



# CITIZEN SCIENCE

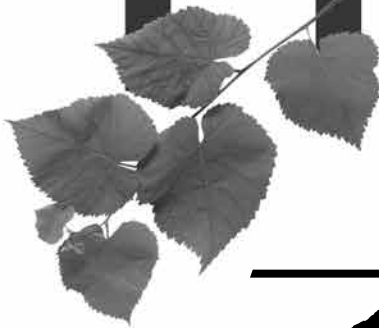
**15** LESSONS THAT BRING BIOLOGY TO LIFE, 6-12

Edited by  
NANCY M. TRAUTMANN  
JENNIFER FEE  
TERRY M. TOMASEK  
AND NANCYLEE R. BERGEY

**NSTA**press  
National Science Teachers Association



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# Acknowledgments

**T**his book was inspired by conversations at an NSTA National Conference among educators involved in citizen science. It represents extensive collaboration between curriculum specialists, science teachers, and scientists, some of whom are named as lesson authors and others of whom contributed vital reviews of lesson strategies and scientific content. The lessons were selected through a competition that yielded more high-quality lessons than we were able to include, and we extend deep thanks to all who participated. Jennifer Goforth served as our indispensable research and writing intern, and Irka Elsevier as a key editorial advisor. Many of the citizen science and education efforts represented in this book have been supported by grants from the National Science Foundation.



# About the Editors

**Nancy M. Trautmann** is Director of Education at the Cornell Lab of Ornithology, where she leads a team that creates educational resources and experiences aiming to spark curiosity, build science skills, and inspire conservation action ([www.birds.cornell.edu/education](http://www.birds.cornell.edu/education)). She is lead author in the Cornell Scientific Inquiry Series published by NSTA Press, with titles including *Assessing Toxic Risk, Decay and Renewal, Invasion Ecology*, and *Watershed Dynamics*. She holds a doctorate in computer supported collaborative learning, and her academic interests center on engaging students in scientific research and citizen science, supporting effective teacher professional development, and exploring the potential of educational technology in supporting student collaboration and project-based learning.

**Jennifer Fee** is the Manager of K–12 Programs at the Cornell Lab of Ornithology. She is the lead author of the BirdSleuth curriculum ([www.birdsleuth.org](http://www.birdsleuth.org)), with modules including Most Wanted Birds, Afterschool Investigators: Nature Detectives, and Investigating Evidence. She is interested in sharing citizen science and inquiry-based teaching with educators, particularly through curricula and online and in-person professional development workshops. She is a graduate from Truman State University (BS in Biology) and Illinois State University (MS in Behavior, Ecology, Evolution, and Systematics).

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# Preface

## Why Citizen Science?

---

*Observing the life cycle of monarch butterflies and following their remarkable migratory journeys between Canada, the United States, and Mexico...*

*Tracking climate change by recording the dates of first leaf, flower, and fruit of local trees, shrubs, flowers, and grasses...*

*Discovering which bird species migrate, where they go, and when...*

*Exploring life cycles and population dynamics of frogs, toads, and other animals in nearby ponds...*

Citizen science projects such as those listed above gather data through public collaboration in scientific research. Who are the “citizens” who take part in such efforts? Some are students and others are interested or concerned individuals from all walks of life. Together, professional and volunteer scientists collaborate to investigate biological and environmental trends over regions and timelines far broader than anyone could tackle individually.

For teachers, citizen science offers a way to motivate and inspire students through participation in research that is relevant both locally and globally. Students build meaningful connections to the natural world as they make observations, collect data, and view their findings within the broader scope of the project. When students design and conduct their own investigations, they also build science practice understandings and analytical reasoning skills through their involvement in citizen science.

In this book, we profile several scenarios of middle school classes engaging in citizen science and provide 15 lessons that present specific ways to build citizen science data collection and analysis into your science teaching. The lessons are organized around the 5E Instructional Model to progress from engagement and exploration through explanation, elaboration, and evaluation, and they engage students in the full range of science practices delineated in the *Next Generation Science Standards (NGSS)*.

