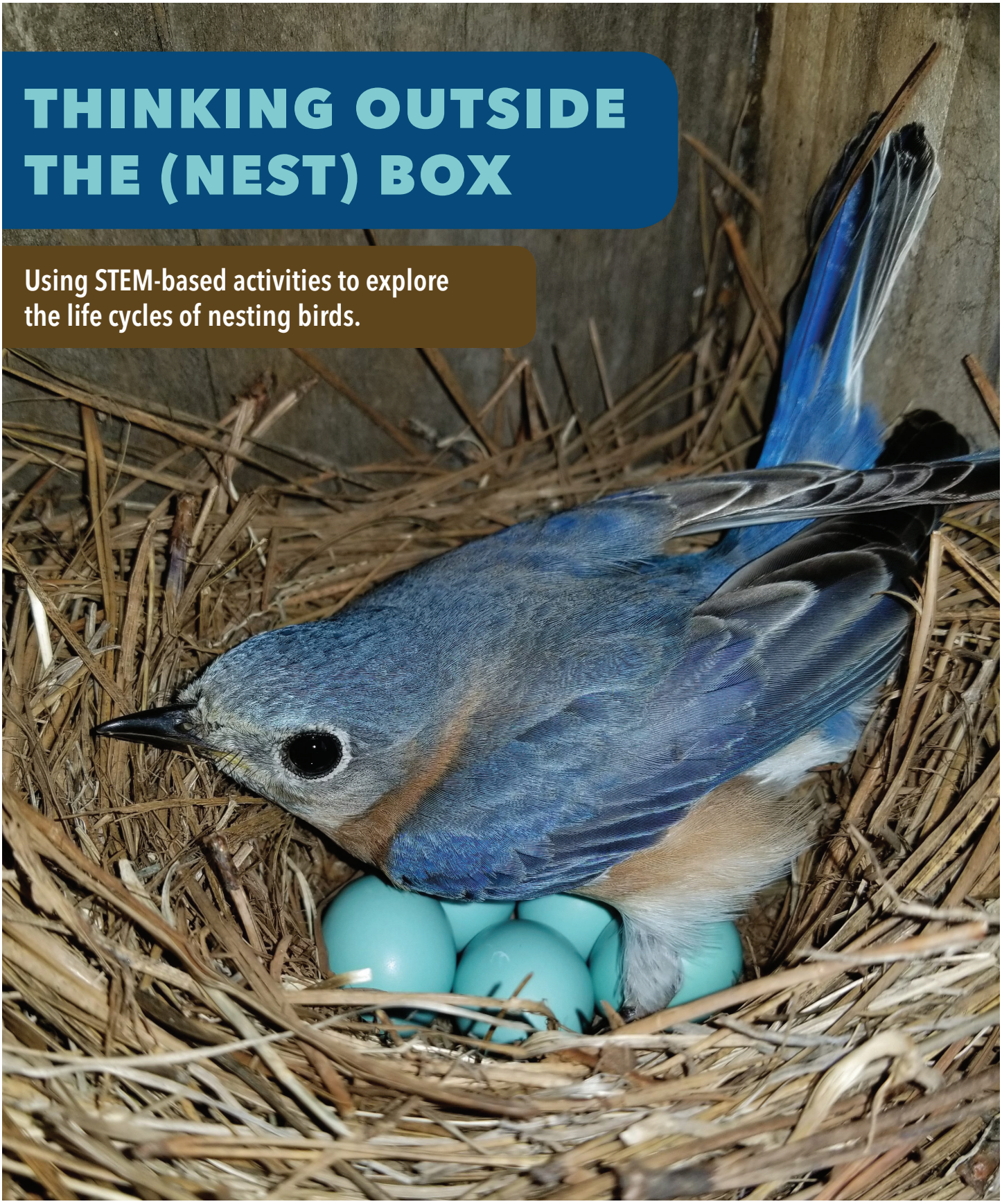
THINKING OUTSIDE THE (NEST) BOX

Using STEM-based activities to explore the life cycles of nesting birds.



NEW YORK STATE 4-H

The Cornell Lab NestWatch

The Cornell Lab K-12 Education

SUSTAINABLE FORESTRY INITIATIVE

SFI-00001

Thinking Outside the (Nest) Box is an educational resource created by NestWatch, a citizen-science program at the Cornell Lab of Ornithology. This curriculum aims to introduce youth to the world of nesting birds and engage participants in STEM learning and citizen science through the construction, installation, and monitoring of nest boxes.

The Cornell Lab of Ornithology is a nonprofit membership institution whose mission is to interpret and conserve the earth's biological diversity through research, education, and citizen science focused on birds.

If you have questions about the curriculum, please contact us.

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sfiprogram.org

What is NestWatch?

The Cornell Lab of Ornithology's NestWatch program is a nationwide citizen-science monitoring program. By finding and monitoring bird nests, NestWatch participants help scientists track the breeding success of birds across North America. Participants witness fascinating behaviors of birds at the nest and collect information on the location, habitat, bird species, number of eggs, and number of young. Launched in 2007 with funding from the National Science Foundation, NestWatch has collected more than 360,000 nesting records. This information helps scientists address how birds are affected by large-scale changes such as global climate change, urbanization, habitat loss, and the introduction of non-native species.

Introduction to *Thinking Outside the (Nest) Box*

These activities will introduce youth to the life cycle of birds and provide instructions for building and installing nest boxes, which in turn will enable youth to become citizen scientists and report their observations of nesting birds to the NestWatch program.

This series of activities will help you make the most of NestWatch. The activities cover:

- habitats;
- building and installing nest boxes;
- life cycles;
- proper monitoring and observation of nesting birds, and;
- data collection and analysis.

If you have not already, please review the NestWatch Code of Conduct and create a NestWatch account by visiting: **nestwatch.org/learn/code-of-conduct**.

To familiarize yourself and your group with vocabulary about nesting birds, please consult our glossary found in Appendix 1 or online at **nestwatch.org/learn/words-about-birds**.

Learning Standards and Key Science Content

This curriculum aligns with Next Generation Science Standards and Common Core Standards for grades 5 through 8. See Appendix 2 for a table that aligns activities to learning standards.

CONTENTS

What is Citizen Science?

Citizen science engages the public by encouraging them to collect data related to the natural world. The public and scientific community share and collaborate on their findings. Participants everywhere use basic scientific procedures to record and report observations. Hundreds of thousands of citizen scientists all across the world contribute millions of observations every year, creating an abundance of data and expanding the number and scope of research questions and opportunities.

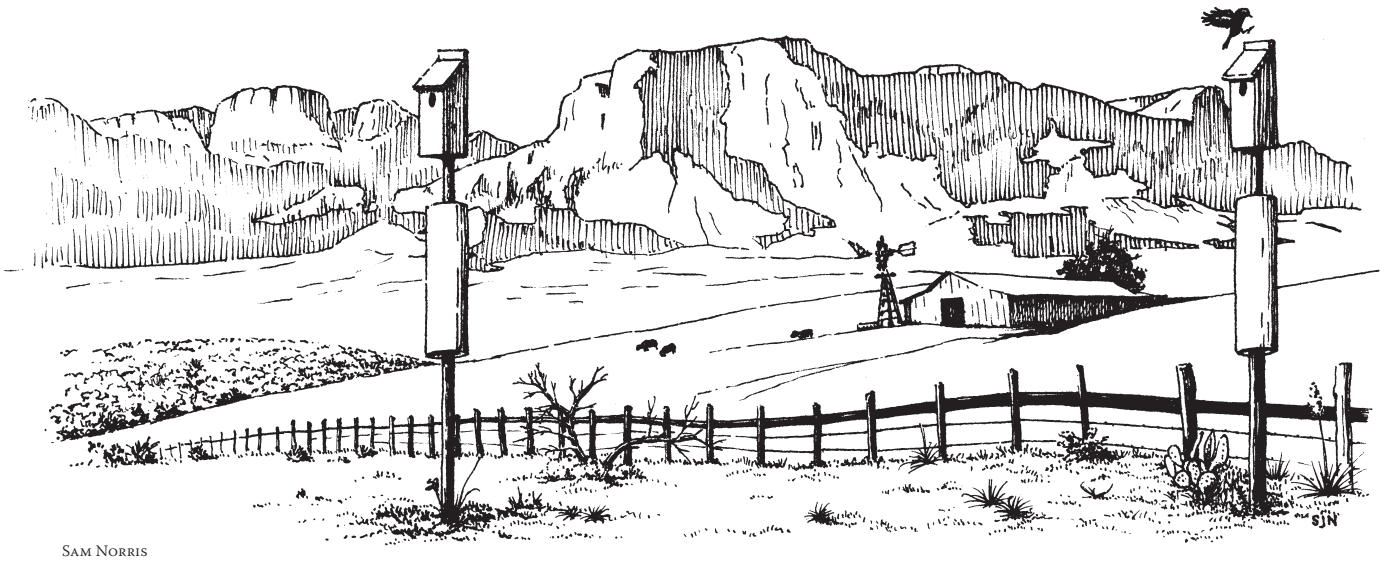
Citizen science is a way for you and your group to learn about birds, scientific inquiry, and conservation by contributing to scientific studies. This partnership between the public and the scientific community constitutes one of the world's largest collaborative scientific endeavors.

Why Nest Boxes?

Why does this curriculum emphasize nest boxes? Development of land and the removal of dead or damaged trees leaves cavity-nesting birds with fewer natural places to nest. Nest boxes provide a wonderful opportunity for students to observe and monitor birds up close—all while helping native birds. The nest box plan provided in this curriculum is designed to attract small songbirds such as bluebirds, swallows, chickadees, wrens, and nuthatches.

A Word of Caution…

Looking into a nest gives you an intimate view of a bird's life cycle. Despite our best efforts, nests are not always successful. Throughout your participation in NestWatch, you may observe competition for nest boxes, predator-prey interactions, and weather events that affect the lives of birds. Please review NestWatch's Features of a Good Birdhouse, **nestwatch.org/learn/features-of-a-good-birdhouse**, to learn how to deter predators and construct your nest box to withstand the elements. These natural processes and the potential death of birds can be upsetting, but are also an important opportunity to learn about the challenges that wild birds face.



Sam Norris

ACTIVITY 1: RIGHT BIRD, RIGHT HABITAT

Goal

Learn why some birds use nest boxes, and discover which birds might live and nest in your area. Also learn that birds prefer different habitats in which to build nests.

Time and Location

45 minutes, indoors

Resources Needed

- Computer, projector, and Internet access
- NestWatch slideshow, Slides 2-6
  Download the slideshow at **birdsleuth.org/nestwatch**
- NestWatch Right Bird, Right House online tool: **nestwatch.org/learn/right-bird-right-house**.

Meeting the Standards

See Appendix 2 for corresponding *Next Generation Science Standards* and *Common Core Standards.*

Conducting the Activity

Right Bird, Right House: Investigating local nesting birds

1. Establish what students know about local birds and solicit their nesting observations through a series of questions and discussions. Consider asking the following questions:
   - What birds have you observed around your school, home, etc? If you do not know the bird's name, what color was it? Where did you see it? What size was it? Did you hear it?
   - Have you seen a bird's nest? Where? What kind of bird? Could you see eggs or chicks?

2. Using NestWatch's Right Bird, Right House tool, explore which species prefer to nest in various habitats around your area. All of the birds on the Right Bird, Right House tool utilize human-made nesting structures such as a nest box, also called a birdhouse. Nest boxes provide homes for cavity-nesting birds, such as Eastern and Western Bluebirds and Tree Swallows. These birds would normally nest in tree holes, but the trees in many yards and parks are not yet old enough to provide suitable cavities. Once trees mature and start to decay (we call these snags), woodpeckers will create holes in the trunk, providing homes for themselves and other birds. Until then, nest boxes are a great way to address the shortage of nesting places for these cavity-nesting birds. See Slide 2 for a bird's perspective on tree cavities versus nest boxes.

3. Show Slide 3 to better understand the Features of a Good Nest Box. This infographic is also available on the NestWatch website: **nestwatch.org/learn/features-of-a-good-birdhouse.**

4. Locate the Right Bird, Right House tool on the NestWatch website. First, filter by region, then by habitat. You can select a variety of habitats to demonstrate and reinforce how different birds prefer different habitats.

