SCIENTISTS IN THE FIELD

Where Science Meets Adventure

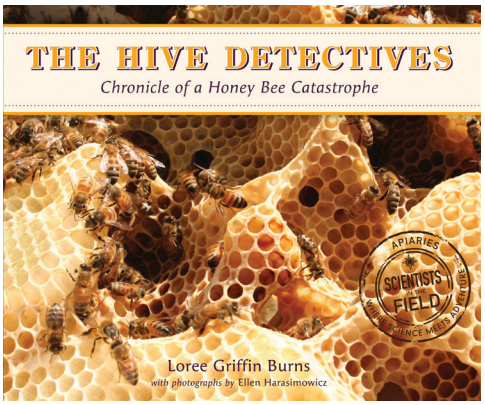
DISCUSSION AND ACTIVITY GUIDE

The Hive Detectives: Chronicle of a Honey Bee Catastrophe

By Loree Griffin Burns Photographs by Ellen Harasimowicz

About the Series

The Hive Detectives: Chronicle of a Honey Bee Catastrophe is part of the award-winning Scientists in the Field series, which began in 1999. This distinguished and innovative series examines the work of real-life scientists doing actual research. Young readers discover what it is like to be a working scientist, investigate an intriguing research project in action, and gain a wealth of knowledge about fascinating scientific topics. Outstanding writing and stellar photography are features of every book in the series. Reading levels vary, but the books will interest a wide range of readers.



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by Loree Griffin Burns
Photography by Ellen Harasimowicz

About the Book

What has caused the sudden and mysterious deaths of millions of honey bees in the United States since 2006? Scientists and beekeepers everywhere are trying to understand why this is happening and how to prevent it. Loree Griffin Burns describes this serious problem and the potential devastating impact the loss of honey bees would cause. She puts the spotlight on several theories for colony collapse disorder and on the scientists trying to discover the answer.

About the Author

Dr. Loree Griffin Burns holds a Ph.D. in biochemistry and has found a way to combine her many interests, exchanging her life as a professional scientist for one as a writer of children's science books. *Tracking Trash*, published in 2007, was her first book and was a Boston Globe–Horn Book Honor Book for Nonfiction. Her lively blog provides information of her life, fascinating research trips, and a list of suggested books and websites.

About the Photographer

Ellen Harasimowicz began work as a photographer and photojournalist in 2004 and has worked for the *Boston Globe* and *Worchester Telegram & Gazette*. Her work has appeared in the *Washington Post* and *Scientific American*, among other places. In 2008, she teamed up with Loree Griffin Burns for *The Hive Detectives*, and since then they have worked on this and two other books together.

EDUCATOR'S GUIDE

The Hive Detectives: Chronicle of a Honey Bee Catastrophe

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Pre-Reading Activity

Ever feel bad but not know why? Think about the steps we take when we are sick or someone in our family is sick. Brainstorm with the class all the possible steps we could take if we had an unknown illness. Make a list of all these steps. Later, after finishing *The Hive Detectives*, compare the steps on this list to the steps taken by the scientists. How are they similar and how are they different?

Define mutualism. Have you ever worked on a large project with a partner in which both of you must produce a separate part of a single product to pass? Look up parasitism, commensalism, and interdependency. Find several examples in nature of organisms that serve as examples for these terms. List both the benefits and drawbacks for each of these terms.

Without using a ruler or a straightedge, draw a series of eight (or more) connected hexagons as close to identical as you can draw them. Share your drawings with your classmates. How well did you do? Take a look at photographs of various hives, webs, nests, and other animal structures. What mathematical principles do you see in the shapes and construction?

Discussion Questions

What is the significance of finding traces of pesticides in the bodies and fluids of honey bees? Do people have trace elements of pesticides in their blood? What are the different types of pesticides? Are some more dangerous than others? What purpose do pesticides serve? Are the benefits of using pesticides worth the risks? What evidence would be needed for a farmer to decide to use or discontinue using a specific pesticide?

If honey bees were to vanish from our planet, what short-term, mid-term, and long-term changes would visit your city and state?

How long have bees been on our planet? Have bees always been responsible for pollinating plants? What does the fact that certain plants, like almond trees, owe their existence to honey bees suggest about the way nature works? What should people learn about themselves from watching bees and plants?

What are the differences between honey, sugar, syrup, and molasses?

When farmers bring bees into a field, how do they know that the bees will pollinate the intended crop?

Does it harm bees to take their honey? Ask a person who eats according to a strict vegan philosophy this same question.

How should federal, state, and local governments work together (or not) to solve the problem of colony collapse?

Have recent scientific discoveries about bees forced any changes to this text? Explain why or why not?

