct Effect on Bees (N/A)	Interacts With Other Threats? (Yes / No)	Human Activity Involved? (Yes / No)
Pesticides	Chemicals used to protect crops from insects	Harms or disorients bees; prevents return to hive	Yes	Yes
Habitat Loss	Replacement of forests and wildflower meadows by cities and single-crop farms	Reduces diverse food sources bees need to survive	Yes	Yes
Climate Change	Shifting temperatures altering flower bloom timing	Creates mismatch between bee	Yes	Yes

Threat to Bee Populations (N/A)	Primary Source or Cause (N/A)	Direct Effect on Bees (N/A)	Interacts With Other Threats? (Yes / No)	Human Activity Involved? (Yes / No)
		activity and food availability		
Disease and Parasites	Varroa destructor mite feeding on bees and spreading viruses	Devastates honeybee colonies worldwide	Yes	No

1. Look at the 'Interacts With Other Threats?' column. All four threats are marked 'Yes.' What does this pattern tell you about why bee population decline is such a complex problem to solve? Use at least two specific threats from the table to support your answer.

2. Three of the four threats involve direct human activity, while the Varroa mite parasite does not. Based on this distinction, which threats do you think scientists and governments have the most power to reduce? Explain your reasoning using evidence from the table and the article.

3. The article states that bees provide approximately \$235 billion per year in ecosystem services through pollination. Using the data in the table, analyze how the combination of habitat loss and climate change could together threaten this economic value more severely than either threat acting alone.

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Reflection Questions

Read each question carefully, think about what the article explained, and write a thoughtful response using evidence from the text.

1. The article describes bees as providing an 'ecosystem service' worth \$235 billion per year. Analyze how the loss of this service would create a chain reaction affecting farmers, businesses, and consumers.

Think about: Think about what would change at each step of the food system if bees disappeared. Who would be affected first, and how would those effects spread to others?

2. The article identifies four threats to bee populations: pesticides, habitat loss, climate change, and parasites. Analyze how two or more of these threats interact with each other to make the overall problem worse than any single threat alone.

Think about: Consider how a bee colony weakened by one threat might become more vulnerable to another. Can you find examples in the article where threats are described as connected?

3. The article argues that planting wildflowers in a backyard is 'a genuine ecological and economic act.' Analyze the reasoning behind this claim. Do you think individual actions at the local level can meaningfully impact a global economic system? Why or why not?

Think about: Think about how local bee populations connect to larger food systems. What does the article suggest about how small actions fit into big systems?

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Short Essay

Read the prompt below carefully. Write a short essay of at least two paragraphs using evidence and details from the article. Your response should analyze the relationships and ideas presented, not just summarize them.

The article describes four major threats to bee populations: pesticides, habitat loss, climate change, and disease and parasites. Analyze how these threats interact with each other to make the problem of bee decline more difficult to solve. In your response, explain what an ecosystem service is and discuss how the decline of bees could affect economic interdependence among farmers, businesses, and consumers around the world.

Multiple Choice

Read each question carefully and choose the best answer from the four options provided. Each question has only one correct answer.

1. A student claims that the decline of bee populations only affects farmers who grow crops. Based on the article, which analysis best explains why this claim is incorrect?

 - A. Bee decline only affects wild plants, not farm crops, so farmers are not impacted at all.
 - B. Bee decline affects farmers, grocery chains, food manufacturers, and consumers because they are all economically interdependent through pollination.
 - C. Bee decline is a problem only in countries that rely on honey production as a major export.
 - D. Bee decline affects only the price of almonds and strawberries, leaving most other food prices unchanged.
2. The article states that bees provide an ecosystem service worth approximately \$235 billion per year. Which of the following best explains how economists arrived at this figure?

 - A. They calculated the total amount of honey produced by bees worldwide each year.
 - B. They measured the cost of building enough greenhouses to grow crops without sunlight.
 - C. They calculated the global market value of crops that depend on pollinators and what it would cost to replace bee pollination artificially.
 - D. They surveyed farmers about how much they spend on renting beehives each growing season.

3. How do pesticides and habitat loss interact to make bee decline worse than either threat alone?

- A.** Pesticides cause habitat loss by destroying wildflower meadows, so they are actually the same threat.
- B.** Habitat loss forces bees to travel farther for food, making them more likely to encounter pesticide-treated crops, increasing their exposure to harm.
- C.** Pesticides and habitat loss only affect different species of bees, so they do not interact with each other.
- D.** Habitat loss makes bees stronger and more resistant to pesticides over time.

4. A farmer decides to plant wildflower strips along the edges of crop fields. Based on the article, which outcome would most likely result from this decision?

- A.** The wildflowers would compete with crops for water and reduce the overall harvest.
- B.** The wildflowers would attract Varroa mites, increasing the risk of disease in nearby bee colonies.
- C.** The wildflowers would provide diverse food sources for bees, supporting local pollinator populations and potentially improving crop yields.
- D.** The wildflowers would replace the need for pesticides entirely, eliminating all threats to bees.

5. The article describes Varroa destructor as a parasite. Which of the following best explains why this organism is classified as a parasite rather than a predator?

