



Science, Technology, Engineering and Mathematics (STEM) Careers: Strategies for Engaging and Recruiting Girls

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Dr. Marilyn Barger is the Principal Investigator and Executive Director of FLATE, the Florida Regional Center of Advanced Technological Education, funded by the National Science Foundation and housed at Hillsborough Community College in Tampa, Florida since 2004. FLATE serves the state of Florida as its region and is involved in outreach and recruitment of students into technical career pathway; has produced award winning curriculum design and reform for secondary and post-secondary Career and Technical Education programs; and provides a variety of professional development for STEM and technical educators focused on advanced technologies. She earned a B.A. in Chemistry at Agnes Scott College and both a B.S. in Engineering Science and a Ph.D. in Civil Engineering (Environmental) from the University of South Florida, where her research focused on membrane separation science and technologies for water purification. She has over 20 years of experience in developing curricula for engineering and engineering technology for elementary, middle, high school, and post secondary institutions, including colleges of engineering. Dr. Barger serves on several national panels and advisory boards for technical programs, curriculum and workforce initiatives, including the National Association of Manufacturers Educators' Council. She is a Fellow of the American Society of Engineering Education, a member of Tau Beta Pi and Epsilon Pi Tau honor societies. She is a charter member of both the National Academy and the University of South Florida's Academy of Inventors. Dr. Barger holds a licensed patent and is a licensed Professional Engineer in Florida.

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Dr. Marie Boyette is the Associate Director for the Florida Advanced Technological Education Center of Excellence, FLATE, a NSF Center of Excellence located at Hillsborough Community College in Tampa, FL. Dr. Boyette's research interests center around data structure and analysis for impact and implementation, and meaningful instructional outcomes for educators, traditional, and non-traditional students. Her practice includes development of experiential learning strategies employed in summer workshops for teachers and exploration of diversity through standard coursework.

Mrs. Nina C Stokes, Florida Advanced Technological Education Center

Nina Stokes joined the Florida Advanced Technological Education Center (FLATE) at HCC in 2011 as Florida Energy Systems Consortium (FESC) Project Manager. She graduated from the University College of North Wales, U.K., with a B.S. in Marine Biology/Zoology before moving to Florida in 1993. She worked at the Department of Environmental Protection's Florida Marine Research Institute in St. Petersburg as an Environmental Specialist for five years before embarking on a high school science teaching career. She graduated from the University of South Florida in 1996 with an M.A. in Secondary Science Education, and in 2010 with an Ed.S. in Interdisciplinary Science Education. She worked for the City of Tampa for 10 years first as a Water Conservation Education Coordinator, and later moved to the Department of Solid Waste as Recycling Coordinator.

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There is no need to reiterate what has become public knowledge in the past several years – we need to recruit more women and girls into STEM career pathways. STEM careers generally provide higher wages and, therefore, a higher quality of life. There is a need for more STEM professionals across the country and across business sectors –and increasing the number of females can help fill that gap. The Florida Advanced Technological Education Center of Excellence (FLATE) has a special initiative for recruiting young girls into STEM courses and careers. A pilot program in its home county began in June 2013 with an intensive all-day workshop at Hillsborough Community College’s Brandon Campus for local and regional educators. Attendees were invited to submit implementation plans for a program in their school using the strategies learned at the workshop and an implementation plan template provided by FLATE. This poster and paper will cover the details of the workshop content and activities and the projects which schools and teachers have begun in order to boost their female enrollments in various STEM programs. FLATE is particularly focused on supporting the manufacturing workforce, and schools working in related disciplines will be highlighted.