5. Review with students several of the birds' breeding ranges, breeding seasons, preferences for nest box placement, and tips for attracting these birds to nest boxes. You can also find more information about

TEACHER TIP

Among the easiest species to attract to nest boxes are bluebirds, swallows, chickadees, and wrens. The nest box construction plan included in this curriculum (page 11) is intended for these species of cavity-nesting birds.

these species, such as what the birds' nests and eggs look like and their specific clutch size on the Common Nesting Birds webpage (**nestwatch.org/learn/focal-species**). Students can also search the All About Birds website (**allaboutbirds.org**) to learn more about species that interest them.

Right Bird, Right Habitat

1. Review the concept of habitat and its components with Slide 4 from the NestWatch slideshow.

2. Demonstrate how different birds prefer to live and nest in different environments. Show Slides 5-6. Point out that not all birds nest in cavities or nest boxes.

3. **Ask:** Do any of these birds look familiar? Can you identify them? Based on the habitats that we saw on Slide 5, can you determine in which habitats these birds might nest (it can be several)? Can you show where the bird might build a nest in that habitat (e.g., in a shrub, on the ground)?

For example, Northern Cardinals nest in shrubs, Mallards nest on the shore, and American Robins may nest on a house porch. You can use the NestWatch Common Nesting Birds tool to learn more about each species: **nestwatch.org/learn/focal-species**.

- **Black-capped Chickadee**—open woodland, forest, town/city
- **Wood Duck**—lake or wetland
- **American Robin**—forest, open woodland, shrub, town/city
- **Mourning Dove**—forest, open woodland, town/city
- **Tree Swallow**—lake or wetland

Ask: Why do most of these birds build nests in various habitat types?

The different habitat types provide the things these birds need to survive: food, water, cover, space, and during the breeding season, a place to nest. The species that can nest in multiple habitats are "generalists," meaning they have some flexibility when choosing nest locations. Other bird species only nest in specific places. For example, Peregrine Falcons only nest on cliffs and tall structures such as buildings and bridges.

Reflect and Evaluate

1. Which species of birds from the slideshow or website had you seen before? Can you name the habitat where you saw the bird?

   Forest, lake, town, field, etc…

2. Which species of birds were new to you? Did you find any of the birds surprising?

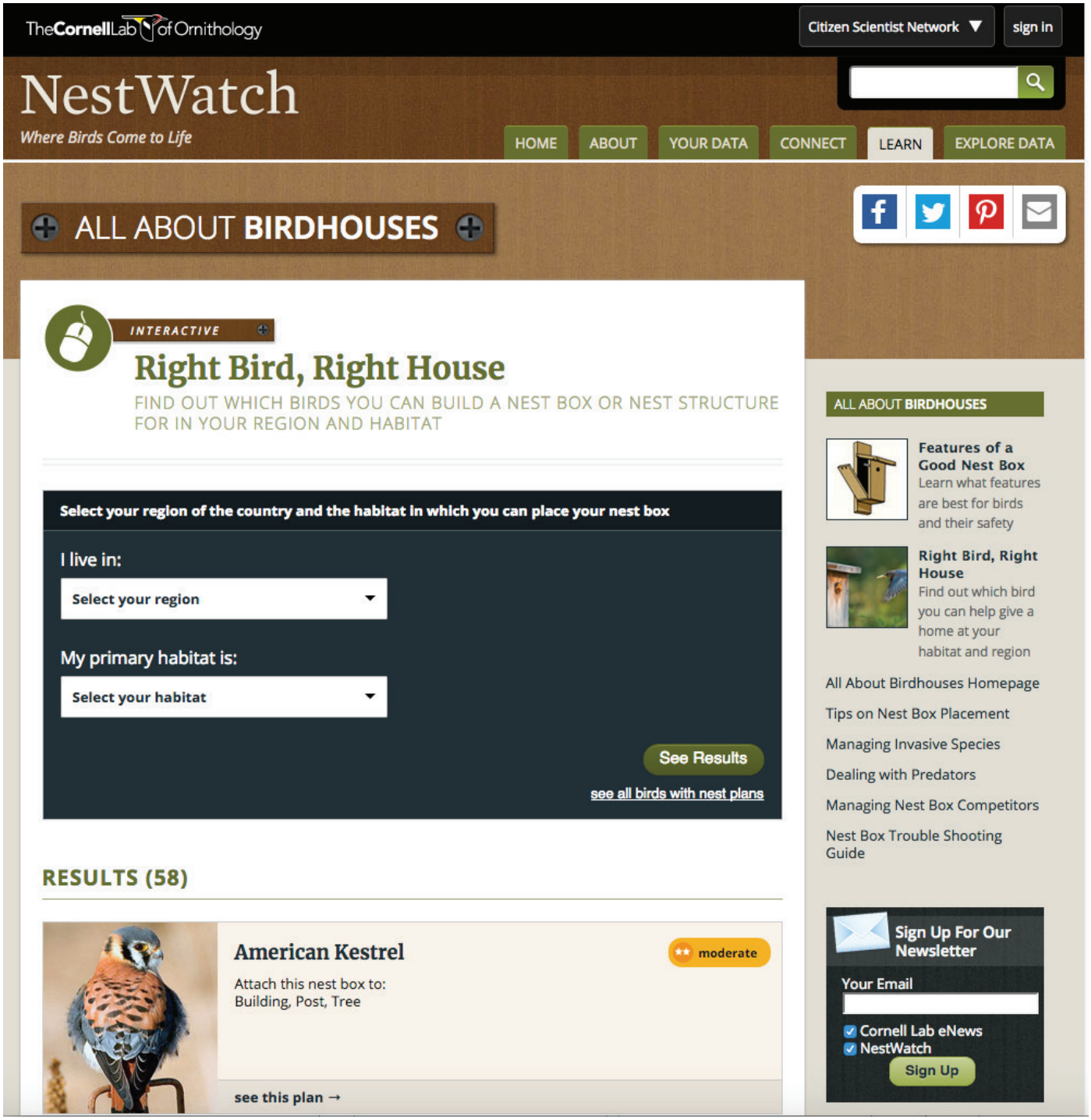
3. When we used the Right Bird, Right House tool, we saw that not all birds use nest boxes. What were some other structures that you saw?

   Examples include platforms for Ospreys, shelves for American Robins, or a nesting cone for Mourning Doves or Great Horned Owls.

4. Why don't all birds nest in nest boxes or tree cavities?

   Each species of bird has evolved to build nests with specific materials (such as sticks, mud, pine needles, or grass), in a certain nest site, and habitat. Selecting a diversity of nesting materials and locations is an advantage for birds. Imagine how hard it would be for all birds to build nests from the same material in the same location!

5. Divide youth into groups and assign each group a species that is likely to nest in your nest boxes (chickadees, wrens, titmice, swallows, and bluebirds). Research the bird's nesting cycle using NestWatch and All About Birds (**allaboutbirds.org**). When do the birds typically nest? What habitat do they prefer? How many eggs do they lay? How many clutches do they have during the nesting season?



The Right Bird, Right House tool lets you review birds that prefer to nest in various habitats around your area. All of the birds in the tool may utilize human-made nesting structures such as a nest box, also called a birdhouse.

Extensions

1. When using the Right Bird, Right House tool, you may have noticed that several of the birds were labeled Species in Decline. In certain regions throughout the United States, populations of some species are declining. One way you can help these birds is by providing them with places to nest. Select one or two declining species and build nest boxes for them. If they live in your area, species you might wish to consider include: American Kestrel, Barn Owl, Northern Flicker, Prothonotary Warbler, and Great Crested Flycatcher.

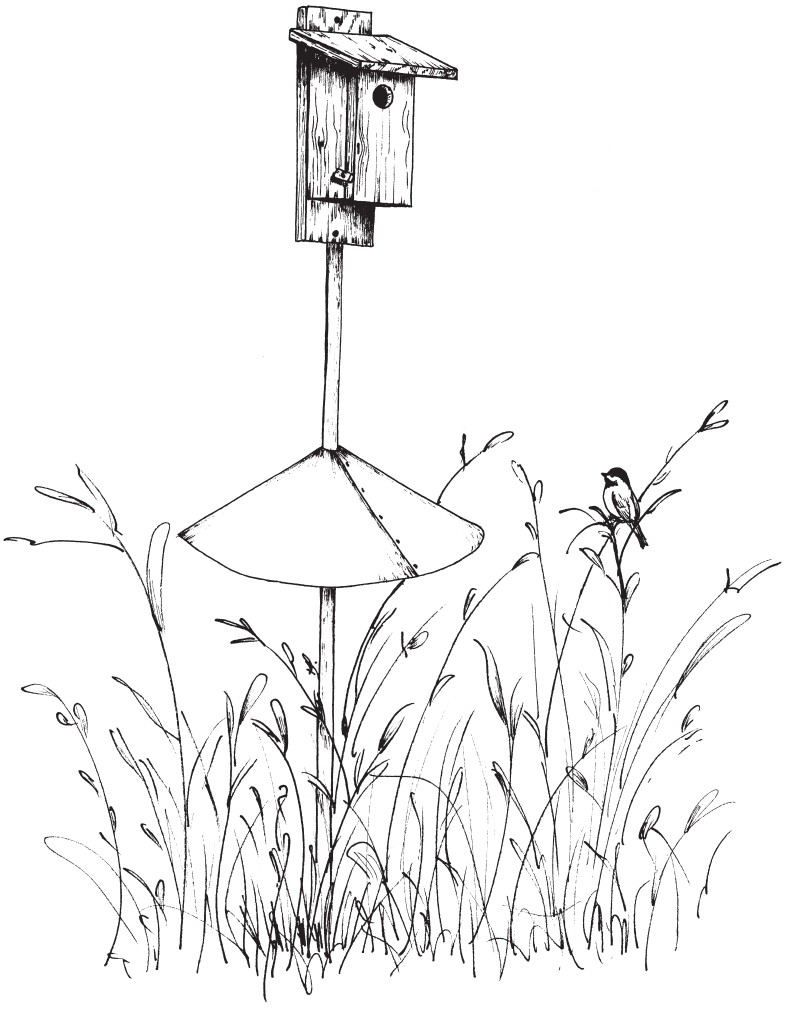
2. What are some of the reasons that a species might be labeled "in decline"? Consider using the latest State of the Birds report to help guide your research: **stateofthebirds.org**.

   Habitat loss, urbanization, climate change, invasive species.

3. If a nesting environment changes (for example: a forest is cut down or a dam is built on a river), how might that affect breeding birds?

   Birds that usually nest in tree cavities may adopt bird houses or birds that prefer lakes may replace birds that preferred the river.

4. Ask students to engage in a writing exercise to share their personal experiences with nesting birds. This could also be a guided group discussion.



Keila Seidenstricker

ACTIVITY 2: NEST BOX CONSTRUCTION & INSTALLATION

Goal

Construct and install nest boxes for focal species.

Conducting the Activity

In Activity 1, students selected several focal species to attract to your area's specific habitat. In this activity, they will construct and install nest boxes in the birds' preferred habitats, as determined by the Right Bird, Right House tool. See the Next Steps for Your Nest Box flowchart (page 14) for a shortcut to help youth select places to install the nest boxes.

Safety Tips

Students should wear closed-toe shoes and safety glasses. Long hair should be tied back. Demonstrate how to properly use a cordless screwdriver (e.g., forward and reverse). Make sure partners are aware of each other's movements and hands/fingers when using tools.

Part 1: Nest Box Construction

Adults should prep the construction spaces in advance. Prepare lumber by cutting it to size and pre-drilling 12 screw holes (pilot holes) and one hole for the duplex nail. (A 9/64 drill bit will work). Provide the materials needed to construct the nest boxes. It may help to have containers of screws distributed across the workspace.

1. Demonstrate to youth how to assemble the box and how to work the screwdriver if you are using cordless screwdrivers. Be sure to note that the stainless steel screws are for the pivot door so that they can open the boxes to perform nest checks and to clean the boxes at the end of the season. The duplex nail is to secure the door. You could also have students watch the demonstration video (**birdsleuth.org/nestwatch**).

Duplex nail

Time and Location

Approximately 3 hours, indoors and outdoors. This activity may need to be broken into separate days, for example Day 1: construction, and Day 2: installation. Times will vary depending on your group's previous construction experience and the number of adults assisting. You may want to ask for help from a parent, community member, or shop teacher.

TEACHER TIP

To attract birds to your nest box, install the boxes by February for southern latitudes and by March for northern latitudes.

Non-native birds can compete with native birds for cavities. Invasive species such as House Sparrows provide both a challenge and a teaching opportunity. To exclude House Sparrows from boxes, make the entrance hole 1 1/8″ in diameter. This will still allow chickadees and wrens to nest. See **nestwatch.org/learn/managing-house-sparrows-and-european-starlings** for more on this subject.

