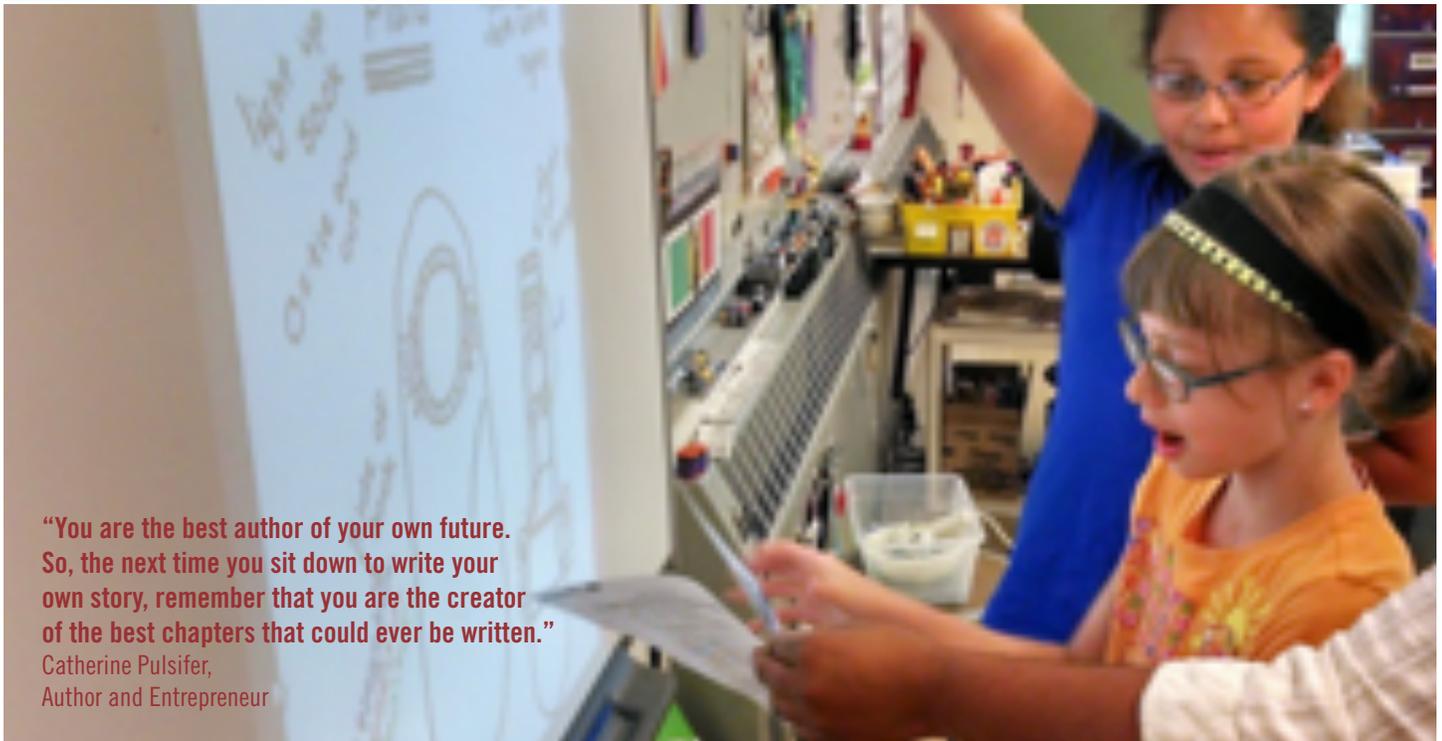


CHAPTER 3

I AM SHAPING MY FUTURE



“You are the best author of your own future. So, the next time you sit down to write your own story, remember that you are the creator of the best chapters that could ever be written.”

Catherine Pulsifer,
Author and Entrepreneur

Violeta García, PhD
Patty Kincaid

As girls move from being children to becoming teenagers, a space commonly referred to as the tween years, they face challenges that may not have been evident in earlier years. The transitions during these years can cause girls to feel a sense of isolation. Tweens seek autonomy, yet they have a need to belong, to be part of something greater than themselves. Having a sense of belonging can instill confidence, motivation, and lead to current and future success. The critical tween years are the time for girls to begin to shape their future. Caregivers and educators can build ecosystems that foster opportunities to expose girls to STEM experiences where they can

learn skills that will help them solve problems and plant the seed for them to start thinking about the contributions they can make in the world. This can set the foundation for the mark they would like to leave behind.

In U.S. mainstream culture, it has been said that, “We raise girls to be perfect, and raise boys to be brave.”¹ What if we—parents and caregivers, educators, and community organizations—change this quest for perfection and instead build a solid foundation for girls to be able to take risks, to fail, to get back up again, and to take pride in the work they do?



By 13 years of age, many girls decide whether or not to pursue STEM career pathways. This is a critical age at which girls' self-confidence in STEM concepts and skills may waver, leading girls to self-select out of these areas because of a perceived inability to succeed.² Therefore, helping girls foster an identity focusing on strategies where they get to see themselves as scientists³ or as engineers, and as people who are capable of creating technology⁴ is essential to improve women's representation in STEM.

Though many of the resources cited in prior chapters are applicable to female students ages 11-13, many of the possible issues they and others perceive, as well as the realities in pursuing and succeeding in STEM-related learning, take on new importance. In 2007, the National Science Foundation Press released a piece titled "[Back to School: Five Myths about Girls and Science](#)."⁵ Many of the myths, like girls being less interested in science than boys when they start school (when the reality is that in elementary school about as many girls as boys have positive attitudes toward science), still resonate today for educators, parents, caregivers, communities, industry, and the public in general. Such misconceptions can block girls from becoming more deeply engaged in STEM.

OUTCOMES BY AGE 13

As girls, including girls from diverse backgrounds who have been historically under-represented in STEM, reach 13 years of age they are prepared in STEM. They:

- Continue to experience design thinking and come up with their own applications
- Design their own investigations focused on questions they care about
- Explore careers in STEM
- Continue to be inspired by STEM
- Understand connections between STEM concepts and other disciplines
- Develop proficiency in foundational STEM skills

WHAT DO STEM OPPORTUNITIES LOOK LIKE FOR GIRLS AGES 11-13?

STEM opportunities can vary widely. Some schools may offer STEM programs and distinguish themselves as problem-based learning (PBL) schools or innovation schools that focus on sustainability, while others may embrace experiential learning or Outward Bound-type principles as the means to integrate STEM learning. STEM opportunities may not always be labeled with the STEM acronym. For example, if a library has a makerspace, this can be considered a STEM space, too. You can read about the Preston Middle School Media Center Makerspace in Box 3.1.

BOX 3.1. IN THE SPOTLIGHT:

PRESTON MS MEDIA CENTER MakerSpace

The Preston Media Center MakerSpace, located in Fort Collins, invites students and staff to tinker, create, prototype, explore, build, and have fun. The MakerSpace offers a variety of activities: 3D printing, soldering, using the Oculus Rift, coding with Arduinos, creating vinyl art with a Cricut, creating digital painting, and designing and creating origami. In addition, there are many literary sources (magazines, books, blogs, printed articles) provided to increase STEM literacy, entrepreneurial thinking, and the love of reading. The MakerSpace offers a friendly environment before, during, and after school explicitly designed to welcome girls and under-represented populations in STEM. It is a safe place for all to learn, collaborate, and make new things, including friends.

To learn more about Preston Middle School and their STEM efforts visit:

<https://pre.pedschools.org/>

To learn more about their signature summer STEM Institutes program visit:

<http://www.steminstitutes.org/>

To learn more about their annual educator symposium visit:

<http://www.stemsymposium.org/>



If you and the girls in your life do not have access to opportunities to learn how to become a scientist, engineer, tech professional, or how to apply math in these contexts, we encourage you to create your own STEM spaces. STEM can be found in everyday moments. You can help girls design their own opportunities. Girls and their families can start at home, using the ideas in the following Try This! box, and then create community spaces so other girls can benefit from these experiences. STEM opportunities can also be offered through [afterschool](#)⁶ or summer programming. In any case, if students have the opportunity to design, make, create, experiment, and they are learning about and applying STEM concepts, they are experiencing STEM learning. Maker experiences that connect to solving problems at school or in their communities are even more engaging for girls. The work needs to be engaging at different levels, from basic curiosity to solving a problem or dealing with an issue that makes their community better. This approach gets girls interested in STEM and keeps them engaged.