Collaborate, Encourage, Lead by Example

It’s no surprise that FLATE’s research focused on the technology and engineering side of STEM shows recruiting and retaining girls in STEM programs is a problem. In Florida’s Engineering Technology (ET) and related technology degree and certificate programs, only 21% of enrolled students were females in 2011-12. Even more troubling is the low percentage of girls enrolled in high school technology programs: 16%. How to get the attention of girls is a hot topic whenever STEM educators and guidance counselors get together, and FLATE’s summer workshop, “Engaging Girls in STEM”, was full in a matter of 5 days with 100 educators signed up and a wait list of 20. The final 80 attendees who gathered to share ideas included 21 elementary school, 27 middle school, and 16 high school teachers as well as 3 university and 6 college faculty members, 5 “other,” and 2 school district administrators from 2 counties. The full day session included FLATE-guided brainstorming sessions, presentations, and a panel showcasing exemplary women in STEM careers. Major themes of collaboration, encouragement, and leadership by example emerged from the qualitative data collected in an online survey from teachers. Fifty one percent of participants responded; this paper reflects a collection of their ideas.

Collaborate

Participants were encouraged during collaboration sessions to learn new ways to collect data to determine if female enrollment increases at their schools. The majority reported access only to basic enrollment at their schools and national statistics. Many used manual counting techniques or talking with counselors or administrators. A few participants shared ways in which their counties were able to access more systemic data such as “AGP data and science FCAT scores in comparison with our boys.” Others felt that they had access to some data but not enough for a longitudinal study:

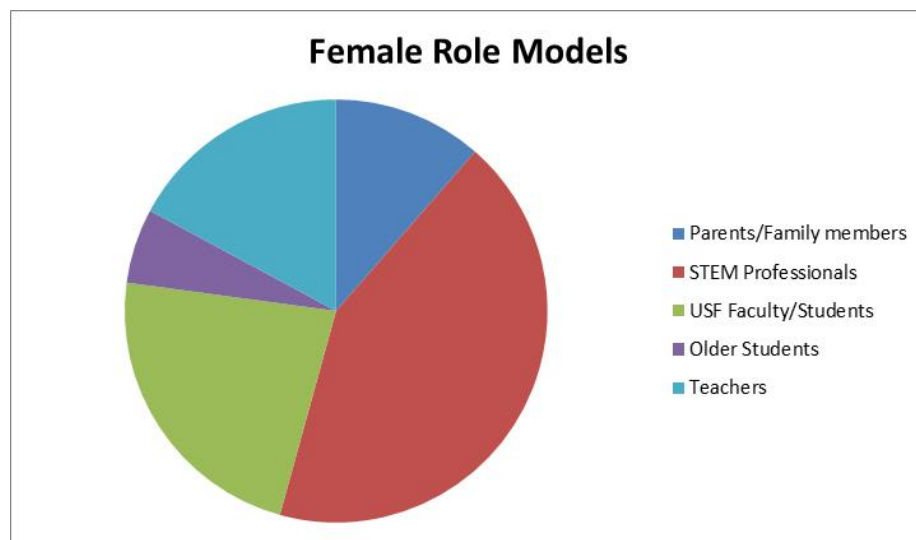
“We can download data that shows the percentage of female students who enrolled in STEM-related programs after leaving elementary school, either in middle or high school. That needs to be compared with the number of students who actually completed the program and successfully entered the workforce or enrolled in a post-secondary STEM program.”

Overall, there was evidence of a lack of consistency among participants as far as being aware of reliable resources for data tracking. This is a potential area district administration may wish to address. Data about local female enrollment could be made more accessible through websites, and information about data mining is a topic of interest for professional development workshops or teacher work days.

Teachers indicated their willingness to collaborate with other teachers (94%):

“I would use my peers (the female science teachers at my school) and also find women in the community by contacting the University of South Florida (USF), Hillsborough Community College, and other local schools and companies. I would hope to have female teachers work with me as facilitators and have community women come in as guest speakers and possibly mentors.” “I will utilize our Math Resource Teacher and our Science Resource Teacher. I will involve them by having them come in and speak to my class, model lessons, and share careers that use their skill set.” Collaboration extended beyond fellow educators including business community contacts made at the “Great American Teach In,” mothers, and student mentors. For example: “The 8th grade girls will complete research projects with the 6th grade girls to increase the interest of Science and Math in girls.” “Students in grades six through twelve will collaborate and research projects that explain how the academic awareness of science and mathematics impact the female's knowledge, income, individual ability, and influence.” The pie chart in **Figure 1** illustrates the different female role models respondents indicated they would use to inspire and encourage girls to pursue STEM careers.

