The bold goal of SciGirls is to change how millions of girls think about science, technology, engineering, and math—or STEM. Research shows that, for a variety of reasons, some girls begin to lose interest (and confidence in their abilities) in math and science in middle school. SciGirls engages girls between 8 and 13 years old, helping them through these challenging tween years to arrive in high school with a positive attitude toward STEM studies and careers.

We know our recipe works: SciGirls grew from our successful outreach program, established in 2005. Today we partner with museums, schools, universities, the Girl Scouts of the USA, the National Girls Collaborative Project, and afterschool programs, offering training, videos, and multilingual activities. And the SciGirls model is flexible. Partner organizations tailor these offerings specifically for the girls (and boys) in their communities.

So, who exactly are SciGirls? SciGirls are curious about how the world works and empowered to investigate it. SciGirls use their brain power to solve real-life problems, often with help from mentors and their friends. SciGirls find STEM in the most unexpected places, such as in their backyards, at the theater, or on the beach, because they know that STEM isn’t just serious business, it’s also everyday fun.

Most importantly, every girl can be a SciGirl. SciGirls is not only for girls who already “get” STEM, but also for those who are reluctant to dive in. A background in STEM teaches important problem-solving skills and a way to think that is transferable to any field and any career. All girls can conquer the fear factor and become confident, capable explorers of all things STEM. It’s the SciGirls way!
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## Our National Girls Collaborative Project Partners

Thank you for your interest in engaging girls in STEM. Did you know that there’s an extensive network of organizations and individuals committed to pursuing this common goal? The National Girls Collaborative Project brings together these groups through local collaboratives and their program directory, which helps organizations and individuals network, share resources, find programs, and collaborate on STEM-related projects for girls. You can list your program at [ngcproject.org/programs](http://ngcproject.org/programs). All programs in the NCGP directory are also featured on the SciGirls website at [pbskids.org/scigirls/find-a-science-club](http://pbskids.org/scigirls/find-a-science-club).
SciGirls airs nationally on PBS, the most trusted media brand for children. Each half-hour SciGirls episode follows a different group of enthusiastic, real girls, who collaborate, communicate, engineer, and discover. They’re accompanied by two animated characters, a determined SciGirl named Izzie and her best friend Jake, who tie the series together with their ongoing adventures.

The backbone of each SciGirls episode is the science, technology, engineering, and math that drive each project. We focus on the process, not the end result. Every experiment may not turn out perfectly, but each episode showcases important characteristics of a STEM project: teamwork, challenges, problem solving, freedom to express ideas, and support from a mentor. We also model important process skills as girls brainstorm, predict, observe, measure, classify, experiment, record, interpret, graph, communicate, and try again. These skills are at the heart of both the scientific and engineering design processes.

Izzie also stars as the webmaster of the SciGirls website, hosted on pbskids.org, one of the premier educational destinations for young people on the Web. This site is a unique and safe science-centric social network where girls can connect, create personal profiles and avatars, share projects, play games, and watch every episode. Check us out at pbskids.org/scigirls.

SciGirls offers parents and educators resources to support girls, start SciGirls clubs, or enhance existing educational initiatives. The SciGirls CONNECT outreach program empowers informal and formal educators nationwide to adopt the research-based strategies that best engage girls in STEM. For more information, check out these sites: SciGirls CONNECT at scigirlsconnect.org; PBS Parents at pbs.org/parents/scigirls; and PBS LearningMedia at pbslearningmedia.org.

Visit pbskids.org/scigirls for videos and projects.
The Big Idea
What the Research Shows

Even though young girls and boys sit side by side in educational settings all across the country, women are much less likely to choose careers in science and engineering (S&E) than men. Although the number of women in STEM fields has increased tremendously over the past half-century, it still is not keeping pace with the rising demand for skilled workers in these areas.

Over the past 10 years, growth in STEM jobs was three times as fast as growth in non-STEM jobs. Between the years 2008 to 2018, STEM occupations are projected to grow by 17.0 percent compared to 9.8 percent growth for non-STEM occupations and STEM workers earn 26 percent more than their non-STEM counterparts (U.S. Department of Commerce, 2011). Although women make up about half the total U.S. college-educated workforce, they represented only 26% of the college-educated workforce in S&E occupations in 2008 (National Science Board, 2012). The simple truth is that Americans cannot remain competitive in STEM fields without more women entering these careers. The graph below shows the number of women who were employed in selected STEM professions in 2011.

