STO-172

Disappearing Bees

Teacher Information

science take·out
just add students™

Summary

Bees are dying! Explore how the loss of bees will affect your food supply. Use simulated lab tests and data from scientific research to identify possible reasons for the decline of honey bee populations. Explore actions that could be taken to protect insect pollinators.

Core Concepts

- Multiple environmental factors may be responsible for the decrease in honey bee populations.
- The decrease in honey bee and native bee pollinators affects the health of humans, animals, and the environment.
- A One Health approach identifies and seeks solutions to problems that affect the health of humans, animals, and the environment.

Time Required

3-4 forty-minute class periods

Kit Contains

- **Food Truck Menu**
- **Bee Virus Test Sheet** (simulated)
- Viruses from Judy's Bees (simulated)
- Dropper
- Chromatography paper
- Clear plastic dish

Teacher Provides

- Access to internet
- Access to tap water or a small cup of water
- Paper towels for clean-up

Warning: Choking Hazard

This Science Take-Out kit contains small parts. Do not allow children under the age of seven to have access to any kit components

Teacher Resources

- This kit is based on these two articles about winter honey bee colony loss:

  Winter Bee Declines Greatest in 13 Years: Survey
  https://www.the-scientist.com/news-opinion/winter-bee-declines-greatest-in-13-years--survey-66068

  Nearly 40% decline in honey bee population last winter 'unsustainable,' experts say
  https://abcnews.go.com/US/40-decline-honey-bee-population-winter-unsustainable-experts/story?id=64191609

- **Centers for Disease Control and Prevention (CDC): One Health**
  https://www.cdc.gov/onehealth/index.html

- **Bee Informed Partnership**
  https://beeinformed.org/

- **Bee declines driven by combined stress from parasites, pesticides, and lack of flowers.**
  https://www.ncbi.nlm.nih.gov/pubmed/25721506

- **ARS Honey Bee Health**
  https://www.ars.usda.gov/oc/br/ccd/index/

- **New Law Could Help Bees – but Could Leave Other Pollinators Out in the Cold**
  https://www.scientificamerican.com/article/new-law-would-help-bees-but-could-leave-other-pollinators-out-in-the-cold/

- **Beyond honey bees: Wild bees are also key pollinators, and some species are disappearing**
  https://theconversation.com/beyond-honey-bees-wild-bees-are-also-key-pollinators-and-some-species-are-disappearing-89214

- **Pollinators in Peril: A systemic review of North American and Hawaiian native bees**
  https://www.biologicaldiversity.org/campaigns/native_pollinators/pdfs/Pollinators_in_Peril.pdf

- **Confronting the Plight of Pollinators**
  https://www.natureserve.org/news-events/news/confronting-plight-pollinators

- **Nearly half of US honeybee colonies died last year. Struggling beekeepers stabilize population**
  https://apnews.com/article/honeybees-pollinator-extinct-disease-death-climate-change-f60297706e19c7346ff1881587b5aced

Teacher Suggestions

- The purpose for Part 1 is to convey the idea that people are reliant on pollinators for foods that are a significant part of their diet. For Part 1, it is OK if students do not have perfectly correct answers.
- Internationally, there is a growing focus on utilizing One Health approaches to solve problems that involve the health of humans, animals, and the environment. One Health problems are complex and solutions to these problems require the collaboration of people from a variety of disciplines. It is important that students are exposed to this type of interdisciplinary and collaborative thinking.
- The decline of bee populations is a One Health problem that involves the health of humans, animals, and the environment. An optional **Part 7** on the following two pages helps students understand what One Health means and see the importance of taking a One Health approach to solving the problem of disappearing bees. Students will need access to the internet to view this YouTube video: https://www.youtube.com/watch?app=desktop&v=TG0pduAYESA
- You may want to ask students to brainstorm examples of other One Health problems and explain how the One Health approach may involve a collaboration of people who have careers in human health, environmental health, and animal health.

Part 7: One Health and disappearing bees

One Health

The State Health Department is suggesting that local governments should take a collaborative One Health approach to solving complex local problems, such as the decline of bee populations. A One Health approach uses the idea that complex problems often involve the health of people, animals, and the environment. Therefore, solutions to One Health problems must be designed to protect the health of people, animals, and the environment.

1. Use the information in the text box above to explain what must be involved in a complex problem for it to be considered a One Health problem.

_____

_____

2. Watch this video from the CDC (Centers for Disease Control). The video provides a brief introduction to One Health and why it is important for public health professionals, veterinarians, ecologists, and environmental health professionals to work together.

Scan this QR code with your smartphone or tablet camera app to link to the video.

3. State one interesting or important thing that you learned about One Health from watching the video.

_____

_____

To support adoption of a One Health approach, the health department officials want to create a series of slides to provide examples of One Health problems in the community. Your team has been hired to create three slides to answer the question, **"Why are disappearing bees a One Health problem?"**

Remember how the CDC video used images with captions (short descriptions) to help people understand what One Health problems and solutions involve. Using pictures and captions in your slides will help people understand and remember what the One Health approach involves.

