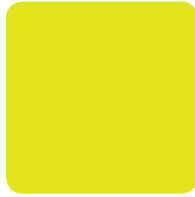
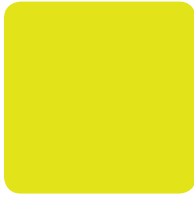
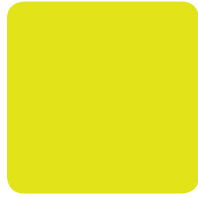
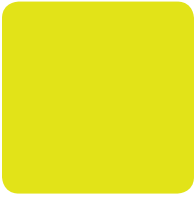
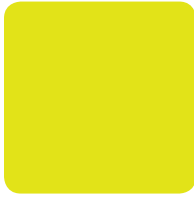


Guide to
Evaluating Promising Practices
in Informal Science, Technology, Engineering,
and Mathematics (STEM) Education for Girls



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GIRLS AND SCIENCE, TECHNOLOGY, ENGINEERING, AND MATH: THE FUTURE

Girl Scouts of the USA and Motorola share a vision: Girls across the country and around the world are the future experts needed in the fields of science, technology, engineering, and mathematics (STEM). This vision led to joint efforts to conduct research on the most promising practices related to informal educational programming that inspires and ignites the imaginations of girls. As more girls are interested and engaged in STEM fields throughout their youth, more girls will go on to pursue careers that use STEM to solve the challenges the world faces.

The latest research shows that jobs requiring science, engineering, or technical training will increase 24 percent between 2004 and 2014 to 6.3 million (U.S. Bureau of Labor Statistics, 2008). The disparity between the growing demand for critical thinkers and the country's ability to adequately prepare students to fill these jobs has been widening for decades. The most recent global survey of 15-year-olds' performance in science shows 24 percent of U.S. students perform at the lowest level — below that at which students begin to demonstrate the ability to successfully participate in the workforce (OECD, 2006).

The lack of skilled graduates in STEM fields poses a significant threat to sustained U.S. competitiveness in the global, knowledge-intensive economy. A National Science Board (2004) report showed that while women make up 46 percent of the U.S. workforce, they represent only 25 percent of the STEM workforce, including social sciences.

“Learning and providing the STEM program has made me more comfortable with science and math. It is not hard and difficult, it is interesting, keeps me asking questions, “What if?” and excites me about finding the answers. Math and science is not scary, hard or just for boys...I can do it too and do it well!”
— Noor G., Girl Scout

The low percentage of women working in STEM careers and the underrepresentation of girls in the pipeline for these careers speaks to the need for ongoing attention to engaging girls in STEM. Research shows that girls' career choices are influenced through informal education programs, and that there are specific practices that result in greater success.

Together, Girl Scouts of the USA and Motorola have researched and documented these promising practices. Informal education programs that use these practices will be more successful in engaging girls in STEM, and ultimately influencing girls' career choices.

This booklet summarizes the promising practices, providing tips for implanting them and references for further information. To view the full report, *Evaluating Promising Practices in Informal Science, Technology, Engineering, and Mathematics (STEM) Education for Girls*, please visit www.girlscouts.org.

“I learned about STEM from our council where I went to a STEM training to become a trainer for younger girls. In my two years as a trainer, I have taught STEM at the Kennedy Space Center, outside locations with students and worked with Girl Scouts at our Day Camp ‘To Infinity and Beyond’.

...I became involved in robotics and went to a national competition in 2008 and hope to advance again this year. I am in my second year of Physics, and first year Calculus. I plan to study science and engineering next year in college. STEM is a fun way to learn and teach science.” — Kelly W., Girl Scout

RESEARCH METHODOLOGY

This summary results from a study that included:

- The creation of a directory of informal STEM education programs for girls
- A literature review to establish a baseline of effective promising practices
- Development and administration of a survey of informal STEM education programs to determine which of the promising practices they found key in achieving successful programs that engage youth in STEM

Representatives from 123 informal education programs responding to the survey had the following characteristics:

- Incorporated multiple STEM content areas into their curriculum, with science and technology being the most dominant disciplines addressed
- Represented 36 U.S. states
- 50 percent served girls only
- Most commonly served participants in grades 6–10
- 35 percent served over 100 participants at once
- Mean percentages of participants’ race/ethnicity
 - 61 percent Caucasian/European American
 - 24 percent Black/African American
 - 12 percent Hispanic/Latino
- 61 percent were nonprofit or community-based programs
- A quarter of programs reported a retention rate of 49–70 percent

1 **Discover by Doing: Experiential activities are critical to success.**

Survey respondents rated hands-on experiences as the greatest contributor to program success, and selected it as the most critical practice of STEM-related, girl-serving, informal education programs. This finding validates long-standing best-practice research.

Haury & Rillero (1994) summarize hands-on learning as an educational experience that actively involves people in manipulating objects to gain understanding or knowledge.

In this study, according to program representatives responding to the survey, through using hands-on, interactive lessons, success in keeping girls engaged and increasing excitement was achieved.

“Our mostly hands-on workshops are continually rated Girl Scouts’ favorite workshops. That is the key to [our] event’s success.”

“The feedback that we receive from participants regarding hands-on experiences is very positive. This [kind of experience] is actually preferred over the use of a PowerPoint or being talked at.”

“Students enjoy themselves more and learn more when they are active and hands-on in the program.”

“Our girls cannot wait to get their hands dirty, making the ‘introduction’ a challenge, sometimes!”

Implementation Tips

- Encourage active, hands-on participation rather than demonstration or lecture.
- Design activities that allow for experimentation and problem solving.

Research

Fancsali, C. *What We Know about Girls, STEM, and Afterschool Programs*. New York City: Academy for Educational Development, 2002.

