

SciGirls

pbskidsgo.org/scigirls



SciGirls Go Green Activity Guide



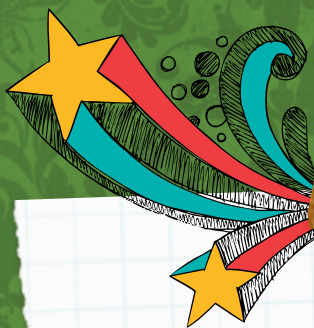
Izzie



Watch companion videos on
Season 1 DVD or online.



ExxonMobil



Going Green, SciGirls Style

Environmentalism is a hot topic these days—especially with kids, who recognize the urgency and importance of the issue. The activities in this booklet are designed to have high appeal for girls and give them hands-on experience with environmentally focused projects. They are based on the PBS Kids television series, **SciGirls**, which features groups of middle school girls modeling authentic girl-friendly approaches to inquiry-based STEM (science, technology, engineering, and math) investigations.

You'll notice these activities:

- follow the Scientific Inquiry Process (outlined on page 2),
- incorporate the **SciGirls Seven** strategies for engaging girls in STEM (outlined on page 3),
- connect to **SciGirls** videos and mentors from the show, and
- align to national standards.

All activities can be used alone, but we encourage you to enhance your girls' experience by using **SciGirls** videos to inspire them and fuel discussion. Then, take your activities to the next level by logging on to the **SciGirls** website at pbskidsgo.org/scigirls. Your girls can create their own profiles and share their investigations with the online community!

Remember, as a leader, you don't need to be an environmental expert, just a capable tour guide who offers exposure and a supportive environment. But keep in mind that with many open-ended activities we recommend a little prep time, which will help you understand the struggles your girls may face.

We hope you enjoy guiding your group as they "go green" with STEM.

Table of Contents

SciGirls Want to Know:
Scientific Inquiry Process 2

The SciGirls Seven: Strategies
for Engaging Girls in STEM 3

Activities

1. Sink or Swim? 4
2. Light Bulb Challenge 6
3. Going Green 8
4. Star Power 11

Standards Correlation 14



©2010 Twin Cities Public Television, Inc. All Rights Reserved. SciGirls, Izzie, associated characters and related logos and indicia are copyright and trademarks/service marks of Twin Cities Public Television, Inc.

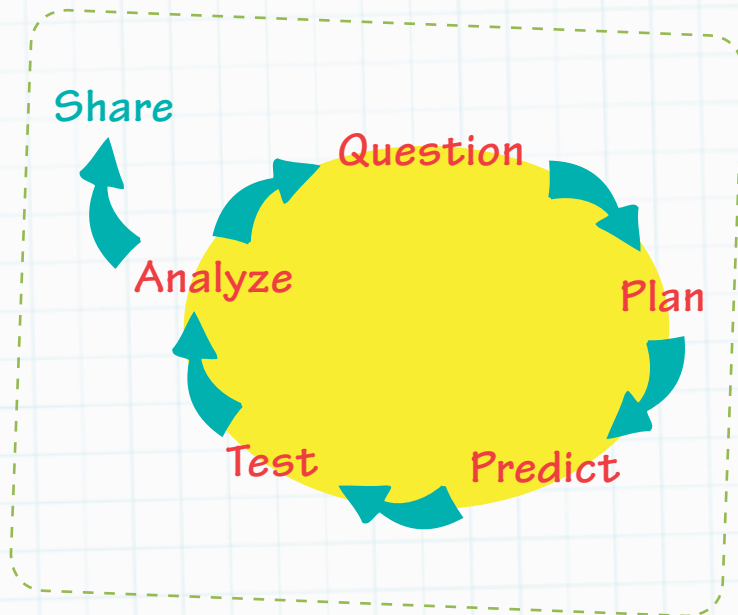
Visit pbskidsgo.org/scigirls for videos and projects!



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 calculate averages, 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.



Throughout this guide, the projector points you to videos on the companion DVD. Or you can watch online at pbs.org/teachers/scigirls.



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 pbs.org/teachers/scigirls.

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.

Visit pbs.org/teachers/scigirls for more activities!

