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ddess

STEM Connections

DDESS Focused on STEM

Sonya Gates

As a way to ensure that military students are globally competitive and ready for tomorrow's workforce, DDESS schools are improving instruction and providing a solid foundation in science, mathematics, engineering and technology (STEM) through the implementation of STEM/STEAM focused schools. STEM/STEAM focused schools are 21st Century learning communities of students and teachers that focus on the curricular integration of Science, Technology, Engineering, (Art), and Math (STEM/STEAM) to create critical thinkers and problem solvers for the future. Students receive a rigorous, well-rounded standards-based education with an engineering design instructional approach. The foundation of the curriculum is the Engineering Design Process (EDP), which allows students to work on design challenges that integrate math, science, technology and other core content areas through an interdisciplinary approach.

During SY 2011-12, DDESS piloted three STEM/STEAM focused schools: Jackson ES (Kentucky) with a focus on STEM; and Shughart ES and Shughart MS in North Carolina with a focus on STEAM. The schools used Engineering is Elementary, a research-based curriculum to integrate STEM into the existing science curriculum. Schools chose their method of implementation based on the needs of their student population. After the first year of implementation, initial assessment showed an increase in excitement and awareness among all stakeholders and gains in science and math student achievement on the Terra Nova for 3rd and 5th grades.

This year 16 elementary schools have volunteered to have a STEM/STEAM focus. These new schools are: ***Kentucky Schools***: McDonald, Barsanti, Barkley, Lincoln, Lucas, Marshall; ***Georgia/Alabama***: Maxwell AFB, Fort Rucker ES, White; ***FT Stewart/South Carolina***: Diamond; ***North Carolina***: Tarawa Terrace, Bitz; and **New York/Virginia/Puerto Rico**: Ramey, Dalgren, West Point ES, West Point MS (5th Grade). STEM training for leadership was conducted during the summer to build a common understanding and knowledge about STEM and the engineering design process. District ISS are providing professional development for teachers involved in the STEM implementation at the school level.

The DDESS STEM focus is designed to help all students develop age-appropriate habits of mind and 21st Century skills. STEM and the engineering design process build on students' prior knowledge and experiences, helping students collaborate, create and apply problem solving strategies in new contexts. An increase understanding of these skills are essential to students becoming lifelong learners, highly skilled workers and informed digital citizens in the 21st Century.

In this issue..

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Engaging Girls in STEM

The number of girls engaging in science, technology, engineering and math (STEM) is growing, but based on statistics gathered by the *National Girls Collaborative Project*, they are not choosing STEM careers at a consistent rate. The gap may lie in whether they engage in science at an early age and continue their engagement and interest as they move through the formal school system. The following are some statistics according to U.S. Department of Commerce Economics and Statistics Administration:

- Although women fill close to half of all jobs in the U.S. economy, they hold less than 25 percent of STEM jobs. This has been the case throughout the past decade, even as college-educated women have increased their share of the overall workforce.

- Women with STEM jobs earned 33 percent more than comparable women in non-STEM jobs – considerably higher than the STEM premium for men. As a result, the gender wage gap is smaller in STEM jobs than in non-STEM jobs.

- Women hold a disproportionately low share of STEM undergraduate degrees, particularly in engineering.

- Women with a STEM degree are less likely than their male counterparts to work in a STEM occupation; they are more likely to work in education or healthcare.

There are many possible factors contributing to the discrepancy of women and men in STEM jobs, including: a lack of female role models, gender stereotyping, and less family-friendly flexibility in the STEM fields. Regardless of the causes, the findings of this report provide evidence of a need to encourage and support women in STEM.

Read the report: Women in STEM: A Gender Gap to Innovation

Introduce a Girl to Engineering Day-*February 21, 2013*

More than just one day, Introduce a Girl to Engineering is a national movement that shows girls how creative and collaborative engineering is and how engineers are changing our world.

Order your 2013 Girl Day kit and sign the 2013 Pledge Rooster

Resources

Engineer Your Life

Hands-on activities

Experiments for young girls

Resources for Girls, Teachers, Parents

Three Cheers for Engineers! student pamphlet

Girl Day Event Archives

Looking for inspiration?
Watch this
Girl Day video

Online Resources

Girl Scouts and STEM National Programs
(1st-12th)

Girl Scouting encourages girls of all ages by offering "fun with purpose" through its K–12 national program. The Girl Scout program includes two curriculum resources: National Leadership Journeys and National Proficiency Badges.