We invite you to dig in and become part of the exciting and rapidly growing citizen science movement. Your students will not only learn science, they will be scientists, and their projects will bring biological and environmental science to life in your classes. What better way to fulfill the NGSS mandate to couple science practice with content and give students a real-world context in which to apply what they are learning?

# Habitat Matters

## YardMap Your School Yard

by Nancy M. Trautmann, Jennifer Fee, and Jennifer Goforth, Cornell Lab of Ornithology



### Overview

Through mapping and planning habitat improvements in their school yard or other open area, students learn about the importance of small-scale habitat management and discover the characteristics of green spaces that create productive habitat for birds.

### Learning Objectives

Students will be able to:

- Define key elements of habitat in support of a diverse range of bird species and other wildlife
- Analyze a green space to determine its potential for providing food, water, and shelter
- Plan and carry out conservation measures to make a green space more bird friendly
- Contribute data to the YardMap citizen science protocol

### Big Idea

Habitat elements include food, water, cover, and space. By improving or providing these elements, people can help birds in their yards, school yards, and other spaces.

### Citizen Science Connection

YardMap ([www.yardmap.org](http://www.yardmap.org))

### Time Required/Location

Two 60-minute class periods, indoors and outdoors

# 7

## LESSON 7 Habitat Matters: YardMap Your School Yard

### Resources Needed

- Computers with internet access
- Interactive whiteboard or projector
- Notebooks in which to take bird and plant notes
- Printouts of an aerial view of your school yard, created by taking a screen shot of your site on the YardMap website (1 per student) (If this is too dark to provide a good base map for annotation by students, a simple map of the school yard can be used instead.)
- Clipboards
- One camera for each group, along with the necessary equipment to upload pictures to a computer (optional)
- Selection of native plants or other materials selected for habitat improvement, and associated gardening tools (optional)

### Background Information

Growth in the amount of lawns across the United States is not good news for birds. How we manage and maintain our lawns, school yards, and other open spaces makes a big difference to birds because the typical manicured lawn provides little in the way of food, water, and shelter needed for a productive bird habitat. Lawns tend to consist of only one or two species of grass, dramatically limiting the potential wildlife they can support. You may think that birds eat only seeds, but in fact they also eat insects, fruits, berries, nuts, nectar, and other animals. Adding some native vegetation provides nutritious seeds, fruits, berries, and even insects that wouldn't otherwise be available. Greater diversity of vegetation supports a greater diversity of foods (especially insects) that birds can eat and feed to their young, resulting in more diverse and abundant bird life. The YardMap Network provides a place to map the habitat characteristics of your school yard, learn about ways to make this space more bird-friendly, track conservation-related improvements on your map, and share with an online community of people interested in establishing safe and productive habitats for birds (Figure 7.1).

### Conducting the Activity

Before digging in, set up a YardMap account. You may wish to create a centralized user account with an independent e-mail address, username, and password

**FIGURE 7.1.**

An example site mapped in YardMap



Source: [yardmap.org](http://yardmap.org)

to share with your students. For more information, see “Tips for Groups Using YardMap” under the “Help” function.