2. Use the information in the text box above, what you learned from the video, and what you learned about disappearing bees to develop three slides that show why the decline of bee populations is a One Health problem. You should create three slides:

   - Slide 1: A picture (or pictures) and a caption to explain how **animals** are involved in the problem.
   - Slide 2: A picture (or pictures) and a caption to explain how **humans** are involved in the problem.
   - Slide 3: A picture (or pictures) and a caption to explain how **the environment** is involved in the problem.

Reusing the Kit

Teachers will need to instruct students on how to handle cleanup and return of the reusable kit materials. For example, teachers might provide the following information for students:

Discard	Return to kit bag
• Used **Food Truck Menu** • Used **Bee Virus Test Sheet** • Used chromatography paper	• Small tube of Viruses from Judy's Bees • Dropper • Clear plastic dish

Refills for **Disappearing Bees** kits are available at www.sciencetakeout.com. The **10 Kit Refill Pack** includes the following materials:

- 10 **Food Truck Menus**
- 10 **Bee Virus Test Sheets** (simulated)
- 10 mL of Viruses from Judy's Bees (simulated)
- Transfer pipet
- 10 prepared sheets of chromatography paper

NGSS Correlation

Working Towards Performance Expectations

MS-LS2-2. Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.

HS-LS2-2. Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.

HS-LS2-7. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.

Science and Engineering Practices

Constructing Explanations and Designing Solutions

- Construct an explanation that includes qualitative or quantitative relationships between variables that predict phenomena.
- Design, evaluate, and refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.

Disciplinary Core Ideas

LS2.C: Ecosystem Dynamics, Functioning, and Resilience

- Extreme fluctuations in conditions or the size of any population can challenge the functioning of ecosystems in terms of resources and habitat availability.
- Moreover, anthropogenic changes (induced by human activity) in the environment—including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change—can disrupt an ecosystem and threaten the survival of some species.

LS4.D: Biodiversity and Humans

- Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth.

Cross Cutting Concepts

Patterns

Patterns can be used to identify cause and effect relationships.

Stability and Change

Much of science deals with constructing explanations of how things change and how they remain stable.

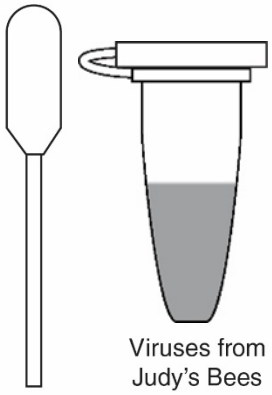
Cause and Effect

Cause and effect relationships may be used to predict phenomena in natural or designed systems.

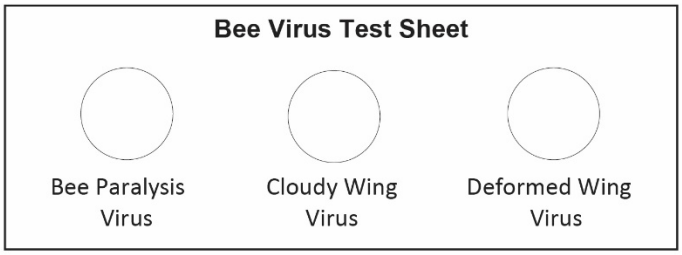
Scale, Proportion, and Quantity

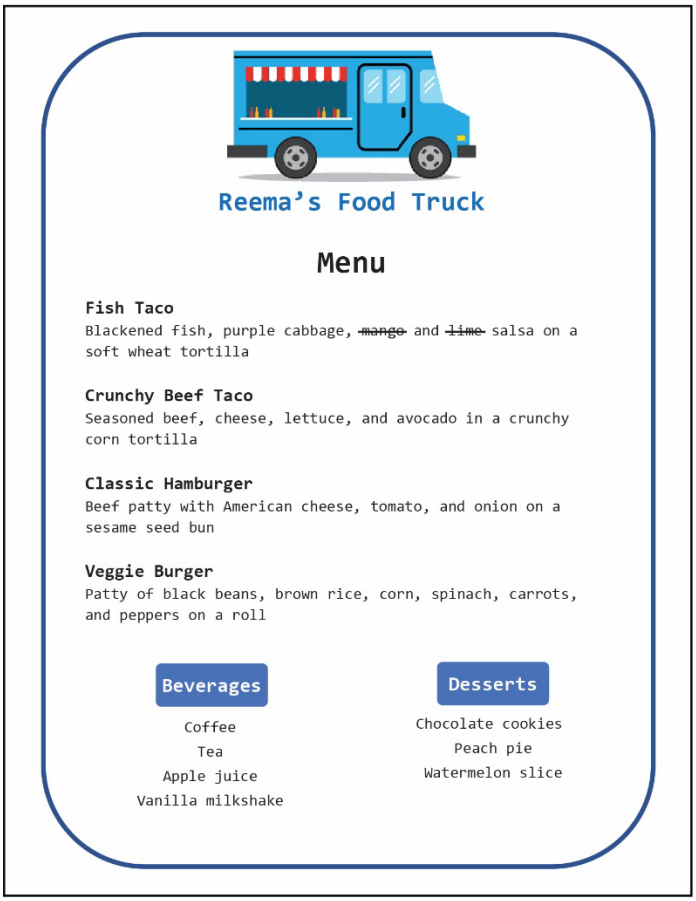
Using the concept of orders of magnitude allows one to understand how a model at one scale relates to a model at another scale.