Resources Needed: Construction

- Nest boxes: Lumber will need to be cut and pre-drilled in advance of the activity. Where available, use sustainably-sourced cedar or pine to make the boxes. See page 11 (Nest Box Lumber Cut List) for the nest box plan and watch our video (**birdsleuth.org/nestwatch**) for tips on how to make assembly more efficient.
- Nest Box Construction Guide for youth, page 12
- #8 × 1 5/8″ exterior screws (10 per nest box)
- #8 × 2″ exterior screws (2 per nest box, for the pivot door, stainless steel preferred)

(Continued on next page)

2. Instruct students to work in pairs to build the nest box. Have partners use a workspace that includes the pre-cut pieces, Nest Box Construction Guide (page 12), screwdriver, safety glasses, and screws.

(Continued from previous page)

- Duplex nails, also called double-headed nails (1 per nest box)
- Cordless battery-powered screwdrivers. You can use regular screwdrivers, but it will be more time-consuming for youth to assemble the nest boxes.
- Safety glasses
- Adults only: Drill with variously sized drill bits for making any additional pilot holes.
- Computer, projector, and Internet connection if showing construction video (**birdsleuth.org/nestwatch**)

Resources Needed: Installation

- 4′ sections of ½″ rebar (1 per nest box)
- 5′ section of ½″ metal conduit (electrical metallic tubing, or EMT, 1 per nest box)
- ½″ EMT coupler with steel set screws; Note: choose a brand that will slide over the length of your rebar and choose a coupler without an interior divider. (1 per nest box)
- M5 machine screws 5mm x 16mm, to connect coupler to rebar (1 per nest box)
- Two-hole pipe strap with ¾″ screws (2 straps and 4 screws per nest box)
- Predator guards (optional, but highly recommended)
  See examples: **nestwatch.org/learn/dealing-with-predators**
- Screwdrivers (battery-powered or regular)
- Rubber mallet or sledge hammer
- Safety glasses
- Work gloves
- Nest boxes
- GPS (or smartphone)
- Compass (or smartphone)
- Tape measure
- Clipboard (optional if using mobile app)
- Pencils (optional if using mobile app)
- Computer, projector, and Internet access
- NestWatch Right Bird, Right House online tool: **nestwatch.org/learn/right-bird-right-house**
- Nest Box Installation Guide, see page 13
- Installation video: **birdsleuth.org/nestwatch**
- Data entry tutorial video; How to Register a Nest: **nestwatch.org/learn/data-entry-tutorial-videos/**
- Nest Check Data Sheets (1 per nest box, optional if using mobile app)
  Find online: **birdsleuth.org/nestwatch**
- Next Steps for Your Nest Box flowchart, page 14

TEACHER TIP

Keep the Nest Check Data Sheets for checking the nests throughout the nesting cycle (optional if using mobile app).

Meeting the Standards

See Appendix 2 for corresponding *Next Generation Science Standards* and *Common Core Standards.*

SUSTAINABILITY TIP

Wood and paper come from trees! Choosing sustainable forest products, such as lumber that has been certified as sustainably grown, and using recycled paper, can help ensure that future generations of birds and people get to enjoy our forests. The Cornell Lab of Ornithology, together with the Sustainable Forestry Initiative, are asking you to choose wood that is certified as sustainably grown and use recycled paper products. The birds will thank you!

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Part 2: Nest Box Installation

1. Use the Right Bird, Right House tool or the Next Steps for Your Nest Box flowchart to determine where nest boxes should be installed, based on your focal species' preferences.

2. With your group, watch the nest box installation video and review the installation guide (page 13) to learn how to properly install nest boxes.

3. Take enough Nest Check Data Sheets for each nest box. As nest boxes are being installed, fill out (1) Nest Site Location, and (2) Site Description. Use a GPS or smartphone to capture latitude, longitude, and box orientation. See page 2 of the Nest Check Data Sheet to learn how to properly fill out the data sheet.

TEACHER TIP

You may want to flag the locations where your group will be installing nest boxes to expedite the installation process. Check that you have permission from the facility manager and that no buried utilities exist in your installation area.

You could also digitally enter nest sites while in the field by downloading the NestWatch app on your mobile device. The app is available from Google Play and the Apple App Store (find links to both at **birdsleuth.org/nestwatch**). Log in with the username and password you created, and your data will automatically sync to your account when connected to the Internet.

If you are using the mobile app, you can map the nest sites while you are installing the nest boxes. If you are using the website, follow these directions:

- Following the nest box installation, go to the Your Data section of the NestWatch website (**nestwatch.org/nw/data**).
- Sign in with the username and password that you have created.
- Once you are signed into Your Data, you and your group should add the nest box locations to your account. To add the nest boxes, select Add a New Nest Site. Use the information the group gathered on the Nest Check Data Sheets during the nest box installation process.
- If your nest boxes are in similar habitats, you can select the button Copy the Description of an Existing Site to accelerate the mapping process.
- Watch the NestWatch data entry tutorial video, How to Register a Nest, if you have trouble mapping your nest sites: **nestwatch.org/learn/data-entry-tutorial-videos**.

Reflect and Evaluate

If lumber or paper products have a certification label on them, it means they came from a certified forest and from a company that manages the forest responsibly. Research with your students how forests can be certified as "sustainable" at the Sustainable Forestry Initiative website, **sfiprogram.org**.

1. Wood comes from trees, which can be valuable habitat for birds and other animals. What does it mean if wood is harvested in a sustainable way? Can you find any examples of how trees can be harvested while habitat is still protected for birds and other animals?

2. While you were installing the nest boxes, did you see or hear any birds? Could you identify them? Use the Merlin app (**merlin.allaboutbirds.org**) to help identify birds.

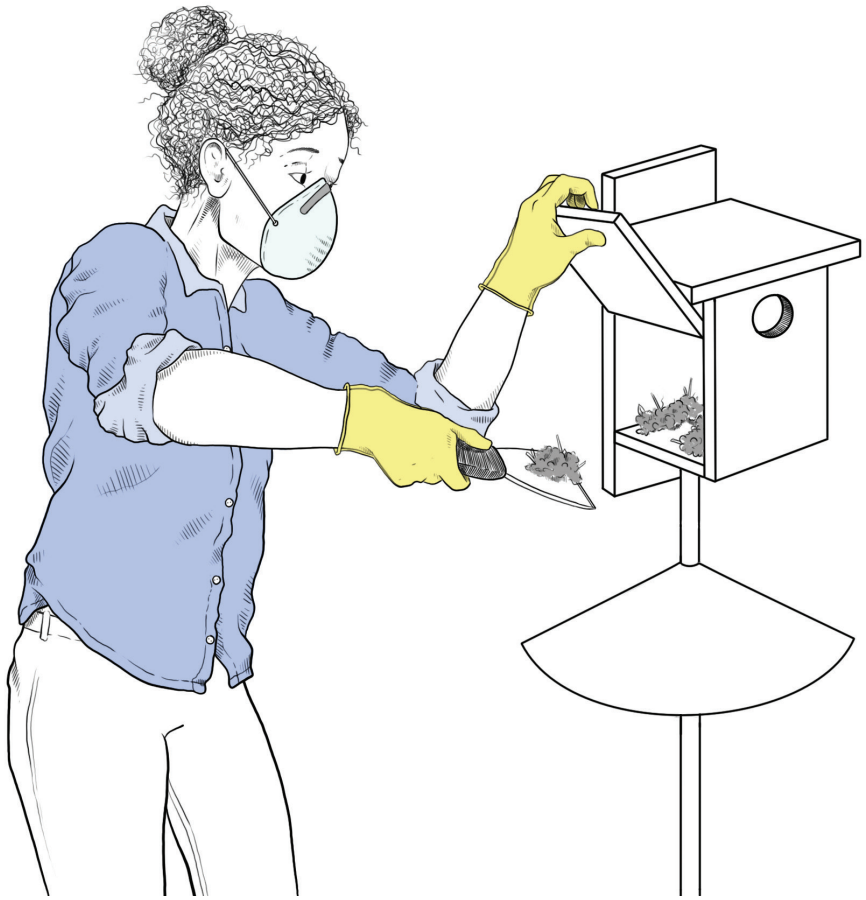
Extensions

1. What steps could you take at home or school to use wood or paper products from sustainable sources? Can you think of ways to reduce consumption of wood or paper products?

2. Based on when the nest boxes were installed and when the breeding season typically occurs for your focal species, when do you predict that your nest box might be occupied?

   *Find nest periods with the Right Bird, Right House tool (***nestwatch.org/learn/right-bird-right-house***) or the Common Nesting Birds webpage (***nestwatch.org/learn/focal-species***).*

3. Research alternative nest-box designs. Have students draw or describe a "better" nest box. Consult the NestWatch Features of a Good Birdhouse: **nestwatch.org/learn/features-of-a-good-birdhouse**. Have students indicate units of measurement when detailing nest box plans.



Megan Bishop, Bartels Science Illustrator

NEST BOX MAINTENANCE

Clean out old nesting materials in the fall or early spring before birds arrive back to their breeding territory (February for southern latitudes and March for northern latitudes). Wear gloves and a mask. Old nests can be messy and rodents often use nest boxes in the winter.

Refresh wood shavings in the spring if your focal species requires them (e.g., Wood Duck, American Kestrel, chickadees, etc.). Make sure predator guards are in place, and trim any plants that have encroached on your nest boxes. Check to see if all screws and nails are in place or are in need of adjustment.

Nest Box Lumber Cut List

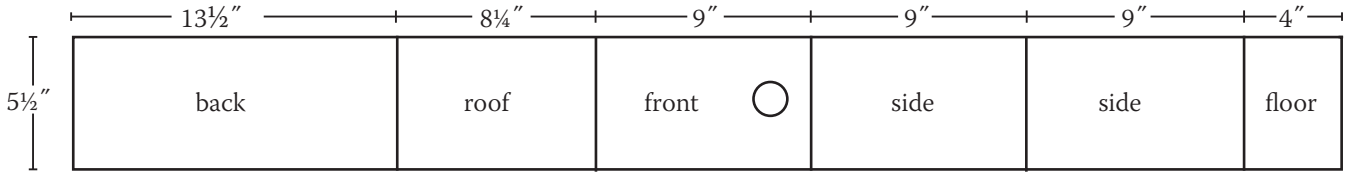
Adults: Use these plans to cut pieces for a nest box for House Wrens, Black-capped or Carolina Chickadees, Tree or Violet-green Swallows, or Eastern, Mountain, or Western Bluebirds

Entrance hole sizes

- House Wrens: 1″ diameter
- Chickadees: 1⅛″ or larger
- Swallows: 1⅜″ or larger
- Eastern Bluebirds: 1½″ diameter
- Mountain or Western Bluebirds: $1^{9}/_{16}$″ diameter