Girls Go Tech
(1st-12th)

Girls Go Tech is a gateway for young girls of all backgrounds to discover careers and organizations which will engage and education them in STEM fields.

Brain Cake
(6th-12th)

Working with girls age 11 - 17 and their parents, teachers, and mentors, Brain Cake draws organizations, stakeholders, and communities together in an effort to ensure that girls succeed in math and science.

SciGirls
(4th-9th)

SciGirls aims to increase engagement among young women in different fields of science by providing information on oceans, technology, machines, earth science, mathematics, environmental science, and athletic science.

Engineer Girl
(6th-12th)

The EngineerGirl website is part of an NAE project to bring national attention to the opportunity that engineering represents to all people at any age, but particularly to women and girls.

Campbell High School Students Embark on STEM Courses

by Lillian Butler, CTE Teacher Ft. Campbell

This is the second year FT Campbell is offering Green Technology Engineering and the first year to offer Robotics. The focus of both STEM courses is to learn the Engineering Design Process (EDP) which teaches students to solve problems that require a developed product as the solution.

The EDP teaches students how to identify the problem, define the criteria and constraints of the problem, brainstorm possible solutions, develop ideas, evaluate the possibilities and then select an approach. Students are presented with a goal and problem. They must research and brainstorm possible solutions to solve their problem and reach their goal. After the approach is selected, the teams build and test a prototype and then document and present their findings. The EDP is a problem-solving model that allows students to revisit steps at any time during the development of the solution. It requires students to work collaboratively as a team and develop 21st Century workplace readiness skills such as decision making, computer literacy, independence, initiative, and self-presentation.

Students use the following steps in the EDP to solve real world problems:

1. Define (Understanding)
   - ⇒ Identify the Problem
   - ⇒ Identify Criteria and Constraints
2. Ideate (Brainstorming)
3. Plan
   - ⇒ Develop Ideas
   - ⇒ Evaluate Possibilities
4. Create (Building)
   - ⇒ Select an Approach
   - ⇒ Build a Model and Prototype
5. Test and Refine
   - ⇒ Solve
   - ⇒ Document and Present
   - ⇒ Manufacture/Scale up

Currently, the Green Technology course has 27 students enrolled. These students will study renewable (alternative) energy systems to include wind, solar, hydrogen/fuel cells, biomass, and hydroelectricity. Students use kits to build and test models. Some of the models students will build and test are wind turbines, fuel cell cars, water wheels, solar cars, solar ovens, and a house powered by renewable energy. Students also design and test their own green technology prototypes geared toward solving a real world energy problem. These alternative energy delivery systems will be created once teams work through the steps of the EDP and research the energy system.

During last year's STEMposium, Ft Campbell students were introduced to robotics. Because of student interest, the school has added three classes of robotics with 49 students enrolled. These students are using robotic engineering as the vehicle to learn the EDP. In this course students learn about electronic systems, structural design, simple and complex machines, robotic fundamentals, and robotic programming. They also learn to use microcontrollers and sensors to perform tasks. Ultimately, students are challenged to use the engineering design process to construct robots that will perform specific tasks to solve a real world problem.

To make connections to content taught in class, students from both STEM courses will participate in study trips. These trips will give students a better perspective of the types of skills students will need to enter STEM careers, the need for more renewable energy systems and the impact of robotics in daily lives. This year the green technology class will visit the local landfill to learn about methane gas production, a hydroelectric dam to learn how electricity is generated from water and a local business that is using solar energy. The robotics classes plan to visit at least one local manufacturing company that uses robotic technology and visit a local university that offers a robotic related manufacturing degree program.

The classes will be an integral part of the school and district's week long STEMposium with a focus on the EDP. Students are also investigating the possibility of organizing a team to enter the Murray State University TEAMS (Tests of Engineering Aptitude, Mathematics and Science) competition in February. Students at Ft Campbell are excited about the new STEM opportunities at their school and are looking forward to a great year!