“Figure 1”



In addition to *who* teachers identified as potential female role models, the following list identifies *how* teachers planned for the female role models to be involved:

- Guest speakers
- Mentors/advocators
- Shadowing opportunities
- Research projects
- Video clips showing female professionals
- HGTV Channel
- School closed-circuit TV – female teachers demonstrating various science experiments and math magic

Collaboration ideas were planned to occur in a wide variety of venues, both in and out of school. Partnership among schools and in the business community at large is key to integrating this type of activity. Teachers shared that they had no trouble talking to parents about engaging girls in STEM, however, funding special activities may be a concern. Grant writing was one solution proposed at the workshop as a means to fund such new ideas. Several teachers indicated that they had no experience writing grants, thus, grant writing is another fertile area for professional development workshops for teachers. Teachers also mentioned a lack of female-focused lesson plans and, in fact, the majority of resources for STEM teachers are in the subject areas of science and math, and not engineering and technology or the integration of any of these. FLATE is a groundbreaker in supplying complete lesson plans focused on the technology and engineering side of STEM, and integrating the “T & E” side of STEM into mainstream curriculum calls for collaboration at the educator level.



Teacher Brainstorming Session – Sharing ideas

Encourage

Teachers were ready to encourage with many good examples and ideas, which included: Women’s History Month, a study of successful women, Science Fair support, mentoring, lunches and breakfasts with mentors, career days, and clubs (such as robotics and engineering). Finding time for students during the school day to participate has traditionally been a problem due to rigorous testing schedules. Although some students may have transportation difficulties,

after-school or weekend clubs may be a good solution for many students. In these types of settings, “all girls” programs flourish, encouraging girls through teamwork, praise, camaraderie, and learning opportunities.

“I think it is critical to build a team of families, other teachers, and staff who can work together to create a holistic approach that raises awareness about the factors that influence girls' perceptions of Science and Scientific careers, to develop strategies for understanding and overcoming biases that young girls face, and to develop lesson plans that highlight the accomplishments of female scientists and incorporate contextualized learning opportunities.”

Encouragement is evident in the plans teachers developed as an outcome of the workshop. Plans were creative. Many used FLATE resources, and terms such as empowerment, equity, and challenge were the norm.

Table 1 below highlights a selection of teachers’ responses to the question, “*What types of encouragement/influence will you use within your classroom and with other educational professionals?*”