Educators looking to explore more ways to keep girls curious can visit [Practice Brief 35: How can I foster curiosity and learning in my classroom? Through talk!](#) The [STEM Teaching Tools](#)⁷ website provides many great briefs on different aspects of STEM teaching and learning.



TRY THIS!

- ❑ Design a makerspace at home, in your classroom, in your community, or in all three! A makerspace can be as simple as a table with a storage bin. Find materials such as scissors, screwdrivers, glue gun, nails, hammer, and other basic tools to put things together and to take them apart. You can also include tools such as soldering irons and 3D printers. They can be helpful, but are not necessarily essential. Let your girl tinker, build, design, and showcase her work.
- ❑ Invite a STEM speaker to your school or library. You can contact STEM employers in your community to request a speaker or you can tap into our nation's resources. For example, your organization can request speakers from [Jet Propulsion Laboratory NASA](#). There are travel costs associated if you want to invite one of the STEM professionals or astronauts to your local site. There are also local professional societies such as the [Society of Women Engineers](#) and the [Society of Hispanic Professional Engineers](#) or the [Colorado Association of Black Professional Engineers and Scientists](#) that can help your organization identify a speaker near you.
- ❑ Meet a scientist virtually. The Denver Museum of Nature and Science (DMNS) also has a [Scientists in Action](#) program that gives students the chance to meet scientists and ask them questions.
- ❑ Take girls on a field study. You can take them to a local cultural organization such as [DMNS](#), [Denver Zoo](#), [Denver Botanic Gardens](#), or [Wings Over the Rockies Air and Space Museum](#). Many organizations have funds available for schools with high populations of students on free or reduced lunch. If you are limited by transportation, several organizations may have the resources to bring programming to your school. Use the school grounds, local parks, natural areas, and community spaces as sites for field studies.
- ❑ Create a space to post STEM programs available in afterschool settings or during the summer. Reach out to students who may need more information or support to access these opportunities.
- ❑ Connect with organizations such as [AAUW Girls in STEM](#) or [Pretty Brainy](#) (see Box 3.2) to explore mentoring opportunities.



Not all STEM experiences are created equal. Programs that place students at the center of the experience, where girls can do hands-on activities and investigate issues that inspire them, where educators are passionate about the work they do and link classroom experiences to learning beyond the classroom walls into the community, tend to be very successful at engaging, motivating, and preparing girls to continue their interest in STEM. Take a closer look at Pretty Brainy in Fort Collins, Colorado and how their program integrates art into the STEM experience to foster curiosity and creativity for innovation (Box 3.2).

BOX 3.2. IN THE SPOTLIGHT:

PRETTY BRAINY: EMPOWERING GIRLS TO GAIN STEAM

The science of electricity. Soldering. Helping her community. This is what Madeleine loved about spending Fridays with Pretty Brainy. Pretty Brainy empowers girls like Madeleine to gain STEAM — science, tech, engineering, art, and math — so they are equipped to pursue their highest ambitions and richly contribute to their communities and world.

Pretty Brainy designs innovative learning in which girls gain the experience and confidence to continue to study science and math and make informed decisions about the broadest of career options. The organization works with schools and nonprofits to provide STEAM enrichment, as well as to reinforce common core standards in the classroom.

Pretty Brainy respects girls as the problem solvers, thinkers, and decision makers that they are and we value their interests in philanthropy, making, and design. Through Pretty Brainy, girls have learned, for example, engineering design thinking to stop adolescent self-harm, increase runner safety on the roads, and find their authentic voice.

“I hope other girls my age get this amazing opportunity to participate in this awesome program. I have learned so much and helped my community while doing it. I want to thank everyone who is helping me want to become an engineer.”

See <http://prettybrainy.com> for information on how the organization supports educators, as well as girls.

Pretty Brainy
Empowering Girls to Gain STEAM™



“Pretty Brainy has been amazing. I could not think of a better way to spend my Friday nights.”

— Madeleine, age 13

Design thinking, a concept introduced in Chapter 2, is an approach mentioned by Pretty Brainy to solve real-world problems relevant to girls' communities. This methodology is a good way to capture students' attention and helps them develop authentic solutions to improve their communities.



IN WHAT WAYS CAN GIRLS 11-13 YEARS USE DESIGN THINKING? HOW CAN THEY COME UP WITH THEIR OWN APPLICATIONS?

Design thinking is an approach that helps students explore problems by putting the user at the center of the problem and at the core of the solution design. Inspiration comes from the desire to solve the problem posed by the user by carrying out a systematic, but not necessarily linear, process that includes the following stages: empathize, define, ideate, prototype, and test. This differs slightly from the science process where question development is inspired from observation, curiosity, or personal motivation, which may or may not include the end user as a core entity. Science is not meant to be learned through cookbook recipes and students benefit from learning science as a process with constant iterations, re-dos, and changes in design. Learn more at [How Science Works](#).⁸

In design thinking, the facilitator may initially pose problems or challenges to help the team understand the design process. Once learners are familiar with design thinking, they can find problems that they are interested in solving and that are relevant to their lives. Problems can range in scope and complexity. Sometimes, the facilitator may limit the range or problems that

students can pursue to make sure they focus on the concepts and skills applicable to their grade level. Other times, students may be free to explore more open-ended interests. Read more about an educator's personal journey using design thinking in the classroom in this Edutopia post on [Empowering Students with Design Thinking](#).⁹ It is important to note that pursuing inquiry in the classroom or in any learning space does not mean "without guidance."¹⁰ If students do not know where to find information, saying, "Don't ask me, figure it out," might be a source of frustration for students and they may or may not figure it out in the end. Facilitators of learning probe with questions and try to get at where the student is and where they need to go next in their exploration or design.

One way to apply design thinking is through problem-based learning (PBL) opportunities at school or in their local communities. When girls see themselves as problem solvers, their identities as creators and critical thinkers are reinforced. These are essential skills that will serve them well as they enter and persist in STEM pathways. Girls can be a vital part of defining problems of relevance to their communities and be recognized as problem solvers. You can read more about schools promoting design thinking and problem-based learning as part of the

BOX 3.3. IN THE SPOTLIGHT:

STEMinspired

STEMinspired (www.steminspired.org) is a nationwide network of K-12 schools, universities, and industry partners. The network originated in 2010 in Adams 12 Five Star Schools in Thornton, CO with the opening of STEM Magnet Lab K-8, and grew as a K-12 continuum with STEM pathways at Northglenn High School STEM and the addition of STEM Launch K-8 in 2012. Working in partnership with the community, STEMinspired fosters risk-taking, resilience, entrepreneurial identities, and growth mindsets through collaboration and stewardship.



As designers, entrepreneurs, and inventors who also happen to be educators, the network approaches its work as a start-up enterprise. STEMinspired's mission is to build bridges between K-12 education, higher education, and industry to change the STEM landscape.

STEMinspired works to create shifts in thinking - so that students become job creators, not just the workforce. Eighth grade students complete ten-hour internships through EPIC (Exploring Possibilities through Internship and Choice). After completing career surveys, planning with counselors, and exploring STEM careers using Couragion (<http://www.couragion.com/>), students experience work in STEM fields that will change the course of both their economic and academic trajectories. These valuable experiences enable girls to create opportunities for themselves as they explore career pathways and build relationships with mentors.

Several of STEMinspired's female science and engineering teachers left industry careers to inspire young women to enter STEM pathways, serving as mentors to many of the female students in the classroom and in afterschool enrichment programming. In partnership with the Colorado BioScience Institute, teachers further their training and expertise in STEM fields as participants in the Research Experience for Teachers (RET) Program. Immersing themselves in STEM-based, industry-relevant projects for several weeks anchors teachers in the professional work of STEMinspired's partners, and helps them bring current knowledge and research to students in the classroom.