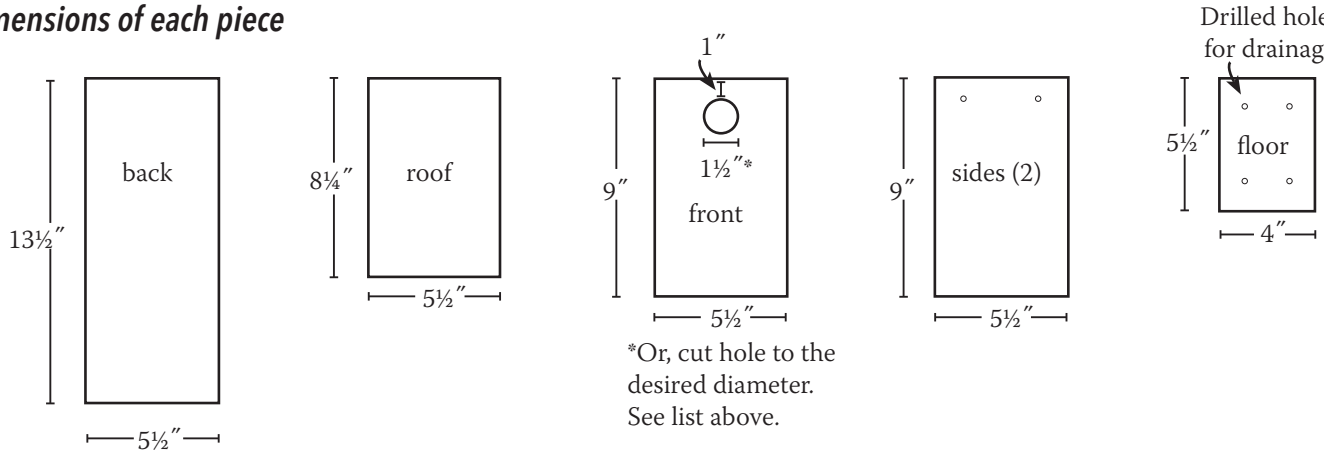
TheCornellLab NestWatch

Nominal lumber dimensions: 1″ x 6″ x 6′



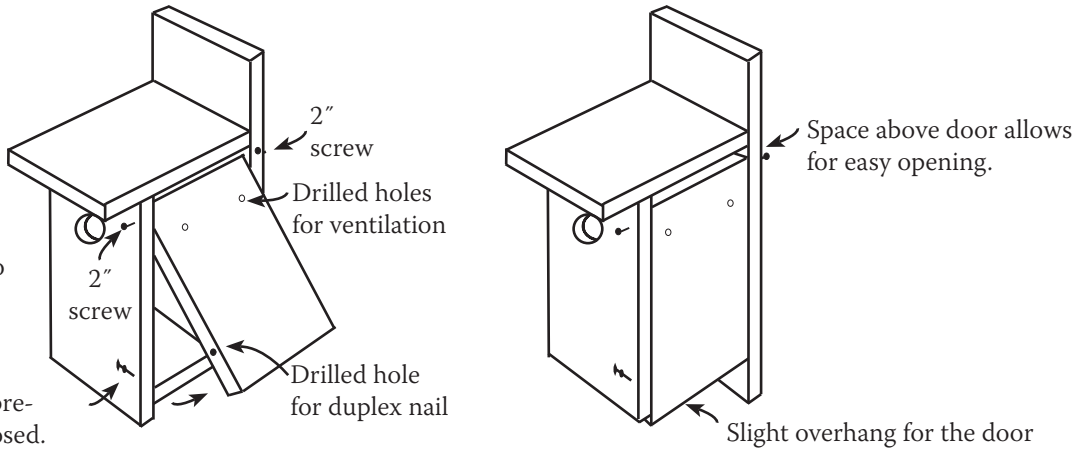
Note: These dimensions are for ¾″ thick board, as this is the actual width of most 1″ boards from lumber stores. Some cedar boards are ⅞″ thick. If so, the floor must be 3¾″ wide, not 4″

Dimensions of each piece



*Or, cut hole to the desired diameter. See list above.

Completed box



Two 2″ screws allow side to swing out for cleaning.

Insert a duplex nail into a pre-drilled hole to keep side closed.

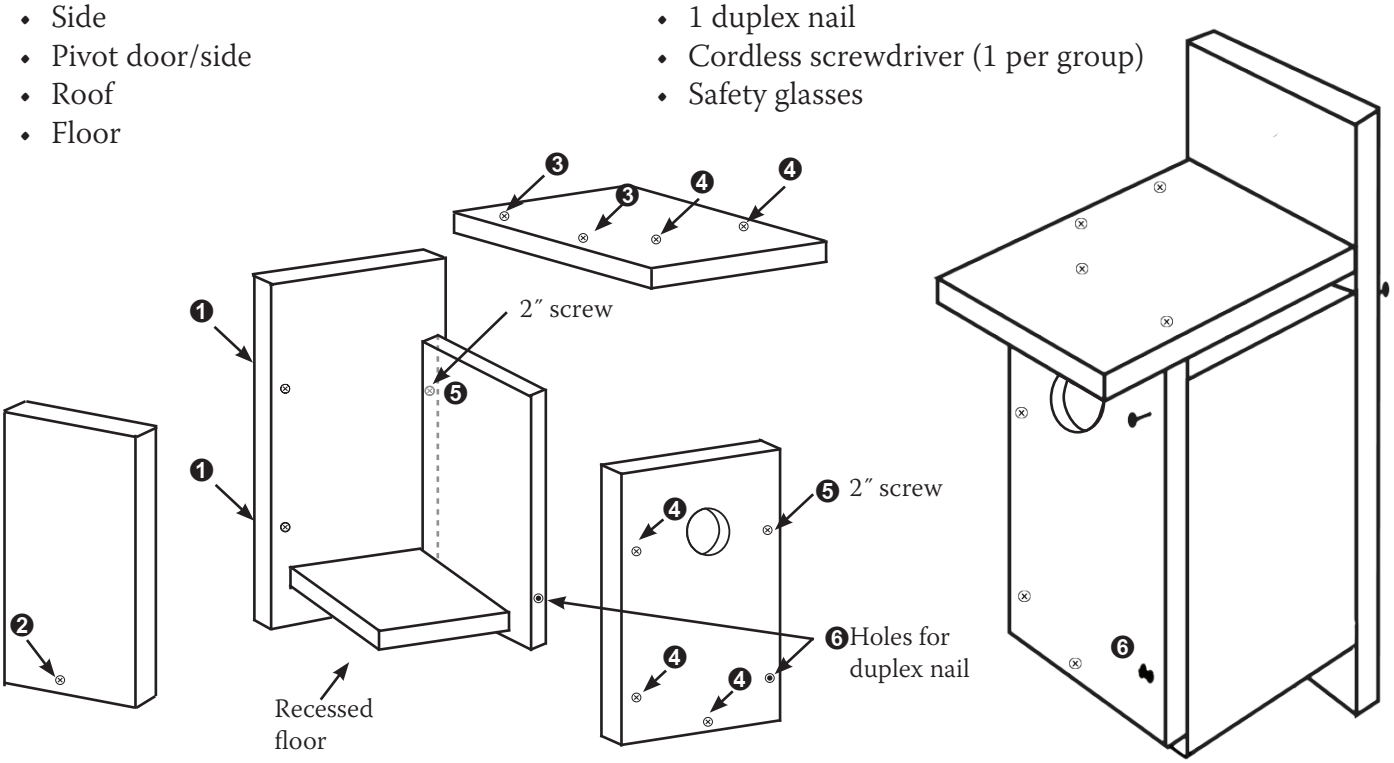
Student Nest Box Construction Guide

Your nest box should have 6 pieces

- Front
- Back
- Side
- Pivot door/side
- Roof
- Floor

To construct this nest box you will need

- 10 exterior screws (1⅝″)
- 2 screws (longer) (2″ exterior screws)
- 1 duplex nail
- Cordless screwdriver (1 per group)
- Safety glasses



❶ Attach the back to the side using 2 screws.

❷ Attach the floor to one side using 1 screw and to the back using 1 screw.

❸ Attach the roof to the side using 2 screws

❹ Attach the front to the side using 2 screws, to the floor using 1 screw, and to the roof using 2 screws.

❺ Attach the pivot door (the other side) to the back using 1 longer (2″) screw, and to the front using another longer (2″) screw. Leave a gap at the top so that the door can be opened.

❻ Attach the back to the roof using 2 screws, and insert a duplex nail into pre-drilled hole in the front to close the pivot door.

CONGRATULATIONS! You made a nest box! Find out how to install your nest box and monitor it for science at **NestWatch.org**.

TheCornellLab NestWatch

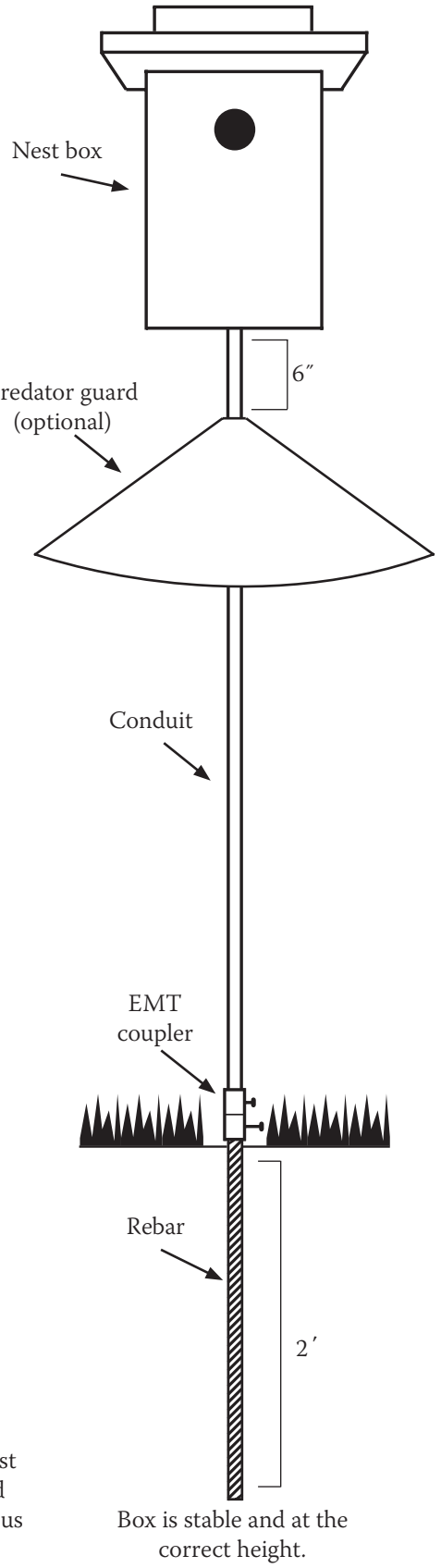
Features of a Good Birdhouse

- Can be opened for cleaning and monitoring
- Has a recessed floor
- Uses unpainted and untreated wood
- The roof overhangs the front of the box
- The entrance hole is the correct size for the intended species
- Does NOT have a perch
- Constructed from sustainably sourced lumber (**sfiprogram.org**)

Nest Box Installation Guide

Items needed

- Rubber mallet or sledgehammer
- Screwdriver
- Work gloves
- Safety glasses
- One 5′ section of ½″ conduit (Usually sold in 10′ lengths; most retailers will cut these to length for you.)
- One ½″ EMT coupler with steel set screws
- One M5 machine screw for the bottom of the coupler
- One 4′ section of ½″ rebar
- Two 2-hole pipe straps
- Four ¾″ screws
- Predator guard (optional, but recommended)



Step 1: Check your dig site for utility lines—you could get injured if the metal rebar comes into contact with electrical cables.

Step 2: Use a rubber mallet to drive rebar into the ground. Leave about 2′ of rebar above ground. Important: Rubber mallets reduce the likelihood of flattening the top of the rebar, which would make Step 4 more difficult.

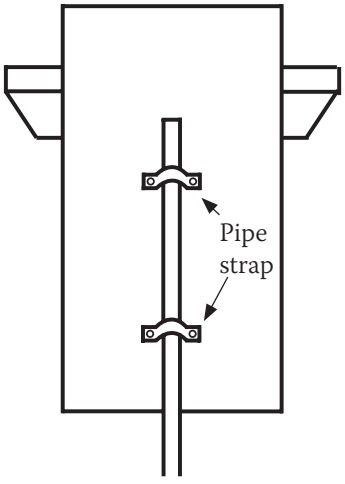
Step 3: Attach the ½″ EMT coupler to the end of the conduit. Tighten the upper screw against the conduit. Switch out the bottom screw for the M5 machine screw, but don't tighten it yet.

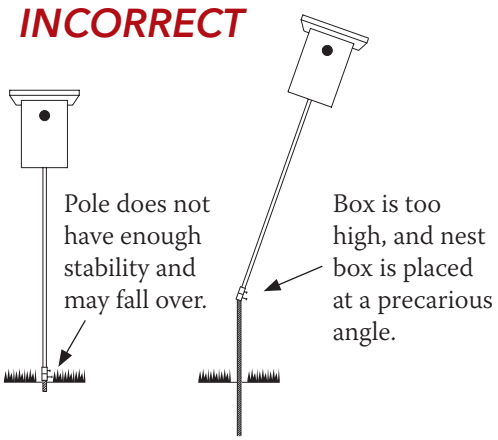
Step 4: Slip the conduit coupler-side down onto the rebar. Once the coupler is at ground-level, tighten the longer screw against the rebar.

Step 5: Add a predator guard to your pole, leaving about 6″ of space below the nest box floor (optional).

Step 6: Attach box to pole with both pipe straps using the ¾″ screws. (See diagram below.)