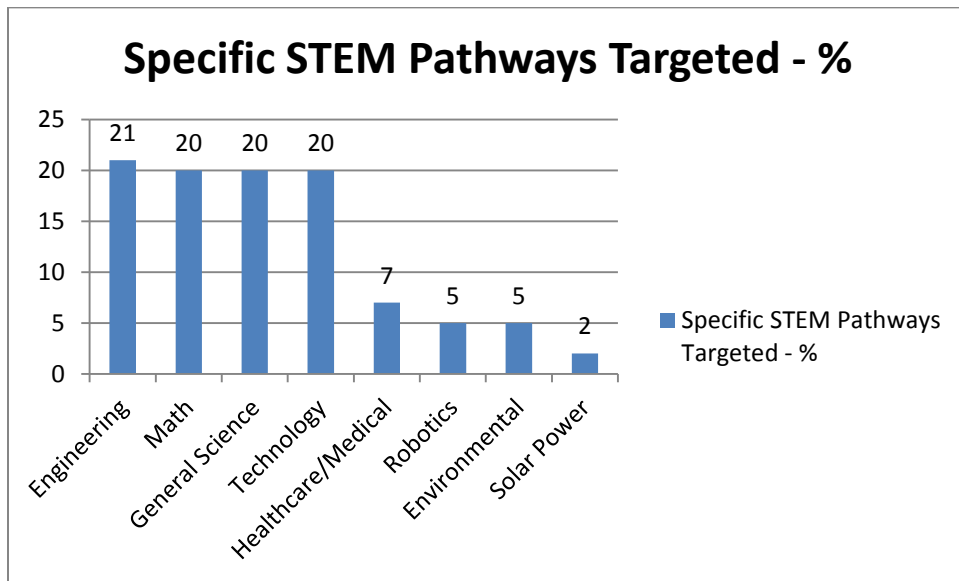
Encourage girls to pursue that career/field of study that interests them the most
Club that gives girls one on one time to explore STEM careers will serve as encouragement, with t-shirts and a name to attract girls who want to feel part of a social group
Be more cognizant about encouraging and challenging girls when it comes to STEM Fair projects as well as long term classroom investigations
Consult the district's secondary science department, and collaborate with the Science Resource teachers and request information that explains real world applications of math and science careers
Share examples from our own lives to show females in the STEM careers
Displays/Posters/Visuals highlighting females in STEM careers
Girls Lunch Bunch to promote leadership while discussing current females who are influential in the community and/or media
Mentoring, service opportunities, tangible rewards for deliverables - t-shirts, stationary, etc.
Focus on real-world application and job experience of STEM occupations
Provide options and information on careers and possible pathways
Encourage co-workers to attend more science/stem training

Although all survey responders mentioned math and science when referring to STEM curriculum, it is important to reframe and better include technology and engineering as belonging to the “helping” sector when talking about STEM education and careers. Such discussions uncover a wealth of careers that may not have occurred to female students. As well, it is important to have STEM college and career explorations early on in girls’ academic experience so that appropriate mathematics and science coursework can be addressed. “All girl” cohorts for gifted as well as remedial work bolster and encourage girls. Experts recommend extra “lab time” for practice and attention to learning styles so that no girl is left behind. Certainly male as well as female teachers have the opportunity to provide praise, support, and make a positive difference for female students. Occasionally, an educator will feel like boys are left out when there is a focus on girls. The erroneous idea occurs when fearing that “more girls” in STEM programs

means “fewer boys.” This is simply not the case. What we hope for is “more students” in STEM overall, with a growing proportion of girls.

Figure 2 illustrates the STEM programs/career pathways which attendees indicated they would like targeted to increase female participation.

“Figure 2”



Lead by Example

Presentations at the workshop revealed positive numbers for girls in STEM enrolled in Hillsborough County Career Academies, and this positive finding suggested strategies for engaging and retaining these girls which are characteristics of the study cohorts. Just a few ideas included consistent outreach to girls in feeder schools, parental involvement with schools, extracurricular as well as in-school activities, problem-based and project-based learning, and an early start.

Table 2 highlights a selection of teachers’ responses to the question, “*What will you do, personally, as a result of becoming more aware of individual, group, and/or societal influences regarding “Women in STEM?”*”

Table 2.

Continuously incorporate activities that empower the female students to desire to be involved in science and mathematics
Remain abreast of the current research being conducted by scientists, particularly females, which will encourage girls to pursue STEM careers
"Spread the word" - invite parents and girls to be inform about STEM for girls program at school
Recruit specific speakers for the Great American Teach-in targeted to STEM and actively seek out women in these fields to visit as guest speakers and mentors

Attend seminars and workshops focused specifically on increasing female participation in STEM-related careers
Prepare and encourage students to attend community and four year colleges and matriculate in STEM related career fields
Counteract negative influences regarding gender: peer pressure to act dumb, cultural mandates like getting married soon, etc.
Make sure to represent STEM careers effectively when talking with students about possible career choices

The “all female” panel of experts was perhaps the most popular part of the workshop. Representing the University of South Florida (College of Engineering and Department of Orthopedics & Sports Medicine at the Sports Medicine and Athletic Related Trauma Institute), Southern Manufacturing Technologies, and the Tampa Electric Company, these women inspired attendees and were mentioned by name in several submitted implementation plans from attendees for programs at their school. A student from a local high school also sat on the panel and represented the perspective of a female student’s experiences and challenges pursuing STEM subjects through middle and high school. The presence and perspective from faculty and student from the local state university, USF, was well received. Teachers reported appreciating the openness, interaction, and variety of perspectives provided by the panel during the question and answer session.