SciGirls



Activity 1

Sink or Swim?

IDENTIFY THE DIFFERENT PLASTICS IN A MYSTERY BAG.

Plastics are everywhere: from cars to drinking bottles to sports equipment. Each plastic is chemically unique and has distinct properties that make it suitable for certain products. Plastics are classified #1 through #7. To find out what type of plastic a product is made from, check the bottom of the object and locate the number inside the recycle symbol. Even though some recycling centers only accept certain numbers, all plastics with this symbol are recyclable. Markets just don't exist for all recycled products.



You'll Need:

For the mystery bag:

- ◆ #1 plastic (clear bottle, e.g., soda, water, mouthwash, or salad dressing bottle)
- ◆ #2 plastic (opaque bottle, e.g., milk, orange juice, shampoo, or lotion bottle)
- ◆ #4 plastic (lightweight bag, e.g., bread, sandwich, and some grocery bags)
- ◆ #5 plastic (tub, e.g., yogurt, cottage cheese, or margarine container)
- ◆ #6 plastic (e.g., Styrofoam products, disposable plates and cups, plastic utensils)
- ◆ scissors
- ◆ sandwich or paper lunch bag (1 per small group)

45 min.

For each small group:

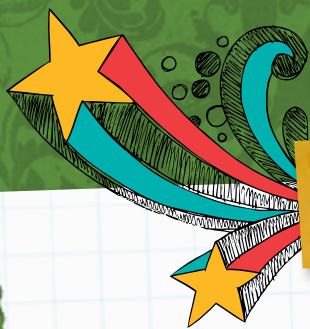
- ◆ plastic containers girls bring from home
- ◆ small, clear container
- ◆ water
- ◆ paper and pencils
- ◆ scissors

SMART START: The day before, you will need to do two things:

- ★ Prepare "mystery bags" for each small group. Find samples of #1, #2, #4, #5, and #6 plastics and cut them into small pieces (about 1 to 2 in.). If the plastics are not easily distinguishable by sight, cut them into different shapes. For example, cut a #1 plastic into squares, a #2 into triangles.

Make a key that identifies each plastic by its number. Then place a mixture of all types into a bag for each group.

- ★ Ask girls to try and find one example of each type of plastic container at home.² Then, clean and bring in examples to share. Plastics with #3 (e.g., PVC pipe) and #7 (e.g., computer cases or sport water bottles) can be hard to find. Explain that this activity focuses on plastics #1, #2, #4, #5, and #6.



Sink or Swim? continued

Here's how:

1. Introduce plastics. Ask girls to name as many things as they can that are made of plastic. Are all plastics the same? How are they different?

2. Collect data. Ask girls to break into small groups ¹ and sort the plastic bottles and containers they brought in according to their numbers. Then, ask them to brainstorm different physical properties that are characteristic of each type of plastic and test them. ³ Here are some examples:

★ **Density** Does the plastic float or sink in water? (This test requires water, a clear container, and scissors. Cut plastics into pieces before dunking in water—#2, #4, and #5 float while #1 and #6 sink.)

★ **Transparency** Is the plastic clear or opaque? Or in-between?

★ **Luster** Is the plastic dull or shiny?

★ **Brittleness** Does the plastic break when bent?

★ **Rigidity** Is the plastic flexible or tough?

3. Classify plastics. Ask each group to make a table of the physical properties of each type of

plastic. They will use this table to classify the plastic pieces in the mystery bag.

4. Identify mystery plastics. Put the bottles and containers away. Hand a mystery bag to each group and present the **SciGirls Challenge**: Identify the different plastics in your mystery bag by their physical properties. Can they assign a number to each sample? Once a group is finished, the girls can check their predictions with the key.

5. Share. Bring the girls back into a large group and discuss how they knew which plastic was which. ⁶ Why might a company choose one type of plastic over another? (durability, contact with food, ability to stack for shipping) How might recycling centers use these properties to sort plastics? Suggest girls research what products each type of plastic can be recycled into!

To see what SciGirls learned when they visited a recycling center, watch the *SciGirls Go Green* DVD. (Select Going Green: Research.)