Besides recognizing girls as makers and problem solvers, educators can also provide opportunities for girls to be recognized by their peers and their parents/caregivers as people who solve problems, who do science, and who can communicate effectively with various constituencies. Events such as [Girls in Science](#) at the Denver Museum of Nature and Science help caregivers see the potential in their girls as future STEM professionals. At this event, girls visit various clubhouses hosted by STEM professionals. Another event that focuses on 6th and 7th grade girls is GESTEM (Girls Exploring Science, Technology, Engineering, Math) hosted by the Society of Women Engineers (SWE). This event attracts

more than 1,200 girls; read more about it at this [link](#).¹¹

When their peers and the community recognize girls as creators and innovators, girls see themselves as experts and embrace their own ability to do science, to solve engineering or tech challenges, and to apply mathematics to solve problems (see Box 3.4). Educators can increase the

visibility of the work happening in their classes by inviting girls to enter local, [regional](#),¹² or [state science fairs](#),¹³ or through national competitions such as the [Google Science Fair](#).¹⁴ Some schools celebrate successes, such as a Science Bowl Championship, with a public event like a Parade of Champions to recognize participants' accomplishments.

BOX 3.4. IN THE SPOTLIGHT:

STEM Leadership Academy, Walking Mountains

STEM Leadership Academy (SLA) is Walking Mountain Science Center's (WMSC) after-school program that provides integrated STEM lessons. Utilizing an inquiry approach, students explore through innovative lessons inspired by student interest, Next Generation Science Standards, and Colorado Mathematics Standards. The SLA seeks to inspire the future of STEM innovators by providing youth access to and confidence in STEM topics. The program is offered to 6th, 7th, and 8th grade students and utilizes the following to prepare girls to pursue STEM careers:

Meaningful Objectives: Some girls hold a mistaken belief that STEM work is not tied to everyday life. In Girls in STEM, which nurtures 3rd, 4th, and 5th grade girls' interests in STEM, and SLA, Walking Mountains chooses topics that are meaningful to girls and that the lessons accomplish a purpose that girls recognize as worthy of their time and efforts. Girls want to see that their efforts are helping others, too.

Collaboration: Research shows that girls prefer STEM work when they are able to work in collaboration with each other. WMSC prioritizes group work. It builds confidence and creates a positive work environment associated with STEM disciplines.

Role Models: Research from several disciplines suggests that the presence of female peers, teachers, etc. increases female retention in STEM fields. WMSC has created an after-school program that provides female youth opportunities to interact not only with female teachers as role models in STEM education, but also guest presenters and video clips of women in STEM professions. This is as an extremely important aspect in inspiring young girls to be motivated in STEM.

Breaking Down Stereotypes: Research shows that the mere existence of negative stereotypes can hinder the academic performance of an individual. WMSC works to break down these stereotypes by creating opportunities for girls to find success in STEM subjects.

Curriculum units focus on topics that are STEM-related and engage students in relevant content. WMSC uses the 5-E model in lesson design, which is a constructivist approach. In and of itself, this approach to lesson design allows for the students to “construct” their own knowledge. They engage in making their own observations, asking questions, and coming to their own conclusions. This ensures that the topics remain interesting and relevant to students.

Learn more at <http://www.walkingmountains.org/programs>.



BOX 3.5. IN THE SPOTLIGHT:

Work Gone WILD (8th Grade - High School)

Work Gone WILD is a new model to introduce youth to careers that support environmental stewardship in partnership with the Colorado Alliance for Environmental Education, the Colorado Youth Corps Association, and Goodwill Industries of Denver. The program takes participants on a series of field trips to visit different natural resource agencies, organizations, and higher education institutions to learn about career paths and engage in hands-on activities that build relevant job skills. Throughout the experience, participants interact with 50 professionals in natural resources from 25 different organizations and agencies. Each day includes skill-building activities to "try on" jobs, activities to build job-related skills, and awareness building activities.



Learn more at

<https://www.caee.org/workgonewild>.

HOW CAN GIRLS DESIGN THEIR OWN INVESTIGATIONS AND PURSUE QUESTIONS THAT THEY CARE ABOUT?

Educators and community organizations can hook girls into STEM learning by giving girls the chance to work on projects of interest to them. Have girls look at the world around them. What problems do they see? What problems would they want to solve? What questions do they want to answer? What do they want to learn more about? How can they improve something in their environment to make it better?

You can use Activity 3.1 to get girls thinking about their world, the questions that spark their interest, and the problems they would like to solve. Help them develop an action plan to get started. Remind them that it is okay to start even

if they don't have all the answers or the details; after all, investigating is exactly that—searching for information.



ACTIVITY 3.1:

Problems, Passions, Or Something You Are Curious About

1. What are you passionate about? What do you love to do?

.....
.....

2. What is one problem that you see in the world?

.....
.....

3. If you could improve something about what you listed above, what would it be?

.....
.....

4. What do you wonder about?

.....
.....

5. How do you plan to investigate or solve this question or problem? (Briefly outline your action plan.)

.....
.....

Once girls identify a question or an area of interest, they can conduct research to find out how others have studied the question or topic. Engineers define problems and design solutions; scientists develop questions with variables that can be tested.¹⁵ They also formulate hypotheses that are based on prior research. These types of questions have components called dependent and independent variables. There are also questions that focus on simple observation or comparison. These are also important to science because they set a foundation to ask deeper questions about the natural world. Many programs in Colorado provide opportunities for middle school girls to conduct research investigations. One example is El Espejo Girls Outdoor Adventure Camp, featured in Box 3.6.

BOX 3.6. IN THE SPOTLIGHT:

Middle School Girls As Researchers

El Espejo Girls Outdoor Adventure Camp in Greeley, CO

El Espejo, which takes its name from the Spanish word for mirror, is a summer science research program for girls in which girls get to see themselves as scientists. During the program, girls experience what it is like to be a scientist through different activities and projects at the [Poudre Learning Center](#) (PLC). During the weeklong program, they also have the opportunity to do their own research investigation in small teams. The PLC provides transportation from any of the middle schools in Greeley to the program. There is a fee to participate, and scholarships are provided for students who seek financial assistance.



Opportunities that inspire girls to ask their own questions help to develop a sense of confidence that is oftentimes lacking in a tween's experience. When girls are able to see themselves as researchers, their STEM persona or STEM identity further develops.¹⁶ The more opportunities that girls have to experience this sense of self-worth, the more resilient they will become, making them less vulnerable to future setbacks in their path towards pursuing STEM careers.

WHAT STRATEGIES CAN BE USED TO CONTINUE TO INSPIRE GIRLS IN STEM?

Organizations such as Walking Mountains Science Center (Box 3.4) and Girls Inc. of Metro Denver (Box 3.7) work hard to design inclusive spaces for girls. Their strategies include offering opportunities to see the value of STEM disciplines, emphasizing the importance of working together, connecting girls with role models, defying stereotypes, developing relevant content, and providing specialized training for staff who will be working with girls. It is very important to train staff who will be working with girls and girls of color to create awareness of biases and to tackle stereotypes associated with STEM professionals, so that they can help girls see themselves in those roles. Additionally, we need to recognize that we cannot make girls fit into STEM, but rather, we need to create inclusive spaces where STEM fits the girl.

BOX 3.7. IN THE SPOTLIGHT:

Girls Inc. Of Metro Denver (GIMD)

GIMD's Staff and Volunteer Training

Girls Inc. of Metro Denver creates trusting mentoring relationships with adult staff and volunteers who are trained in an approach that is grounded in a belief in girls' rights and abilities. Each new program instructor participates in at least 40 hours of training on best practice approaches in youth development.



Training Objectives:

- Bolster understanding of the Girls Inc. mission
- Build knowledge and skills around interactive lesson planning, engaging facilitation, and effective evaluation
- Increase the expertise of staff in youth development
- Increase the knowledge and expertise of participants in developing a Girls Inc. experience with impact
- Provide experiences, tools, and resources to build engaging and interactive programming

Each year, returning staff continue their professional development in training workshops that enhance their knowledge of youth development. In addition to staff, volunteers who regularly work with girls receive eight hours of training in developmental stages of girls, discipline methods based in positive reinforcement, anti-oppression and inclusiveness, and how to inspire and empower girls. The [Girls Inc. National Research Resource Center](#) provides a broader accessibility to training opportunities and resources via face-to-face and multimedia-based distributed learning to enhance the quality of programming, support programming outcomes for girls, and build organizational capacity.