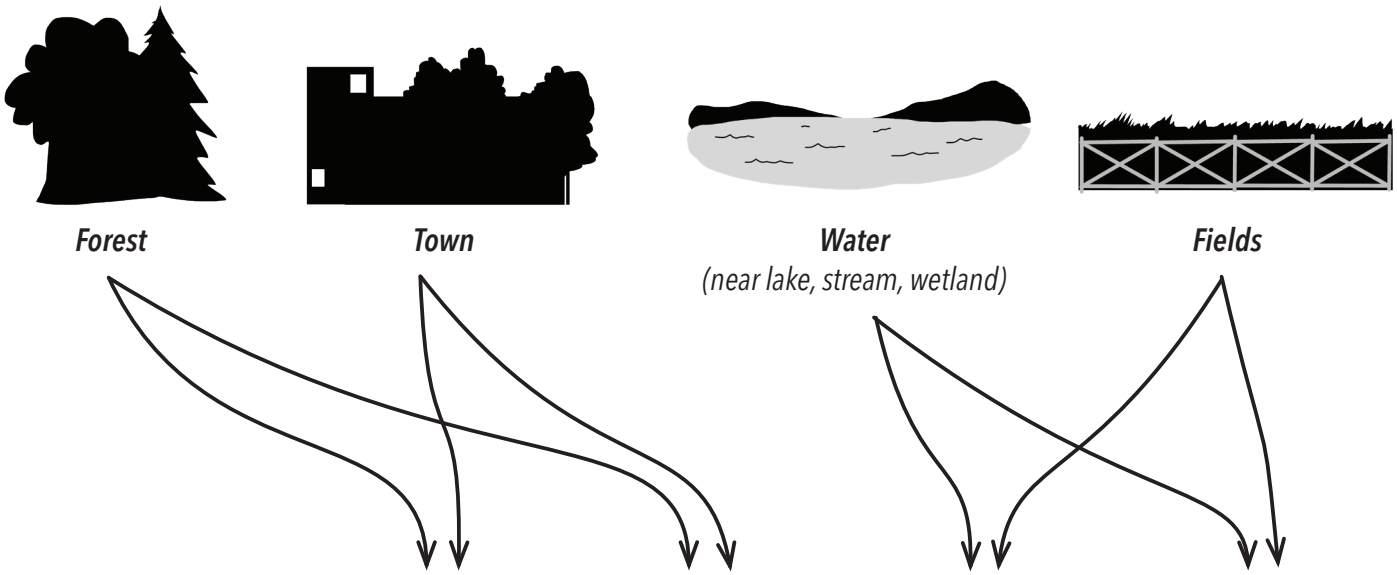
Diagram for Step 6





Next Steps for Your Nest Box

The habitat type around me is mostly:



House Wren | **Black-capped or Carolina Chickadee** | **Tree Swallow or Violet-green Swallow** | **Eastern, Mountain, or Western Bluebird**

Attach this box to	Building, post, or pole	Building, post, or pole	Pole or post	Pole or post
Face entrance hole	Any direction, within 100 ft of woody vegetation	Away from prevailing wind	South or east	East, toward open habitats
Height	5–10 feet	5–15 feet	5–6 feet	4–6 feet
Clutch size (# of eggs)	4–8	6–8	4–7	4–5
Breeding Season	May–August	April –July	May–July	March–August
Incubation Period	13–15	12–15	11–19	11–19
Nestling Period	15–17	12–19	15–25	17–25
Tips	Male House Wrens typically defend more than one cavity, and may fill all of the nest boxes in the territory with twiggy "dummy nests."	Place 1" wood shavings on box floor.	If competition with bluebirds arises over nest boxes, place another box about 20-25 ft away for the bluebird.	Clean out old nests as soon as a brood fledges so that the nest box can be used for a second nest attempt.

ACTIVITY 3: FROM NEST TO EGGS TO FLEDGE

Goal

Learn about the nesting cycle and become certified NestWatchers by reviewing the NestWatch Code of Conduct for monitoring nests safely.

Conducting the Activity

Your group has established a nest box trail and is familiar with the species that may inhabit these nest boxes. Learn the stages of the nesting cycle so that you know what to expect when checking your nest boxes.

Become certified: To participate in NestWatch and submit your nest checks, participants need to become certified NestWatchers.

1. Review Slides 7–17, which cover the nesting cycle and include presenter notes.

2. Review the NestWatch Code of Conduct on Slides 18–28 and play the bingo game to become certified.

Bingo: Now that your group understands the nesting cycle and the NestWatch Code of Conduct, play bingo to check their knowledge.

3. Each person will need a bingo card, answer sheet, pencil, and bingo chips. Read each question and allow time for players to write an answer. Ask for responses and then reveal the correct answer with explanation provided in the answer key. Youth who have the correct answer can add a bingo chip to the corresponding number on their bingo card. You will probably get many bingos throughout the game; continue playing until the end to review all the important concepts.

4. **Congratulations, you are certified NestWatchers!** You are now ready to check nest boxes! *Optional: You can print NestWatch certificates for your group, see page 20.*

Time and Location

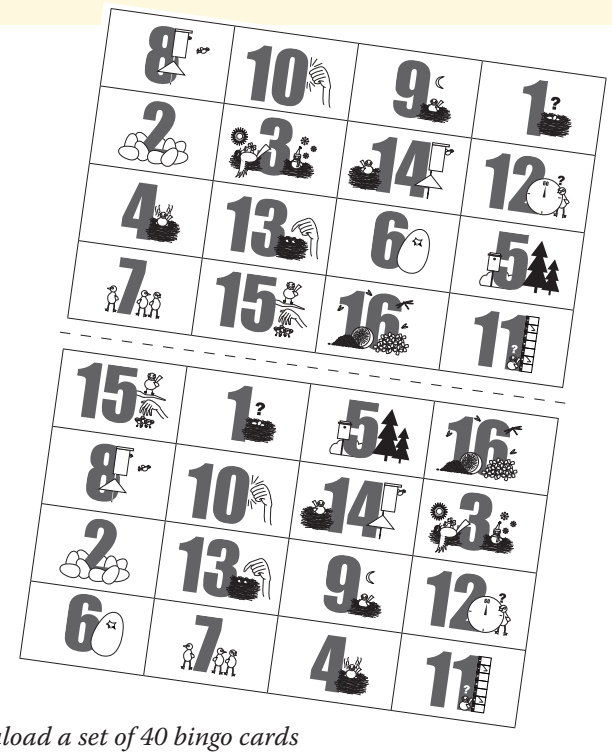
1 hour, indoors

Resources Needed

- Computer, projector, and Internet access
- NestWatch slideshow, Slides 7–28
  Download the slideshow at **birdsleuth.org/nestwatch**
- Bingo Questions & Answers key, pages 17–18
- Bingo Answer Sheets, page 19 (one per student)
- Bingo cards: Download a set of 40 cards at **birdsleuth.org/nestwatch**
- Bingo chips
- Pencils
- NestWatch Certificates (optional), page 20
- Prizes (optional)

Meeting the Standards

See Appendix 2 for corresponding *Next Generation Science Standards* and *Common Core Standards.*



Download a set of 40 bingo cards at **birdsleuth.org/nestwatch**.

Reflect and Evaluate

1. Soon you will be checking the nest boxes that you installed. What stages of the nesting cycle do you predict you will see?

2. Birds build nests from a variety of materials. Can you name any materials that were not listed in the slideshow?

   See Slide 10 of the slideshow. Other materials may include moss, snakeskin, spider's silk, human-made items such as string, plastic, or trash.

3. Have you seen baby birds? Were they precocial or altricial?

   See Slide 15 for definition and images.

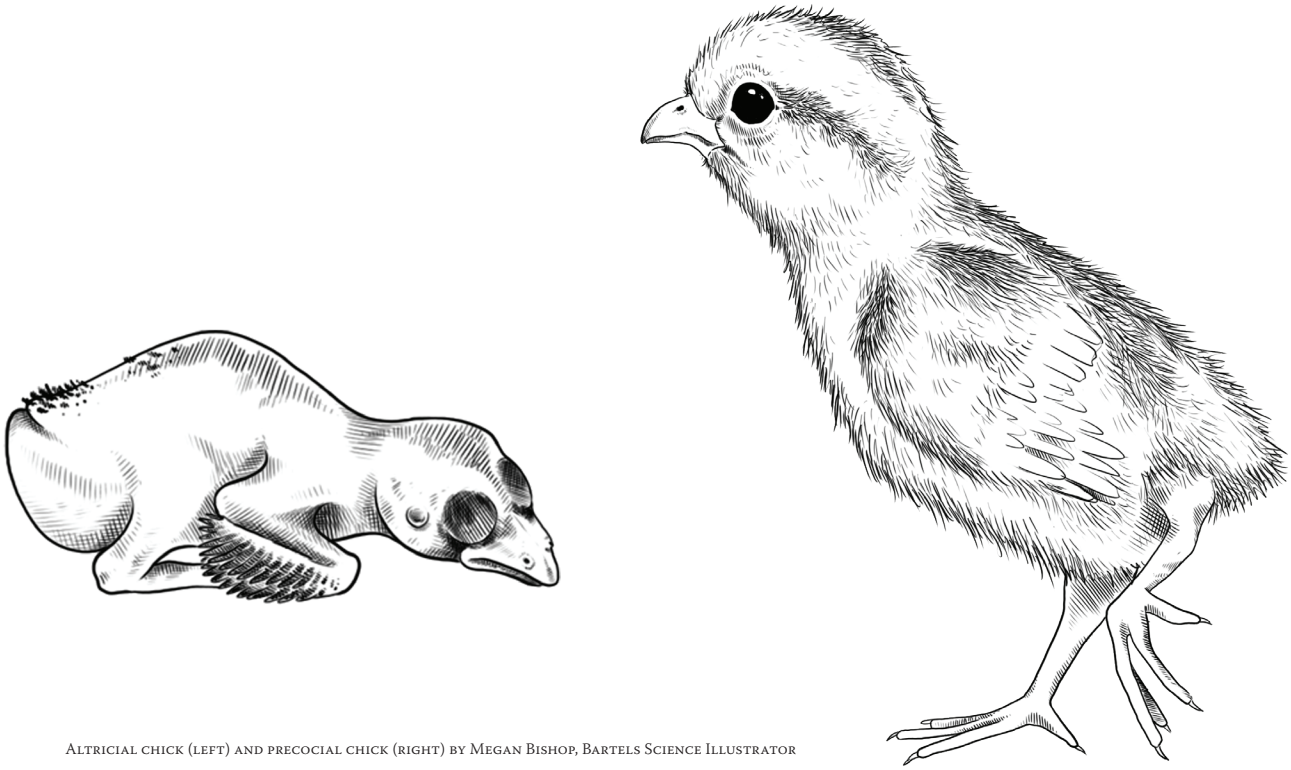
Extensions

1. Create a timeline of the breeding season for each of your focal species based on the answers to these questions: When does the breeding season typically start and end? How long are the eggs incubated? How long is the nestling period (e.g., the number of days between when the eggs hatch and the chicks fledge)? Does your focal species only have one clutch of eggs or do they have several clutches per year?

   *Use NestWatch's Common Nesting Birds webpage (**nestwatch.org/learn/focal-species**) and All About Birds (**allaboutbirds.org**) to help develop your species timeline.*

2. Sketch a focal species' nest with eggs. Assign youth different species to sketch and have them compare and contrast species. How are each species' nests different or similar? How are the eggs different or similar?

   *Use NestWatch's Common Nesting Birds webpage (**nestwatch.org/learn/focal-species**) and All About Birds (**allaboutbirds.org**) to find images and descriptions.*



Altricial chick (left) and precocial chick (right) by Megan Bishop, Bartels Science Illustrator

NestWatch Bingo Questions & Answers

Prior to playing bingo, participants should review the Nesting Cycle Slideshow and will be introduced to the basic NestWatch Code of Conduct, Slides 17-27.

1. **True or False?** All birds build a nest.

   False. *Some species lay eggs directly on the ground (Killdeer) and some species reuse other birds' nests (Great Horned Owl). Some birds even lay their eggs in the nests of other birds and let them do the work! (Brown-headed Cowbird)*

2. **True or False?** Females lay multiple eggs each day.

   False. *Females can only lay one egg per day.*

3. **True or False?** Most birds live in their nest year round.

   False. *Most birds only use nests as a place to incubate eggs and raise young. Once chicks fledge, adults and young do not typically continue to use the nest. However, some birds will return to the same general areas to nest year after year.*

4. **True or False?** Eggs need to be incubated and kept warm in order to hatch.

   True. *Eggs must be kept warm in order to hatch. Most parents incubate the eggs by sitting on them. In some rare cases, but not in the U.S., the eggs are kept warm by being buried (Australian Brush-turkeys).*

5. Name two different places where birds can build nests.

   Possible answers: *ground, tree, bushes, nest box, cliffs, human-made structure e.g.: planters, under roof eaves, bridges.*

6. When a baby bird is ready to hatch, it rubs its egg tooth along the inner wall of the egg until it breaks through. The process of breaking through the eggshell is called_____.