Applying and Extending Our Knowledge

On the dedication page before the text begins are images of three jars of honey. We know that honey is produced by bees after pollinating various flowers. These three pictures, however, are visibly different. The colors are very different. The bottle on the left is a light, almost translucent yellow. The middle is an orange color. The jar on the right is a very dark blue or even black color. Do this BEFORE looking at page 48!

- Have students find pictures of the flowers and the plants that they predict could have produced this honey.
- If you are able, find small jars of honey that have different colors and do a blind tasting. If the honey has a label listing the plants that produced it, hide the label until after the activity. Have students predict which taste belongs to which color. Have them bring in pictures of the plants and flowers that they predict produce the honey. Share the plants and flowers that produced each honey sample and review predictions. What conclusions and new predictions do students have now?

The Hive Detectives: Chronicle of a Honey Bee Catastrophe

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- Compare the taste of honey, syrup, and sugar (small tastes).
- Have students survey local food establishments to discover whether or not they use honey and if they do, how extensively honey is used in the foods sold around your city.
- Interview managers of local grocery stores to find out how much honey is sold during the year. How many different types of honey are in your community?

Read the information on pages 11 and 12 carefully. Find how many hives were lost. From reading about the number of hives and amount of honey collected each year:

- Find out how much honey one hive produces each year, assuming that none of the hives were lost.
- Find out how much honey was lost from the dead hives. Use the information from the previous activity to calculate a rough retail-dollar amount of the loss. Predict what the economic impact over the next ten years will be if losses stabilize, if losses continue at the same rate, and if there is a ten percent increase each year in the number of hives replaced from the number lost.
- Research the approximate number of hives lost worldwide and predict the financial harm (assuming everything is priced close to the values found in your neighborhood, using U.S. dollars). Have an economist visit the class and adjust these numbers according to world market values.
- Create graphs and displays showing the information above.

Common Core Connections

CCSS.ELA-Literacy.RST.6-8.1
Cite specific textual evidence to support analysis of science and technical texts.
CCSS.ELA-Literacy.RST.6-8.3
Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.
CCSS.ELA-Literacy.RST.6-8.7
Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
CCSS.ELA-Literacy.RST.6-8.9
Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.
CCSS.ELA-Literacy.W.7.7
Conduct short research projects to answer a question, drawing on several sources and generating additional related, focused questions for further research and investigation.

On page 13 we read, "Wind, rain, spiders, and other animals can pollinate plants, but nothing does the job as efficiently as the honey bee."

- What is it about the honey bee that makes it the most efficient pollinator? Make a poster or online presentation showing how the honey bee pollinates almond trees (and/or other local plants).
- Other flying animals pollinate plants, such as hummingbirds, bats, flies, and butterflies. Compare and contrast the different ways these animals pollinate. Convince us of the reasons why the honey bee is best.
- Research apiaries such as Hackenberg Apiaries. Find out how these businesses insure that the honey bees actually pollinate the crops and plants they are hired to pollinate. What is to stop honey bees from pollinating other flowering plants instead of the almond trees or blueberries or other plants that depend on honey bees? Ask bee keepers and farmers whether or not honey bees prefer certain flowers over others. Present your findings to the class.
- Write a skit about honey bees that do not want to pollinate the farmers' crops and present it to younger elementary-school students. Make sure to have factual reasons for why the bees are not pollinating the intended crop. Make sure the bee behavior mimics actual honey bee behavior. After sharing your skit, present a short, nonfiction explanation about honey bees to share with the students. Share with the students how research guided your skit and your acting.
- If time and interest permits, find music that fits with honey bee behavior. On page 56, we read that honey bees communicate by dancing. Create an interpretive musical dance that shows a day in the life of a honey bee or the honey bee life cycle or other aspects about these insects. Try to create a clear message exclusively with music and dance

The Hive Detectives: Chronicle of a Honey Bee Catastrophe

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(no lyrics or words). Use the Inside the Hive section on page 32–33 to create different roles for different students. It should be clear to the audience who is a drone, worker, or queen.

Common Core Connections

CCSS.ELA-Literacy.W.7.7
Conduct short research projects to answer a question, drawing on several sources and generating additional related, focused questions for further research and investigation.
CCSS.ELA-Literacy.RST.6-8.7
Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
CCSS.ELA-Literacy.W.7.4
Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. (Grade-specific expectations for writing types are defined in standards 1-3 above.)
CCSS.ELA-Literacy.W.7.2
Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.
CCSS.ELA-Literacy.W.7.6
Use technology, including the Internet, to produce and publish writing and link to and cite sources as well as to interact and collaborate with others, including linking to and citing sources.
CCSS.ELA-Literacy.SL.7.4
Present claims and findings, emphasizing salient points in a focused, coherent manner with pertinent descriptions, facts, details, and examples; use appropriate eye contact, adequate volume, and clear pronunciation.
CCSS.ELA-Literacy.SL.7.5
Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points.