Women in Selected STEM Occupations, 2011


Supported by:

PPG Industries Foundation

NSF FOR GIRLS IN SCIENCE Foundation
While women are making gains in some fields, the careers in which women are advancing are not the ones in which demand is growing the most. Approximately 58% of the projected increase in S&E jobs is in computers and math (NSB, 2012). But in 2011, the percentage of jobs held by women in computer science was only 26%. Many people argue that encouraging women and minorities in these fields will ultimately improve these professions, maximizing innovation to create products and services that are better representative of all users (Hill, Corbett, & St. Rose, 2010).

But the problem begins even earlier. The graph to the right shows the number of bachelor’s degrees earned by women and men in S&E fields in 2010. Women have steadily increased their numbers in some areas of science, including social and biological sciences, but they are still lagging behind in areas such as physics, computer science, and engineering.
To prepare our girls for the 21st century workforce, it is crucial to reverse these trends. First, it is important to recognize that girls and boys do not display a significant difference in their abilities in math and science. The cause for the gender gap in STEM achievement is social and environmental (Hill et al., 2010). Where gender differences consistently appear is in boys’ and girls’ interest and confidence in STEM subjects, starting at a very young age. For girls, this can be linked to a negative self-perception (Halpern et al., 2007). A study by the National Science Foundation in 2003 showed that in grades 4, 8, and 12, females were less likely than their male counterparts to agree with the statements, “I am good at math” and “I am good at science” (National Science Foundation, 2003). Ultimately, these viewpoints matter. If girls do not believe they are capable, they are unlikely to succeed. While the gender gap in STEM interest had remained relatively steady over the past two decades, it is now increasing at a significant rate. Male students are over three times more likely to be interested in STEM majors and careers, compared to female students (My College Options & STEMconnector, 2013).

This is where SciGirls can help. It is important to spark and strengthen girls’ interest and confidence in STEM subjects before high school, when academic choices will either open or close doors to postsecondary STEM studies and careers (Halpern et al., 2007). The SciGirls videos, combined with our gender-sensitive, inquiry-based activities and a community-focused website, can foster girls’ interest in STEM and shape their attitudes toward these fields. At the same time, SciGirls resources can advance gender sensitivity among educators. With this awareness, educators can recognize and avoid the unconscious behaviors that often contribute to STEM-focused climates that are unfavorable for girls.

**Meeting the Challenge**

We know that eliminating the gender gap is challenging work. It is difficult to convince administrators, parents, or fellow staff of the importance of this mission. For help beyond the research outlined here, please see our suggested readings on page 18. Your efforts will not only help girls, but will improve the general climate in your educational setting and level the playing field for all learners.

For more information on the importance of STEM encouragement and for tips on how you can help, please see pbs.org/parents/scigirls/tips.
The SciGirls approach—for the TV show, website, and educational materials—is rooted in research about 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. We call these strategies the SciGirls Seven.

1. **Girls benefit from collaboration, especially when they can participate and communicate fairly.** *(Parker & Rennie, 2002; Scantlebury & Baker, 2007; Werner & Denner, 2009)*

Girls are energized by the social part of science—working and learning together. Provide opportunities for small group work, and encourage girls to talk about their ideas and consider all possibilities before digging in. Make sure discussions remain respectful and inclusive, and that each girl’s contributions are valued. Girls are likely to remember not only what they learned, but also how they felt when they learned it.

> “Whenever you come together with a team, you can find the answer to any question.”

Josie, age 12

2. **Girls are motivated by projects they find personally relevant and meaningful.** *(Liston, Peterson & Ragan, 2008, Lyon & Jafri, 2010; Mosatche, Matloff-Nieves, Kekelis, & Lawner, 2013; Patrick, Mantzicopoulos, & Samarapungavan, 2009; Thompson & Windschitl, 2005)*

Girls become motivated when they feel their project or task is important and can make a difference. Support them using STEM as a tool to explore issues or topics they care about. If they see how STEM is relevant to their own lives and interests, their attraction to these subjects is likely to increase.

3. **Girls enjoy hands-on, open-ended projects and investigations.** *(Chatman, Nielsen, Strauss & Tanner, 2008; Denner & Werner, 2007)*

SciGirls promotes exploration, imagination, and invention. Encourage your girls to ask questions and find their own paths for investigation.

For more information, go to scigirlsconnect.org
4. **Girls are motivated when they can approach projects in their own way, applying their creativity, unique talents, and preferred learning styles.** (Calabrese Barton et al., 2013; Calabrese Barton, Tan, & Rivet, 2008; Eisenhart & Finkel, 1998; Lyon & Jafri, 2010)

Encourage girls to develop their own ways of exploring and sharing knowledge, paying attention to the unique learning styles that motivate your group. You may be surprised by what creative, exciting approaches girls come up with when designing investigations, collecting data, and communicating results.