   Pipping

7. **True or False?** Canada Geese hatchlings are precocial, meaning they emerge from the egg covered in soft feathers, can walk and swim shortly after hatching, and are less dependent on their parents.

   True. *Precocial species such as geese, ducks, and shorebirds are born with feathers, are fairly mobile and have their eyes open. Songbirds are altricial; they are born naked with their eyes closed, rely on their parents for food and warmth, and are not mobile.*

8. When a baby bird is old enough to leave the nest, we say it has _____ the nest.

   Fledged

9. **True or False?** It is best to check nests in the early morning or at night.

   False. *It is best to check nests in the late morning or in the afternoon. Avoid the early morning because most birds lay eggs in the morning. Avoid dusk and nighttime because females may be returning to the nest at night and you don't want to scare them away from their babies. Avoid checking nests in bad weather, or when young are visibly hanging out of the nest box entrance hole (ready to fledge).*

NestWatch Bingo Questions & Answers *(continued)*

10. **True or False?** Knock softly on the nest box before opening it up.

    True. *Approach a nest box with caution. First, watch for activity. Knock once, pause, and knock again before opening a nest box to allow the bird to exit the box. If you open a box and a bird is sitting on the nest, do not force it to leave. Come back later.*

11. You found a nest! How often should you check the nest?
    (A) A couple of times a day
    (B) Every day
    (C) Twice a week
    (D) Once a month

    *(***C) Twice a week.** *Checking a nest every day is disruptive to the birds, but checking once a month will not give researchers enough information about the nest. Checking every 3-4 days allows you to collect good information about eggs and babies without bothering the birds too much.*

12. How long should you spend at the nest?
    (A) One minute or less
    (B) 5 minutes
    (C) 10 minutes

    (A) Less than 1 minute. *Remember we do not want to stress the birds. Less time is better! Be prepared before you open a nest box. Have your data sheet ready and know what information you are collecting.*

13. **Yes or No?** Is it okay to remove an egg or baby bird from the nest?

    No! *Handling eggs and baby birds is illegal (unless you have the right permits). Even if you can't see how many eggs or babies there are, leave them alone and check back later to get a better count.*

14. During what stage of the nesting cycle should you avoid checking nests?

    Early incubation OR fledging. *Disturbing the birds during early incubation could cause the parents to abandon the nest and an egg that isn't incubated will not hatch! Disturbing the babies close to fledging could cause them to fledge too soon, before they are ready to deal with life outside the box—think cold nights, lack of food, and predators!*

15. **Yes or No?** You find a baby bird hopping around on the ground under the nest box. The parents are nearby. Should you pick up the bird and place it back in the box?

    No. *That bird has fledged the nest and its parents are nearby. Chances are when you leave, the parents will return to feed their baby and to help guide it to safety. If you find a naked bird, look for the nest and return it to the nest if possible. If you can't find the nest, contact a local wildlife rehabilitator before taking further action.*

16. Name two different foods baby birds eat.

    Possible answers: *Insects, fruits, seeds, meat, nectar. (Various answers are possible.)*

NestWatch Bingo Answer Sheet

Name: _____

1. Circle one: TRUE FALSE

2. Circle one: TRUE FALSE

3. Circle one: TRUE FALSE

4. Circle one: TRUE FALSE

5. _____ and _____

6. _____

7. Circle one: TRUE FALSE

8._____

9. Circle one: TRUE FALSE

10. Circle one: TRUE FALSE

11. Circle one: (A) A couple times a day (B) Every day (C) Twice a week (D) Once a month

12. Circle one: (A) One minute or less (B) 5 minutes (C) 10 minutes

13. Circle one: YES NO

14. _____

15. Circle one: YES NO

16. _____ and _____

The Cornell Lab of Ornithology

is now a certified

NestWatch Monitor

Please remember to always abide by the NestWatch Code of Conduct:

- Learn about the birds that you monitor
- Plan and prepare
- Collect data carefully
- Choose an appropriate time to visit nests
- Search carefully
- Be wary of nest predators
- Minimize disturbance to nest sites
- Do not handle eggs or nestlings without a permit
- Don't leave dead-end trails
- Understand the Migratory Bird Treaty Act

Teacher

Robyn Bailey, NestWatch Project Leader

ACTIVITY 4: NEST CHECKS

Goal

Learn how to check nest boxes, collect data, and search for open-cup nests.

Conducting the Activity

Nest Check Storyboards

Begin the activity with copies of the Nest Check Storyboards (pages 23–27).

1. People who make movies use storyboards to illustrate scenes for films. You will be using storyboards to illustrate the nesting cycle. (See sample storyboard on page 23.) This can be either a group or individual activity.

2. Assign groups or individuals a nest-check story to illustrate on a storyboard (page 24). There are three stories that describe a person checking a nest box during the nesting cycle of a Black-capped/Carolina Chickadee (page 25), House Wren (page 26), or Tree Swallow (page 27). Each group or individual will pick one story and illustrate the scenes depicted in that story. Feel free to let youth be creative when illustrating storyboards—some may incorporate dialogue or additional scenes.

3. When individuals or groups complete their storyboard, they can share it with the rest of the group. If there is time and interest, you could create a skit using the storyboard as the guide.

Time and Location

Approximately 1.5 hours, indoors and outdoors. The time it takes to conduct nest checks depends on how many nest boxes your group is monitoring and the distance between nest boxes.

Resources Needed

- Computer, projector, and Internet access
- Nest Check demonstration video: **birdsleuth.org/nestwatch**
- NestWatch Slideshow, Slides 29–33 Download the slideshow at **birdsleuth.org/nestwatch**
- Nest Check Storyboards and stories, pages 23–27 (one per person or group)
- Nest Check Data Sheets (use the same sheets from Activity 2 and bring extras in case you discover additional nests; optional if using the app)
- Pencils (optional if using the app)
- Clipboards (optional if using the app)
- Optional: Field guides, binoculars, smartphone/tablet if using the NestWatch app, step-stool, and hand mirror to see into nest

Meeting the Standards

See Appendix 2 for corresponding *Next Generation Science Standards* and *Common Core Standards.*

Discover Other Nests

We have spent a lot of time discussing nests that are located in nest boxes; however, we do not want to overlook nests that are found in vegetation or on human structures (called open-cup nests). These nests are built by robins, doves, cardinals, and jays, to name just a few.

1. Review our tips for finding these hidden treasures throughout the breeding season (see Slides 29–33).

2. While checking nest boxes, have youth carefully search for nests in the shrubs, trees, around and on buildings, and even on the ground—watch your step!

3. If your group finds nests, monitor them and submit data the same way you would for nests in boxes.

Nest Checks

Before going into the field to check on the nest boxes, watch the Nest Check Video (**birdsleuth.org/nestwatch**) to learn how to safely check nests according to the NestWatch Code of Conduct and to review the important data that your group will be collecting.

1. You are ready to check nests. Make sure the data sheets (from Activity 2) are in order and your group is prepared to collect information. You will be observing the nest boxes to check for signs of nest building (nest status), adult activity, and young status, along with trying to identify what species are utilizing the nest boxes. See page 2, section 3, of the Nest Check Data Sheet for codes and descriptions that will help to guide your nest checks. Nest Check Data Sheets are optional if you are using the mobile app.

2. When you return from the field, be sure to log onto NestWatch.org and enter your nest checks into the Your Data page. If you have nesting activity at your nest box, click on the nest site list or the map icon. Select Add Attempt to enter your nest and species information. Watch the instructional video How to Enter a Nest Attempt if you have any trouble (**nestwatch.org/learn/data-entry-tutorial-videos**). Alternatively, you can enter data in the field using the NestWatch app.

3. Check nests every 3-4 days. If your group can only visit the nest sites once a week, those data are important too! Have youth record their observations on the Nest Check Data Sheets and enter the data on the NestWatch website or the NestWatch app on a regular basis. When a nesting attempt is complete because the young have fledged or failed, summarize the nesting attempt. If the nest site has a new nesting attempt, select the nest site and click Add Attempt.

Reflect and Evaluate

1. Have students work in small groups to create a nest check skit that demonstrates proper nest-checking technique. Be sure to follow the NestWatch Code of Conduct.

2. Did you find any nests of unknown species? Use the NestWatch Common Nesting Birds webpage (**nestwatch.org/learn/focal-species**) to identify what bird created the nest that you discovered.

3. Predict what stage of the nesting cycle you will see during your next checks for each nest. *Review Slides 7–17 if necessary. This is a good habit to develop and will help your group determine when you should not check nests—during early incubation and when chicks are close to fledging.*

Extension

1. Have you come across any unsuccessful nests? What were the causes for nest failure? Is there anything your group can do to prevent nest failure? (See page 28, *Nest Box Troubleshooting Guide* and **nestwatch.org/learn/dealing-with-predators**.) Ask students to design a habitat improvement plan to help nesting birds. See Project Learning Tree's *PreK-8 Environmental Education Activity Guide*, Activity 96, for a template. (Visit **plt.org/curriculum/environmental-education-activity-guide.**)

2. What factors are out of your control? *Weather, infertile male/female.*

3. One section of NestWatch data entry asks about the presence of brood parasites. Read about Brown-headed Cowbirds: **nestwatch.org/learn/general-bird-nest-info/brown-headed-cowbirds** and research other examples of brood parasitism.

NEST CHECK STORYBOARD: ILLUSTRATING THE NESTING CYCLE

Name Susie Sample **Page** _____

Story title Checking my Black-capped Chickadee nest box

Instructions: Fill in the storyboard below by drawing pictures in the big boxes and writing text explaining the picture in the box. Use more than one page if needed!

I walked into the woods to find my nest box. It was a little way off the trail and it had a predator guard on the pole.

I quietly came up to the box and knocked. Nothing came out so I opened the side and suddenly a bird flew right out!

I looked inside the box and saw that the Black-capped Chickadee had laid six speckled eggs!

I came back after a few days and saw that five of the eggs had hatched. Some of the baby birds still had bits of eggshell on them!

The next time I stopped by, the nestlings were much bigger and louder, but the sixth egg still hadn't hatched.

Next time, the parents were making noise nearby and I could see the chicks were about to fledge. I left so they could do it in peace!

NEST CHECK STORYBOARD: ILLUSTRATING THE NESTING CYCLE

Name_____**Page**_____

Story title _____

Instructions: Fill in the storyboard below by drawing pictures in the big boxes and writing text explaining the picture in the box. Use more than one page if needed!

Black-capped/Carolina Chickadee Storyboard

(Pick the chickadee species that is most common in your region.)

Green leaves dance in the breeze as you make your way through the forest. Tucked off the path sits a small nest box mounted on a slim metal pole. Attached to the pole is a broad metal cone—a barrier meant to keep predators away, meaning "do not enter" to passing hungry animals.

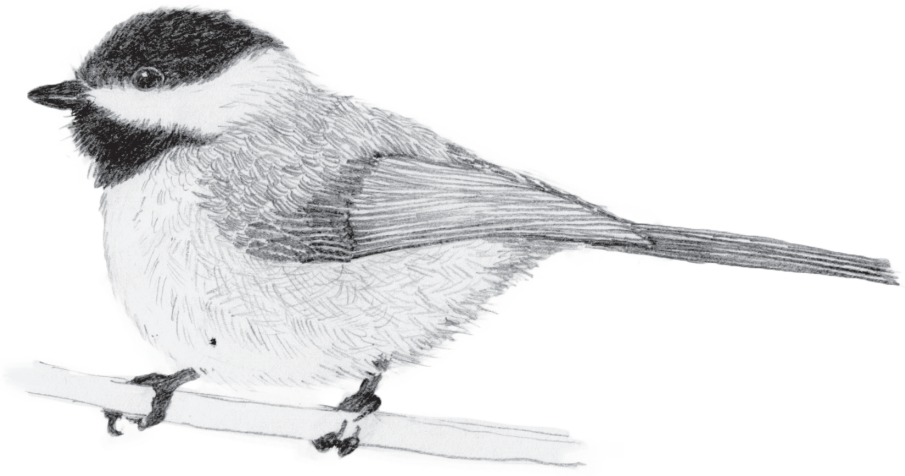
You approach cautiously and wonder if any woodland birds have adopted this nest box. "Knock, knock, anyone home?" A small black and white bird bursts from the nest box and lands in the nearby tree sounding the alarm, "Chicka-dee-dee-dee!" With her call, she gives away her name: chickadee.

