



# SciGirls

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## SciGirls Participate Citizen Science Adventures



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# Citizen Science Adventures

Public participation in scientific research, also known as citizen science, engages ordinary people (kids and adults) in the collection of data for use by research scientists. The activities in this book support and prepare your girls for participation in citizen science. In conjunction with these activities, girls can use their **SciGirls Nature Nurture** journal (available for download at [scigirlsconnect.org](http://scigirlsconnect.org)) to learn how to identify, describe, and collect data. These skills will help them in all areas of science, technology, engineering, and math (STEM).

The activities included here are based on the Emmy Award-winning national PBS Kids television series, **SciGirls**, which features groups of middle-school girls modeling girl-friendly approaches to inquiry-based STEM investigations.

These activities follow: the scientific inquiry process (found on page 2); incorporate the *SciGirls Seven Strategies for Engaging Girls in STEM* (outlined on page 3); feature **SciGirls** videos and mentors from the show; and align to national standards.

While the activities can be used alone, we encourage you to enhance your girls' experience by showing the videos to incorporate **SciGirls** as role models and mentors. Log on to the **SciGirls** website and participate in monthly citizen science challenges that are part of the new **Rule the Roost** game on [pbskids.org/scigirls](http://pbskids.org/scigirls). Your girls can also take citizen science to the next level by participating in a real project. There are many examples throughout the book and on page 22.

We encourage you to inspire your girls using the **SciGirls Seven**, making personal connections between the girls' lives and the activities in this book. Look to this material for ideas. But remember that your girls can be the best source of information to help make their learning authentic.

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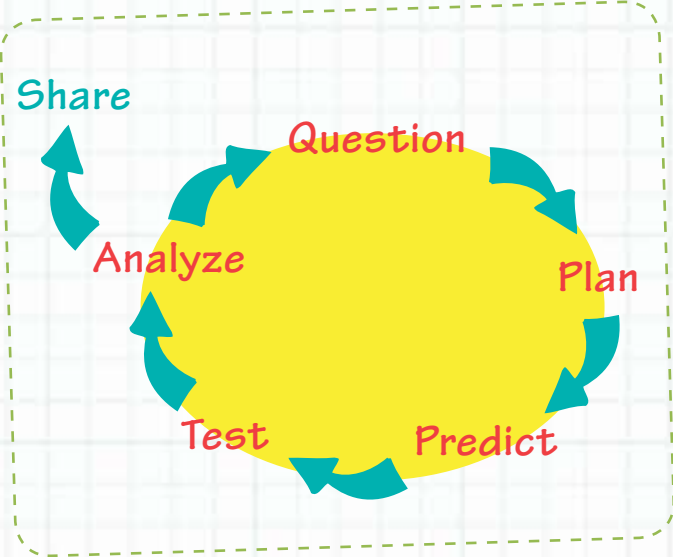
The **SciGirls** activities align to national education standards. To download the complete and most current alignments, please visit [scigirlsconnect.org](http://scigirlsconnect.org).



# SciGirls Want to Know

## Scientific Inquiry Process

Here is the **SciGirls**' scientific inquiry process, the same steps all scientists use when tackling a new problem. Encourage your girls to follow these steps as they approach each **SciGirls Challenge**.



**Question** The **SciGirls Challenge** lays out the initial question for investigation, but girls might come up with new questions as they work their way through the process. Steer them away from questions that have simple yes/no answers toward ones they can answer through their own investigations.

**Plan** Research ideas by consulting experts, reviewing books, browsing the Internet, and then brainstorming with others. Each group should choose one idea and plan an investigation that tests one variable at a time, includes multiple trials, and has a clear way to measure results.

**Predict** This important step is sometimes forgotten. Ask girls what they think will happen before diving in. It's OK to disagree. Different predictions make the experiment more interesting and discussing predictions can improve critical thinking skills.

**Test** Let the experimentation begin! Be sure to encourage girls to write down every observation and result in their science journals.

**Analyze** After each test, analyze the data. A failed test can still lead to important results—and new ideas. Encourage girls to make calculations, organize their data in a table or chart, and discuss. This evaluation sometimes raises new questions and starts the entire process over again.

**Share** Encourage girls to be creative when making charts, graphs, or models to share their results. Have them use these visual aids to tell an effective story. Allow time for feedback and discussion, which could open new doors for future investigations.

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Credits: Sarah Carter, Joan Freese, content | Ann Pavlish, design | Denise Fick, illustrations Richard Hudson, Executive Producer | Special thanks: Susan Buechler, Katherine Langenfeld

Visit [pbskids.org/scigirls](http://pbskids.org/scigirls) for videos and games!



See [scigirlsconnect.org](http://scigirlsconnect.org) for how this process aligns to the scientific practices as outlined in the Next Generation Science Standards.



# The SciGirls Seven

## Strategies for Engaging Girls in STEM

The SciGirls approach is rooted in research on how to engage girls in STEM. A quarter of a century of studies have converged on a set of common strategies that work, and these have become SciGirls' foundation—aka the **SciGirls Seven**. All the activities in this booklet were created with the **SciGirls Seven** in mind and incorporate as many strategies as possible. We even mark the use of select strategies within each activity. (Look for superscript numbers and refer back to this page.) For additional information, please see our introductory booklet, *SciGirls Seven: How to Engage Girls in STEM*, which includes tips for implementing these strategies. You can download it for free at [scigirlsconnect.org](http://scigirlsconnect.org).

1. Girls benefit from collaboration, especially when they can participate and communicate fairly.
2. Girls are motivated by projects they find personally relevant and meaningful.
3. Girls enjoy hands-on, open-ended projects and investigations.
4. Girls are motivated when they can approach projects in their own way, applying their creativity, unique talents, and preferred learning styles.
5. Girls' confidence and performance improves in response to specific, positive feedback on things they can control—such as effort, strategies, and behaviors.
6. Girls gain confidence and trust in their own reasoning when encouraged to think critically.
7. Girls benefit from relationships with role models and mentors.