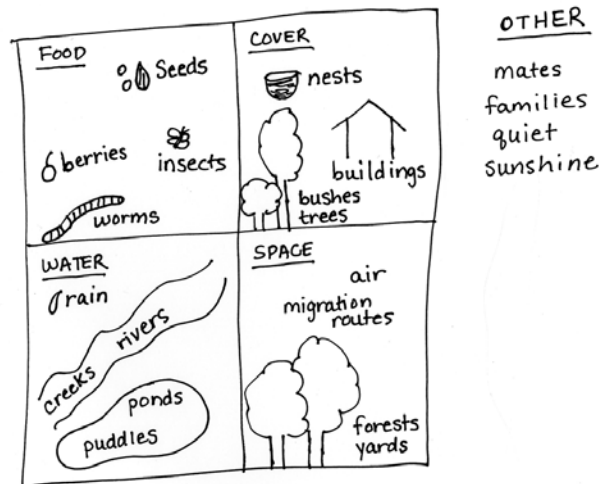
### Engage

1. Ask students to imagine that they are a bird—any bird. Ask: What are you doing? Where do you live? What do you see? Now focus more on habitat needs. What do you eat? Where do you find food? How do you eat? Where do you find water? Where do you sleep? Where do you lay your eggs? Where would you hide if something scared you? After plenty of imagination time, ask students to share ideas as a group, pair up and interview a partner about his or her story, draw the adventure, or write a creative story about the life of an individual bird.
2. As a group, brainstorm a list of ideas about what birds need for survival. Write ideas on the board, grouping them into categories representing food, water, cover, and space. If things in all four categories have not been mentioned, continue the discussion and encourage deeper thinking. If other things, such as “love” or “parents” are mentioned, put them in a separate place on the board for non-habitat needs. Once the list is complete, summarize that all living things need a place that supplies their own specific needs with regard to types of food, water, cover, and space. Together these make

up that organism's habitat. If an animal, such as a bird, cannot find these things in an area, and in the right arrangement, its habitat needs are not met and it will not be able to survive there.

**FIGURE 7.2.**

An example chart showing the four categories of needs related to habitat



### Explore

1. Tell students that they are going to create a detailed map of their school yard, paying special attention to ways in which it helps to meet habitat needs of birds and other wildlife, and they will submit this map to a citizen science project called YardMap. Find your school yard in YardMap and project the aerial image. With guidance from the class, ask one student to use YardMap's tools to outline the boundaries of your space. Have the rest of the class draw a similar outline on their printouts of the aerial view of the school yard.
2. Ask students, "What is citizen science, and how does it relate to YardMap?"

**Citizen science** refers to efforts in which volunteers partner with professional scientists to collect or analyze data. The YardMap Network is a citizen science project designed to inspire people to create better habitat for birds in their yards, school yards, and other open spaces. In YardMap, people map the characteristics of these green spaces, learn about potential ways to improve bird habitat, and track changes they have made in the landscape. Networking with other participants provides opportunities to share conservation strategies, challenges, and successes. Scientists are using the data represented in everyone's maps to investigate questions such as what practices best improve the wildlife value of residential landscapes and over how large an area must they



*be implemented in order to make a difference. See Chapter 1, "What Is Citizen Science?" for more information.*

3. Break into small groups to go outside and collect data about the space you have outlined. If possible, provide each group with a camera, and tell students to bring their aerial view printout and a pen or pencil for making annotations. Assign tasks using one of two options:
  - If the area you wish to map is large, or students are accustomed to independent work, consider having each group map and photographically document a separate piece of the total space.
  - If the area is small or students require more supervision, have each group map and photograph selected aspects of the overall habitat (for example, Group 1 maps the trees, Group 2 the shrubs, and so on).
4. Instruct students to investigate their assigned area with the goal of refining the map. They should look for different kinds of land cover and sketch the boundaries of areas covered by pavement, buildings, lawn, grasses, flowers/herbs, forest, shrubs, water, wetlands, and bare ground (dirt, gravel, or sand). Then they should think about where birds might find food, water, and cover and add information to their maps to indicate bird-friendly plants or objects such as bird feeders, water sources, and brushy areas.

### Explain

Back in the classroom, discuss what the students found outside. In YardMap, use the "Tool Shed" to refine your map, for example by creating polygons indicating areas covered by lawn, garden, or shrubs and adding features such as individual trees, bird feeders, or a rock pile. View photos taken by students. If you wish to include photos on your YardMap site, you will first need to upload them to a site you can link to (such as Flickr or your school's website). When you place an object icon on your map, you can click on it, select "open" and then provide information and links to photos.