Peeking into the box, you spy six cream-colored speckled eggs the size of tiny jelly beans. The eggs are nestled deep in a soft nest of moss and fur. You close the nest box, record your observations, and head back to the trail.

Returning one week later, the sky is gray and the air is cool. You need to make this nest check quick before the rain falls. A gentle rap on the nest box; all is quiet. Opening the box, you see five naked hatchlings with broken shells still clinging to their red skin. New babies! Will the sixth egg hatch? A chickadee flits into view and scolds. It's feeding time for the hatchlings, and time for you to leave.

As you approach the nest box the following week, a pair of chickadees is coming and going. You wait until they both leave and open the nest box. Five small yellow mouths gape open, begging. The sixth egg must not have hatched and is buried deep underneath the developing nestlings.

Last check; soon the young will be ready to fledge. You can hear begging from the trail. As you open the box, five wide-eyed nestlings stare back at you in surprise—you're not mom! The parents sit in the branches above the nest box calling loudly. You quickly close the nest box, returning in another week to clean out the empty nest box.



Black-capped Chickadee by Holly Faulkner

House Wren Storyboard

You've rushed home from school to check on your nest boxes. Back behind the swing set, at the edge of the lawn, are the nest boxes you've mounted to two trees. You open the first box to find a small pile of twigs, which looks like the start of a new nest. You look closer. No eggs. Maybe they will finish the nest later.

You tiptoe over to the other nest box and peek in to find a messy collection of small twigs and spider egg sacs—House Wrens! You wonder, "Why spider eggs?" Then you realize spiders eat other insects and mites that might bother the nest. The nest is packed with sticks, which makes it hard to see inside, but you spy four eggs clustered together. The eggs are small and cream-colored with reddish speckles (especially around the larger end).

You have been out of town during school vacation, so you haven't checked the boxes in two weeks. You knock on the first box, but you don't hear anything. You peek in and see the exact same pile of twigs you saw the first time—this must be a dummy nest. This is the wren's way of keeping other birds from nesting nearby. You tap on the second box and flush a wren, who flies off and lands on your swing set with its tail feathers tipped up high above its back. You look in the box and see four little beaks begging for food. All the eggs hatched!

It's been nearly a week. You return to the nest boxes to see how the hatchlings are doing. You check the first box just to make sure. Yep, definitely a dummy nest. No neighbors here. As you approach the second box, you hear peeping and chirping! Inside you see three beaks making all the noise, but there is no sign of a fourth. Was it a runt and didn't survive, or is it just under its siblings?

You are swinging on your playset when you see the parents flying in and out of the second nest box with food. When they are both away, you open the box to see three fully-feathered nestlings. It looks like the fourth did not survive, but the other three look ready to fledge any day.

A week later, you return to find the nest is empty! The wrens have fledged. You clean out the nest box, hoping that another pair of birds might nest in it this summer.

House Wren by Holly Faulkner

Tree Swallow Storyboard

Through your classroom window, you can see a row of nest boxes along the tall grass behind the soccer field, close to a small pond. You catch an iridescent glimmer of dark blue as a bird dives from the top of a nest box and swoops over the water. It circles the cattails and abruptly turns in pursuit of something—maybe a dragonfly caught its attention.

After school, you venture out to check the nest boxes. You knock on the box and open it to see a nest constructed of grass with a soft bowl of white feathers. On the bed of feathers rest five white eggs. This nest definitely belongs to a Tree Swallow.

One week later, you return to the nest box; this time the pair of Tree Swallows is nearby. They see you approach and start swooping near your head! They are serious. You quickly open the box and spy six small white eggs and one large heavily speckled brown egg! That's weird. You close the nest box as the parents continue to sound the alarm and fly about.

After asking your science teacher about the odd egg, you learn that it belongs to a Brown-headed Cowbird. Instead of building their own nests and raising their own young, cowbirds lay their eggs in other birds' nests. It's unusual to find a cowbird egg in a nest box; they usually lay their eggs in open-cup nests such as those built by a robin or phoebe.

You've been watching the swallows from your classroom window. It seems like the parents are delivering food constantly. After school, you head over toward the pond to check. When you open the box, the cowbird towers above four begging nestlings. Did the other two eggs not hatch? The birds are developing feathers, but probably won't fledge for another week or so.

You want to check the nest box one last time to see how the swallows are faring, but as you approach the box, you see several heads peeking out of the entrance. One is almost hanging out of the box. These birds are really close to fledging and you can't open the nest box for fear that the birds will leave before they are ready.

During class, you watch for activity at the nest box, but it seems quiet. You decide it's safe to check the nest after school. You open the box and all you see is a flattened nest and two unhatched eggs. The cowbird and the other four swallows fledged. You scan the area, hoping to see the swallow family. You clean out the nest box and spy four young swallows on a branch, quivering their wings and opening their mouths as an adult swallow swoops down and delivers an insect!

Tree Swallow by Holly Faulkner

Nest Box Troubleshooting Guide

What you might find	What may be the cause	What you could do
• Eggs or nestlings missing, nest intact	• Snake, rodent, House Sparrow, House Wren	• Install predator guards or baffles on the box pole • Move boxes away from areas where House Sparrows are prevalent • Place House Sparrow deterrent or excluders on the nest box • Move boxes away from prime House Wren habitat
• Eggs or nestlings missing or on ground under box • Nest disturbed, partially pulled out of hole, or on ground under box • Adult feathers scattered on ground below box	• Raccoon, cat, squirrel, human vandalism	• Install predator guards or baffles on the box pole • Install boxes high enough so cats can't leap from the ground to the box roof • Place box away from trees or fences to prevent raccoons and cats from climbing or jumping to the box • Securely close box with screws or nails
• Eggs on ground under nest, nest intact and tiny holes pecked in eggs • Nestlings dead in box and with signs of trauma, especially around the head. • Adult dead in nest, signs of trauma, especially around the head	• House Wren, House Sparrow Note: Dead adults and nestlings more likely due to House Sparrows	• Move boxes away from areas where House Sparrows are prevalent • Place House Sparrow deterrent or excluders on the nest box • Move boxes away from prime House Wren habitat
• Eggs fail to hatch • Nestlings or adults dead in box, no signs of foul play	• Infertile eggs, runt eggs, female disappeared, bad weather, chemical poisoning, nestlings or adults could not climb out of box	• Don't use lawn, garden, and insect chemical products • Discuss possible chemical application problems with neighbors, golf courses, etc. • Install fledgling ladder or roughen up the inside of the nest box directly under the entrance hole • Some things are beyond our control

ACTIVITY 5: HOW TO USE YOUR NESTING DATA

Goal

Examine the data that have been collected for NestWatch, and begin interpreting nesting data.

Time and Location

45 minutes, indoors

Resources Needed

- Computer equipped with Microsoft Excel, projector, and Internet access
- NestWatch slideshow, Slides 34–39 Download the slideshow at **birdsleuth.org/nestwatch**
- Calculator
- Pencils
- Paper

Meeting the Standards

See Appendix 2 for corresponding *Next Generation Science Standards* and *Common Core Standards.*

Conducting the Activity

Your group has collected and entered nesting data at NestWatch.org or on the mobile app.

1. Log on to the NestWatch website. Find the download options below the Quick Summary on your data entry homepage, and choose Download Breeding Data.

2. If necessary, briefly review how to calculate simple fractions and means, and review rounding with your students. You may find it helpful to walk students through the questions, and allow time for self-paced work.

3. Show the NestWatch slideshow and work through the data questions with your group. Begin by showing Slides 34–35 and see examples of why breeding bird data are important.

Part 1: Analyzing Nest Success Data

1. Now that you have downloaded your nesting data, calculate nesting success for any of your NestWatch species, preferably the one with the most nests. (*You can pool all of your nests together if you need a higher sample size, or you can use the example below.)*

    a. Number of nests for focal species_____

    b. Number of those nests which fledged at least one young_____

    c. Nesting success rate expressed as a percentage_____

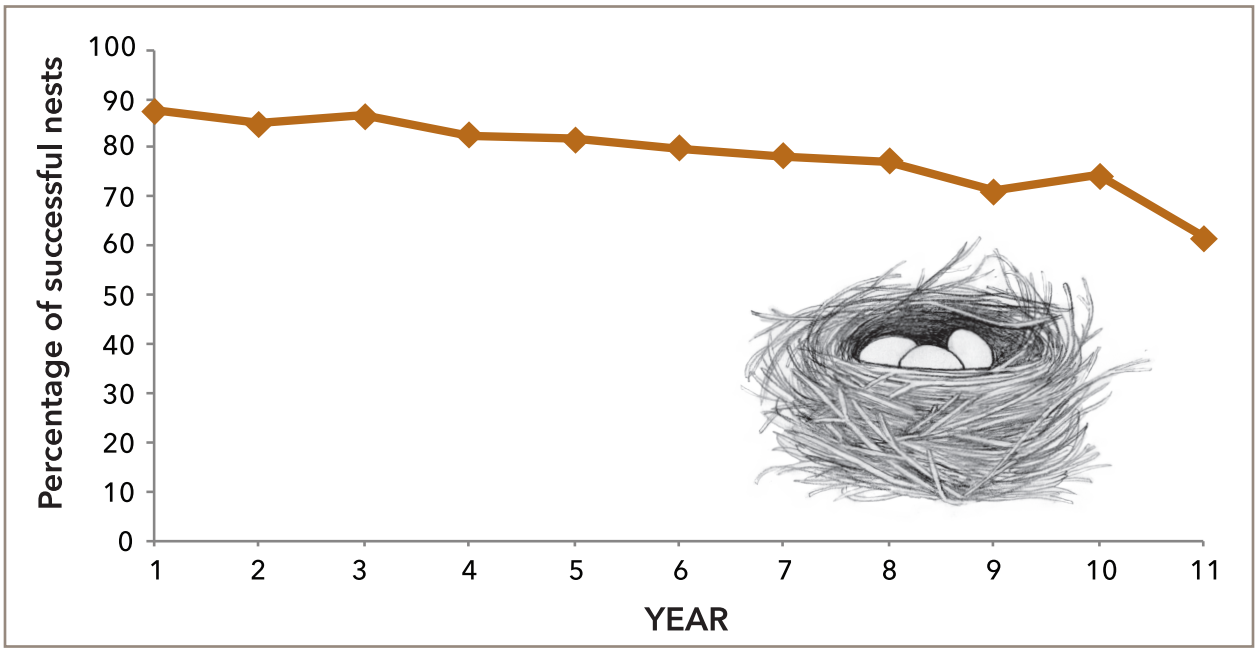
    Example: *You had 8 nests and 5 of them were successful. Nesting success rate was 5/8 or 0.625. Express this as a percentage as 62.5%.*

2. Show Slide 36. Let's assume that you have data from 10 previous years on your focal species, making this the 11th year of your study. Calculate the average nesting success rate and determine if nesting success has generally increased, decreased, or stayed about the same. See the slideshow for presenter notes.

3. Graph the sample data from Slide 36 with year on the X axis (1–11) and percentage of successful nests (0–100%) on the Y axis, and plot the nesting success for each year. Draw a line connecting the dots. This could be an individual or group activity. *(See sample graph below.)* **Hint:** It is OK to round the means to the nearest whole number to simplify the process.

   Ask: Using the example data for year 11, is the trend increasing or decreasing, or has it remained about the same? *In this example, the trend is decreasing, meaning fewer nests are successful.*

Sample graph of percentage of successful nests over an 11-year period.



American Robin and nest by Holly Faulkner

Reflect and Evaluate

1. How might ornithologists use data accumulated over long time periods to determine the health of bird populations? Why might it be important to look at data from more than one year?

   Ornithologists can use long-term data sets to see if nesting success is changing for a population over time (i.e., seeing trends). These trends can reveal a lot about the health of a population and can be useful for predicting what might happen in the future. If nesting success is increasing, it might indicate that the population is doing well. If nesting success is decreasing, it might indicate that something in the environment has changed or that the population is in trouble. This information can help ornithologists make important conservation decisions. It's important to look at multiple years of data because a single year's data might be affected by unusual events such as drought, excess rain, hurricanes, or other severe weather events. Long-term data sets allow ornithologists to see the big picture and get a more realistic idea of a population's health.

2. Were there any challenges or limitations that might have affected how much data your group collected? Could you have done anything differently?

   Weather, not enough time, birds were not using nest boxes.

3. Is there anything that could be done to improve nesting success for this species?

   Installing predator guards, relocating nest boxes, providing bird food or nesting materials, etc.