To learn more about the numbers found in the recycle symbol, watch the *SciGirls Go Green* DVD. (Select Going Green: Mentor Moment.) ⁷



Mentor Moment

Alexis Clark is a chemical engineer who works for General Mills. She designs food packaging for products like yogurt and thinks about design considerations such as: weight, durability, stacking, and consumer appeal. She has always been interested in the food industry and likes that she has an effect on how consumers view the products we buy on store shelves.

Visit pbskids.org/scigirls for videos and projects!

Activity 2

Light Bulb Challenge



PUT THE LIGHT BULBS IN YOUR HOUSE TO THE TEST.

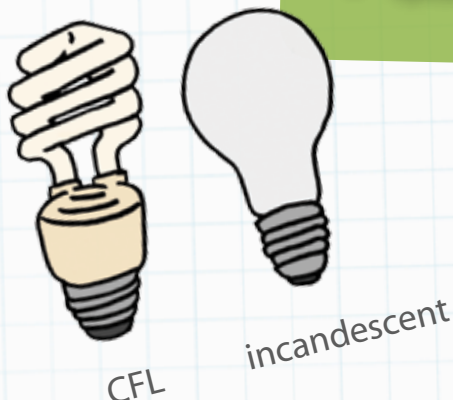
Ever wonder if those funny looking compact fluorescent light (CFL) bulbs are really worth it? Traditionally, incandescent bulbs have been used to light our homes and schools, but they are not very energy efficient. Why? Some of the electricity used is lost to heat. Let your girls see firsthand the difference between the two types of bulbs (see below) and encourage them to make the switch!



SMART START: Set up three stations ahead of time. Either post instructions at the stations, or explain to the girls what to do.

Here's how:

- 1. Question.** Ask your girls to break into small groups,¹ and deliver the **SciGirls Challenge:** Are incandescent or compact fluorescent light bulbs more energy efficient? Brainstorm ways to test this before rotating through each station.³ The activities can be done in any order.



You'll Need:

For Station 1:

- ◆ incandescent bulb, any wattage
- ◆ 1 desk lamp, shade included
- ◆ 1 tbsp. cooking oil
- ◆ 1 dropper
- ◆ half-sheets of plain paper (1 per small group)
- ◆ ruler
- ◆ 2 books of equal thickness
- ◆ stopwatch or clock
- ◆ paper and pencils
- ◆ optional: thermometer

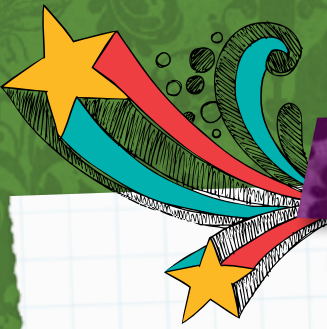


For Station 2:

Same items as Station 1, but substitute a compact fluorescent light (CFL) bulb for the incandescent bulb. Be sure to choose two bulbs with equivalent light outputs. (For example, a 15-watt CFL is equivalent to a 60-watt incandescent.)

For Station 3:

- ◆ paper and pencils
- ◆ optional: calculator



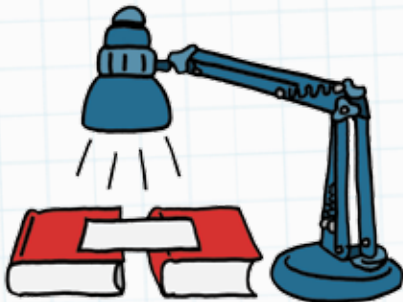
Light Bulb Challenge continued

Station 1: Measure the heat output of an incandescent bulb. Have girls perform these steps:

- ★ Make a bridge with a half-sheet of paper and books and place the lamp about 6 in. from the paper. (See below.)
- ★ Place 1 drop of oil on the paper and *quickly* measure the initial diameter of the oil circle.
- ★ Turn on the lamp and observe for 5 min.
- ★ Measure the diameter again (quickly!), record the results, and calculate the difference.

Station 2: Measure the heat output of a CFL bulb.

Have the girls repeat the experiment in Station 1, but substitute a CFL for the incandescent bulb.