### Activity 1



## Season Seeking

### PHENOMENAL PHENOLOGY

Observing plants and animals often involves noticing and recording seasonal changes over time. Every species moves through a series of life cycle stages that are related to environmental cues. The study of these life cycle stages is called phenology and the observable stages are called phenophases. Examples of phenophases include the breaking leaf buds on a plant; pollinator interaction with flowers; bird nest building; mammal hibernation; or butterfly emergence from a cocoon.

#### SMART START:

- ★ For resources about leaves, flowers, and fruits, use the Nature's Notebook phenophase definition sheets ([usanpn.org/nn/species\\_search](http://usanpn.org/nn/species_search)), Botany and Phenophase Primers, local field guides, or someone knowledgeable about the natural history of your area.
- ★ Find a spot that is accessible, whether it's a schoolyard, local botanical garden, arboretum, nature center, park, or wildlife refuge. Observations can start short (10 mins.) and can be made during a walk, hike, or while just sitting, looking, and listening.

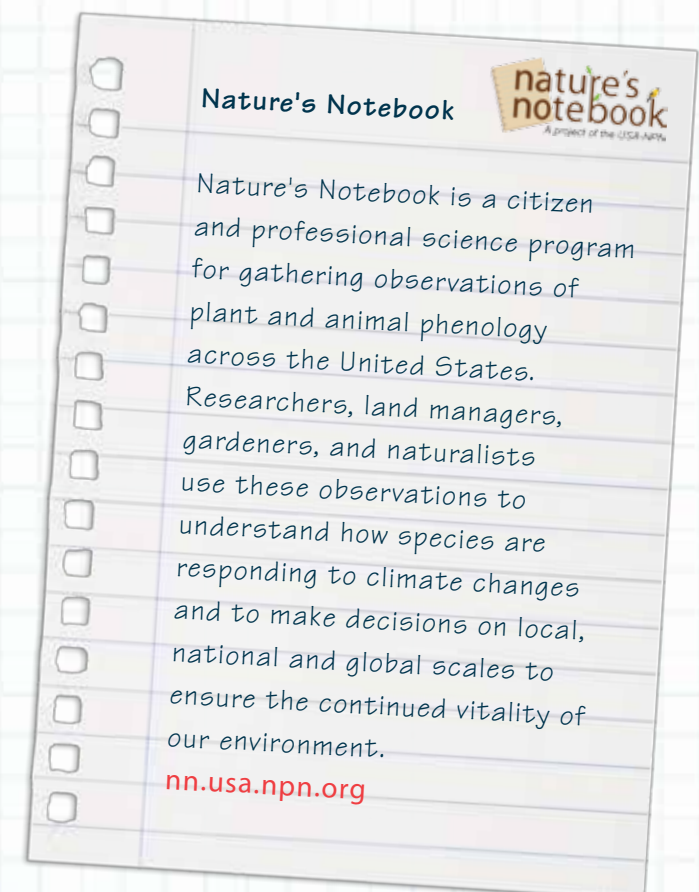
#### Here's how:

1. **Introduce phenology.** Discuss phenophases and phenology. Have the girls brainstorm different phenophases and what time of year they appear. Is there a connection between when a phenophase occurs and what's happening in the environment?<sup>6</sup>

### You'll Need:

1+ hours

- ♦ pencil
- ♦ markers or colored pencils
- ♦ journals, sketch pads, or drawing paper
- ♦ optional: SciGirls Nature Nurture journal
- ♦ optional: magnifying glasses, binoculars, plant and animal field guides





## Season Seeking

continued



Watch SciGirls learn about phenophases on the *SciGirls Participate DVD*. (Select **Flower Power: Data Collection**.)

## 2. Observe. Introduce the SciGirls Challenge:

Identify and describe as many phenophases as you can find. (Girls should look for green leaves, a plant in bloom, a plant bearing fruit, a bird and its behaviors, a mammal and its behaviors, and an insect and its behaviors.)

**3. Plan.** Divide the girls into small groups<sup>1</sup> and have them discuss what information they should record when making scientific observations in nature. Ask each group to share one item until you have a group list. Make sure it includes these things:

- ★ date
- ★ time spent observing
- ★ weather conditions (precipitation, temperature)
- ★ drawings and/or photos
- ★ location of the plant or animal
- ★ name of the plant or animal  
(can be looked up)

**POINTER:** Remember, it's also important to record when you don't see a phenophase!

**4. Collect data.** Time to make observations! Travel to your selected site and begin looking, making sure to carefully record all observations.

**5. Share.** Have each group share one of its most interesting finds. If time allows they can do more research and create a fun presentation to share.<sup>4</sup>

**6. Continue exploring.** Return to the same location multiple times over the course of the year to look for changes in the plants and animals.

Watch Lauren and the SciGirls look for signs of spring on the *SciGirls Participate DVD*. (Select **Flower Power: Mentor Moment**.)



## Mentor Moment

Lauren Borer is a naturalist in Minnesota who shares her love of the outdoors and the natural world with kids and adults. Born a city kid who longed to be in the woods, she was interested in how plants, animals, and humans interact with each other. In one year she worked as a naturalist in four different states, including living in a lighthouse in Door County, Wisconsin and teaching in Yellowstone National Park. Her dog, named Lucy, also likes to hike and watch birds.

## Activity 2

# Bird Is the Word

## WATCHING BIRDS

Birds are fascinating animals to watch and it's easy to learn how to identify them. Casual observers can use the same techniques to identify birds that scientists use. You can help scientists monitor bird populations and look for patterns in bird movement by counting your local birds and submitting the data.