Panel Moderator: Sabrina Peacock, Hillsborough Community College. Panel Members left to right: Shannon Sweatman, Southern Manufacturing Technologies, Barbara Austin, University of South Florida, Sidney Luzier (student), Strawberry Crest High School, Dr. Patricia Zarate, University of South Florida (from left to right). Not pictured: Vonia Walther, Tampa Electric Company.

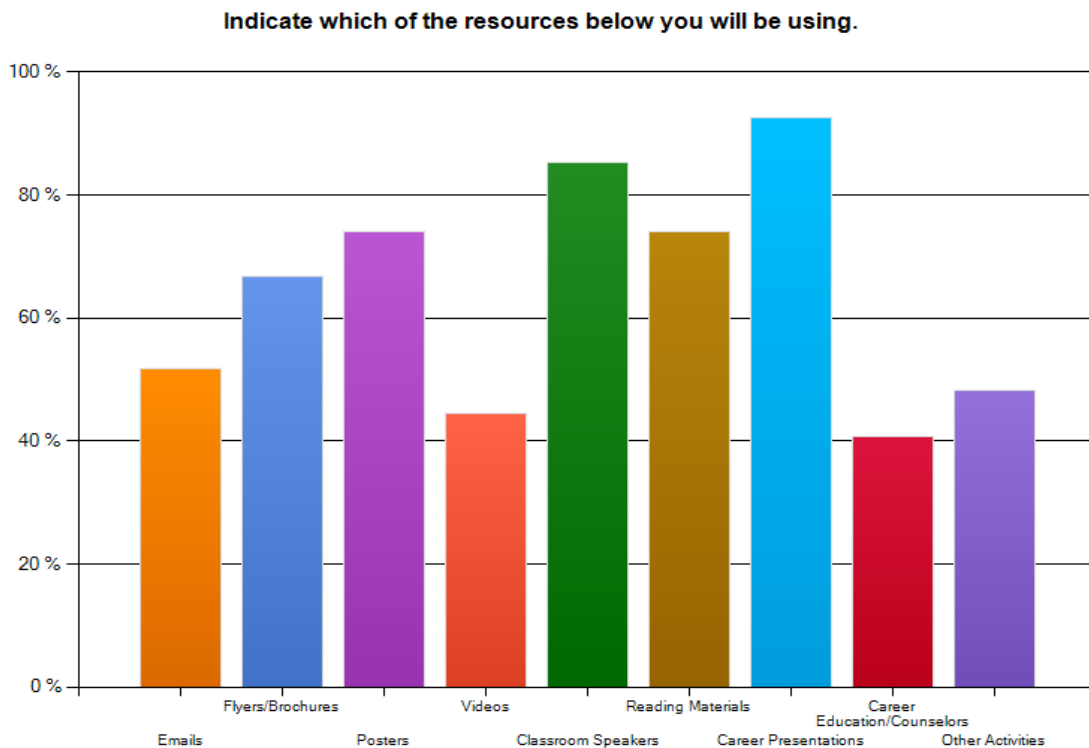
Using the strategies learned at the workshop and the implementation plan template provided by FLATE, new programs targeting engaging girls in STEM will lead by example in each school and lead to outcomes data for research surrounding engaging girls, in 2014. Implementation plans included collaboration with other teachers and parents (72%) and STEM professionals and industry experts (77%). All of the submitted plans emphasized the need to expose girls to professional women in STEM fields to help boost their confidence and to provide

them with real life examples of the kinds of careers available. Thirty eight percent of respondents listed establishing STEM clubs specifically for girls as an excellent way to encourage girls and expose them to aspects of STEM careers that they may not be aware of. Long-term strategies for change included monitoring female students’ academic progress, matching students with STEM mentors in the community, bringing in industry experts to work on science projects with girls, and providing guidance counselors with STEM career information and asking for their support in promoting these careers to female students.