Haury, D., and Rillero, P. “Perspectives of Hands-on Science Teaching. Pathways to School Improvement.” The ERIC Clearinghouse for Science, Mathematics, and Environmental Education, 1994. (Retrieved December 5, 2006, from <http://www.ncrel.org/sdrs/areas/issues/content/cntareas/science/eric/eric-1.htm>.)

2 **Make It Real: Connect activities through relevant, project-based, real-world examples.**

When girls can link new learning to their knowledge and life experiences, they practice critical thinking skills. As they sort and integrate information in different contexts, it becomes relevant to them! Girls want to affect the world in positive ways and see the impact of their efforts in the world around them.

Girls will explore information if it is relevant to them, and as they explore, they increase their critical thinking skills. This research confirms that the practice of incorporating real-world learning is very highly rated as a contributor to program success.

“One of our electric circuitry projects is particularly successful with young people when they compare it to the popular game of Operation. It puts things into context. ‘Oh, this is how Operation works!’ As they increase their understanding of the technology involved in the workings of a familiar activity/game, they are encouraged to explore how other things ‘work.’”

Implementation Tips

- Show girls how STEM disciplines are part of and relate to their everyday experience.
- Allow girls freedom to choose the curriculum themes and activities that interest them most.

Research

Facione, P. A. “Critical Thinking: What It Is and Why It Counts.” Insight Assessment, California Academic Press, 1998. (Retrieved September 24, 2008 from http://www.insightassessment.com/pdf_files/what&why98.pdf.)

Howe, A., Jones, M. G., and Rua, M. J. “Gender Differences in Students’ Experiences, Interests, and Attitudes Toward Science and Scientists.” *Science Education*, 84, 180–192, 2000.

Packard, B. W-L., and Nguyen, D. “Science Career-Related Possible Selves of Adolescent Girls: A longitudinal study.” *Journal of Career Development*, 29(4), 251–263, 2003.

3 Provide positive relationships with role models and mentors.

The opportunity for girls to expand their networks and engage in learning relationships with women who are knowledgeable and experienced in STEM is extremely beneficial and positively shapes students' perception of their interests and future roles.

Program representatives indicated that they felt mentoring was an important aspect of their program's success.

“This is a huge part of the program, and the interaction with STEM professionals (females in particular) was crucial.”

Mentoring demonstrates to girls that females are involved in STEM fields.

“Meeting real, live women who work in STEM-related fields has a huge impact on girls' perceptions of who STEM careers are for.”

Survey respondents believe that meeting mentors encourages girls to envision themselves in similar positions.

“Girls really make a connection when they meet a woman employed in the field that is being explored. It proves to them that a woman can do a job in that area.”

Providing role models and mentors allows girls to create connections with the women and learn about their personal and career lives, and their work-life balance.

“They unanimously loved the opportunity to discuss not only careers but also other life choices with the women.”

Implementation Tips

- Use mentors to bring context to potential career choices.
- Choose mentors from diverse backgrounds to allow girls to see others like them and different from them who are succeeding in STEM careers.

Research

Lee, J. D. “More Than Ability: Gender and Personal Relationships Influence Science and Technology Involvement.” *Sociology of Education*, 75, 349–73, 2002.

U.S. Department of Education. “Encouraging Girls in Math and Science.” *IES Practice Guide*. Institute for Education Sciences, Sept. 2007. (Retrieved October 29, 2007, from <http://ies.ed.gov/ncee/wwc/pdf/20072003.pdf>.)

OUR COMMITMENT AND VISION

Gaps in formal education are increasing and well documented. Girl Scouts of the USA and other informal education programs are in a unique position to provide opportunities and support for girls in STEM education to help fill those gaps.

Motorola's focus on STEM education in the U.S. directly addresses obstacles to achievement by engaging students — particularly girls and under-represented minorities — in the practical applications that concept engineers and technologists employ every day at Motorola.

Reaching nearly three million girls each year from kindergarten through 12th grade, GSUSA's STEM programming focuses on career exploration, hands-on activities, mentoring, and project-based learning in a girl-centric, supportive environment. Girl Scouting brings girls exceptional STEM opportunities through research-based programming and collaboration with academic and industry leaders. Girl Scouts helps girls build strong, hands-on foundations to become future female leaders and meet the growing need for skilled STEM professionals in the United States.

“When I heard about STEM I became so excited since I love math...it has given me the opportunity to share my love of math and sciences with almost 3000 girls in all types of Girl Scout and non-Girl Scout settings. I have taught STEM at several Girl Scout Day Camps which were both very exciting for the girls and made me even more excited about the program...”
— Cortney H., Girl Scout

WHAT CAN YOU DO?

Speak up

How can you ensure that experiences offered to girls in your community build on the best-known practices?

Connect girls to networks of experts

Be a mentor to girls and help them build their own networks of women in STEM.

Collaborate

Form collaborative partnerships between informal education programs and formal education, higher education, professional organizations, and businesses to better serve girls.

Share resources

Disseminate key strategies. Create the means or opportunity for STEM programs to communicate on effective practices, including that which has been established as successful, and new and innovative developments in the field.

To find informal STEM education program for girls in your community, check out <http://www.ngcproject.org/directory>.

Research

Bureau of Labor Statistics, U.S. Department of Labor. *Occupational Outlook Handbook, 2008–09 Edition*. (Retrieved September 18, 2008, from <http://www.bls.gov/oco/ocos042.htm>.)

Camp, T., and Güerer, D. “Investigating the Incredible Shrinking Pipeline for Women in Computer Science.” ACM Committee on Women in Computing, 1997. (Retrieved October 11, 2006, from <http://women.acm.org/documents/finalreport.pdf>.)

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OECD PISA 2006 Survey. Organization for Economic Co-operation and Development. Paris, France, 2006.

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