POINTER: To better understand the heat output from each bulb and its effects on the oil, have girls hold a thermometer about 1 in. from each bulb for 1 min. and record the temperatures, or hold their hand under the bulb for a few seconds and talk about what they felt. ⁶

Station 3: Calculate the amount of energy used.

Present the following word problem: "When your neighbors go on vacation, they set a timer to turn on a lamp at 9 p.m. each night and turn it off at 6 a.m. each morning. How much energy would this light use in two weeks if it used an incandescent bulb? If it used a CFL bulb?" ²

$$\text{hours of use} \times \frac{\text{wattage of bulb}}{1000} = \text{energy used (kilowatt-hours [kWh])}$$

First, find the total hours the light is on during the two-week period.

$$9 \text{ hours/day} \times 14 \text{ days} = 126 \text{ hours}$$

Then, find the energy used by each bulb.

Incandescent bulb:

$$126 \text{ hours} \times \frac{60 \text{ Watts}}{1000} = 8 \text{ kWh}$$

CFL bulb:

$$126 \text{ hours} \times \frac{15 \text{ Watts}}{1000} = 2 \text{ kWh}$$

- 2. Share.** Reconvene the entire group to discuss results. How do the findings from each station compare? (Incandescent bulbs give off more heat than CFLs, causing the oil to spread farther. They also require more energy because some of the energy is lost to heat.)

Adapted from: Little, Diane "Investigating CFLs and Incandescent Light Bulbs." Sustainable and Renewable Energy Fund, PA. 2008.

Activity 3

Going Green



2 hours

MAKE A PLAN TO REDUCE WASTE IN YOUR AREA.

Most people don't think about what happens to the trash they throw away. Unfortunately, garbage doesn't just disappear once it goes into a garbage can. Paying attention to what actually *is* garbage helps us be more efficient at reducing waste so we don't needlessly send everything to landfills.

Here's how:

1. Tackle a real-world problem. Introduce the **SciGirls Challenge:** Conduct a waste audit (e.g., at your school, community center, home, or other institution) and use your findings to implement a plan for reducing trash. ²

To see girls tackle the trash in their school, watch the *SciGirls Go Green* DVD. (Select *Going Green: Identify the Problem.*)

2. Select a site. If you choose your school, for instance, collect all the cafeteria's garbage for one day. Make sure you get permission as needed (e.g., from the principal) before digging in!

3. Research. If appropriate, coordinate with the custodial staff to learn trash collection times and plan accordingly. You want to make sure there is garbage in the bags when you pick them up! Get a copy of local recycling guidelines so you know what should and should not be in the trash.

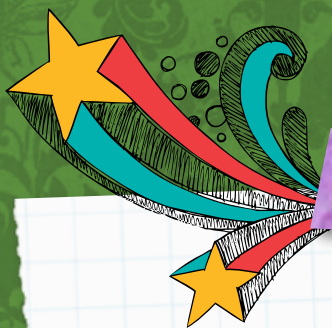
You'll Need:

- ♦ garbage
- ♦ safety glasses (for each girl)
- ♦ plastic or rubber gloves (for each girl)
- ♦ large plastic tarp (or equivalent)
- ♦ area to dump the waste (ideally, outside)
- ♦ pole or stick (to prevent any injury due to broken glass or sharp items in the trash)
- ♦ garbage bags
- ♦ paper and pencil
- ♦ optional: several buckets of varying volumes (e.g., 5 gallon bucket, 2.5 gallon kitchen bucket), bathroom scale

4. Plan. Have girls brainstorm questions they want to answer through this investigation. (e.g., What percentage of the total waste could have been recycled?) Now have them figure out the tasks necessary to answer their question. ⁴ For example, they'll need to decide how to measure the waste (by weight, volume, or visual estimate) and what tools they'll need to do so. They'll want to measure the total amount of trash first, sort the trash, measure each type, and record their data.

To gather some sorting ideas, watch the *SciGirls Go Green* DVD. (Select *Going Green: Classify.*)





Going Green continued

Here are some ways girls might decide to measure the trash:

- ★ **Weight** Use a bathroom scale to weigh each trash bag and record the results. If the bag is not stable on the scale, weigh a garbage can alone first, and then weigh the can filled with trash. Subtract the weight of the can from the total weight to find how much the trash weighs.
- ★ **Volume** Estimate the volume by comparing the trash to known volumes, such as a 5-gallon bucket.
- ★ **Percent** Visually eye the volume of each type of trash. If the total amount collected is 100%, girls can guesstimate the percent of each type of waste.