Extension

Compare your data to the data for the same species around the country. Go to **nestwatch.org/nw/public/export** to download national data. For best results, choose the previous year to avoid getting data for the year in progress. Select All Locations (Aggregate) for the location. Under Select Data Type, choose Reproductive Success by Species. Now click Export Data (leaving the file type as .xls).

1. Open the downloaded spreadsheet and note the total number of nesting attempts, nesting success rate, hatch rate, and fledge rate.

   a. How does your percentage from question 1C (page 29) compare to the "nesting success rate" for the entire country? Why might your value be higher or lower?

      Presence or absence of predators, weather events nearby or elsewhere, abundance or lack of prey items, small sample size (too few nests for the data to be informative). If you pooled all of your nests together by species for Question 1 (page 29), discuss the limitations of not having enough data for a single species.

   b. What do you think the numbers for "hatch rate" and "fledge rate" represent? What does the "nesting success rate" represent?

      Hatch rate is the percentage of eggs that hatched into live young. The fledge rate is the percentage of hatched young that fledged. The nesting success rate is the number of nests that fledged at least one young divided by the total number of nest attempts. It is usually represented as a percentage.

Part 2: Analyzing Egg Data

Review the map of House Wren average clutch size, grouped by region (see Slide 37), then answer the questions below.

1. Which region had the largest average clutch size? The smallest? Have youth come up to the map.

   Largest = northwestern region, at 6.3 eggs; smallest = northeastern region, at 4.6 eggs

2. Which environmental factors might vary in a way that could influence clutch size?

   Climate (temperature, precipitation), food availability

   Phenology is the study of when events occur, in this case, when eggs are first laid. Look at the graph on Slide 38 and you will see the number of nests initiated by two species throughout a nesting season. Ask the following questions:

   a. A brood is a group of young raised together at one time. Some birds only have one set of young, while others can have two or more. Which species is more likely to have multiple broods per year?

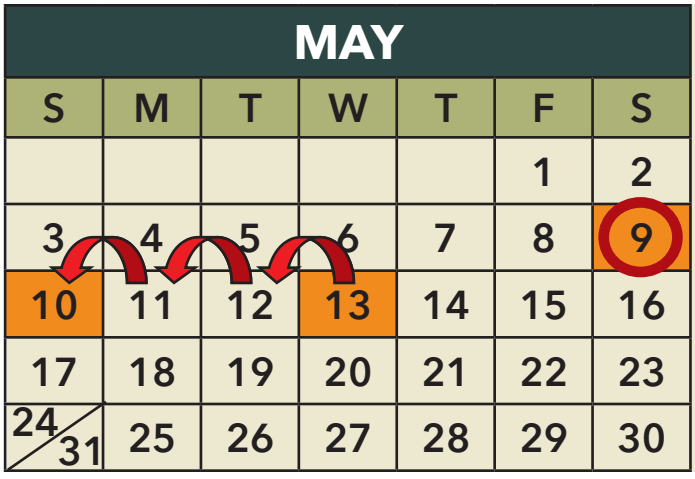
      The graph pattern of multiple peaks indicates that Eastern Bluebirds are more likely to have two or even three broods a year. The single large peak for Tree Swallow indicates that it typically has only one brood per year.

   b. We can see from the graph (Slide 38) that Eastern Bluebirds start laying eggs sooner than Tree Swallows. Look up both species on All About Birds (**allaboutbirds.org**) and look at the species' range maps. Note where each species spends the winter. Why might bluebirds start laying their first clutch of eggs earlier than swallows?

      Tree Swallows are long-distance migrants that spend the winter in parts of the southern United States, Cuba, Mexico, and Central America. However, Eastern Bluebirds can reside in the same location year round or migrate short distances within the United States. The farther a bird migrates in the winter, the longer it takes to return and start nesting in the spring. Also, some birds may start nesting sooner/later depending on habitat, weather, and food availability.

   c. Now return to your class data. What was the earliest first-egg date of any species? Did you notice whether any birds had more than one nest per year? If so, which one(s)?

      The first-egg date is the date on which an individual nest received its first egg. If you're not sure of the exact date, it is OK to estimate.



If you monitor nests during egg-laying, you can determine first-egg dates for songbirds by counting backward one egg per day.

In this example, if you saw two eggs on May 10 and five eggs on May 13, you can determine that May 9 was the first-egg date.

Reflect and Evaluate

1. Why might ornithologists be interested in when birds nest, and how nesting dates might be changing over time?

   Earlier spring nesting could indicate the climate is changing and warmer temperatures are suitable for nesting and food (insects, plants) availability; changes in prey abundance and distribution; looking for differences by region or habitat. For example, southern birds may nest earlier than northern birds because temperatures are warmer sooner. Also, scientists have discovered that some species are nesting earlier in the spring because of changes in climate.

2. What are some ways that you can tell when the "first-egg date" was?

   If the nest is visited during the egg-laying period, you can tell the first-egg date by either (a) observing only one egg in a nest, followed by more eggs later, or (b) seeing an increase in the number of eggs between two nest checks, and counting backwards assuming one egg per day.

Extensions

1. What keeps most birds, especially non-migratory birds, from nesting year round?

   Raising young requires a lot of energy and birds need down-time to recover energy/fat reserves; reduced food availability during the nonbreeding season would make feeding young difficult; eggs/young might freeze in winter; nests not as camouflaged when leaves are off the trees and grass isn't green; some species remain dependent on their parents for most or all of the first year; lack of suitable nesting materials.

2. Are birds the only animals that lay eggs?

   No, other egg-laying species include insects/bugs, snakes, turtles, fish, duck-billed platypus, frogs, echidnas, octopuses, etc.

3. Do you think that species that lay eggs (other than birds) also restrict their egg-laying to a specific season? Why or why not?

   Yes. In temperate North America, most egg-laying species have a defined reproductive season and don't breed year round for many of the same reasons that birds don't: unfavorable climate, access to resources such as food or water may be limited. Mammals (species that do not lay eggs), on the other hand, can control the temperature of the young developing within the female's body, and are therefore not as limited by climate as are birds, reptiles, insects, and others (the platypus and echidnas are known mammalian exceptions).

American Robin nest by Holly Faulkner

APPENDIX 1: GLOSSARY–WORDS ABOUT NESTING BIRDS

Altricial—A developmental classification of birds at hatching where young are relatively immobile, lack feathers or down, have closed eyes, and are completely dependent on their parents for survival. Altricial birds include herons, hawks, woodpeckers, owls, and most songbirds.

Breeding range—The geographic area or spatial distribution in which a species is normally found reproducing.

Breeding season—The period of time during each year when a species reproduces (mates and has young).

Brood (n)—The young of a bird that are hatched or cared for at one time.

Brood/brooding (v)—To sit on and keep young birds warm that cannot maintain their own body temperatures.

Brood parasitism—The act of laying eggs in the nests of other birds. The eggs are left under the parental care of the host parents which can be of the same or different species. Brown-headed Cowbirds are common brood parasites.

Brood patch—An area that develops on the lower abdomen of birds in which the feathers drop off and the skin thickens and becomes densely packed with blood vessels. Used in incubation to keep eggs and young warm. Also known as incubation patch.

Cavity—A hole or opening in a tree trunk or limb.

Clutch—Total number of eggs laid by a female bird in one nest attempt.

Colony—A spatially discrete cluster of breeding territories, usually tightly packed together.

Dummy nest—One of several nests built to attract females, serve as shelter for juveniles, act as decoys for predators, or serve as a back-up nest if the first nest is disturbed or destroyed.

Egg tooth—a hard white bump on the beak of a bird embryo that is used for breaking out of the shell and is later reabsorbed or falls off.

Fledge/fledging—The act of leaving the nest or nest cavity after reaching a certain stage of maturity.

Fledge rate—The percentage of hatched young that fledged.

Fledgling —A young bird that has left its nest.

Flush—To drive a bird from its nest or sheltering place.

Habitat—The place or environment where a plant or animal naturally or normally lives and grows.

Hatch—To emerge from an egg, pupa, or chrysalis.

Hatchling—A newly-hatched bird or animal.

Hatch rate—The percentage of eggs that hatch into live young.

Incubate/incubation—The process by which birds keep eggs at the proper temperature to ensure normal embryonic development until hatching. In most cases, birds sit on eggs and transfer their body heat through a patch of skin known as the brood patch. In many species, only the female incubates; in other species, both males and females incubate. Less commonly, only the male incubates.

Incubation period—The period of time during which adults (usually the breeder female) remain on the nest, using their bodies to keep the eggs warm and protected.

Latitude—South to north measurement of location.

Longitude—East to west measurement of location.

Migration—Regular, extensive, seasonal movements of birds between their breeding regions and their wintering regions.

Nest box—A box, typically made of wood, in which cavity-nesting birds can nest; also called a birdhouse.

Nesting cycle—The time period beginning at nest building through egg laying and raising young to the point of independence.

Nestling—A young bird after hatching and before leaving the nest.

Nesting success rate—The number of fledglings divided by the clutch size.

Open-cup nesting—The tendency to nest in areas with little or no permanent enclosure, such as on trees, shrubs, herbaceous cover, bare ground, or on a platform.

Ornithologist—A scientist who studies birds.

Phenology—The study of cyclic and seasonal natural phenomena, especially in relation to climate and plant and animal life.

Pip/pipping—When a bird breaks through the shell of its egg until it is hatched.

Precocial—Young that are capable of a high degree of independent activity immediately after hatching. Precocial young typically can move about, have their eyes open, and will be covered in down at hatching. They are generally able to walk away from the nest as soon as they have dried off.

Premature fledging—When nestlings leave the nest before reaching the stage of maturity at which they normally fledge. Premature fledging may be caused by heat, parasites, or disturbance by a predator or a human nest monitor.

Snag—A standing dead tree, often a vital source of nesting sites for cavity-nesting birds.

Species—One of the basic units of biological classification and a taxonomic rank. A species is often defined as a group of organisms capable of interbreeding and producing fertile offspring.

Territory—A defended area of any shape or size that contains nest site and/or food resources; its boundaries may shift during the breeding season.

APPENDIX 2: MEETING THE STANDARDS

1. Right Bird, Right Habitat

Next Generation Science	Common Core
Middle School: Interdependent Relationships in Ecosystems MS-LS2-2 Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems. MS-LS2-5 Evaluate competing design solutions for maintaining biodiversity and ecosystem services.	RI.5.1 Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. RI.5.7 Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. RI.5.9 Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. WHST.6-8.2 Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. WHST.6-8.9 Draw evidence from informational texts to support analysis, reflection, and research.

2. Nest Box Construction and Installation

Next Generation Science	Common Core
Middle School: Engineering Design MS-ETS1-1 Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. MS-ETS1-2 Evaluate competing design solutions using systematic process to determine how well they meet the criteria and constraints of the problem. **Middle School: Earth and Human Activity** MS-ESS3-3 Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.	RI.5.1 Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. RI.5.7 Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. RST.6-8.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6-8 texts and topics. MP.2 Reason abstractly and quantitatively. MP.4 Model with mathematics. MP.5 Use appropriate tools strategically.

3. From Nest to Eggs to Fledge and 4. Nest Checks

Next Generation Science	Common Core
Middle School: Growth, Development, and Reproduction of Organisms MS-LS1-4 Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively.	RI.5.1 Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. RI.5.7 Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. RI.5.9 Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably.

3. From Nest to Eggs to Fledge and 4. Nest Checks *(Continued)*

Next Generation Science	Common Core
MS-LS1-5 Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms. **Middle School: Matter and Energy in Organisms and Ecosystems** MS-LS2-1 Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations in an ecosystem. MS-LS2-2 Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.	RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. RST.6-8.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6-8 texts and topics. WHST.6-8.2 Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. WHST.6-8.9 Draw evidence from informational texts to support analysis, reflection, and research.

5. How to Use Your Nesting Data

Next Generation Science	Common Core
Middle School: Natural Selection and Adaptation MS-LS4-4 Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment. MS-LS4-6 Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time. **Middle School: Matter and Energy in Organisms and Ecosystems** MS-LS2-1 Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem. MS-LS2-4 Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.	RI.5.1 Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. RI.5.7 Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. RI.5.9 Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. 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). W.5.9 Draw evidence from literary or informational texts to support analysis, reflection, and research. WHST.6-8.2 Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. WHST.6-8.9 Draw evidence from informational texts to support analysis, reflection, and research. SL.8.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, teacher-led) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly. MP.2 Reason abstractly and quantitatively. MP.4 Model with mathematics. MP.5 Use appropriate tools strategically. 6.RP.A.1 Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. 6.SP.B.5 Summarize numerical data sets in relation to their context. 7.RP.A.2 Recognize and represent proportional relationships between quantities.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