### Elaborate

1. Ask students to create a chart similar to Figure 7.2 but including only items found in their study site, using their data as evidence in constructing explanations for which parts of the school yard provide the most basic habitat necessities for birds. If the school yard does not provide food, water, and cover, what is lacking?

# 7

## LESSON 7 Habitat Matters: YardMap Your School Yard

2. Ask students if they saw any birds while exploring the school yard. If so, what were the birds doing?
3. As homework or in class, ask students to explore the YardMap website and come up with ideas for making the schoolyard more bird friendly and justifying these suggestions with evidence they collected from the site or other sources. Encourage them to use the “Explore” and “Learn” sections of YardMap’s site. In the “Explore” section, they can type in your school’s ZIP code and bring up information about your local ecoregion, community gardens, native plant species, regional guidance in planting for pollinators, and contact information for local experts for further information and assistance. This section also provides a listing and mapped locations of birds reported to eBird within 20 miles of that ZIP code over the past 30 days. The “Learn” section provides detailed information about all aspects of bird habitat and bird-friendly landscaping.

### Evaluate

Assign students to write a one-page essay describing the extent to which the schoolyard currently provides food, water, and shelter for birds and outlining one or more steps they would like to propose for improving it in terms of bird habitat. The Additional Resources section lists references that provide detailed guidance for a variety of habitat improvement efforts.

Example responses might be to hang up bird feeders, plant fruit-bearing trees or shrubs, put in a birdbath, clean up trash, install nest boxes, plant native wildflowers, or even create a wetland.

### Extend

Compile a class list of plans outlined by students, and select one or more habitat improvement steps to implement as a class project. If you have the opportunity to carry out this lesson with multiple classes or in multiple years, you could start from scratch with each group or cumulatively build an increasingly detailed map and increasingly bird-friendly habitat. Students could present their habitat improvement plans to the school administration for approval and to parent or community organizations for help with fundraising through efforts such as selling bird houses, native plants, or birdseed.

If students identify birds seen in the schoolyard and submit these data to eBird (<http://ebird.org>), they can also use eBird’s online data outputs to follow trends and determine whether changes occur in bird diversity or abundance in conjunction with your habitat improvement efforts.

## Additional Resources

- Kolstad, C., K. Vollherbst, and K. K. Mullin. 2011. *Schoolyard habitat project guide, 2nd ed.* U.S. Fish & Wildlife Service. [www.fws.gov/cno/pdf/HabitatGuideColor.pdf](http://www.fws.gov/cno/pdf/HabitatGuideColor.pdf)  
Summary: A how-to guide stepping through planning, installing and sustaining a school yard habitat improvement project including specific considerations for creation or restoration of woodlands, meadows, and wetlands
- Kress, S. 2006. *The Audubon Society guide to attracting birds: Creating natural habitats for properties large and small, 2nd ed.* Ithaca, NY: Cornell University Press.  
Summary: A guide to attracting birds by planting native species and providing water and nest sites
- Tallamy, D. 2009. *Bringing nature home: How you can sustain wildlife with native plants.* Portland, OR: Timber Press.  
Summary: Explains the ecological link between native plant species and native wildlife, with insects that feed on native plants playing key roles in the food webs supporting birds and other wildlife.
- Zickfoose, J. 2001. *The bird-friendly backyard: Natural gardening for birds: Simple ways to create a bird haven.* Emmaus, PA: Rodale Press.  
Summary: A guide to creating plantings that attract, feed, and shelter birds and butterflies

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# CITIZEN SCIENCE

## 15 LESSONS THAT BRING BIOLOGY TO LIFE, 6-12

*"Observing the life cycle of monarch butterflies and following their remarkable migratory journeys between Canada, the United States, and Mexico..."*

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The editors of this book have a straightforward goal: to inspire you to engage your students through public collaboration in scientific research—also known as citizen science. The book is specifically designed to get you comfortable using citizen science to support independent inquiry through which your students can learn both content and process skills. *Citizen Science* offers you the following:

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