- 5. Divvy up tasks.** You may want to assign small groups specific tasks (e.g., collecting trash, weighing trash, estimating volume, recording data, sorting garbage) or let girls designate tasks based on their plan.⁴

Do not sort bathroom or health room waste. Wear close-toed shoes, gloves, and safety glasses.



- 6. Start the Sort!** First, have girls measure the total amount of garbage using the method they've determined. Then, have the girls empty the trash onto a tarp and begin sorting into piles (e.g., cardboard, food waste, plastics—see table below).

Type of Material	% by Volume (estimate)	Compostable?	Recyclable?	Trash?
Cardboard/paper (with food waste)	10%	X		
Cardboard/paper (clean)	10%		X	
Aluminum cans	5%		X	
Food waste	20%	X		
Glass	10%		X	
Plastics	40%		X (some)	
Other	5%			X

Going Green continued

POINTER: As the sorting progresses, encourage girls to take the experiment in any direction they like and research.³ For example, they may wonder why some cardboard can be recycled and others cannot, or why only some plastics can be recycled. (Cardboard containing food, such as a pizza box, cannot be recycled, but could be composted. In many areas, #5 plastics aren't recycled, not because they can't be, but because there is no market for the recycled products made from them.)

7. Calculate. Now ask girls to measure each type of waste and compile their data in a table. Which type of waste makes up most of the trash? Using their initial measurements, ask girls to figure out what percentage of the total each type represents. Plastics (although very light) take up a lot of space in a waste sort and in a landfill!

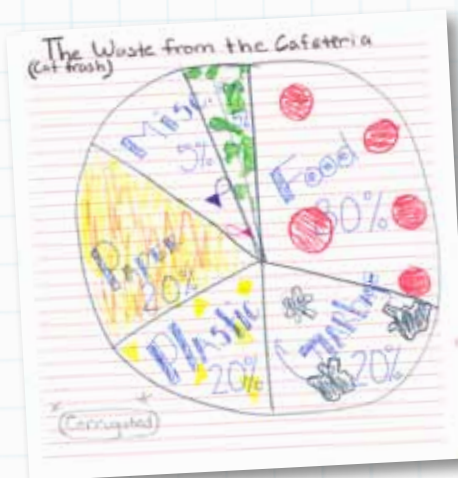
Share your results with other girls on our website, at pbskidsgo.org/scigirls.

8. Clean up. Ask the girls to return non-recyclables to garbage cans, sort recyclables into recycling bins, and compost perishables, if possible. They'll need to wash the tarp and buckets and sweep the floor. Don't let them forget to wash their hands.

9. Share. Have girls make a presentation of the data. Be creative!⁴ (See right.) Were

there items that could have been recycled, composted, or simply reused instead of thrown away? Have kids brainstorm ideas about what they could do to reduce the amount of waste at their site.^{2,4} (clearly mark all recycling bins, place recycling bins near trash cans, make posters of what can and cannot be recycled) The girls may decide to reuse waste to create a new product.

To see how SciGirls reused yogurt cups, watch the *SciGirls Go Green* DVD. (Select Going Green: Prototype.)



10. Continue exploring. Reward girls' efforts⁵ and encourage them to implement their waste reduction plan and then conduct another waste sort one month later. (You may need to obtain permission or discuss ideas with appropriate authorities.) Did anything change?



Activity 4

Star Power

CREATE A STAR SHOW AND LEARN HOW YOU CAN PREVENT LIGHT POLLUTION.

The stars in the night sky have fascinated humans since we first walked the Earth. But today, electric outdoor lighting threatens our ability to see the stars. Light pollution is a real problem, and not just for astronomers. Animals become disoriented from the excess lights, which can disrupt their mating, migration, and predation behaviors. For example, sea turtle hatchlings follow light from the moon to find their way to the ocean, but coastline lighting can lure them toward roads and predators.