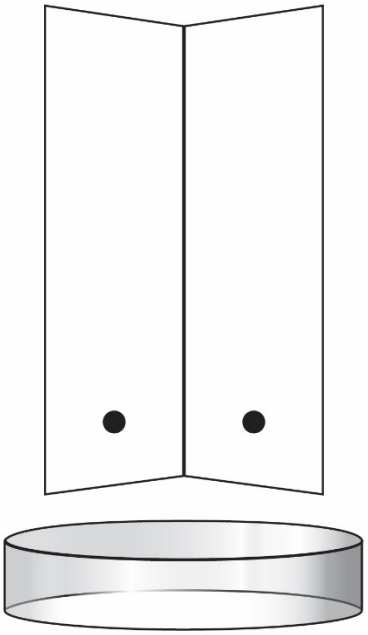
Kit Contents Quick Guide



Viruses from Judy's Bees







Read these instructions before using Science Take-Out kits

Parental or Adult Supervision Required

This kit should be used only under the supervision of an adult who is committed to ensuring that the safety precautions below, and in the specific laboratory activity, are followed.

Chemicals Used in Science Take-Out Kits

Every effort has been made to reduce the use of hazardous chemicals in Science Take-Out kits. Most kits contain common household chemicals or chemicals that pose little or no risk. Safety Data Sheets (SDS) provide specific safety information regarding the chemical contents of the kits. SDS information for each kit is provided in the accompanying teacher instructions. We encourage students to adopt safe lab practices when performing laboratory activities involving chemicals.

Warning: Choking and Chemical Hazard

Science Take-Out kits contain small parts that could pose a choking hazard and chemicals that could be hazardous if ingested. Do not allow children under the age of seven to have access to any kit components.

No blood or body fluids from humans or animals are used in Science Take-Out kits. Chemical mixtures are substituted as simulations of these substances.

General Safety Precautions

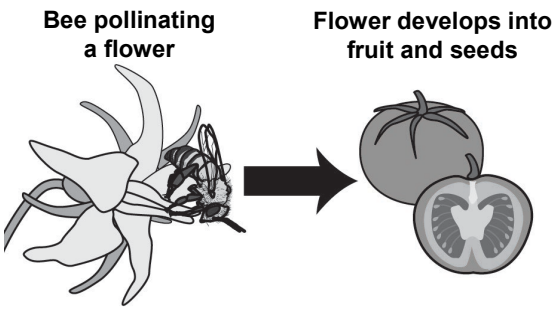
1. Never taste, smell, or ingest any chemicals provided in the kit - they may be hazardous.
2. Chemicals used in Science Take-Out experiments may stain or damage skin, clothing or work surfaces. If spills occur, wash the area immediately and thoroughly.
3. Report any chemical spills or contact with chemicals to your teacher.
4. Work in a clean, uncluttered area. Cover the work area to protect the work surface.
5. Read and follow all instructions carefully.
6. Pay particular attention to following the specific safety precautions provided by your teacher or included in the kit activity instructions.
7. Do not use the contents of this kit for any other purpose beyond those described in the kit instructions.
8. Do not leave experiment parts or kits where they could be used inappropriately by others.
9. Do not eat, drink, or apply make-up or contact lenses while performing experiments.
10. Wash your hands before and after performing experiments.

Disappearing Bees

Teacher Answer Key

Part 1: A World Bee Day event

The next time you see a bee buzzing around, remember it may be carrying pollen from one flower to another. Once a flower has been pollinated, it develops into seeds and fruit. Without the assistance of pollinators, many plants cannot produce fruits and seeds that are an important food source for people and wildlife.



World Bee Day is celebrated on May 20 to remind people that much of the food they eat depends on pollination by insect pollinators. Reema, a food truck owner, would like to celebrate World Bee Day by deleting all foods on the food truck menu that depend on honey bees, wild bees, or other pollinators. The menu for Reema's food truck is provided in your kit.

1. Cross off all foods on **Reema's Food Truck Menu** (in your kit) that <u>you</u> think rely on insect pollinators. *Note: See the cross outs for Fish Taco as an example.*

Many nutritious crops in your diet (including many fruits and vegetables) rely on insect pollinators. Pollinators also pollinate crops used for animal feed. For example, alfalfa requires a pollinator. Cows eat alfalfa, and cows produce milk, dairy products, and meat. A decrease in pollinators may also disturb ecosystems by decreasing food available for wildlife.

Not all crops are pollinated by insects. Leafy veggies, such as lettuce and spinach, do not rely on pollinators. Some foods, such as wheat, rice, and corn, are wind-pollinated, so insect pollinator decline does not affect these crops.

2. Based on the information in the text box above:

   - List additional foods that you should cross off the menu because they rely on insect pollinators. Explain why these foods should be crossed off the menu.

   - List foods that you should <u>not</u> cross off the menu because they do <u>not</u> rely on insect pollinators. Explain why these foods should <u>not</u> be crossed off the menu.

Part 2: A bee problem

Judy is a beekeeper. She started keeping honey bees as a hobby but it has turned into a profitable business for her. Last year, Judy and her two employees maintained approximately 2,000 hives. Each hive contains one colony of honey bees.