About Girls Inc. of Metro Denver

Girls Inc. of Metro Denver's mission is to inspire all girls to be strong, smart, and bold. In 32 years, the organization has served over 35,000 girls with comprehensive programs and life-changing experiences that address the unique issues girls face. At Girls Inc., girls have access to the tools and support to succeed, including trained professionals who mentor and guide them in a safe, girls-only environment, peers who share their drive and aspirations, and research-based programming. Girls learn to set and achieve goals, boldly confront challenges, resist peer pressure, see college as attainable, and explore nontraditional fields such as Science, Technology, Engineering, and Math. Girls Inc. of Metro Denver is an affiliate of the national Girls Incorporated organization.

To learn more about Girls Inc. of Metro Denver's program, visit www.girlsincdenver.org.



Girls need to meet women who work as STEM professionals to defy the stereotypes or misconceptions they may have about STEM professionals. STEM professionals also need to tell girls about their interesting jobs, and connect with girls at a personal level to inspire them to continue their journey in STEM. SciGirls has put together a great [resource](#)¹⁷ to help role models connect with girls in this age group.



WHAT CAREER EXPLORATION TOOLS ARE AVAILABLE FOR GIRLS AGES 11-13?

Girls can begin to learn about STEM careers by meeting professionals in these fields and asking them about their personal and professional journey. These stories can help them determine what careers they want to learn more about. Keep in mind that technology is changing so quickly that the careers that girls in this age band will pursue may not yet exist. Entrepreneurial skills and 21st-century skills will be essential in the pathways they choose to follow.

In Colorado, all students must develop an Individual Career and Academic Plan ([ICAP](#)) starting as early as 6th grade. Parents/caregivers should become familiar with what the process entails. Even if ICAP is not offered in early grades (6th – 8th) at your school, caregivers and parents can help their girls learn about career options so they are better informed once the time comes to explore different pathways. There are several strategies that educators or community organizations can use to help parents/caregivers learn more about STEM careers and how exciting they can be.

TRY THIS!

- ❑ Invite girls and their parents to STEM events. Even though girls may think it is totally uncool to have their parents at these types of events, it is critical that adults see their girls as people who immerse themselves in science, and as people who develop solutions as future STEM professionals.
- ❑ Check out community STEM opportunities. The Denver Museum of Nature and Science offers a Girls in Science Day and Boulder and Fort Collins residents can visit Expanding your Horizons (see Box 3.9). You can also find other local STEM events at [The Connector](#).

EXPOSE GIRLS TO STEM PROFESSIONALS

When girls are exposed to women STEM professionals, they may learn that STEM professionals love to solve problems. They may also learn that many STEM professionals work in teams. Oftentimes, people working in STEM careers have a big project to tackle, and everyone takes a piece of the project, or multiple people collaborate on one aspect of the project. Girls will see that the problems they solve make a difference in our daily lives, covering everything from transportation, to clean water, to creating apps, or studying ecosystems. Sometimes, STEM professionals work alone and contribute their work to a larger problem. STEM professionals may also work in places such as banks or other finance companies and apply their skills to solve big problems using a lot of math and asking good questions.

Girls can meet STEM professionals in the community or they can visit companies that might give tours to show the work that happens

there. In these tours, they may see STEM professionals designing new products, working to improve the human condition, or helping other species on our planet. To learn more about STEM careers, visit [ScienceBuddies](#) or [WeUseMath.org](#). You can also view episodes of [SciGirls](#) (see Box 2.9 in Chapter 2) and pay attention to the mentors who help the girls figure out their projects. SciGirls has also developed role model [profiles](#) that you can view. If you have STEM professionals planning to visit your classroom or organization, share this best practice [resource](#) to get them started. Couragion (see Box 3.8) has also developed tools to help students explore STEM careers.

BOX 3.8. IN THE SPOTLIGHT:

Couragion Case Study

STEM Intention in Girls Increases Once Exposed to Couragion Role Models

At Couragion, we believe in measuring what matters. And when it comes to inspiring girls to pursue skills, competencies, and careers in science, technology, engineering, and math, we believe that measuring interests, intentions, and best-fit careers are what matters. Couragion gives students a firsthand look at careers via role model videos, games, and quizzes. In a 9th grade class recently exposed to just three Couragion role models, STEM intent increased by 4.6 points in all girls and by 16.3 points in Latina girls.

Why Couragion's career exploration & readiness works:

- 84 percent of the company's role models are under-represented in STEM and 81 percent are women. And many are "near peers" – all making it easier for students to relate to the role models and envision themselves pursuing those paths.
- Students see firsthand what a career is like and rate characteristics of each career to determine if it is a fit for their values, interests, and desired work characteristics. Couragion shows students the applicability of their current coursework while inspiring them to take and succeed in challenging STEM courses and educational pathways.
- For best-fit careers, students receive ongoing programming that enables them to continue to explore whether the career is truly a good match. For example, a girl with a high fit for a game development career would be presented with recommended coursework, relevant extracurricular activities, and tips about free tools such as the Unity game development platform. Such programming not only helps her to further explore whether the career is a good fit, but also enables her to hone 21st-century skills and make immediate progress toward such a career – thereby improving her career and workforce readiness and employability.

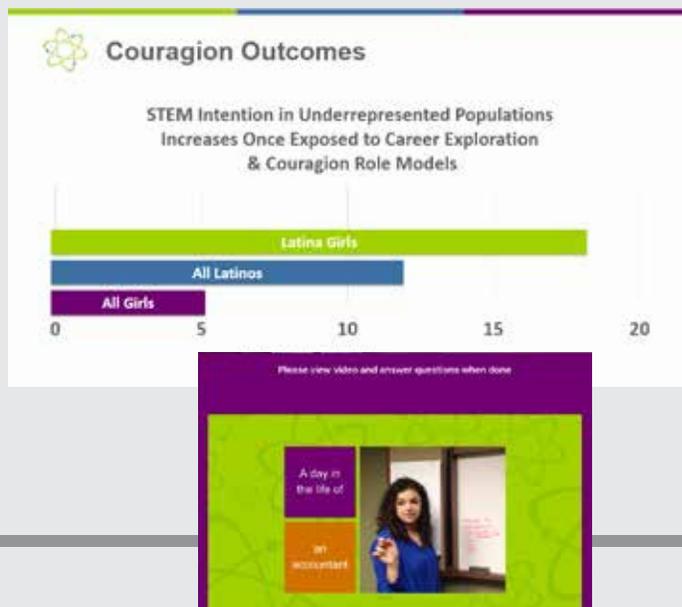
Who's a good fit for Couragion?

Students in 5th grade through career – in the classroom, after the bell, and at home.

Continued on page 93

About Couragion

Couragion is a women-owned education technology company. Our mission is to inspire under-represented youth to pursue skills, competencies, and careers in STEM. We recently celebrated our one-year anniversary and have just been awarded an innovation research grant from the National Science Foundation! The funded project mission is to improve the awareness and perception of careers that require STEM competencies. **To learn more, visit: www.couragion.com/.**



You can use Activity 3.2 with your girls to determine what STEM professionals they may be interested in meeting.

ACTIVITY 3.2:

Tweens Meet STEM Professionals

I want to meet someone who _____

[fill in what problems/issues this person likes to solve.]

- Example 1: I want to meet someone who makes sure our water is clean.
- Example 2: I want to meet someone who works with robots in search and rescue.
- Example 3: I want to meet someone who builds apps.

To make this happen, I need to:

1. _____
2. _____
3. _____

Girls in rural Colorado may benefit from online interactions with STEM professionals. [Nepris](#) is one organization that connects industry leaders to Colorado classrooms. Some cultural organizations, such as the [Denver Museum of Nature and Science](#), showcase scientists in action through virtual fieldtrips as well.

BOX 3.9. IN THE SPOTLIGHT:

Expanding Your Horizons (EYH)

EYH is a national network that hosts one-day conferences to encourage young women to pursue science, technology, engineering, and mathematics careers. Locally organized EYH Network programs provide STEM role models and hands-on activities for middle and high school girls. The ultimate goal is to motivate girls to become innovative and creative thinkers ready to meet 21st-century challenges.