Developing an outreach plan is an essential component of any implementation plan, and respondents were asked to list the resources they would utilize to develop a plan for outreach materials for their program. Figure 3 displays the responses aggregated from the submitted implementation plans. Career presentations and classroom speakers ranked the highest, and are relatively low cost and easy to implement by most teachers. The “Other” activities portion of the chart included using the resources found on the FLATE [wiki site](#), including a variety of hands-on, STEM-themed lesson plans and information, to engage students with real-world scenarios relevant to their lives.

Figure 3 shows the resources teachers indicated that they would utilize to develop a plan for outreach materials for their program.

“Figure 3”



Selected exemplary plans are included in the Appendix. A follow-up survey is planned for February 2014 to find out how these teachers’ plans are progressing, as well as challenges they have faced and continue to face as they move forward in their efforts to recruit more girls to STEM careers.

Appendix



Resources for Engaging Girls in STEM

From the White House, April 2012

"Knowing that your ideas...might change the future is something that I like," says Eva, a high school student from California, who is featured in a recent video released by the White House Council on Women and Girls. *Girls in STEM*, featuring young women scientists and engineers who wowed the President and the nation at the White House Science Fair in February 2012, shines a spotlight on these extraordinary young role models and their exciting projects. <http://www.whitehouse.gov/photos-and-video/video/2012/04/24/girls-stem-new-generation-women-and-science>

National Institute for Women in Trades, Technology & Science | IWITTS - The National Institute for Women in Trades, Technology and Science: helping educators close the gender gap. www.iwitts.org/

Proven Practices – Research summary results for Best Practices in recruiting girls into advanced technologies. <http://www.stemrecruiting.org/>

STEM Equity Pipeline – Resources and free online webinars on research and recruiting best practices. www.stemequitypipeline.org

National Girls Collaborative Project – Collaborative of organizations and activities throughout the US focused on recruiting and retaining girls in STEM professionals. www.ngcproject.org/

American Association of University Women (AAUW) – Advocacy organization for women equity resource page for STEM for girls. <http://www.aauw.org/what-we-do/stem-education/>

Siemens STEM - Home - The nation's first online community designed exclusively to foster achievement in science, technology, engineering and math through the collaboration of STEM. On this website you will find: www.siemensstemacademy.com

Resources for Women in Science and Engineering – a huge variety of great information and resources. <http://www.engineeringedu.com/wieres.html>

STEM Career Expo Posters – a selection of ready to print posters with text that can be edited for your event. <http://ed.fnal.gov/programs/careerfair/posterpage.html>

National Women's History Project - Founded in 1980, the NWHP is an educational nonprofit organization whose mission is to recognize and celebrate the diverse and historic accomplishments of women by providing information and educational materials and programs. <http://www.nwhp.org/>

Women in Science: Why So Few? – A great video from the Huffington Post. http://www.huffingtonpost.com/2012/02/06/women-in-science_n_1256479.html

Girls like STEM! Introduce a Girl to Civil Engineering during Engineers Week. Article. <http://blogs.asce.org/prblog/2013/01/04/girls-like-stem-introduce-a-girl-to-civil-engineering-during-engineers-week/>

[Top Ten STEM RESOURCES \(Plus More\) \(From NSTA Philadelphia\)](#)

Many activities can be found on this site. Which do you think your female students will find most appealing? Constructing a list of key terms to create a study guide is always a plus when introducing a new topic to students of all ages. You can adapt an activity to include more math by recording results on a chart and analyzing the results.