## SMART START:

- ★ Choose a bird watching location (school playground, local park or garden). If it's winter and you are in a cold climate, you can observe bird feeders from indoors.
- ★ Visit the location ahead of time and make a list of birds that the group is most likely to see. (Remember that the birds can change with the season.) If you're unable to visit your location in advance, the eBird database is a good resource for finding the birds in your area. Visit [ebird.org](https://ebird.org) and click on "Explore Data."
- ★ If your girls don't have much experience with birds you will want to take them on a field trip to observe and draw birds first, then use the drawings for the comparing/contrasting conversation.

Here's how:

**1. Identify birds.** Ask girls to share names of birds they know. Make a list. Compare and contrast the birds on the list. How do they know how to identify those birds? (For example: size, shape, colors, location, habitat, behavior, sound). Where have they seen the birds? <sup>2</sup>

### You'll Need:

- journals, sketch pads, or drawing paper
- pencils
- markers or colored pencils
- bird field guides
- optional: SciGirls *Nature Nurture* journal
- optional: binoculars, bird feeders, Merlin bird ID app (free)



## Celebrate Urban Birds

The Celebrate Urban Birds citizen science project connects participants to birds through the arts, greening activities, and neighborhood events. Watch birds for 10 minutes and share your observations by mail or online with Cornell Lab of Ornithology scientists. Watch birds anywhere—home, school, or a park. It's easy!

[celebrateurbanbirds.org](http://celebrateurbanbirds.org)

The **Cornell** Lab of Ornithology  
Celebrate Urban Birds





# Bird Is the Word continued



**POINTER:** Bird silhouettes are a good way to talk about overall size and shape. You can also use photos of birds to aid discussion.

**2. Choose a bird.** Introduce the **SciGirls** **Challenge:** Choose a bird that lives in your area and learn how to identify it. Each girl will become a bird expert<sup>6</sup> and teach the rest of the group about her bird. The girls can use photos, videos, and websites to learn about the species. Have the girls consider the following characteristics:

- ★ overall size and shape
- ★ field marks (breast color, rump color, tail color and length, wing shape and color, eye stripe, eye ring color, head color)
- ★ behaviors (tail movements, eating on the ground, flight pattern, sounds the bird makes)

To see what the SciGirls learned about identifying birds, watch the *SciGirls Participate DVD*. (Select **Feathered Friends: Research**.)



**3. Observe.** Go on a field trip to watch birds. Place girls in small groups so that each group has a variety of bird expertise.<sup>1</sup> Encourage the girls to draw the birds they see, paying attention to the characteristics listed above. The girls in each group should work together to identify the birds.

**POINTER:** Field guides or mobile apps such as Merlin can help with identification if the girls get stuck.



**4. Explore more.** Have your girls teach a younger group of girls how to identify birds.<sup>3</sup> Plan a community birding afternoon and practice drawing birds of different types.

Learn about Viviana's interests and best science moment on the *SciGirls Participate DVD*. (Select **Feathered Friends: Mentor Moment**.)<sup>7</sup>

## Mentor Moment

Dr. Viviana Ruiz-Gutierrez is a senior scientist at Rocky Mountain Bird Observatory. Her research focuses on studying resident and migratory bird populations in Latin America and their responses to environmental changes. A native of Costa Rica, she is the third Costa Rican ornithologist with a Ph.D., and the first female. Viviana likes to smile and laugh often and says her older sister still holds secret powers over her. She loves mammals as well as birds and will soon be adopting two rabbits.



SciGirls

## Activity 3

# Wetland Band

## TRACKING FROGS

Frogs and toads find each other by calling, and each species makes a unique call. They use these calls during the breeding season to find a mate. Most frogs and toads call at night when they are protected from the sun and can hide from predators. Scientists listen to the calls to collect information on how frog and toad populations are doing.

## SMART START:

Research the frog and toad species that live in your area ([aza.org/states-and-territories](http://aza.org/states-and-territories)) and obtain their calling sounds either online or on a CD. (Check with your state natural resource department.)

Here's how:

### 1. Introduce frog and toad calling.

Brainstorm reasons that animals make noises (warning others, defending territory, finding a mate, communicating with parent or child, keeping track of their social group). Share some frog and toad calls from your area and talk about how frogs and toads use calling to attract a mate.

Watch SciGirls learn the calls of their local frogs and toads on the *SciGirls Participate DVD*. (Select **Frog Whisperers: Research**.)



## You'll Need:

45 min.

- CD or website with frog and toad calls
- 1 empty glass or plastic bottle
- speakers
- optional: *SciGirls Nature Nurture journal*

For each small group

- small rocks
- marbles
- small bells
- small plastic comb
- rubber bands
- small plastic cup
- balloon
- zipper
- whistle
- optional: amphibian field guide



1-7 See **SciGirls Seven** strategies on page 3.



# Wetland Band

## continued

**2. Brainstorm.** Listen to the calls of some frogs and toads from your area. Introduce the **SciGirls Challenge:** Create an instrument that will mimic a frog or toad call.<sup>4</sup> Demonstrate this by playing the American bullfrog call and then blowing across the top of an empty plastic or glass bottle. Examples of instruments:

- ★ green frog – strum a rubber band
- ★ western chorus frog – run your finger over a comb
- ★ spring peeper – shake some bells
- ★ southern leopard frog – run your finger over an inflated balloon
- ★ Blanchard's cricket frog – knock small rocks together
- ★ spotted chorus frog – open and close a zipper
- ★ American toad – blow a whistle



**POINTER:** Make sure girls have access to listening stations so they can compare their instruments' sounds with the actual frog and toad calls.

**3. Create.** Give groups plenty of time to create and fine-tune their instruments so they work consistently.<sup>6</sup> Make sure each girl has an instrument. (It's OK to have multiples in a group.)