5. **Girls’ confidence and performance improves in response to specific, positive feedback on things they can control—such as effort, strategies, and behaviors.** (Blackwell, Trzesniewski, & Dweck, 2007; Dweck, 2000; Halpern et al., 2007; Kim et al., 2007; Mueller & Dweck, 1998)

Self-confidence can make or break girls’ interest in STEM. Foster their efforts, compliment their strategies for problem solving, and let them know their skills can be improved through practice. Celebrate the struggle. Wrestling with problems and having experiments fail is a normal part of the scientific process!

6. **Girls gain confidence and trust in their own reasoning when encouraged to think critically.** (Chatman, Nielsen, Strauss & Tanner, 2008; Eisenhart & Finkel, 1998; Kim et al., 2007)

Cultivate an environment in which asking questions and creative thinking are a must. Throughout the centuries, this same trust in logic and re-examination of ideas made advances in science, technology, and engineering possible.

7. **Girls benefit from relationships with role models and mentors.** (Holmes, Redmond, Thomas, & High, 2012; Liston, Peterson & Ragan, 2008; Lyon & Jafri, 2010; Mosatche et al., 2013; Weber, 2011)

Seeing women who have succeeded in STEM helps inspire and motivate girls, especially when they can relate to these role models as people with lives outside of the lab. Role models and mentors not only broaden girls’ views of who does science, but expand girls’ vision of what’s possible in their own lives.
In the next several pages, we offer practical tips for implementing the SciGirls Seven. Please note that for an activity to be a gender-equitable success, you do not need to incorporate all seven strategies. Practice introducing one or two different techniques each time you do an activity and discover what works best for your group.

1. **Girls benefit from collaboration, especially when they can participate and communicate fairly.**

   - **Create a community atmosphere that is open and positive.** Start with activities to “break the ice,” involving communication and teamwork for girls who may not know one another.

### Icebreaker: Who Am I?

Pin the name of an animal, planet, or female scientist to the back of each girl. Girls must try to guess who they are by asking one question at a time to others in the room. Allow 10 minutes for girls to wander the group asking questions. The answers will help them discover the secret identities written on their backs.

- **Encourage working in small groups.** Keep in mind that kids should be grouped with different members from time to time.

  - Small groups generally consist of members with assigned roles (e.g., recorder, supplies manager, procedure/time manager). This approach can help motivate participants, but be mindful of stereotypical gender roles, such as girls recording and boys using tools.

- **Speak up promptly if someone makes a distasteful remark, even jokingly.** Set the rules at the start: no teasing or unfriendly talk. Explain why a comment is offensive or insensitive. If conflicts arise, resolve them through group (or pair) dynamics, in which each person voices what they think happened and how it made them feel. Then work on agreement and resolution.

Visit pbskids.org/scigirls for videos and projects.
Girls are motivated by projects they find personally relevant and meaningful.

- Look for ways to connect the material to the girls’ lives. If you are teaching an environmental studies lesson, for instance, ask the girls to identify examples of environmental issues in the area where they live and bring information to share from articles in local magazines, newspapers, videos, etc.

- Demonstrate and talk about your own enthusiasm for the scientific material, and how it affects you personally. Enthusiasm is contagious!

- Create a “need to know.” As you are preparing your activities, ask yourself—why would kids need to know this?

  > Ask girls to prepare a table of their thoughts, including: what they know, want to know, have learned, and how they can learn more. Use this in groups or individually as a tool for tapping into prior knowledge and encouraging personal reflection.

- Use case studies. Kids generally relate to characters who face decisions or dilemmas; they often make connections from the story to their own lives. Using SciGirls videos, as suggested throughout our companion activity guides, provides one avenue to accomplish this. Ask girls if they have ever felt like the girls in the video, or ask what similarities they may have seen between themselves and the SciGirls. Visit scigirlsconnect.org for videos and activities.

- Use follow-up prompts that focus girls’ attention on ideas or assumptions embedded in their first answers. These prompts can help them explore and express what they know even when they aren’t sure they know it. For example:

  - then what?
  - Tell me more.
  - Could you give me an example?
3. **Girls enjoy hands-on, open-ended projects and investigations.**

- **Try an activity without step-by-step directions.** Don’t shortchange your girls by assuming they can’t do an investigation without prescribed directions. Release their inner explorers and let them surprise you!

- **Pose questions using “what” or “how.”** Instead of, “Is noise considered a pollutant?” try, “How can you test whether noise is a pollutant?”

- **Resist the urge to intervene.** Practice this by keeping your hands in your pockets throughout the activity.