Judy sells honey from her hives. However, most of Judy's profit from her business comes from renting her honey bee hives to farmers. Farmers rent hives from Judy because the honey bees from the hives pollinate the flowers of fruit and vegetable plants.

Judy's hives are shipped throughout the country—to California for almond tree pollination, to Florida to pollinate orange trees, and to the Northeast to pollinate a variety of fruits and vegetables. In the fall, Judy's hives are returned to her farm in Texas where the bee colonies produce more honey and prepare for the winter.

Over the past few years, Judy noticed that the bee colonies in many of her hives were dying. She lost 50% of the bee colonies in her hives during the 2018-2019 winter. Judy wonders why her bee colonies are dying.

Judy and other beekeepers in the United States contribute bee health data and samples of honey bees from their hives to the ***Bee Informed Partnership*** (https://beeinformed.org/). The ***Bee Informed Partnership*** conducts laboratory tests and analyzes data to identify possible causes for the loss of bee colonies.

1. Why would farmers rent honey bee hives from Judy?

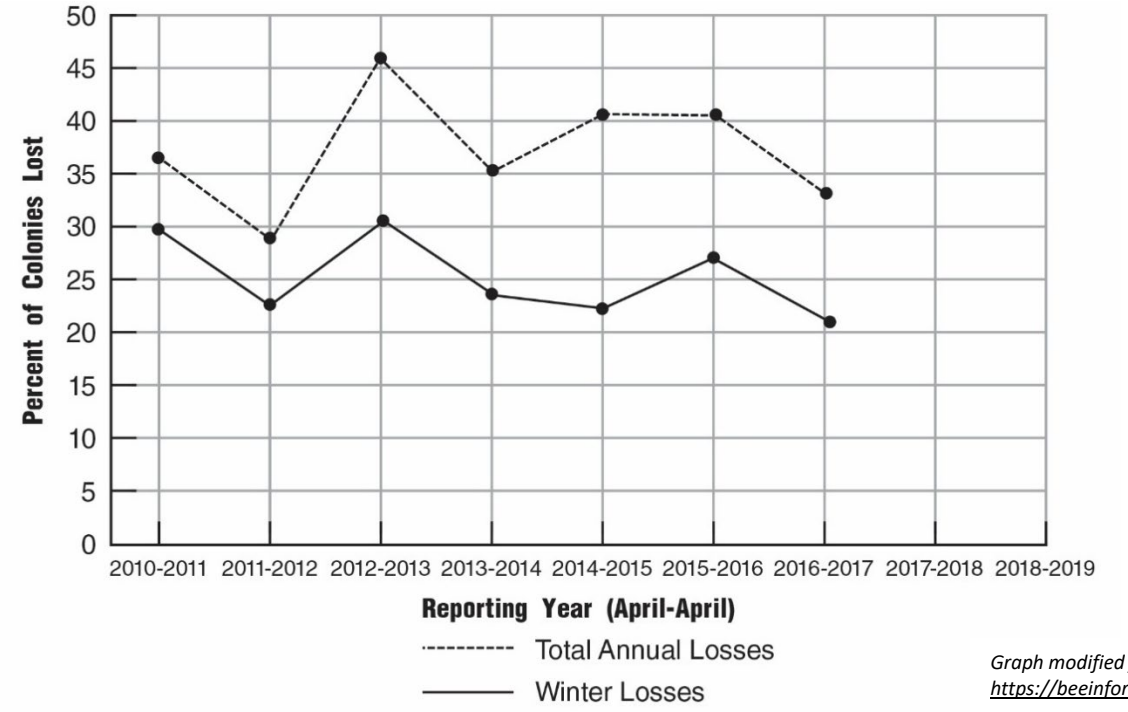
2. What ideas do <u>you</u> have for things that might have caused the death of Judy's bee colonies during the 2018–2019 winter? List at least two possibilities.

3. Use the information in the data table below to update the graph, **Annual Estimated U.S. Honey Bee Colony Losses**.
   - Plot the data for total annual losses and winter losses for the 2017–2018 and 2018–2019 reporting years.
   - Then, connect the lines to the data from previous years.

Data Table

Reporting Year	Total Annual Losses (% of colonies lost)	Winter Losses (% of colonies lost)
2017 - 2018	42	30
2018 - 2019	42	38

Graph: Annual Estimated U.S. Honey Bee Colony Losses



Graph modified from https://beeinformed.org

4. Judy lost 50% of the bee colonies in her hives during the winter of 2018–2019. Compare Judy's bee colony loss with the bee colony loss experienced by other beekeepers. Support your answer with evidence from the graph above.

Part 3: Sick bees - Are colony losses caused by pathogens and parasites?