SciGirls

FrogWatch USA™ **FROG WATCH** USA™

FrogWatch USA™ is a citizen science program of the Association of Zoos and Aquariums (AZA). Community volunteers help scientists collect information on frogs and toads throughout the United States. Volunteers visit local wetlands during specified times and seasons to listen to the toads and frogs calling. They identify individual species, rate their calling intensities, and submit observations to a national database. Data dating back to 1998 are available online for analyses to support the conservation of amphibians and their wetland habitats.

[aza.org/](http://aza.org/)



# Wetland Band

## continued

**4. Play.** Bring the whole group together and have everyone play their instruments at the same time. It's a lot of noise! Have everyone play their instrument again, this time closing their eyes (with adults acting as monitors) and trying to find their same species of frog or toad. Can the same species find each other?

**POINTER:** If you have a large group you can split it in half, but make sure that everyone has a match in their half.

**5. Discuss.** Was it hard to find another frog or toad of the same species? How do you think scientists use frog and toad calls to monitor the population's health?

**6. Challenge.** Have two girls leave the room. (They will be the citizen scientists.) The rest select the number and types of frogs or toads that will be calling. Invite the citizen scientists back into the room, blindfold them, and then play the chosen frog and toad calls. Can the citizen scientists identify the species, number of individuals calling and assign calling intensities to each species? What methods did they use for identification?

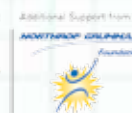


Watch Laura and the SciGirls look for frogs and toads on the *SciGirls Participate DVD*. (Select **Frog Whisperers: Mentor Moment**.)<sup>7</sup>



### Mentor Moment

Laura Seger works in environmental education at the St. Louis Zoo. When she was young, she spent her free time searching for toads, helping injured birds, and building elaborate crayfish cities. Laura loves spending time in nature and has even taken two groups of teen volunteers to the rainforest for a week. Her favorite animals are the ones that are often feared or disliked (sharks, bats, and snakes). She's on a mission to see every reptile and amphibian species in Missouri.



<sup>1-7</sup> See **SciGirls Seven** strategies on page 3.



# Cloud Clues

## PARTLY CLOUDY

Clouds play an important role in maintaining the Earth's temperature. One of the ways they regulate the amount of light (energy) coming from the sun is their opacity. The terms transparent, translucent, and opaque describe how much light gets through a cloud and help us understand why clouds make shadows.

Here's how:

**1. Introduce visual opacity.** One of the properties of a material is the ability of light to pass through it. This property is called visual opacity. Discuss the terms *transparent*, *translucent*, and *opaque*. Create a list of descriptors for each.

- ★ **transparent** – light passes through, things on the other side can be seen clearly
- ★ **translucent** – light passes through, things on the other side can't be seen clearly
- ★ **opaque** – little to no light passes through

**2. Investigate.** Put girls into small groups<sup>1</sup> and give them a collection of materials to investigate. Introduce the **SciGirls Challenge:** Determine whether the items in the collection are transparent, translucent, or opaque.<sup>3</sup> Be prepared to share results with the whole group.



## You'll Need:

45 min.

- optional:  
SciGirls Nature Nurture journal

For each small group

- transparent items (cellophane, drinking glass or glass jar, bottle full of water)
- translucent items (wax paper, frosted contact paper, tracing paper, parchment paper, tissue paper)
- opaque items (construction paper, cardboard, aluminum foil, cotton balls)
- light source (small desk lamp, overhead light, natural light)
- white paper

# Cloud Clues continued

**POINTER:** A good way to test the opacity of materials is to hold your hand behind them and see if you can observe details. You can also see if the materials cast a shadow when placed in front of a light source.

**3. Share.** Each small group can share a couple of items that it investigated. Were the items transparent, translucent, or opaque? How did they test each item?

To get started, watch SciGirls collect data about clouds on the *SciGirls Participate DVD*. (Select *SkyGirls: Collect Data*.)



**4. Go outside.** Once groups have shared their results, go outside and observe clouds. Are the clouds in the sky transparent, translucent, or opaque? Are the clouds casting shadows on the ground?

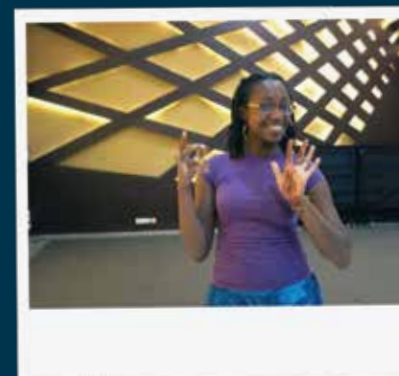
**POINTER:** When observing clouds, observe the clouds directly above you. Remember that where a shadow falls depends on the location of the sun—the shadow may not be directly below the cloud. When observing clouds make sure not to look directly at the sun.

Watch Yolanda teach the SciGirls about citizen science and clouds on the *SciGirls Participate DVD*. (Select *SkyGirls: Mentor Moment*.)<sup>7</sup>



## Mentor Moment

Dr. Yolanda Roberts is a physical scientist at NASA Langley Research Center who studies Earth-reflected sunlight to



help understand how and why the Earth's climate is changing. As a young girl she was terrified of thunderstorms and would glue herself to the Weather Channel to make sure tornadoes weren't coming. Soon the meteorologists and cool maps ignited her interest in what was happening in the sky. Yolanda is a first generation American; both her parents immigrated to the United States from Trinidad. When she has time to relax she likes to play classical, folk, and bluegrass music on her violin. She loves weightlifting because it makes her feel powerful and she's almost reached her goal of dead-lifting half her bodyweight.