At the conference, girls pick from a series of workshops on topics such as food science, biomedical engineering, and particle physics. The students have a great time learning about new careers and participating in hands-on activities led by female professionals from a wide variety of STEM fields. The workshop leaders aim to give the students a positive experience and answer any questions about what they do and how they prepared for their careers. This is a wonderful opportunity for students to gain hands-on exposure to a variety of STEM careers and meet great role models.

Examples of EYH workshops:

Exploring the Micro World: Learn about the bugs that live everywhere around you, even on your body.

Build an Electric Butterfly: Using circuits and engineering, design a take-home electric butterfly.

Brain Power: See how your brain works and use the power of your brain to influence your environment.

Operation Build: Learn the basics of architecture through designing your own one-bedroom apartment.

“Making” with Minions: A Maker is an inventor, creator, builder, designer, or producer. Design your own minion with software and circuits.

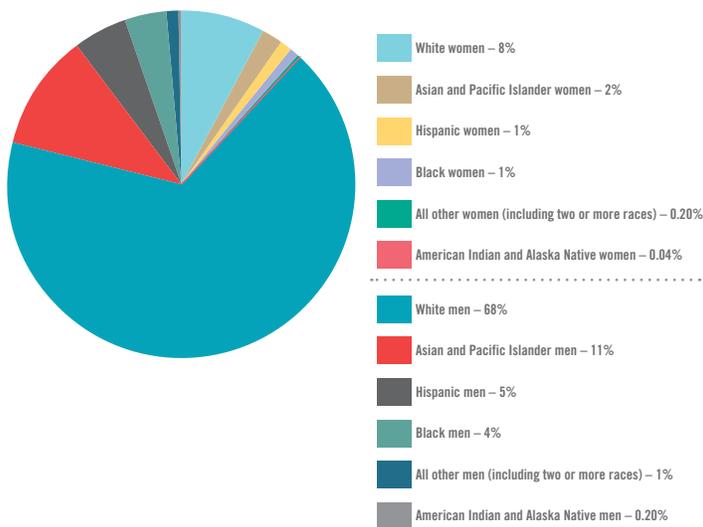
As girls learn more about STEM professionals, they may start to notice that women of different racial and ethnic backgrounds are not equally represented. They may even notice that relatively few STEM professionals are women. This might be evident if they go on a site visit to a tech company or an engineering company, where the average female representation is 17 percent and 8 percent respectively.¹⁸

When girls understand the issue of under-representation, they can take action. This can range from finding opportunities to creating their own programs. For example, they can mentor younger girls and teach them strategies that have helped them get where they are now. As they enter the workforce, their level of awareness of issues that typically push women out of these fields will help them search for workspaces that are inclusive of women and families. They may value companies that are willing to create those spaces over companies that perpetuate the status quo. Ultimately, girls can lead in being the change that is so needed in these spaces and the earlier they start learning about the issues, the more time they will have to develop solutions that work for them to make sure they do not enter and get pushed out by a system that was not designed for them. Such systems have to adapt as well to be inclusive of the needs of this changing workforce.

FIGURE 1.

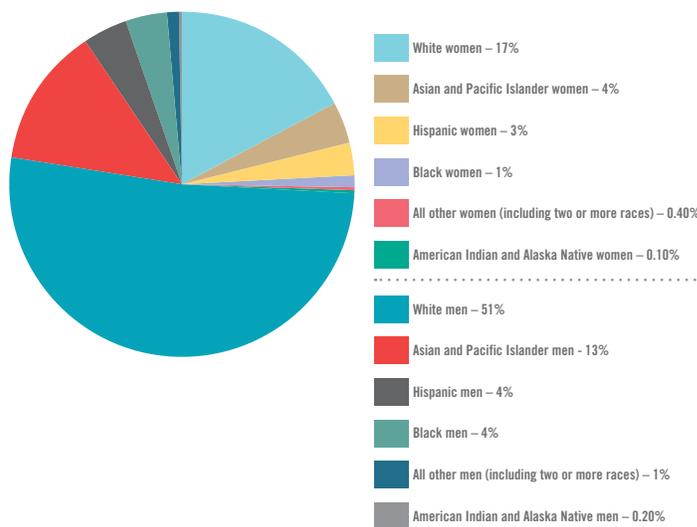
ANALYSIS OF ENGINEERING AND COMPUTING WORKFORCE BY GENDER AND RACE/ETHNICITY FROM 2006-2010¹⁹

ENGINEERING WORKFORCE, BY GENDER AND RACE/ETHNICITY, 2006-2010



Source: AAUW analysis of U.S. Census Bureau (2011a).

COMPUTING WORKFORCE, BY GENDER AND RACE/ETHNICITY, 2006-2010



Source: AAUW analysis of U.S. Census Bureau (2011a).

PROFESSIONALS FROM GROUPS HISTORICALLY UNDER-REPRESENTED IN STEM

Amazing women throughout history have made scientific discoveries and created tools and products that we use today; however, formal curriculum rarely covers this history in depth. Parents, caregivers, and educators can seek out and share information about women and women of color who have done amazing things. You will find many stories waiting to be told and waiting to be written. We have the ability to use these stories to inspire and prepare the next generation of girls, including girls of color, to pursue STEM careers.



TOOLBOX

Untold Or Seldom Told Stories Of STEM Professionals

Dr. Justina Ford: Dr. Ford was the first African American woman to practice medicine in Denver. At first, she was denied a medical license because she was a woman and African American. Once she was granted a license to practice medicine, area hospitals denied her and her patients access, so she forged her own path. Dr. Ford went on to have a 50-year career in medicine, serving diverse community members and learning many languages to provide them the care they needed.

Pearl Young: “The first woman to break the gender barrier at NASA Langley... was Pearl Young. She became an engineer at Langley in 1922 and eventually became the chief technical editor for the National Advisory Committee for Aeronautics.”²⁰

Katherine G. Johnson: Johnson is a retired African-American NASA mathematician. She was awarded the Presidential Medal of Freedom in 2014 “for her contributions to the space program, starting with the Mercury missions in the ‘50s and early ‘60s, through the Apollo moon missions in the late ‘60s and early ‘70s, and ending with the space shuttle missions in the mid ‘80s. Among other things, she calculated the trajectories of America's first manned mission into orbit and the first Moon landing.”²¹

Mary Sherman Morgan: Morgan is called America's first female rocket scientist. Read about her in the book *Rocket Girl: The Story of Mary Sherman Morgan, America's First Female Rocket Scientist* by George Morgan.

Dr. Grace Hopper and Forgotten Female Programmers. There is a group of women who were referred to as “computers” since their job was to compute things. Their stories are seldom told. You can read more about them at this [National Public Radio link](#).

Dr. Rosalind Franklin: Dr. Franklin was a British chemist and is “best known for her role in the discovery of the structure of DNA, and for her pioneering use of X-ray diffraction. She also laid foundations for structural virology.”²²

Dr. Ellen Ochoa: Dr. Ochoa is a Mexican-American woman and the first Latina astronaut to go into space. In 1993, she went on her first flight on space shuttle Discovery. She solved problems using her robotics knowledge and skills.

Dr. Mae Jemison: In 1992, Dr. Jemison became the first African-American woman in space.

Encourage girls to learn about the STEM professionals currently working in research labs at universities in our state. There are professionals such as Dr. Prieto at Colorado State University, Fort Collins, developing game-changing technologies like more efficient batteries, and other scientists and engineers working on renewable fuels. Or find examples of girls who are close in age to the girls you serve so they can see the potential for their contributions at whatever stage in life they are in. Girls might be inspired to follow in the steps of [Sara Volz](#), who dedicated her high school years to growing algae to create biofuel. Use Activity 3.3 to get girls thinking about the untold stories of amazing STEM women all around them.

ACTIVITY 3.3:

Get To Know Her-story

1. **Research:** Find the name of a woman in STEM whose accomplishments are not widely known. Start [here](#) if you need a little help.
2. **Learn whatever you can about her.** What was her life like? What problems did she like to solve? What was life like during her era? What was she doing when she was your age?
3. **How does her story inspire you?**
4. **Share her story** with your parents/caregivers, teachers, and anyone willing to listen!
5. **Participate in The UN International Day for Women and Girls in Science** on February 11th each year. You can post pictures of your favorite scientists on social media.