The beginning of this book shows Mary Duane and her healthy hives. She describes the bees and the work she does with them. Many people around the country label all sorts of flying insects "bees." We read a lot about hives and honey, but not much about what makes a bee a bee. We have a section entitled Bee Bodies on pages 40 and 41 with some information. On page 56, we read that there are more than four thousand species in North America and close to twenty thousand species worldwide!

- Draw and label a honey bee prototype. Compare your drawing to other flying insects, pointing out how they are similar and how they are different.
- What types of honey bees are found in your neighborhood? Using iPads or cameras or video cameras, collect pictures of the honey bees found in your area.
- Many people confuse honey bees, hornets, wasps, and other flying insects with bees. Prepare a presentation showing the similarities and differences between these animals. Be sure to have drawings or slides and explanations for what is unique about the honey bee.
- The confusion of honey bees with wasps and hornets has many folks eager to destroy bee hives, such as the one pictured on page 3. It may also reduce the public's desire to help save honey bees from colony collapse disorder. Take wasps and hornets to court for slandering the good name of honey bees. Make sure that the defense attorney has plenty of information on the value to the ecosystem of wasps and hornets.
- Find large colored pictures of various types of wasps, hornets, bees, and honey bees. Take one picture around your school or neighborhood. Show the picture (without any labels or identification) and ask students and neighbors what it is. Keep tallies and records of your answers.
- If your area has a large degree of confusion about these animals, plan a brochure or information campaign that will make it easy for even very young students to tell the difference between a honey bee, a bumble bee, a wasp, a hornet, and any other local flying insects that are misidentified as honey bees. Make sure your brochure has information on how to deal with stingers and hives. Make sure the brochure has a section on how to minimize the hazard of getting stung (and what to do if one is stung).
- Speaking of bee stings, prepare a table showing the range of human responses to bee stings. Research the range of percentages for each category of response. Use a range from no reaction, slight reaction, moderate reaction, severe reaction, and fatal reaction (a zero to four scale).
- Research insects with stingers. Make a chart of all the insects that have stingers. On the chart show what happens to the insect after it stings another animal.

EDUCATOR'S GUIDE

The Hive Detectives: Chronicle of a Honey Bee Catastrophe

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Common Core Connections

CCSS.ELA-Literacy.W.7.7
Conduct short research projects to answer a question, drawing on several sources and generating additional related, focused questions for further research and investigation.
CCSS.ELA-Literacy.RST.6-8.7
Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
CCSS.ELA-Literacy.W.7.4
Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. (Grade-specific expectations for writing types are defined in standards 1-3 above.)
CCSS.ELA-Literacy.W.7.2
Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.
CCSS.ELA-Literacy.W.7.6
Use technology, including the Internet, to produce and publish writing and link to and cite sources as well as to interact and collaborate with others, including linking to and citing sources.

On page 17, the most probable causes for colony collapse disorder (CCD) are listed as an existing bee pest, a new and deadly bee germ, pesticides, or a combination of these factors. Later, on page 25. we read, *"Something was making these honey bees so sick that they could no longer fight off routine infections."*

- Draw and label a *Varroa* mite, a tracheal mite, and a honey bee. Make the drawings to scale. Explain in your own words why these pests are not considered to be a significant cause of CCD.
- Diana Cox-Foster suspects a viral infection is the culprit behind CCD. What is the difference between a virus and pests like mites? She finds that many bee colonies have Israeli acute paralysis virus (IAPV). However, to prove that IAPV is the culprit, she would have to inject a healthy hive with the virus. The author suggests that this could make the problem worse. Explain in your own words why injecting one little hive could have such disastrous consequences. Couldn't they simply move the hive to a big empty field with a lot of flats of flowers trucked in for the bees to gather nectar while they injected the virus? Would there be any way to make this work?
- Eventually the group decides to build an indoor bee yard. Diana says that IAPV is the leading candidate, but she is cautious because IAPV has been around a lot longer than CCD. Why does this bother the hive detectives? Discuss in small groups and then present each group's findings to create a class list of considerations. Then have the class present a theory about what the hive detectives should do next.
- The chart on page 46 shows all the different chemicals found in pollen samples. Maryann Frazier says, "I don't think CCD is caused by one thing. I do think it's a combination of things that are just over the top." Are pests a part of the problem, along with IAPV and pesticides? If it is a combination, what percentages of each are responsible? What does this mean for beekeepers in terms of making their hives safer? Create a graph showing your predictions for what is causing CCD. Write a rationale justifying your graph.
- Since this book was published, many new ideas and theories explaining CCD have been presented. Do an online search to discover the most recent theories on CCD. What did the hive detectives do right? Is IAPV still the leading candidate? What has changed? Present this information to the class and come up with new theories about what hive detectives should do next.