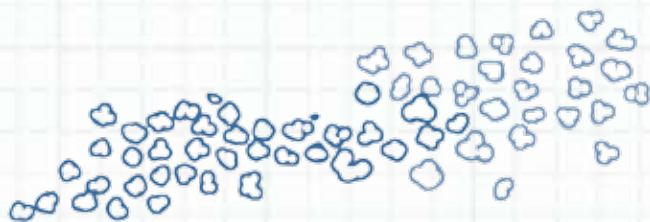
# Cloud Clues continued

**5. Discuss.** Share what you observed outside. Were the clouds transparent, translucent, or opaque? Were there different types of clouds with different types of opacities?<sup>6</sup>

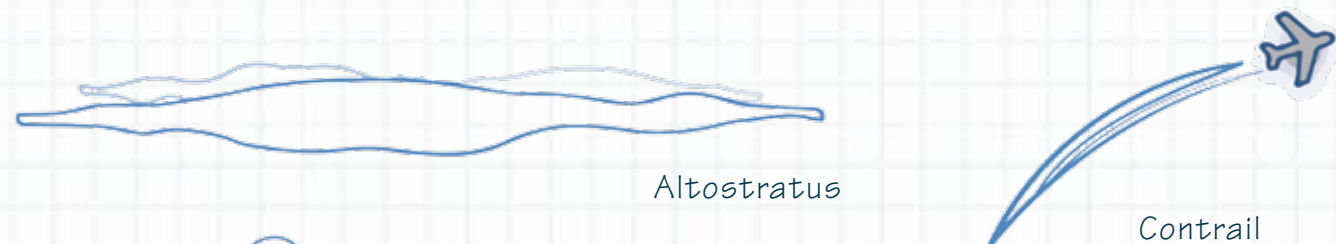
**6. Extension.** Make multiple observations over time and learn different cloud types. Use transparent, translucent, and opaque materials to create a 3D illustration of the clouds you observed.



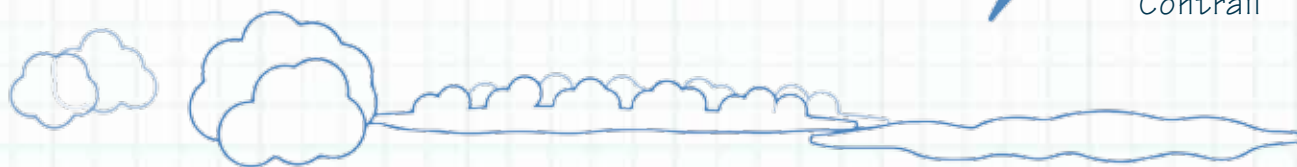
Cirrus



Cirrocumulus



Altostratus



Cumulus

Stratocumulus

Stratus



Contrail

S'COOL



Students' Cloud Observations On-Line (S'COOL) is a hands-on project that supports NASA. S'COOL involves students in weather and climate research. Participants provide NASA with cloud observations to validate data from CERES satellite instruments. Ground observations are an important piece of the puzzle, providing a different perspective of clouds and their behavior. Who knew science was as easy as looking up!  
[scool.larc.nasa.gov](http://scool.larc.nasa.gov)

## Activity 5

# Out and About

## CREATE YOUR OWN FIELD GUIDE

When studying a specific animal (or focal species), like a butterfly, scientists also study the other species (plants and animals) that live in the animal's habitat. The interactions between the focal species and the other plants and animals can help scientists understand it better. Because all butterflies are herbivores (they eat plants), plants are particularly important parts of butterfly habitats. Field guides are great tools for helping identify unknown species.

### SMART START:

- ★ Collect a selection of different field guides for girls to refer to. You can either purchase these or check them out from your local library (for example, Peterson First Guides, Take Along Guides, or, for older girls, Peterson Field Guides, or many others).
- ★ Plan a visit to a local butterfly garden, park, or field.

### Here's how:

**1. Introduce field guides.** Talk about field guides. Has anyone used one before? Why are they useful? Have groups look through the sample field guides and make a list of what types of information are in the guide. Share as a whole group. The list should contain the following:

## You'll Need:

1+ hours

- journals
- pencil
- markers or colored pencils
- plant and animal field guides
- optional: SciGirls Nature Nurture journal
- optional: magnifying glasses, binoculars

- ★ pictures or photos
- ★ name of the species (Latin and/or common)
- ★ description of the species
- ★ location of the species (maps and/or text description)

**2. Observe.** If possible, visit a butterfly garden or other natural area. (Or collect photos of plants in their habitats.) Introduce the **SciGirls Challenge**: Create a field guide for a local butterfly garden or natural area.<sup>3</sup>

**3. Plan.** Have each girl choose one plant and create a field guide page for it. Make sure to represent a variety of plants from the garden. If there aren't enough plants, some girls can create a page for an animal.<sup>4</sup>







## Out and About continued

**4. Collect data.** Visit the location a couple of times to gather additional observations. Each page should include the following items:

- ★ plant name
- ★ plant illustration
- ★ flower color (if the plant has flowers)
- ★ blooming season
- ★ height of plant
- ★ organisms observed on this plant
- ★ optional: butterflies that use the plants, if any, and how they use them

**5. Share.** Each girl should share her page. Once the girls are happy with their individual pages, combine them into one guide. Encourage the girls to work together to create a cover for the collection.<sup>4</sup>

**6. Continue exploring.** Return to the same location multiple times over the course of the year to look for changes in the plants and animals.

Watch Kelly and the SciGirls learn about adult monarch butterflies on the *SciGirls Participate* DVD. (Select **Butterfly Diaries**: Mentor Moment.)<sup>7</sup>



### Mentor Moment

Kelly Nail is a research assistant at the University of Minnesota's Monarch Lab where she is pursuing her Ph.D. in conservation biology. She studies how non-native milkweed and climate change might affect the migration of the eastern North American monarch butterfly. Biology has sent Kelly all over the world, to places as diverse as the forests of southern India, rural Mississippi, and Finland. Her favorite trip was when she got to see the monarch overwintering sites in Mexico. Kelly practices aerial arts, including tricks on the trapeze. She loves water parks and trying out new waterslides.