Part 1 Design a Constellation Box

Here's how:

1. Introduce constellations. Ask girls to name their favorite constellations. (Use books or the Internet for help.) Do they know what each constellation represents and the myths associated with it? (Constellation myths are stories that try to explain how stars and their positions in the sky came to be.) Share the myth about your own favorite constellation with your girls. ²

2. Prep the constellation box. Break into small groups. ¹ Each group gets one box, which needs to be completely enclosed. If using a shoe box, they should tape the lid on tight. If using a rectangular tissue box, they should cut a piece of paperboard (e.g.,

You'll Need:

- ♦ room that can be darkened
- ♦ 1 desk lamp with lamp shade removed

Part 1 (for each small group):

- ♦ shoe box (the narrow, skinny kind is best), or rectangular tissue box and extra paperboard (e.g., cereal box)
- ♦ 3"x5" index card
- ♦ tape (duct or masking)
- ♦ scissors
- ♦ pushpin
- ♦ LED keychain flashlight
- ♦ optional: book that contains drawings of constellations, construction paper, glue, markers, crayons, colored pencils

Part 2 (for each small group):

- ♦ aluminum foil
- ♦ paperboard (e.g., cereal boxes)
- ♦ tape (duct or masking)
- ♦ scissors

2 hours



from a cereal box) and tape it over the opening. Then girls should cut a hole—just big enough to fit the LED flashlight—in the center of one of the small ends of the box.



hole for
LED flashlight

Visit pbs.org/teachers/scigirls for more activities!

SciGirls



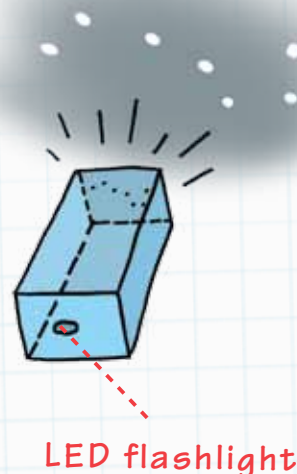
Star Power continued



3. Choose a constellation. Ask each group to choose one constellation to display with their constellation box. Guide each group to choose a different constellation so you have a variety to display.

4. Make a constellation template. Have groups sketch their constellation on an index card, and then use a pushpin to poke the stars of the constellation in the card. Now, flip the card over, so girls are looking at the **mirror image** of the constellation.

5. Use the template to poke holes in the constellation box. Have girls tape the card over the other small end of the box and use a pushpin to poke the stars of the **mirror image** of the constellation in the box. Otherwise, it will project backward! (See right.) Groups can now remove the card. Girls who finish early can decorate their constellation box with images depicting their myth.

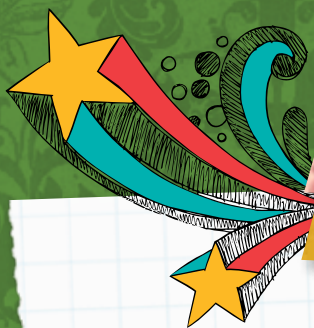


6. Display constellations. Hand out an LED flashlight to each group. Remind girls not to shine the light in anyone's eyes! One girl in each group should insert the flashlight into the hole at the end of the box. Then turn out the lights in the room, and tell the girls to aim the constellations at the ceiling or a wall. They can experiment with holding the box at different distances. Have each group shine its constellation one at a time and share what it represents and its myth.⁴

Watch girls learn how to monitor light pollution by becoming a citizen scientist on the *SciGirls Go Green* DVD. (Select Going Green: Mentor Moment.)⁷



Mentor Moment Gurtina Besla is working on her PhD in astrophysics at Harvard. For the past several years, she has been a mentor for the Science Club for Girls in Boston, MA, guiding girls from elementary through middle school on various STEM-ventures! She is excited to pursue a career in which she gets to study how galaxies evolve and teach students about space science.