- **Encourage girls to suggest approaches to a problem.** Instead of swooping in to rescue them, encourage girls to problem solve by identifying, drawing, or labeling things they do understand.

- **Resist answering the question, “Is this right?”** Highlight unexpected results and suggest ways for girls to investigate further by asking, “How could we figure that out?” or, “What do you think?”

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**Use Think-Pair-Share!**

If girls are struggling, ask them to take a moment and **think** about the question first and then write down their ideas. Next, have girls **pair** up and discuss. Finally, invite pairs to **share** their ideas with the larger group.
4. Girls are motivated when they can approach projects in their own way, applying their creativity, unique talents, and preferred learning styles.

Act as a facilitator rather than as a leader or expert. Encourage groups to share their plans with you, but emphasize that everyone is learning and discovering together.

Let girls communicate their findings using a variety of techniques relevant to their lives: poetry, music, posters, plays, slideshows, 2D- and 3D-models, drawings, etc.

🌟 Have your girls create their own project pages at pbskids.org/scigirls.

Use your girls’ language to reiterate their points. Use a board or large sheet of paper to document each person’s participation.

🌟 Write the idea as you hear it—don’t reword unless you have permission from the speaker.
🌟 When meanings are unclear, restate what the girls said in their own words first, and then ask them to expand on their thinking with, “Tell me more” or, “What makes you think that?”

Ask girls to write personal narratives relating to a particular time or place and share these in small or large groups.

🌟 A journal or blog (for older girls) provides an avenue for reflection on learning.
Girls’ confidence and performance improves in response to specific, positive feedback on things they can control—such as effort, strategies, and behaviors.

- **Reward success publicly and immediately.** Focus on specific contributions such as, “You were really thinking outside the box with that design” or, “I love the way you and Kate worked together to solve that problem.”

- **Avoid statements such as, “You are really good at this!”** They send the message that success comes naturally and doesn’t require effort or struggle.

- **Convey the same level of respect for and confidence in the abilities of all your girls.** Introduce girls to the good work done by their peers. Share the ideas, knowledge, and accomplishments of individuals with the group as a whole.

- **Let a girl know you believe she can improve and succeed over time.** When you identify a child’s weakness, make it clear that your comments relate to a particular task or performance, not to the child as a person. The brain is a “muscle” that can get stronger with time; skills can be improved with practice.

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Someone said to me recently, “In your culture, struggle is a bad word,” and I thought... “That’s right.” We talk about it as an unfortunate thing, but when you think about a career in science or math or anything, of course you struggle. That’s the name of the game! If you’re going to discover something new or invent something new, it’s a struggle. So I encourage educators to celebrate that, to say: “Who had a fantastic struggle? Tell me about your struggle!”

Carol Dweck, professor of social psychology, Stanford University
6. Girls gain confidence and trust in their own reasoning when encouraged to think critically.

- Support an environment free of “instant answers.” By working through a problem, girls will experience a sense of achievement and confidence that will increase their motivation to learn. When you simply give kids the solution, you rob them of the chance to think for themselves.

  - Address girls’ anxiety about not getting the answer by refocusing their attention on the problem at hand. Build on what they do know to move forward.

- Think like scientists and engineers. It is okay to make mistakes; there is more than one way to solve a problem. Experimentation may never lead to an answer, but rather to new questions. Practice developing alternative explanations for results.

- Meet a question quota. Insist on each girl asking a certain number of questions each day.

- It’s okay to disagree. Stress the importance of considering different approaches and viewpoints.

  - When disagreements arise, allow each girl to voice her viewpoint while all others listen and record the main points. Remind girls of the importance of using solid evidence when making a claim. Consensus may be difficult and perhaps unnecessary, but listening to one another is important.

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My mother made me a scientist without ever intending to. Every other Jewish mother in Brooklyn would ask her child after school, “So? Did you learn anything today?” But not my mother. “Izzy,” she would say, “did you ask a good question today?” That difference—asking good questions—made me become a scientist.

Isidor Isaac Rabi, winner of the Nobel Prize in Physics, 1944

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- PPG Industries Foundation
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For Girls in Science: 2014
7. Girls benefit from relationships with role models and mentors.

- **Invite guest speakers**, who work on the subjects you are studying at all levels, including high school, undergraduate, and graduate students, along with professional scientists.

- Probe visitors to describe what their work looks like along with how they identify and ask questions, answer them, and share information with others.

- Remind them to talk about their hobbies, interests, family and life outside of the lab.

- Share the **SciGirls Role Model Strategies** to help them prepare for the event. Download this resource at scigirlsconnect.org/page/role-models.