Test for Pathogens

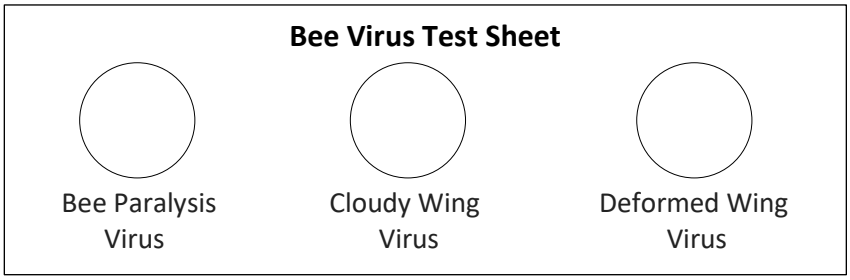
Some beekeepers claim that the health of a bee colony is severely threatened if bees become infected with pathogens such as viruses that affect their ability to fly. Bees need to fly to collect food (pollen and nectar) that is stored in the hive to support the bees during the winter.

In August, Judy sent a sample of 100 bees from one of her hives to the ***Bee Informed Partnership*** lab. Chemists in the lab prepared a sample of concentrated viruses from Judy's bees.

A Bee Virus Test Sheet can be used to determine which types of viruses are present in the sample. Each circle on the test sheet contains a different chemical that can attach to one type of virus. If the viruses attach to the chemical, the circle on the test sheet will turn pink.

1. Use a dropper to add 2 drops of **Viruses from Judy's Bees** to each of the circles on the **Bee Virus Test Sheet.**

2. Color in the circles below to show which circles turned pink when you added the virus sample to the circles on the test sheet.



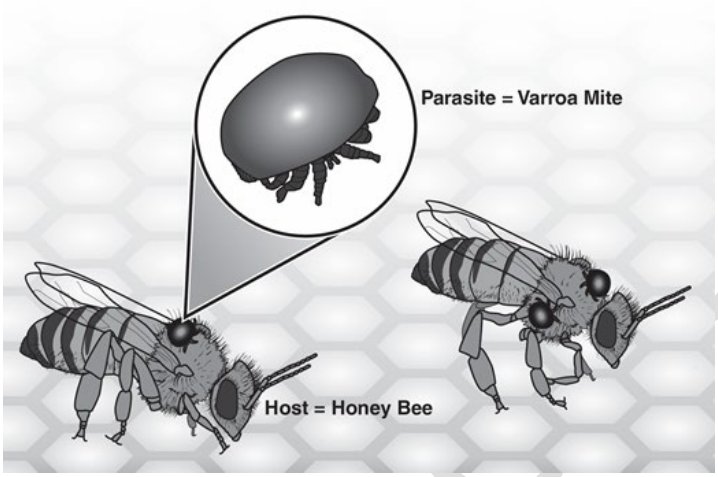
3. Based on the results of the virus tests, what type(s) of viruses are present in the sample from Judy's bees?

4. Explain how evidence from the virus tests that you conducted supports the claim that viruses contribute to the winter die-off of Judy's bees.

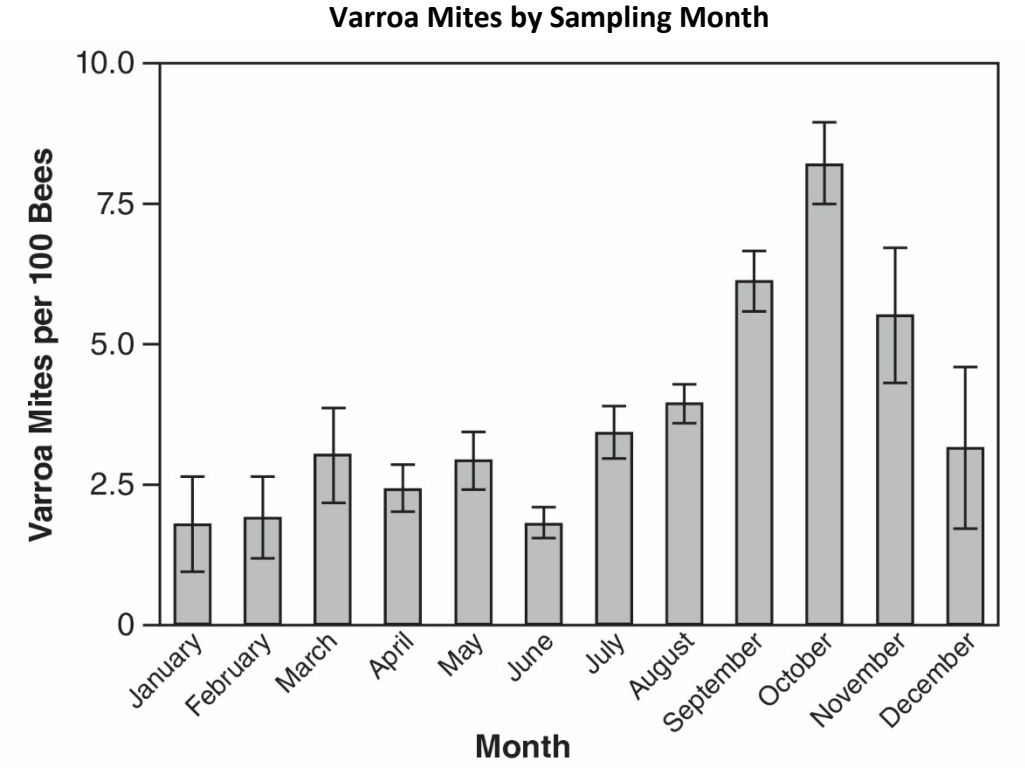
Tests for Parasites

Some beekeepers claim that winter bee colony losses are due to parasites that weaken or kill the bees. High parasite levels in the fall make it more difficult for bees to survive the winter.