Star Power continued

Part 2 Prevent Light Pollution

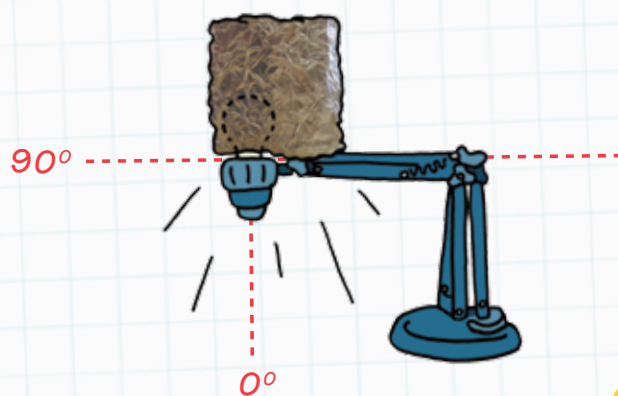
7. Introduce light pollution. Light pollution is light that is not doing what, or directed where, it should be. Can girls think of situations in which light would be considered a pollutant? (light preventing the viewing of stars, shining into a window and on a property, or creating an uncomfortable glare) Ask how this light might be harmful. (wastes energy and money, makes nighttime environments less safe, interrupts sleep, interferes with behavior of nocturnal animals) ²

8. Demonstrate light pollution. Place a desk lamp on a table in the center of the room and aim the bulb toward the ceiling. Before you turn on the lamp, spread out the constellation boxes, having some girls stand near the lamp and some far away. Tell kids the lamp represents city light. (Areas close represent the city and areas farther away represent suburban and rural areas.) Turn on the lamp. What happened to the constellations? Can you see the constellations in each of the areas? Why or why not?

To see girls look for good and bad lighting in their community, watch the *SciGirls Go Green* DVD. (Select Star Power: Observe.)

9. Experiment with light direction. Ask girls to consider the direction in which the light is shining. What effect does this have on the ground? Have a few girls sit underneath the lamp, and ask the others how well can they see their friends. How shadowy do they look? Would this kind of lighting make the night more or less safe?


10. Build a light shield. Deliver the **SciGirls Challenge**: How can you shield a light to reduce light pollution and increase visibility of constellations? Pass out the supplies for Part 2 and let each group brainstorm ways to redirect the light coming from this streetlight in the "city" to where it would be most useful. ³ Guide them toward building a shield that can go over the light bulb. (Shielded light should not extend past a 90-degree angle.)




Use aluminum foil to cover the paperboard light shield before placing it over the lamp bulb.



Star Power continued



POINTER: If girls are struggling, encourage everyone to share their creations. Then, point out the unique features of each groups' design. Emphasize that even working scientists and engineers struggle when designing something new! ⁶



Watch girls build a light shield on the *SciGirls Go Green* DVD. (Select Star Power: Design.) ⁷

11. Demonstrate a light shield. Shine the constellations on the ceiling, and hold each group's shield over the lamp. What do the "stars" look like now? Have a few girls sit underneath the lamp again. How visible are they now? Ask girls to come up with other ideas to reduce light pollution (timers, dimmers, motion sensors). ⁶

12. Keep going. Take a walk around your building or neighborhood to examine the light fixtures. ² (look at the type of bulb, how long they are left on, and if they are shielded.)

Take pictures and post them on your **SciGirls** project page at pbskids.org/scigirls/!



Your group can also become citizen scientists, just like the SciGirls! For more information on participating in the Great World Wide Star Count, visit windows2universe.org/citizen_science/starcount.

This activity was adapted from the Dark Skies Awareness Rangers Program. For more investigations to try with your girls, check out darkskiesawareness.org/DarkSkiesRangers.

Standards Correlation

The activities in this book align to national education standards including: Standards for Technological Literacy, National Science Education Standards and the National Council of Teachers of Mathematics Standards. To download the complete and most current alignments, please visit pbs.org/teachers/scigirls.



Join the SciGirls Revolution
at pbskidsgo.org/scigirls



SciGirls®



Be a
SciGirl!



Create a profile and
make new friends!



Share cool science
projects and learn what
other girls are doing.

Watch real SciGirls go on
STEM-ventures online
and on PBS stations!



Going Green



Star Power



Underwater
Eco-Adventure



Collect all the SciGirls
Educator Resources.

SciGirls is produced for PBS by tpt National Productions
and is made possible by the National Science Foundation.
Additional support by ExxonMobil.



ExxonMobil