IN WHAT WAYS CAN WE HELP GIRLS UNDERSTAND CONNECTIONS BETWEEN STEM LEARNING AND EVERYDAY LIFE?

STEM professionals may work in specific areas, but something they all share is their ability to solve problems and to ask really good questions. The more girls practice asking good questions and developing project plans to test solutions, the better prepared they will be to pursue pathways in STEM.

An engineer may ask questions that can improve the human condition. For example, engineers may work on ways to divert water from towns to prevent flooding and damage to homes. They may also design systems to make homes energy efficient. Scientists and engineers can develop

new materials or technologies to make our lives easier or more efficient. Check out [Engineer Girl](#) for more information.

Professionals in information technology (IT) may create systems that make communicating with people all over the world easier. For example, they create social media platforms such as Snapchat, Facebook, Instagram, and other apps. They have to figure out the problem and create a solution, or a product, to solve that problem. Parents and educators can send girls to the [TECHNOLOchicas](#) website housed under the National Center for Women & Information Technology ([NCWIT](#)) to learn more about careers in IT.

Math professionals work in all STEM fields because mathematics is the language of science. It helps us understand the world and it requires numerical and logical thinking, a skill that all STEM professionals need. Logical thinking refers to the ability to clearly express what the problem is, the approach or multiple approaches that can be used to solve the problem, and the assumptions that come with each problem-solving method. Numeracy refers to an understanding of numbers and the ability to work with them. Math is all about looking for patterns and connecting ideas.²³

Educators can better understand the connections between the different STEM disciplines by taking advantage of the many opportunities offered at higher education institutions and through industry partners who provide educators with externships, research opportunities, and coursework to extend STEM pedagogy and content knowledge. One example of a teacher externship is the Colorado BioScience Institute's Research Experience for Teachers (see Box 3.10).

BOX 3.10. IN THE SPOTLIGHT:

Colorado BioScience Institute

The Colorado BioScience Institute (The Institute) Research Experience for Teachers (RET) program, provides middle and high school teachers real-world STEM work experiences and helps them translate those experiences and new knowledge into the classroom. RET is an intensive four-week summer program in which teachers spend about 130 hours with an innovative STEM company working on real-world projects and 30 plus hours in professional development. The goal is to build long-term, collaborative partnerships between 6th-12th grade teachers, industry leaders, and the local university research community by involving the teachers in STEM-based, industry-relevant projects and helping them increase student engagement and interest in STEM topics/careers through increased teacher enthusiasm and knowledge about STEM industries. Data collected on the program to date indicate that teachers who participate have a 22 percent increase in self-confidence in teaching scientific research on average and a nearly 30 percent increase in their understanding of the business of science. Also, their students report a 33 percent increase on average of interest in pursuing a career in a STEM field. Participating companies conveyed that the presence of the teacher helped them better communicate their processes and findings to members of a non-scientific community and allowed them to gain a different perspective on their work. The Institute's RET program has led to increased company engagement with students as well, with host companies providing student tours, content expert presentations, and, in one case, an engineering challenge for students. By providing teachers experiential opportunities along with professional development, classroom implementation planning time, and authentic materials, the Colorado BioScience Institute's RET program is making a tremendous impact in Colorado's 6th-12th grade STEM classes.



Nicole McWright, 8th grade teacher from Adams 12, STEM Launch School, working in an Immunology & Beryllium Lab at National Jewish Health in the summer of 2015.

Learn more at [RET](#). 



HOW CAN GIRLS DEVELOP PROFICIENCY IN FOUNDATIONAL STEM SKILLS?

For girls to develop proficiency in foundational STEM skills, they need a supportive learning ecosystem composed of caregivers, educators, and community resources that can advocate on their behalf and provide authentic learning experiences grounded in the girl's reality. Educators must realize that foundational STEM skills are grounded in experiences that are meaningful and relevant to young girls. To see the connections, it is imperative that educators see what STEM professionals do and that they experience the practices of STEM professionals so they can create opportunities for STEM learning for their students.

Educators do not have to start from a blank page to design STEM learning experiences. If educators have existing curriculum, they can begin by adapting existing resources and using the Arizona STEM Network's STEM Immersion Guide. This guide outlines different levels of STEM integration: exploratory, introductory,

partial immersion, and full immersion. It also provides information to guide teachers, schools, administrators, and districts in program design. To read the guide, visit the [Arizona Framework for STEM](#).

With conversations, proposals, research, and policies flourishing around STEM education through Next Generation Science Standards, resources abound to support those involved in the redesign and implementation of curriculum. See [Curriculum Adaptation to NGSS](#) for more details.

Additional Colorado-based sample STEM units can be found in eNet Colorado. There are a significant number of resources organized by grade band, as well as math and data sets here: [eNet CO STEM Resources Database](#)²⁴ and sample science instructional units here: [eNet CO Middle School Sample Units and Resources](#).²⁵

In addition, [STEM Road Map: A Framework for Integrated STEM Education](#) provides an integrated approach for each grade from K-12. Educators will even find a complete sample middle school

unit on Transportation—Motorsports, focused on the crosscutting science concept of cause and effect, and a blank template to use for planning purposes.

Girls need teachers who are well-versed in designing STEM learning experiences. In designing STEM curriculum, consideration should be given to the “five core characteristics that distinguish *integrated STEM learning experiences*” as outlined in the *STEM Road Map*:

- “The content and practices of one or more anchor science and mathematics disciplines define some of the primary learning goals
- The integrator is the engineering practices and engineering design of technologies as the context and/or an intentional component of the content to be learned
- The engineering design or engineering practices related to relevant technologies requires the use of scientific and mathematical concepts through design justifications
- The development of 21st-century skills/competencies is emphasized
- The context of instruction requires solving a real-world problem or task through teamwork”²⁶



Well-crafted STEM learning experiences help build girls' identities in science and mathematics. A person's perception of what she is capable of doing can impact her ability to do well in math and science. Take a look at María's self-efficacy in mathematics.

María's grandfather, Papa, was born and raised in Central America. He was a business owner and drove buses for a living. During his breaks from driving, Papa would pull out a notepad and a pencil and play math games with the other drivers. He knew all sorts of tricks. He would ask his audience to start with a certain number and then he would insert additional numbers. The sum was always a row of nines. That was his favorite number. María internalized that if grandpa was that good at math, she could be good, too. When María moved to the U.S. her math performance was very strong. She loved playing with numbers and she practiced a lot.

Some people think that people are born with an aptitude for math. María thought that because her grandpa was good, she had a chance at being good, too. María's performance was not necessarily a result of her family genes, rather it was constant practice. Every time she interacted with her grandpa, he would help her understand concepts such as numbers, patterns, and place value. She learned skills such as counting, subtracting, adding, composing, and decomposing numbers.

The opposite can be true when talking about belief in your ability to be good at something. For example, parents' and caregivers' perceptions of their ability (or inability) to do math and science as children may influence how their children feel about these subjects and how they perform in school. If parents/caregivers say they were bad

at math or science, their child might start believing that they will have the same fate. This is not the case. Girls must learn that, if they practice skills they are not yet good at, they will get better. Girls can even teach their parents/caregivers as they learn so they can recognize their daughters' abilities as STEM learners.

There is another phenomenon at play that impacts girls' perception of their abilities. It's called [stereotype threat](#).²⁷ This is when a person is afraid that the action or behavior they exhibit

will reinforce ideas that are stereotypical of their cultural group or gender. For example, if someone says, "Boys do really well on this task," and the person performing the task is a girl, she will not perform well on that task. She will perform better if she is told that the test is about problem solving abilities, or told nothing at all.

The following toolbox has been designed to help girls develop awareness of their thoughts and to move them towards a growth mindset. You can give it directly to the girls in your life.