Varroa mites are tiny parasites that attach to bees. These mites weaken the bees when they feed on the bees' body fat. Varroa mites also carry viruses and bacteria that can cause bee diseases.



5. Judy and other bee keepers completed tests for Varroa mites each month for a year. The results of these tests are shown in the graph below.



Source: https://www.vanengelsdorpbeelab.com/student-updates/the-national-honey-bee-disease-survey-varroa-nosema-in-the-us

6. Explain why high Varroa mite infections in a hive might increase the likelihood of winter die-off for a hive.

7. According to the information in the **Varroa Mites by Sampling Month** graph on the previous page, during what month would it be most important to treat bee hives to kill Varroa mites?

Part 4: Poisoned bees - Are colony losses caused by pesticides?

Pesticides are chemicals used to kill various pests such as insects, weeds, and fungus. Unfortunately, the use of pesticides is not good for bees. Flowers, nest sites, and the general environment around bees are often contaminated with pesticides. Bees are exposed to pesticides through pollen, nectar, and through the air, water or soil.

Pesticides known to pose a threat to bee health include:

- **Insecticides** that kill insects that feed on crops
- **Herbicides** that kill weeds that compete with crop plants
- **Fungicides** that kill fungus that causes crop diseases

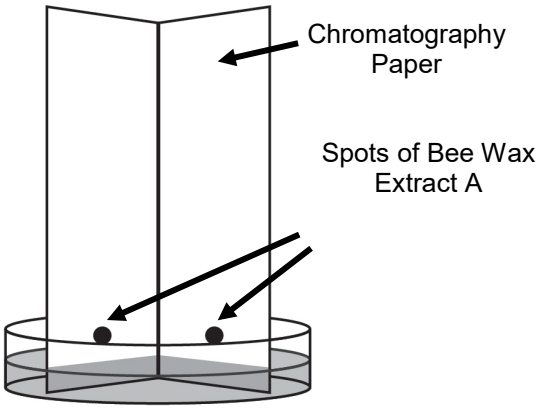
To provide data related to pesticides in her hives, Judy sent samples of bee wax to the ***Bee Informed Partnership*** lab for pesticide analysis. The chemists in the lab create concentrated extracts from the bee wax. The chemists then use paper chromatography to separate and identify the pesticides from the bee wax extracts.

1. Chemists use droppers to apply spots of bee wax extracts to pieces of chromatography paper. Your kit contains a small piece of folded chromatography paper that has two spots of bee wax extract **A**. This extract is from a bee hive that remained on Judy's farm in Texas.

2. You will use paper chromatography to separate and identify the pesticides present in the spot of bee wax extract **A**.

   a) Add just enough water to the small plastic dish so that it is <u>filled halfway</u> with water.

   b) Place the end of the folded piece of chromatography paper in the water as shown on the right. The spots of bee wax extract **A** should be <u>above</u> the surface of the water.



3. Watch as the water in the dish moves up the chromatography paper and dissolves the pesticides. As the water moves up the chromatography paper, the different pesticides move through the paper at different rates. This separates the pesticides into colored bands.

4. Remove the chromatography paper from the dish once the water has moved about 3/4 of the way up the paper. Observe the colored bands on the chromatography paper.

5. Complete the first row for bee wax extract **A** in the table below:
   - Write the colors of the bands in Column 1
   - Use the Key on the right to identify the names of the pesticides. Write the names of pesticides present in Column 2.

KEY
Red-Pink Band = Fungicide
Blue Band = Herbicide
Yellow Band = Insecticide

Results of Paper Chromatography of Bee Wax Extracts

Bee Wax Extract	Column 1 Color of Bands	Column 2 Which pesticides are present in the bee wax extract?
A Extract from a bee hive that remained at Judy's farm in Texas		
B Extract from a bee hive sent to almond and orange orchards in California	Black Red-Pink Yellow	
C Extract from a bee hive sent to soybean farms in North Dakota and Michigan	Black Red-Pink Yellow Blue	

6. Use the Key to identify the pesticides that are present in bee wax extracts **B** and **C**. Write the names of these pesticides in Column 2.

7. What types of pesticides are present in bee wax extract **A** from the bee hive that remained at Judy's farm in Texas?

8. Which location (orchards or soybean farms) is most likely to cause the greatest winter die-off when the bee hive returns to Judy's farm? Support your answer with information from the **Results of Paper Chromatography of Bee Wax Extracts** table on the previous page.

9. Does the data from Judy's bee wax sample support the claim that pesticide use may lead to winter bee colony loss? Explain why or why not.

Part 5: Hungry Bees - Are colony losses caused by poor nutrition?

Bees feed on flower pollen and flower nectar (a sweet secretion that attracts insects or birds). They collect and carry this food back to the hives to feed developing young bees and to store it for use during the winter. This means that bee colonies need a supply of different kinds of flowers near their hives throughout the bee season (spring, summer, and fall).

Natural areas with a diversity of wildflowers that bloom at different times of the year are important in providing nutrition for bees. Poor bee nutrition results when there are not enough blooming flowers during all parts of the bee season. Poor nutrition leads to winter loss when bees cannot store enough food to feed the hive for the winter.