- A. It is classified as a parasite because it is smaller than the bees it harms.
- B. It is classified as a parasite because it lives on bees and harms them while feeding on them and spreading viruses, rather than killing them outright as a predator would.
- C. It is classified as a parasite because it only affects honeybees and not wild bee species.
- D. It is classified as a parasite because it competes with bees for the same food sources in the ecosystem.

6. Climate change causes a mismatch between when bees are active and when flowers bloom. Which of the following best analyzes how this mismatch connects to the broader economic impact described in the article?

- A. The mismatch causes bees to produce less honey, which lowers profits for beekeepers but does not affect crop production.
- B. The mismatch reduces successful pollination, which lowers crop yields, which raises food prices for consumers worldwide, demonstrating economic interdependence.
- C. The mismatch only affects wild plants and has no measurable impact on agricultural crops or food prices.
- D. The mismatch encourages farmers to plant more crops to compensate, which actually increases food production overall.

7. The European Union banned several pesticides linked to bee harm. Which of the following best analyzes a potential trade-off of this policy decision?

- A. The ban would have no trade-offs because protecting bees is always the most economically beneficial choice.
- B. The ban could protect bee populations and long-term crop yields, but farmers might face short-term challenges managing crop pests without those chemicals.
- C. The ban would immediately eliminate all threats to bee populations, solving the decline problem completely.
- D. The ban would cause food prices to drop immediately because farmers would no longer need to purchase pesticides.

8. Based on the article, which of the four threats to bee populations would most likely be the most difficult to solve at the individual or local level, and why?

- A. Pesticide use, because individual farmers can easily switch to hand-pollination without any additional cost.
- B. Varroa mites, because scientists have already developed complete cures that are available to all beekeepers worldwide.
- C. Climate change, because it is driven by global greenhouse gas emissions and cannot be meaningfully addressed by individual or local actions alone.
- D. Habitat loss, because wildflowers are impossible to grow in urban environments.

9. The article states that one out of every three bites of food humans eat depends on bee pollination. Which of the following conclusions can be best supported by analyzing this statistic alongside the \$235 billion ecosystem service value?

- A.** Bees are responsible for producing all of the world's food supply, making them the single most important organism on Earth.
- B.** The economic value of bees is significant but limited to luxury food items like almonds and chocolate.
- C.** Bee pollination is deeply embedded in global food systems, meaning a serious decline in bee populations would have widespread economic and food security consequences.
- D.** The \$235 billion figure overestimates bee importance because most crops can be pollinated by wind instead.

10. A city creates a pollinator corridor by connecting patches of bee-friendly plants across urban areas. Which of the following best analyzes how this action reflects the concept of economic interdependence described in the article?

- A.** The corridor only benefits city residents who keep backyard gardens and has no connection to broader economic systems.
- B.** By supporting urban bee populations, the corridor contributes to regional pollination, which supports agricultural production, food availability, and ultimately the economic well-being of communities beyond the city.
- C.** The corridor is purely an environmental project with no measurable economic effects on food systems or consumers.
- D.** The corridor reduces the need for farmers to plant wildflower strips, shifting all responsibility for bee conservation to city governments.

True / False

Read each statement carefully. Decide whether the statement is True (T) or False (F) based on what you have learned about bees, pollination, ecosystem services, and economic interdependence. Write T or F on the line next to each statement.

1. Bees contribute to the global food system by transferring pollen between flowers, which allows plants to produce fruits, vegetables, and seeds.

True False

2. Scientists estimate that bees are responsible for pollinating approximately one out of every two bites of food that humans eat.

True False

3. The \$235 billion figure represents the estimated annual global value of crops that depend on pollinators like bees.

True False

4. An ecosystem service is a benefit provided by nature that would cost significant money to replace if it were lost.

True False

5. If bees disappeared, farmers could easily replace pollination at no additional cost by using existing farm machinery they already own.

True False

6. The Varroa destructor mite is a parasite that harms honeybee colonies by feeding on bees and spreading viruses.

True False

7. Climate change can harm bee populations by causing a mismatch between when bees are active and when the flowers they depend on are blooming.

True False

8. The four major threats to bee populations — pesticides, habitat loss, climate change, and parasites — each operate completely independently and do not affect one another.

True False

9. Farmers, grocery chains, food manufacturers, and consumers are all economically connected to one another through the pollination work performed by bees.

True False

10. Planting wildflower strips along farm fields is one strategy scientists and farmers are using to help support bee populations and maintain pollination services.

True False

Vocabulary

Study each vocabulary term and its definition below. These words come directly from the article about bees and their role in the global economy. As you review them, think about how each term connects to the others and to the bigger ideas in the lesson.

pollination

The process by which bees and other pollinators transfer pollen from flower to flower, allowing plants to reproduce and produce fruits, vegetables, and seeds. Explain in your own words:

ecosystem service

A benefit that nature provides for free — such as bees pollinating crops — that would cost enormous amounts of money to replace if it disappeared. Explain in your own words:

economic interdependence

The way that farmers, businesses, and consumers across the world are all connected to and dependent on each other through shared systems like food production. Explain in your own words:

parasite

An organism that lives on and harms another living thing, such as the Varroa destructor mite that feeds on honeybees and spreads disease through their colonies.