Visit [scigirlsconnect.org](http://scigirlsconnect.org) for more activities!

SciGirls

## Activity 6

## All Tangled Up

### WE'RE ALL CONNECTED!

All organisms in an ecosystem depend on each other to survive; when one species starts to decline, multiple species may be affected because of the interconnectedness of life within the system. A food web shows how energy moves through a community and the relationships among the different food chains. Scientists monitor species in an ecosystem to make sure everything is in balance.

### SMART START:

- ★ Create a list of plants or animals within an ecosystem in your area (woodland or temperate forest, wetland, freshwater lake or pond, ocean, rain forest, desert, prairie). Make sure to include producers, herbivores, carnivores, omnivores, decomposers, and scavengers in your list.
- ★ Collect a variety of materials for girls to use in part two including; art supplies, poster paper and technology for recording video and audio<sup>4</sup> (if available).



### You'll Need:

2  
hours

- notecards
- string or yarn
- optional: *SciGirls Nature Nurture* journal

For each small group

- clear tape
- markers
- plain white paper
- colored paper

### Part 1: Make a Food Web

Here's how:

**1. Discuss ecosystems.** Ask girls if they know what an ecosystem is. [A community of living (plants, animals, and microbes) and nonliving (air, water, and soil) components that interact.] Choose an ecosystem the girls are familiar with and create a list of all the living things in it. Use the list you generated in the Smart Start to guide the discussion.



**POINTER:** Make sure your list has the same number of living things as there are girls in the group. If your group is large you might want to split it into smaller groups.



1-7 See **SciGirls Seven** strategies on page 3.



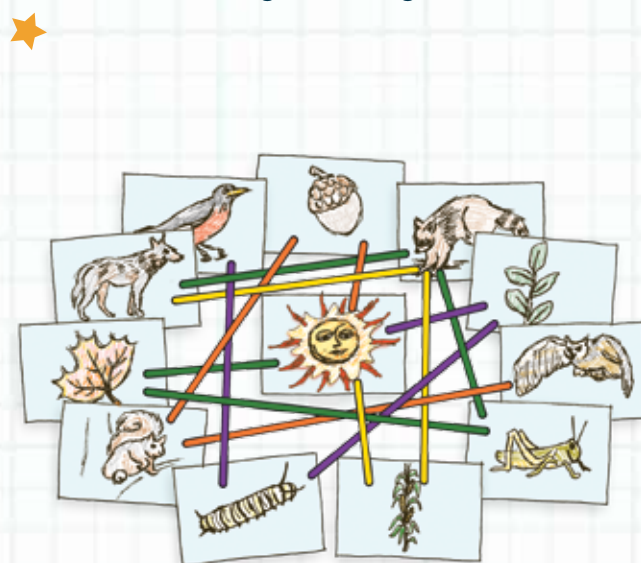
# All Tangled Up continued

**2. Create a food web.** Have the girls draw each living thing you brainstormed on a separate notecard. Add the card "sun" to your collection, as the sun is the energy source for plants and the nexus for your food web. Each girl should pick a card and stand in a circle around the girl with the sun card. Using a ball of yarn, begin the first food chain at the sun:

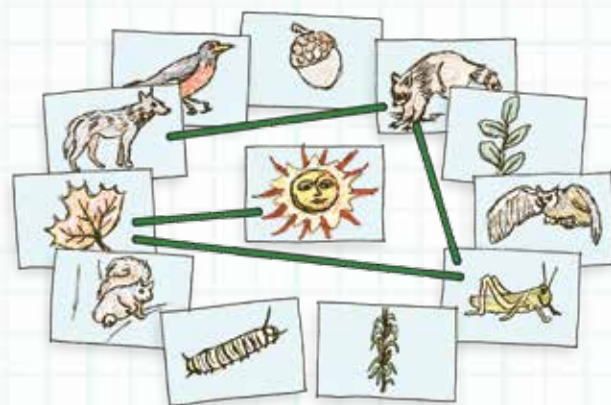
- ★ The sun passes the yarn to a plant of their choice.
- ★ The plant then passes it to an animal (herbivore/omnivore) that consumes that plant.
- ★ The animal passes it to another animal (carnivore/omnivore) that is their predator.
- ★ Build the chain, ending at the top predator, then cut the string.

multiple food chains to form an interactive food web<sup>6</sup>.

Start again at the sun. Create multiple food chains until every girl is holding at least one string. (See diagram below.)



**3. Draw conclusions.** Now have the girls apply their knowledge of ecosystems to create



SciGirls



# All Tangled Up continued

## Part 2: SciGirls Challenge

**4. Brainstorm.** In a large group brainstorm some environmental problems (local, regional, or national) that can affect the food web in an ecosystem. [For example, leaves and grass clippings in storm drains flow to bodies of water, causing algae blooms, which reduce the oxygen content in the water, harming aquatic wildlife.] Present the **SciGirls Challenge**: In small groups, choose a problem that is affecting the environment and create a presentation to share the information with the public.<sup>2</sup> The presentation can be a play, poem, story, song, poster, or public service announcement. Get creative!<sup>4</sup>

Watch the SciGirls create and edit a video encouraging people to care for the ocean on the *SciGirls Participate DVD*. (Select **Terrific Pacific**: Interviewing & Editing.)



**5. Create.** Give the girls time to plan, create, and then practice presenting their information. Each presentation should include examples of how the problem affects the environment (including people) and what individuals can do to help solve the problem.<sup>3</sup>

**POINTER:** Create a time limit for each presentation. Most Public Service Announcements are short (less than 2 minutes long).