Put an **X** in front of the descriptions below that are the 5 most likely to contribute to poor bee nutrition ("bee hunger") for Judy's bee colonies.

1. _____ The farms surrounding Judy's bee hives grow only one kind of crop.

2. _____ Homeowners near Judy's hives apply herbicides to their yards to kill flowering weeds.

3. _____ Judy's farm is surrounded by her vegetable garden and natural areas with many different wildflowers.

4. _____ Judy's neighbor planted a pollinator garden of colorful and scented plants that bloom during different parts of the year.

5. _____ The dairy farm near Judy's bee farm grows alfalfa to feed their herd and has natural areas between fields to act as windbreaks and wildlife habitats.

6. _____ Climate change (increased temperatures and decreased rainfall) has affected the kinds of crops and wildflowers that can survive in the area around Judy's farm.

7. _____ Climate change has caused "season creep" so that flowering no longer happens when Judy's bees are emerging from their hives in the spring.

8. _____ Climate change has resulted in unpredictable and severe weather (droughts and flooding) in the area around Judy's farm.

Part 6: Protecting Pollinators

Honey bees are not the only pollinators. Birds, bats, butterflies, moths, flies, beetles, wasps, small mammals, and native (wild) bees are also pollinators. When they visit flowers to drink nectar or feed off of pollen, they transport pollen grains as they move from spot to spot.

Pollinators are essential for a healthy environment because they maintain **biodiversity** (the variety of life in a particular habitat or ecosystem). Bees maintain biodiversity by contributing to the complex, interconnected relationships that allow many different species to co-exist in an ecosystem.

It's not just farm-grown fruits and vegetables that rely on pollinators to thrive. Many species of wild plants depend on insect pollinators as well. Bees are responsible for the production of many seeds, nuts, berries, and fruit, which serve as a vital food source for wild animals. Bees also support the growth of trees, flowers, and other plants which serve as food and shelter for animals.

Bees are also a source of food for animals. Raccoons, opossums, and insects will raid beehives to eat the nutritious honey and the bee larvae. At least 24 species of birds, including the blackbird, ruby-throated hummingbird, and starling, prey on bees. Many spiders and insects, like dragonflies and praying mantises, eat bees as well.

1. Biodiversity is essential for the health of the environment. Describe <u>two</u> ways that a decline in populations of bees and other pollinators could result in a loss of biodiversity in an ecosystem.

2. Protecting bees and other pollinators is important for the health of humans, animals, and the environment. Based on what you learned in Parts 1–5, suggest <u>three</u> things that people could do to protect pollinators.

3. Do an internet search to identify three additional things that people could do to protect bee populations.

Section 1 Chemical Product and Company Information

Science Take-Out
150 Office Park Way
Pittsford, NY 14534
(585)764-5400

CHEMTREC 24 Hour Emergency
Phone Number (800) 424-9300
For laboratory use only. Not for drug, food or household use

Product	Buffer Solution pH10
Synonyms	"Viruses from Judy's Bees"

Section 2 Hazards Identification

This substance or mixture has not been classified at this time according to the Globally Harmonized System (GHS) of Classification and Labeling of Chemicals.

Signal word: WARNING
Pictograms: None required
Target organs: None known

GHS Classification:
Skin irritation (Category 3)
Eye irritation (Category 2B)

GHS Label information: **Hazard statement(s):**
H316: Causes mild skin irritation.
H320: Causes eye irritation.

Precautionary statement(s):

P264: Wash hands thoroughly after handling.

P305+P351+P338: IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.

P332+P313: If skin irritation occurs: Get medical attention.

P337+P313: If eye irritation persists: Get medical attention.

Ca Prop 65 - This product does not contain any chemicals known to the State of California to cause cancer, birth defects, or any other reproductive harm.

Section 3 Composition / Information on Ingredients

Chemical Name	CAS #	%	EINECS
Water	7732-18-5	99.08%	231-791-2
Potassium chloride	7447-40-7	0.40%	231-211-8
Boric acid	10043-35-3	0.33%	233-139-2
Sodium hydroxide	1310-73-2	0.19%	215-185-5

Section 4 First Aid Measures

INGESTION: Call physician or Poison Control Center immediately. Induce vomiting only if advised by appropriate medical personnel. Never give anything by mouth to an unconscious person.

INHALATION: Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

EYE CONTACT: Check for and remove contact lenses. Flush thoroughly with water for at least 15 minutes, lifting upper and lower eyelids occasionally. Get immediate medical attention.

SKIN ABSORPTION: Remove contaminated clothing. Flush thoroughly with mild soap and water. If irritation occurs, get medical attention.

Section 5 Fire Fighting Measures

Suitable Extinguishing Media: Use any media suitable for extinguishing supporting fire.

Protective Actions for Fire-fighters: In fire conditions, wear a NIOSH/MSHA-approved self-contained breathing apparatus and full protective gear. Use water spray to keep fire-exposed containers cool.

Specific Hazards: During a fire, irritating and highly toxic gases may be generated by thermal decomposition or combustion.

Section 6 Accidental Release Measures

Personal Precautions: Evacuate personnel to safe area. Use proper personal protective equipment as indicated in Section 8. Provide adequate ventilation.