Girl Start – Resources for girls, parents, volunteers, and educators. www.girlstart.org

Nanooze - Explore the science and technology of nanotechnology. www.nanooze.org

Ruff - Promotes science, engineering, and the jobs which support them through fun for kids 8-10. Engineering - Go for It! <http://pbskids.org/fetch/>

PBS Design Squad Educator's Guide - Hands on challenges, which bring engineering alive for kids. Designed for 9-12 year olds. <http://pbskids.org/designsquad/parentseducators/index.html>

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Robot Arm Exercise & Resources <http://curiosity.discoveryeducation.com/teachers.cfm>
http://www.ieee.org/documents/Build_Your_Own_Robot_Arm_Lesson_Plan102364.pdf

Tri-IT - A unique, high-tech initiative designed to provide high school girls opportunities to participate in interactive technology experiences and cultivate their interest in information technology (IT) careers. Visit the t3girls web site for a wealth of information and curriculum resources. <http://www.t3girls.com/>

[STEM Career Resources](#)

You can research many science, technology, engineering and mathematics related careers through these sites. They include information on trends, education, salaries, nature of the work, tasks, knowledge and skills needed.

- [Careers in Science and Engineering](#). A Student Planning Guide to Grad School and Beyond, National Academies Press, 1996.
- [NOVA The Secret Life of Scientists and Engineers](#)
- [O*NET OnLine STEM Career Clusters](#)
- [Occupational Outlook Handbook](#), U. S. Department of Labor, 2010-11 Edition.
- [Science Buddies: Careers in Science](#)
- [Sloan Career Cornerstone](#)



Visit the FLATE wiki site to download free [MadeinFlorida](#) Lesson plans designed to enrich STEM and browse through many other great resources.

Also visit FLATE on the web at:

www.fl-ate.org

www.madeinflorida.org

www.flate-mif.blogspot.com



Workshop Assignment - Recruiting Girls for STEM Pathways

Please respond to the following questions. All responses must be submitted ...

***1. Name:**

***2. School / College:**

***3. Email:**

Please respond to the following questions. All responses must be submitted ...

Develop a plan for increasing participation of female students to STEM program(s) in which women/girls are under-represented. If you convince others to carry out these strategies, describe how you will persuade them to do this, what data you will use, and who else can help you facilitate this process.

***4. Which STEM programs/career pathways are you targeting to increase female participation?**

***5. How will you involve female role models and who might you use specifically?**

***6. What data from your school and/or district do you have to show the percentage of female students in STEM-related programs to support wider participation among educational professionals with whom you work?**

***7. What types of encouragement/influence will you use within your classroom and with other educational professionals?**

***8. What will you do, personally, as a result of becoming more aware of individual, group, and/or societal influences regarding "Women in STEM?"**

Workshop Assignment - Recruiting Girls for STEM Pathways

What are your short-term (up to 12 months) strategies for change?

Please make sure that these correspond with your target audience and include action steps, who is responsible for each step and a timeline for each strategy.

***9. Strategy 1**

***10. Please indicate your Action Steps (1-3) below:**

***11. Strategy 2**

12. Please indicate your Action Steps (1-3) below:

What are your short-term (up to 12 months) strategies for change?

13. Strategy 3

***14. Indicate your Action Steps (1-3) below:**

***15. What long-term strategies do you want to keep in mind for implementation beyond 12 months?**

GOAL: Develop a plan for outreach materials for your program

You may use pre-made materials such as those that can be found via the STEM resources or you may prefer to develop materials on your own. Describe what you will be using and to whom these will be directed (students and/or parents and/or other professionals).

Workshop Assignment - Recruiting Girls for STEM Pathways

16. Indicate which of the resources below you will be using.

- Emails
- Flyers/Brochures
- Posters
- Videos
- Classroom Speakers
- Reading Materials
- Career Presentations
- Career Education/Counselors
- Other Activities

17. Expand on the resources you have indicated you will use including to whom they will be directed.

18. Thank you for your support and participation - we will be contacting many of you in early 2014. Stipends will be mailed out by the end of December 2013. If you have any questions, please don't hesitate to contact me (Nina Stokes) at nstokes@fl-ate.org or (813) 259-6587.

Please use the area below to add any other comments.