**6. Share.** Each group should share its presentation. Invite community members and families to see the presentations.

Watch Holly and the SciGirls collect data in the kelp forests of California on the *SciGirls Participate DVD*. (Select **Terrific Pacific**: Mentor Moment.)<sup>7</sup>



## Mentor Moment

Holly Fletcher helps create and run citizen science programs on the beach, in the backcountry, and on boats at Crystal Cove Alliance in California. She has been prone to seasickness since she was a kid but didn't let that stop her from studying marine biology and getting her sea legs. Holly enjoys adventure and has been bridge jumping in Ecuador, skydiving in California, bungee jumping in New Zealand and swimming with sharks in California, Australia, and Fiji.



1-7 See **SciGirls Seven** strategies on page 3.





## Citizen Science Resources

Citizen science projects, which engage volunteers and professionals in collaborative research to generate new scientific knowledge, come in all shapes and sizes and cover a wide variety of topics. Project models include: data collection by volunteers, data classification by volunteers, and community based collaborative projects. Data classification projects take advantage of the Internet, are based on the concept of crowdsourcing and include volunteers in a wide variety of activities such as mapping the 3D structure of neurons, looking for galaxies, and even digitizing a ship's logs from the 1800s! See [scistarter.org](http://scistarter.org) and [zooniverse.org](http://zooniverse.org) for more examples.

Participating in citizen science can help connect girls to the outdoors and create greater interest in environmental issues. Citizen science projects also map directly to the **SciGirls Seven**. When girls participate in citizen science they actively engage in hands-on science, collect data on local, personally relevant topics, and work in collaborative settings that provide room for their creativity.

### Thank You!



Special thanks to our project partner, the Cornell Lab of Ornithology, a world leader in the study, appreciation, and conservation of birds. The Lab's hallmarks are scientific excellence and technological innovation to advance the understanding of nature and to engage people of all ages in learning about birds and protecting the planet. The Cornell Lab of Ornithology uses science to understand the world, to find new ways to make conservation work, and to involve people who share their passion. The Cornell Lab's Citizen Science program offers an array of projects that engage thousands of people in recording bird observations—whether in backyards, city streets, or remote forests—to help researchers better understand birds and their responses to environmental change.

[birds.cornell.edu](http://birds.cornell.edu)



**SciGirls**

## Citizen Science Apps



### Active Explorer

Active Explorer, from the American Association for the Advancement of Science, lets educators create Quests that kids—or Explorers—join on their phones or tablets. Each Quest has a to-do list to guide Explorers as they collect images, video, audio, notes, and sketches, and then upload them to their Active Explorer web account. Later, they can go online to access everything they collected and use it to make fun SmartWork: comics, posters, ebooks and slide shows they can share with their friends and teachers.

[active-explorer.com](http://active-explorer.com)

### FieldScope

For over 125 years, National Geographic has explored and documented the farthest corners of the planet. FieldScope is an interactive mapping platform that extends the tools of exploration and investigation to everyday science enthusiasts. This digital tool enables citizen scientists to document and understand the world around them—in both indoor and outdoor settings. Projects currently in progress investigate topics such as water quality, phenology, and environmental restoration. More organizations are launching their citizen science projects in FieldScope, so check back often.

[education.nationalgeographic.com/education/programs/fieldscope/](http://education.nationalgeographic.com/education/programs/fieldscope/)

### Merlin Bird ID App

Everyone asks the question, “What is that bird?” The Cornell Lab of Ornithology's Merlin Bird ID app helps you find the answer. Merlin asks five fun and simple questions about the bird you saw, then presents a list of best matches based on your location and time of year to help solve your mystery bird sighting. Merlin can help you identify up to 400 bird species and provides more than 2,000 photos, 1,000 bird sounds, maps, and ID tips to explore. Download the free app to your iOS or Android device to take with you while you go bird watching!

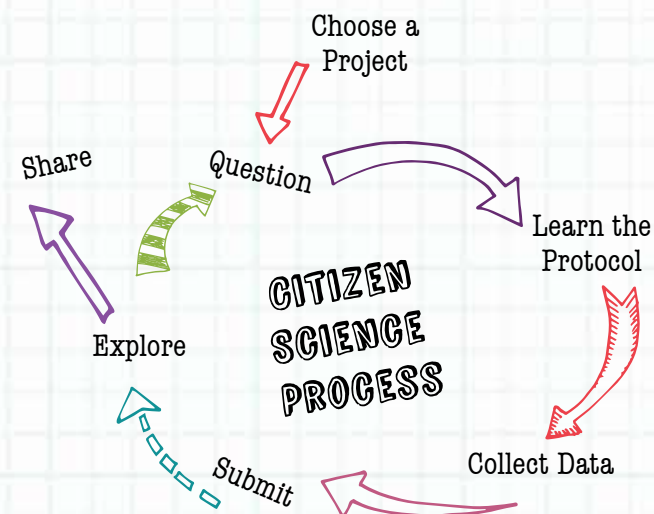
[merlin.allaboutbirds.org](http://merlin.allaboutbirds.org)





# Citizen Science Process

Here is the **SciGirls Citizen Science Process**. Use these helpful steps to engage your girls in citizen science projects.



**Choose a project.** Citizen science projects cover lots of content areas, ranging from animals and plants to natural phenomenon and human behavior. Choose a project that is age appropriate and connects to your girls' lives. You can find a project in this guide or go to [pbskids.org/scigirls](http://pbskids.org/scigirls) for more ideas.

**Question** When possible, use the project's research question to connect data collection to your girls' lives. Girls can also look at data that's already been collected for the project to brainstorm their own questions before beginning data collection.

**Learn the protocol.** Each citizen science project has a protocol. Some projects suggest

activities for learning the protocol, others assume you will learn the protocol as you collect data.

**Collect data.** Let the data collection begin! Encourage girls to make observations that go beyond the required data collection. Remember that although accuracy is important, girls should not be discouraged from participating for fear of making mistakes. Working in groups is a great way to improve data quality.