Environmental Precautions: Avoid runoff into storm sewers and ditches which lead to waterways.

Containment and Cleanup: Absorb with inert dry material, sweep or vacuum up and place in a suitable container for proper disposal. Wash spill area with soap and water.

Section 7 Handling and Storage

Precautions for Safe Handling: Read label on container before using. Do not wear contact lenses when working with chemicals. Keep out of reach of children. Avoid contact with eyes, skin and clothing. Do not inhale vapors, spray or mist. Use with adequate ventilation. Avoid ingestion. Wash thoroughly after handling. Remove and wash clothing before reuse.

Conditions for Safe Storage: Store in a cool, well-ventilated area away from incompatible substances.

Section 8 Exposure controls / Personal Protection

Exposure Limits:

Chemical Name	ACGIH (TLV)	OSHA (PEL)	NIOSH (REL)
Potassium chloride	None established	None established	None established

Engineering controls: Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower and fire extinguishing material. Personnel should wear safety glasses, goggles, or faceshield, lab coat or apron, appropriate protective gloves. Use adequate ventilation to keep airborne concentrations low.

Respiratory protection: None should be needed in normal laboratory handling at room temperatures. If misty conditions prevail, work in fume hood or wear a NIOSH/MSHA approved respirator.

Section 9 Physical and Chemical Properties

Appearance: Clear, colorless liquid.
Odor: No odor.
Odor threshold: Data not available.
pH: 10.0
Melting/Freezing point: Approx. 0°C (32°F) (water)
Boiling point: Approx. 100°C (212°F) (water)
Flash point: Data not available

Evaporation rate (Water = 1): <1
Flammability (solid/gas): Data not available.
Explosion limits: Lower/Upper: Data not available
Vapor pressure (mm Hg): 14 (water)
Vapor density (Air = 1): 0.7 (water)
Relative density (Specific gravity): Approx. 1.0 (water)
Solubility(ies): Complete in water.

Partition coefficient: Data not available
Auto-ignition temp.: Data not available
Decomposition temp.: Data not available
Viscosity: Data not available.
Molecular formula: Mixture
Molecular weight: Mixture

Section 10 Stability and Reactivity

Chemical stability: Stable
Hazardous polymerization: Will not occur.

Conditions to avoid: Excessive temperatures which cause evaporation.
Incompatibilities with other materials: Acids, alkalies, and air will change the buffer's ability.
Hazardous decomposition products: Boron oxide and chlorine gas.

Section 11 Toxicological Information

Acute toxicity: Data not available
Serious eye damage/irritation: Data not available
Germ cell mutagenicity: Data not available
Skin corrosion/irritation: Data not available
Respiratory or skin sensitization: Data not available
Carcinogenity: Data not available

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.
IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.
OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

Reproductive toxicity: Data not available
Aspiration hazard: Data not available
STOT-single exposure: Data not available
STOT-repeated exposure: Data not available

Potential health effects:
Inhalation: May be harmful if inhaled.
Ingestion: May be harmful if swallowed.
Skin: May cause mild irritation.
Eyes: May cause mild irritation.

Signs and symptoms of exposure: To the best of our knowledge the chemical, physical and toxicological properties have not been thoroughly investigated. Specific data is not available. Exercise appropriate procedures to minimize potential hazards.
Additional information: RTECS #: Data not available

Section 12 Ecological Information

Toxicity to fish: No data available
Toxicity to daphnia and other aquatic invertebrates: No data available
Toxicity to algae: No data available
Persistence and degradability: No data available
Mobility in soil: No data available
Bioaccumulative potential: No data available
PBT and vPvB assessment: No data available
Other adverse effects: An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.

Section 13 Disposal Considerations

These disposal guidelines are intended for the disposal of catalog-size quantities only. Federal regulations may apply to empty container. State and/or local regulations may be different. Dispose of in accordance with all local, state and federal regulations or contract with a licensed chemical disposal agency.

Section 14 Transport Information

UN/NA number: Not applicable
Hazard class: Not applicable
Exceptions: Not applicable
Shipping name: Not Regulated
Packing group: Not applicable
2012 ERG Guide # Not applicable
Reportable Quantity: No
Marine pollutant: No

Section 15 Regulatory Information

A chemical is considered to be listed if the CAS number for the anhydrous form is on the Inventory list.

Component	TSCA	CERLCA (RQ)	RCRA code	DSL	NDSL	WHMIS Classification
Potassium Chloride	Listed	Not Listed	Not Listed	Listed	Not Listed	Uncontrolled Product
Sodium hydroxide	Listed	1,000 lbs (454 kg)	D002	Listed	Not Listed	E

Section 16 Additional Information

The information contained herein is furnished without warranty of any kind. Employers should use this information only as a supplement to other information gathered by them and must make independent determinations of suitability and completeness of information from all sources to assure proper use of these materials and the safety and health of employees.
NTP: National Toxicology Program, IARC: International Agency for Research on Cancer, OSHA: Occupational Safety and Health Administration, STOT: Specific Target Organ Toxicity, SE: Single Exposure, RE: Repeated Exposure, ERG: Emergency Response Guidebook.

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