TOOLBOX

Growth Mindset

| <i>When you hear this in your head...</i> | <i>Change your thoughts to this...</i> |
|---|---|
| I can't do this. | What do I need to do first to tackle this problem? |
| My mom told me she hated math. Maybe I'm the same. This stuff is hard. | Just because my mom did not do well in math doesn't mean that the same applies to me. I can learn. I might not be good yet, but I will continue trying. |
| I failed. This is horrible! | Well, that didn't work. I'll see why it didn't work and try again. It's okay to fail and try again. |
| Only boys are good at this STEM stuff. | I can be good at this, too. Everything takes practice. Keep going. |
| I'm going to do horribly on this test. (Even though you studied and practiced a lot.) | I worked very hard to perform well. I am confident that my hard work will pay off. |
| Add your own: | Add your own: |
| Add your own: | Add your own: |

The tips in the Toolbox are meant to be a starting point. Girls will experience many situations that will prompt negative thoughts about their abilities. The more they practice having a growth mindset, the more they will see that even if they do not know something now, it does not mean they will never know it.

The following questions are also helpful for educators to make sure their own thinking is not limiting their girls' abilities. If educators have the inclination to change the learning environment for students, they can start by asking themselves the following "how might we" questions:

- ❑ How might we create opportunities for students to ask questions?
- ❑ How might we get more opportunities for students to design their own investigations and ask questions they are interested in exploring?
- ❑ How might we take issues that are relevant to our communities and come up with solutions?

WHAT DOES A GREAT STEM CLASSROOM LOOK LIKE?

In a great STEM classroom, students have the opportunity to ask their own questions and develop solutions to problems that interest them. They learn about STEM ideas in depth. These ideas may include

our role as a human in the environment and improving the human condition. This classroom may not be a traditional classroom at all. Students may be learning in their community, outdoors, or at home. Learning takes place anywhere, anytime.

Learning should be linked to students' everyday lived experience. Students excel when they have opportunities to collaborate and find viable solutions to problems by asking authentic, relevant questions about their environment. Teachers facilitate deep and meaningful learning by helping students to ask good questions and at the same time, rarely give answers, but stimulating thought about solutions and developing students' ability to make connections that link ideas.

As students develop the ability to connect ideas, they will start seeing many opportunities to solve problems in their communities or at home. They may even start to expand their reach globally and work with organizations on the other side of the world. For example, middle school kids at Preston Middle School are working on a lights project for Uganda (see Box 3.11.).



BOX 3.11. IN THE SPOTLIGHT:

Engineering Brightness

[Engineering Brightness](#), formerly One Million Lights, is a group of students and teachers committed to making the world brighter. Through global collaboration with New Brunswick, the Dominican Republic, Uganda, Honduras, and Nicaragua, Engineering Brightness participants are engineering 3D printed, sustainable lanterns and distributing them to people without reliable electricity worldwide. Learn more about how Preston Middle School in Fort Collins, CO is helping to make the world a better place.

<http://linkis.com/nstacommunities.org/iWn1M>

HOW CAN COMMUNITIES HELP GIRLS PREPARE FOR STEM CAREERS?

Community organizations are a great asset to connect girls and educators to STEM professionals. In some Colorado communities, careers in natural resources may be more common, and in others, careers in technology may be more represented. For example, Boulder has many STEM professionals because of the presence of government labs and they have the highest high-tech start-up density in the region.²⁸ In rural Colorado, educators and community organizations can connect with the Bureau of Land Management, U.S. Forest Service, or the National Park Service. Learning about STEM careers and the many places where STEM professionals work gives girls the chance to see themselves in those careers. Where a girl lives in Colorado should not be a barrier to connecting her to STEM professionals.

Please share the following toolbox with girls you work with. Help them break the tasks into smaller components to accomplish them if necessary.

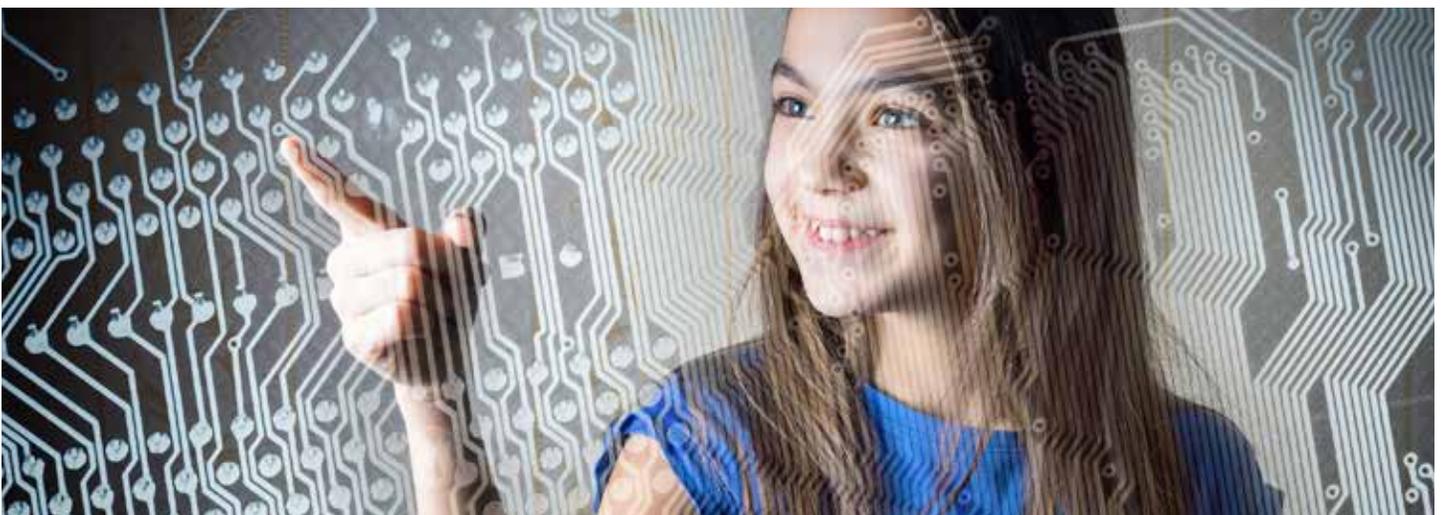


TOOLBOX

Tool For Tweens. Shaping Your Future In STEM

- Be aware of the skills you should be learning to be successful in STEM:
 - ◆ STEM Practices: Learn the skills scientists and engineers use to investigate questions and to solve problems. You will see that these practices are easy to incorporate in everyday thinking and tasks as a way of life.
 1. Asking questions and defining problems
 2. Developing and using models
 3. Planning and carrying out investigations
 4. Analyzing and interpreting data
 5. Using mathematics and computational thinking
 6. Constructing explanations and designing solutions
 7. Engaging in argument from evidence
 8. Obtaining, evaluating, and communicating information
 - ◆ Improving your spatial reasoning skills:
 - Play 3-D video games to improve spatial reasoning.
 - Solve puzzles that require three dimensional abilities.
 - ◆ Understand what 21st-century skills are and improve them:
 - Communication, collaboration, creativity and innovation, critical thinking, and problem-solving skills.

- Explore careers in STEM:
 - ◆ Use career exploration apps and watch role model [videos](#) on SciGirls.
 - ◆ [Nepris](#) - Use this site to connect industry leaders to the classroom. Ask your teacher for help.
- Participate in citizen science projects or community service:
 - ◆ [Project BudBurst](#) - <http://budburst.org/> Collect data about plants in your own backyard and submit your data for scientists to use.
 - ◆ [Celebrate Urban Birds](#) - <http://celebrateurbanbirds.org/> Add data about migratory birds and experience other activities to study birds.
 - ◆ [Nest Watch](#) - <http://nestwatch.org/> An opportunity to help scientists collect data about nesting birds.
 - ◆ Check out [SciStarters](#) for many more ideas!
- Enter a science fair:
 - ◆ [Denver Metro Science Fair](#) (6th Grade - high school)
 - ◆ [Colorado State Science and Engineering Fair](#) (6th grade - high school)
 - ◆ [Google Science Fair](#)
- Participate in a Design Challenge.
- Learn how to [code](#). Coding is a great way to utilize the design process. If you are not successful the first time, you can try again, and again.
- Shadow a STEM professional. The best way to start learning about what people do for a living is to see them in action. Ask STEM professionals if you can shadow them for a day to learn about what they do and the skills they use. You may discover that some careers require skills that employees do over and over again; others require people to be creative and to come up with new ideas. There are a wide range of STEM careers out there to discover. You can also begin to volunteer over the summer to learn more about what certain professionals do.



WHY DOES IT MATTER IF GIRLS PURSUE OR CHOOSE NOT TO PURSUE STEM CAREERS?