**Submit data.** Each citizen science project will have a way it wants participants to send in data. Most are through a website. Depending on the protocol, you might record one set of data for the whole group or different sets of data for each small group. This is a great opportunity for girls to take ownership of their data and enter it into the site themselves.

**Explore** For most projects girls will have the opportunity to explore their data in combination with data submitted by many other participants. They can use all the available data to answer their own questions about the organism or phenomenon they've observed.

**Share** Encourage girls to find ways to share what they learned doing the citizen science project. They may want to tell people about the answers they found to their questions, or share what it was like to collect the data.

Resource: Trautmann, N., Fee, J., Tomasek, T. Bergey, N. (2013). Citizen science: 15 lessons that bring biology to life 6-12. Arlington, VA: NSTA Press.

# Citizen Science Projects

## Additional kid-friendly citizen science projects:

**Community Collaborative Rain, Hail, and Snow Network (CoCoRaHS)**  
[cocoahs.org](http://cocoahs.org)

Provide high quality precipitation data for researchers by taking measurements when it rains, hails or snows.

**eBird**  
[ebird.org](http://ebird.org)

Collect observations of birds and submit them to one of the largest data resources in North America. Scientists use this data to understand bird distribution across the western hemisphere.

**Firefly Watch**  
[legacy.mos.org/fireflywatch](http://legacy.mos.org/fireflywatch)  
Not much is known about the ecological and human-made factors affecting firefly populations. Collect data about where fireflies are found and their activity to learn more about the effects of pesticides and light pollution.

**Floating Forests**  
[floatingforests.org](http://floatingforests.org)  
Scientists are trying to understand how kelp forests grow and change. Identify kelp forests using images taken from space.

**The GLOBE Program**  
[globe.gov](http://globe.gov)  
The GLOBE Program is a hands-on, primary and secondary school-based science and education program active in more than 100 countries around the world. GLOBE engages students in study and research about the dynamics of Earth's environment.

**Great Big Backyard Bird Count (GBBC)**  
[birds.audubon.org/great-backyard-bird-count](http://birds.audubon.org/great-backyard-bird-count)

This annual four-day bird-counting event gives researchers a snapshot of bird populations over a specific period of time. The data is used to understand how birds are doing and how to protect them.

**Great Sunflower Project**  
[greatsunflower.org](http://greatsunflower.org)  
Honeybee and native bee populations are in trouble and scientists are trying to figure out how this affects pollination of gardens, crops, and wild lands. Collect data on numbers and types of pollinators visiting plants (especially sunflowers).

**Journey North**  
[learner.org/jnorth](http://learner.org/jnorth)  
Track wildlife migration and seasonal change by recording sightings of birds, mammals, insects and plant phenophases.

**Lost Ladybug Project**  
[lostladybug.org](http://lostladybug.org)  
Across North America certain species of native ladybugs are disappearing. Catch, photograph, and submit images of ladybugs to help researchers find out where the ladybugs have gone and why.

**Migratory Dragonfly Partnership**  
[migratorydragonflypartnership.org](http://migratorydragonflypartnership.org)  
Dragonflies migrate in the spring and late summer/fall between Canada, the United States, Mexico, and the Caribbean. Collect data on presence, emergence and behaviors of five main species.

**Plankton Portal**  
[planktonportal.org](http://planktonportal.org)  
Without plankton there would be no life in the ocean. Identify different plankton species using digital images collected at different levels in the ocean.

**Project Budburst**  
[budburst.org](http://budburst.org)  
Monitor plants as seasons change, collecting data about when plants leaf, flower, and bear fruit. Scientists use this data to learn more about how individual plants respond to changes in climate locally, regionally and nationally.

**Project FeederWatch**  
[feederwatch.org](http://feederwatch.org)  
Scientists track large-scale movements of winter bird populations and look for long-term trends in bird distribution and abundance. Count the birds that visit winter feeders in backyards, nature centers and community areas.

**Project Squirrel**  
[projectsquirrel.org](http://projectsquirrel.org)  
Monitor grey and fox squirrel populations. Squirrels are important indicators of local ecology and tracking them can help scientists understand the environmental conditions and predator populations that affect neighborhood wildlife.

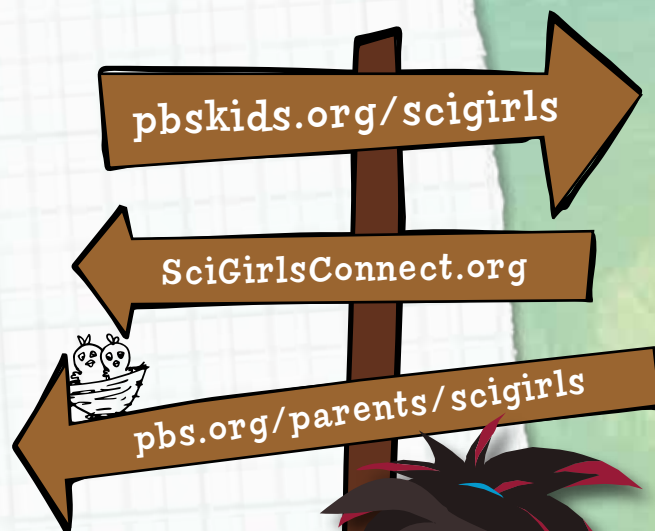
**School of Ants**  
[schoolofants.org](http://schoolofants.org)  
Scientists are interested in the presence of native and non-native ants in urban areas. Make a kit for collecting ants and submit your sample for analysis.

**WhaleFM (Whale Song Project)**  
[whale.fm](http://whale.fm)  
Listen to and compare killer and pilot whale calls to help categorize them. This work helps scientists begin to understand what whales are saying.

**YardMap**  
[content.yardmap.org](http://content.yardmap.org)  
Draw a map of local landscapes (backyard, park, farm, school, garden) to help scientists gain a richer understanding of bird habitat.



# Grow your programs with **SciGirls!**



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