Explain in your own words:

habitat loss

The destruction or replacement of natural environments — like forests and wildflower meadows — that leaves bees without the diverse food sources they need to survive.

Explain in your own words:

pesticides

Chemicals used to protect crops from harmful insects that can also disorient or harm bees, making it difficult for them to return to their hive.

Explain in your own words:

climate change

Long-term shifts in global temperatures that can alter when flowers bloom, sometimes causing a mismatch between when bees are active and when their food is available.

Explain in your own words:

wildflower strips

Rows of diverse flowering plants planted along the edges of farm fields to give bees a variety of food sources and support healthy pollinator populations.

Explain in your own words:

pollinator corridors

Connected patches of bee-friendly plants spread across urban areas, designed to give pollinators safe pathways and food sources through cities.

Explain in your own words:

pollen

Tiny grains produced by flowers that stick to a bee's body and are carried from plant to plant, enabling fertilization and the production of fruits and seeds.

Explain in your own words:

Exit Ticket

Answer both questions in 2-3 sentences each. Use evidence from the article to support your thinking.

1. The article describes four threats to bee populations: pesticides, habitat loss, climate change, and disease/parasites. Analyze how two of these threats interact with each other to make bee decline worse than either threat alone.

2. The article states that bees provide an 'ecosystem service' worth \$235 billion per year. Analyze what this figure reveals about the economic interdependence between bees, farmers, and consumers around the world.



A bee collects pollen from a wildflower. As it moves from flower to flower, it pollinates crops that feed billions of people around the world.



Many of the fruits and vegetables at a farmers market — from strawberries to avocados — exist because bees pollinated the plants that grew them.

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CROSSWORD PUZZLE



The \$235 Billion Insect: Why Bees Hold the World Together

CROSSWORD PUZZLE

ACROSS

1. An organism that lives on and harms another living thing, such as the Varroa destructor mite that feeds on honeybees and spreads disease through their colonies.
3. Long-term shifts in global temperatures that can alter when flowers bloom, sometimes causing a mismatch between when bees are active and when their food is available.
6. Tiny grains produced by flowers that stick to a bee's body and are carried from plant to plant, enabling fertilization and the production of fruits and seeds.
9. Chemicals used to protect crops from harmful insects that can also disorient or harm bees, making it difficult for them to return to their hive.

DOWN

1. Connected patches of bee-friendly plants spread across urban areas, designed to give pollinators safe pathways and food sources through cities.
2. The way that farmers, businesses, and consumers across the world are all connected to and dependent on each other through shared systems like food production.
4. A benefit that nature provides for free — such as bees pollinating crops — that would cost enormous amounts of money to replace if it disappeared.
5. Rows of diverse flowering plants planted along the edges of farm fields to give bees a variety of food sources and support healthy pollinator populations.
7. The process by which bees and other pollinators transfer pollen from flower to flower, allowing plants to reproduce and produce fruits, vegetables, and seeds.
8. The destruction or replacement of natural environments — like forests and wildflower meadows — that leaves bees without the diverse food sources they need to survive.

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WORD SEARCH

C E C O N O M I C I N T E R D E P E N D E N C E
Z P G G V G Q L H V X Q D Q F E Q X N S Z R Z K
N I Z S Z F K S V G E A N W O N D C M Z C P C W
B F B T J E J K W Z U A W B K Q G I Z L G O A I
E D B I Y C M D F S H F K S Y P A R A S I T E L
C P E S T I C I D E S G N J V X I I F J M Y Z D
O P V I S V V P D D Y K C W G P L D M U F L R F
S B A C Z A A Q U T Q H L Z C B Y B J V T F D L
Y U S E D S Q Z J N G D I Z A X I C S D B V L O
S G L S N E I M X A W O M E V O K U I P M B E W
T K W B Q Y D S U W C D A W U J B V C B Y Q Z E
E G U D H P X R O K Y C T K V P O L L E N D H R
M D Z W G L W C O F B H E F G E R K Y T P F H S
S B L G G A E K D O M D C G T Q M J I U O P F T
E I N N C Y U J N M P G H O I V I B D I L S H R
R C C D G D H G L Q H L A G N E P G W S L K P I
V F D R J S C D M K Z J N D U L A U F E I Q F P
I X D R M H H N O Z O Q G O D S W F K W N E C S
C V E L J H T S O G F I E G X G Y K O D A O T A
E H A B I T A T L O S S F R T I X O Q O T X K V
C Q Z V K P I S V Y P M P D T T E S K M I B J Q
V U B H B D M S J L P Q Y J E X W D R K O E K S
S X I J O Z J U H H J N L Y A Y M O L L N D G V
S X J S B P O L L I N A T O R C O R R I D O R S

FIND THESE WORDS

economic interdependence
climate change
parasite

pollinator corridors
habitat loss
pollen

ecosystem service
pollination

wildflower strips
pesticides