Women and girls make up half the population of the world, and we need women and girls to name the problems and issues that impact them and contribute to their solutions. STEM careers offer girls an opportunity to help and to contribute their perspectives, skills, and talents to make the world a better place. What girls bring to STEM no one else can bring. The current under-representation of women, including women of color, means that problems relevant to those communities may be going unsolved. STEM careers also offer good salaries. Early career women can earn enough to sustain themselves and their families if they enter an in-demand STEM career. A wider talent pool also brings new ideas and perspectives to solve problems. When we do not include girls in solving problems, we let potential remain undiscovered.

HOW CAN COMMUNITY ORGANIZATIONS ADVANCE GIRLS IN STEM?

Community organizations can play a vital role in changing the STEM learning trajectories of girls by working with multiple partners to improve STEM opportunities and the conditions in which these opportunities take place. Community organizations are part of the ecosystem that touches multiple aspects of girls' development. They can forge partnerships between industry leaders, other organizations, and schools.

Girls ages 11-13 need engaging experiences that give them the chance to continue learning about STEM pathways. They need to be surrounded by a community that helps them see their own potential, in which people are equipped with tools to help them acknowledge and recognize their abilities.

To advance girls in STEM, community organizations can:

- Help spread the message of the importance of having gender parity in STEM career pathways and into the workforce
- Help build capacity for educators and community organizations by providing tools, resources, and training on topics such as bias, micromessaging, teasing, putdowns, stereotypes, competition, marginalization, opportunities in STEM, and encouragement to enter and stay in STEM fields²⁹
- Provide tools for girls to recognize their voice, abilities, and potential
- Create awareness so that girls and their families understand that learning is a continuous process that can occur anytime, anywhere.
- Connect girls to mentors, expose them to career exploration, create awareness of opportunities in STEM, and help girls start to think about STEM pathways and multiple access points to enter those pathways

By the time girls reach 13 years of age, they should have options to explore different STEM career pathways. The activities in this chapter are a starting point for caregivers, educators, and community organizations to help girls advance in their STEM trajectory. To fully take advantage of these opportunities, they need to know about and practice design thinking and its applications, they need to design their own investigations, and they need to learn foundational ideas in STEM. These big ideas include cause and effect, innovation, and sustainable systems. Girls also need to develop skills to be able to solve problems, collaborate, utilize technology, work with people from other cultures, and distribute their time to manage projects and finish them on time.³⁰ The community must recognize and celebrate girls' contributions so girls see themselves as capable and feel confident in their ability to solve problems.

REFERENCES

- ¹ Saujani, R. (2016). Teach girls bravery, not perfection. TED https://www.ted.com/talks/reshma_saujani_teach_girls_bravery_not_perfection?language=en
- ² American Association of University Women (2010). Why do few? Women in science, technology, engineering, and mathematics. Washington, DC: AAUW. Accessed on January 29, 2017 from <http://www.aauw.org/research/why-so-few/>
- ³ Calabrese Barton, A., Tan, E., and A. Rivet (2008). Creating Hybrid Spaces for Engaging School Science Among Urban Middle School Girls. *Ame Educ Res J* 45 (1): pp. 68–103 <http://aer.sagepub.com/cgi/content/abstract/45/1/68>
- ⁴ Kelleher, C. (2006). Motivating Programming: using storytelling to make computer programming attractive to middle school girls. Thesis. https://c.ymcdn.com/sites/www.csteachers.org/resource/resmgr/Docs/Research/KeyResearch/kelleherThesis_CSD.pdf
- ⁵ National Science Foundation (2007). Back to School. Five Myths About Girls in Science. Accessed on January 29, 2017 from https://www.nsf.gov/news/news_summ.jsp?cntn_id=109939
- ⁶ Afterschool Alliance. Afterschool & STEM Learning. Accessed on January 29, 2017 from <http://www.afterschoolalliance.org/STEM.cfm>
- ⁷ STEM Teaching tools. Accessed on January 29, 2017 from <http://stemteachingtools.org/tools>
- ⁸ Understanding science: How science really works. Accessed on January 29, 2017 from <http://undsci.berkeley.edu/article/scienceflowchart>
- ⁹ Riddle, T. (2015). Empowering Students with Design Thinking. Accessed on January 29, 2017 from <http://www.edutopia.org/blog/empowering-students-with-design-thinking-thomas-riddle>
- ¹⁰ Shumow, L., and J. A. Schmidt (2014). *Enhancing adolescents' motivation for science: Research based strategies for teaching male and female Students*. Thousand Oaks, CA: Corwin A SAGE Company. P. 48.
- ¹¹ Girls Exploring Science, Technology, Engineering, Math Final Report. Accessed on January 29, 2017 from http://www.swe-rms.org/uploads/2/0/2/4/20242143/geset_2006_final_report_6-17-06.pdf
- ¹² 2016 Colorado Regional Science Fairs. Accessed on January 29, 2017 from http://www.csef.colostate.edu/Regional_Science_Fairs.htm
- ¹³ Colorado State Science Fair, Inc. Accessed on January 29, 2017 from <http://www.csef.colostate.edu/>
- ¹⁴ Google Science Fair. Accessed on January 29, 2017 from <https://www.google-sciencefair.com/en/>
- ¹⁵ Next Generation Science Standards. Appendix F—Science and engineering practices in the NGSS. <http://www.nap.edu/read/13165/chapter/7>
- ¹⁶ Garcia, Y.V. (2013). A case study exploring science competence and science confidence of middle school girls from marginalized backgrounds. Dissertation. Greeley, CO: University of Northern Colorado.
- ¹⁷ Twin Cities PBS SciGirls (2016) Role Models. Accessed on January 29, 2017 from <http://scigirlsconnect.org/page/role-models>
- ¹⁸ American Association of University Women (2015). Solving the equation: The variables for women's success in engineering and computing. Washington, DC: AAUW. Accessed on January 31, 2017 from <http://www.aauw.org/research/solving-the-equation/>
- ¹⁹ Ibid.
- ²⁰ Atkinson, J. (2014). From Computers to Leaders: Women at NASA Langley <https://www.nasa.gov/larc/from-computers-to-leaders-women-at-nasa-langley>
- ²¹ Whitney, AK. (2015). The black female mathematicians who went astronauts to space. <http://mentalfloss.com/article/71576/black-female-mathematicians-who-sent-astronauts-space>
- ²² Bio. (2016) Biography: Rosalind Franklin. Accessed on January 29, 2017 from <http://www.biography.com/people/rosalind-franklin-9301344#synopsis>
- ²³ Wanko, J. J. (2014). Numbers and shapes everywhere. Mathematics Teachers Blog. Accessed on January 29, 2017 from <http://www.nctm.org/Publications/Mathematics-Teacher/Blog/Numbers-and-Shapes-Everywhere/>
- ²⁴ STEM Resources from eNetLearning. Accessed on January 29, 2017 from <http://www.livebinders.com/play/play?id=1577489>
- ²⁵ Grades 6-8 MS Science Sample Instructional Units and Resources. Accessed on January 29, 2017 from <http://www.livebinders.com/play/play?id=1699160>
- ²⁶ Editors, Johnson, C. C. Peters-Burton, E. E., and T. J. Moore. (2016). *STEM Road Map: A Framework for Integrated STEM Education*. New York, NY: Routledge. pp 24-25.
- ²⁷ What is Stereotype Threat? Accessed on January 29, 2017 from <http://www.reducingstereotypethreat.org/definition.html>
- ²⁸ Boulder Economic Council. Accessed on January 29, 2017 from <http://bouldereconomiccouncil.org/living-boulder/know/>
- ²⁹ Welsh, J. (2013). Things keeping women out of science. *Business Insider*. Accessed on January 29, 2017 from <http://www.businessinsider.com/7-things-keeping-women-out-of-science-2013-10>
- ³⁰ Johnson, C. C., Moore, T.J., Utley, J., Breiner, J., Burton, S. R., Peters-Burton, E. E., Walton, J., and C. L. Parton. (2016). *The STEM Road Map for Grades 6-8. In STEM Road Map: A Framework for Integrated STEM Education*. Johnson, C. C. Peters-Burton, E. E., and T. J. Moore (Eds) New York, NY: Routledge. pp 96-123.