- **Invite guest scientists to help lead an activity.** If you are unsure of their comfort level working with children, pair them with other educators or leaders. The experience will be valuable for both the students and the scientists!

- **If you can’t get someone live, show videos.** Use **SciGirls** episodes to showcase peers as mentors. Or checkout our female scientist profiles and mentor moments at scigirlsconnect.org.

- **Encourage mentor pairings** for individual efforts such as science fair projects.

The FabFems directory is a national database of women in STEM professions who are inspiring role models for young women. The FabFems directory is accessible to young women, girl-serving STEM programs, and other organizations that are working to increase career awareness and interest in STEM. Search for role models, or become a FabFem, by visiting fabfems.org.

For more information, go to scigirlsconnect.org.
Pages 16 and 17 show how to take traditional science or engineering activities and apply the SciGirls Seven, making subtle shifts in how the activities are presented. In these examples, we model incorporating a few strategies at a time. (Refer to pages 7 and 8 for full explanations of each strategy.) You can do the same with your activities and watch your girls’ confidence soar!

**Miniature Hovercraft**

**Supplies for each group**

- an empty thread spool
- a 4-inch square of cardboard
- white glue, or a hot-glue gun
- a sharpened pencil
- a balloon (12 inch, when inflated)

1) Glue the bottom of the empty spool to the center of the cardboard square.

2) Use the sharpened pencil to punch a hole in the cardboard that lines up with the center of the spool.

3) Blow up the balloon. Hold the bottom without tying it.

4) Get your partner to hold the spool for you. While pinching the neck of the balloon, stretch the bottom over the top of the spool, release the neck, and lift off!

5) Experiment with different sizes and shapes of cardboard to get the best hover out of your balloon hovercraft. Give your hovercraft a shove along a smooth tabletop, and see how far it goes.

**Strategy 3**

Have a table full of additional supplies to promote creative solutions to the hovercraft design: old CDs, water bottle caps of various shapes and sizes, an assortment of tape, scissors, push pins, paperboard cereal boxes, etc.

**Strategy 4**

Ask girls to write a story, poem, or song describing how hovercrafts are used to rescue families or animals in flooded coastal areas or along rivers.

**Strategy 6**

Once hovercrafts have been constructed and tested, change the focus from “best hover” to fastest craft, farthest hover, or maneuverability/steering through a course. Ask girls to redesign their craft to meet the new challenge.

**Strategy 7**

Invite a rescue worker who may use hovercrafts or an engineer who designs them.
What’s in an Owl Pellet?

Supplies for each group

• a commercially prepared owl pellet
• a magnifying glass
• tweezers
• 2 sheets of white office paper
• a bone identification chart of small rodent skeletons
• non-latex gloves

1) Practice excellent hygiene when handling the owl pellets. Keep hands away from eyes, nose, and mouth.

2) Carefully unwrap the owl pellet from its foil. Gently break it apart by hand.

3) Sift through the pellet, looking for bone pieces. Most pellets contain recognizable skull, jaw, leg, or rib bones from small rodents, such as a mouse or a vole. Use tweezers to remove bones from the pellet debris.

4) Lay out each bone on a clean sheet of white paper.

5) Count the number of bones in the pellet, and identify each by matching it to one on the chart.

6) Try laying the bones out in a rough skeleton arrangement. Parts of the skeleton may be missing; discuss why that might be.

7) Wash hands thoroughly when finished.

Strategy 1
Distribute only one glove per person. This not only saves on gloves, it encourages cooperation. One girl utilizes tweezers while the second holds the pellet.

Strategy 2
Talk about the types of owls that live in your area. Or, create a story emphasizing the importance of studying owl pellets. For example, “You’re a veterinarian. A man brings in his pet owl, who got sick from something it ate the night before. By identifying the ingredients of the owl’s last meal, you can help it recover.”

Strategy 5
Some girls may be “grossed out” by owl pellets. Encourage them to participate by handling the pellet before dissection or picking up the bones to identify them after dissection. Patience with squeamish girls can empower them to get closer to the pellets. Offer words of praise, even for small steps toward participation.

Strategy 7
Invite a mentor from a nearby raptor center to bring a live owl and discuss its role in the food chain. Or take a field trip!
References and Readings

= suggested readings


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Every girl can be a SciGirl!

Kids
pbskids.org/scigirls

Parents
pbs.org/parents/scigirls
Learn more about how to encourage your daughter in STEM!

Educators
scigirlsconnect.org
Find educational resources: videos, hands-on activities, and the best in gender equitable STEM teaching and learning!

Download Activity Guides in English and Spanish at scigirlsconnect.org