Common Core Connections

CCSS.ELA-Literacy.RI.7.1
Cite several pieces of textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.
CCSS.ELA-Literacy.W.7.7
Conduct short research projects to answer a question, drawing on several sources and generating additional related, focused questions for further research and investigation.
CCSS.ELA-Literacy.RST.6-8.7
Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
CCSS.ELA-Literacy.SL.7.2
Analyze the main ideas and supporting details presented in diverse media and formats (e.g., visually, quantitatively, orally) and explain how the ideas clarify a topic, text, or issue under study.
CCSS.ELA-Literacy.SL.7.4
Present claims and findings, emphasizing salient points in a focused, coherent manner with pertinent descriptions, facts, details, and examples; use appropriate eye contact, adequate volume, and clear pronunciation.

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Jeff Pettis says that before CCD, the general public would probably guess three of the four essential elements necessary to produce an apple to eat: sunlight, water, and nutrients. He said that after CCD, they will now be able to add the fourth: pollinators (p. 47).

- Go to a shopping mall or other safe place with lots of people and ask one hundred people what four essential elements are necessary to produce an apple for the table. Keep track of the answers and consolidate into a spreadsheet. Produce a graph of the results. Analyze the results and discuss. Depending on the results, prepare a campaign to remind people of the importance of pollinators (and other elements that have low percentages).
- Go to a local elementary school and repeat this survey. After analyzing the results, prepare a presentation for elementary students to teach students of the importance of pollinators.

Common Core Connections

CCSS.ELA-Literacy.RST.6-8.1
Cite specific textual evidence to support analysis of science and technical texts.
CCSS.ELA-Literacy.RST.6-8.3
Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.
CCSS.ELA-Literacy.SL.7.1
Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 7 topics, texts, and issues, building on others' ideas and expressing their own clearly.
CCSS.ELA-Literacy.W.7.4
Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. (Grade-specific expectations for writing types are defined in standards 1-3 above.)
CCSS.ELA-Literacy.W.7.2
Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.
CCSS.ELA-Literacy.SL.7.4
Present claims and findings, emphasizing salient points in a focused, coherent manner with pertinent descriptions, facts, details, and examples; use appropriate eye contact, adequate volume, and clear pronunciation.

On page 52 we read: "By the end of the day the bottom of the settling bucket will be filled with crystal clear blue-ribbon honey." And on page 53, "Honey flows faster when it is warm." On page 55 we read, "Mary lets the bees help her whenever possible. Excess honey on the discarded wax caps, on the emptied honey frames, and on any utensils is given back to the bees. Mary simply sets the honey-covered objects outside and the within minutes the bees arrive to suck them dry."

- Extracting honey takes a long time because it is sticky. Why don't bees get stuck in the honey? Make a prediction for why this sticky mess does not trap bees. Then do the research to find out from scientists why bees do not get stuck themselves.
- Write a poem or tall tale explaining why bees do not get stuck in honey. Present this work to a local senior center. If time permits, design a program of music, dance, poetry, and nonfiction research on the importance of honey bees to share with seniors or elementary students (or both).

Common Core Connections

CCSS.ELA-Literacy.W.7.7
Conduct short research projects to answer a question, drawing on several sources and generating additional related, focused questions for further research and investigation.
CCSS.ELA-Literacy.W.7.4
Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. (Grade-specific expectations for writing types are defined in standards 1-3 above.)
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Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.
CCSS.ELA-Literacy.SL.7.4
Present claims and findings, emphasizing salient points in a focused, coherent manner with pertinent descriptions, facts, details, and examples; use appropriate eye contact, adequate volume, and clear pronunciation.
CCSS.ELA-Literacy.W.7.3
Write narratives to develop real or imagined experiences or events using effective technique, relevant descriptive details, and well-structured event sequences.

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Other Websites to Explore

Honey Bee Information
www.buzzaboutbees.net
Buzz About Bees site offers extensive information about bees, their anatomy, care, types, and also diseases and CCD.

Honey Bees and Colony Collapse Disorder
ars.usda.gov/news/docs.htm?docid=15572#recent
Site from the U.S. Agricultural Research Service provides information and links to recent research on CCD.

Use of Common Pesticide Linked to Honey Bee Colony Collapse
www.hsph.harvard.edu/news/press-releases/colony-collapse-disorder-pesticide
Harvard School of Public Health Article on Pesticide Use and CCD

Harvard Study Rebuttal
scientificbeekeeping.com/the-harvard-study-on-neonicotinoids-and-ccd
Rebuttal from biologist and beekeeper to the Harvard study.

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