STEM Resources

With the plethora of resources available regarding STEM education, it can be daunting to know where to begin your search. The sites listed are intended to be a helpful starting point for learning about STEM, getting ideas for lesson plans, finding STEM resources, and discovering opportunities for all ages to engage in STEM.

DEPARTMENT OF DEFENSE STEM PROGRAMS	
eCYBERMISSION - sponsored by the U.S. Army and managed by the Research, Development and Engineering Command, the competition is designed to share the importance of Science, Technology, Engineering and Mathematics (STEM) education with the leaders of tomorrow and encourage them to understand the real-life applications of these subjects. The competition is open to all states, territories, and DoDEA, which is considered as a state for this competition.	*https://www.ecybermission.com/*
The Junior Science Humanities Symposium –sponsored by the Armed Forces the program is designed to encourage and recognize the next generation of scientific talent. Sponsors include the Office of the Assistant Secretary of the Army (Acquisition, Logistics & Technology), the Office of Naval Research, and the Air Force Office of Scientific Research, in cooperation with higher education.	http://www.jshs.org/
MATHCOUNTS Reel Math Challenge- sponsored by the Department of Defense is an innovative program involving students using cutting-edge technology to create videos about math problems and their associated concepts. The Reel Math Challenge allows students to hone creativity and communication skills in a math setting. These skills are not typically the focus of most traditional math classroom activities, yet they are essential for success in future STEM careers.	http://www.reelmath.org/about-reel-math-challenge
National Defense Education Program LabTV-includes video episodes that demonstrate the amazing research that is everyday work at DoD labs. We are in the process of aligning the videos to science lessons for classroom use. *DVR/CD sets of these videos are available upon request.	http://ndep.us/LabTV
West Point Bridge Design Contest-the purpose of the contest is to provide middle school and high school students with a realistic, engaging introduction to engineering.	http://bridgecontest.usma.edu/
REAP- encourages high school students, 16+ years of age, to pursue careers in math, science and technology through hands-on experience in research and development. REAP apprentices are high-school age students selected for their interest in science, technology, engineering and mathematics (STEM). Special consideration is given to under-represented groups. REAP apprentices typically spend a summer in a university research program under the guidance of a professional mentor.	www.aas-world.org
The Education Arcade-based out of the Massachusetts Institute of Technology (MIT) and supported by DoD, explores games that promote learning through authentic and engaging play.	*www.educationarcade.org*
Lure of the Labyrinth- is a digital game for middle-school pre-algebra students. It includes a wealth of intriguing math-based puzzles wrapped into an exciting narrative game in which students work and actually think like mathematicians.	http://labyrinth.thinkport.org/www/educators.php

The SciGirls Seven

Proven Strategies for Engaging Girls in STEM

http://www.pbs.org/teachers/includes/content/scigirls/print/SciGirls_Seven.pdf

The **SciGirls** approach—for the TV show, website, and educational materials—is rooted in research about how to engage girls in STEM. A quarter of a century of studies have converged on a set of common strategies that work, and these have become **SciGirls**' foundation. We call these strategies the **SciGirls Seven.**

1. Girls benefit from collaboration, especially when they can participate and communicate fairly. *(Fancsali, 2002; Parker & Rennie, 2002)*

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

2. Girls are motivated by projects they find personally relevant and meaningful. *(Eisenhart & Finkel, 1998; Liston, Peterson, & Ragan, 2008; Thompson & Windschitl, 2005)*

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

3. Girls enjoy hands-on, open-ended projects and investigations. *(Burkam, Lee, & Smerdon, 1997; Chatman, Nielsen, Strauss, & Tanner, 2008; Fancsali, 2002)*

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

4. Girls are motivated when they can approach projects in their own way, applying their creativity, unique talents, and preferred learning styles. *(Calabrese Barton, Tan, & Rivet, 2008; Eisenhart & Finkel, 1998)*

Encourage girls to develop their own ways of exploring and sharing knowledge, paying attention to the unique learning styles that motivate your group. You may be

surprised by what creative, exciting approaches girls come up with when designing investigations, collecting data, and communicating results.

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

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

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

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

7. Girls benefit from relationships with role models and mentors. *(Evans, Whigham, & Wang, 1995; Liston et al., 2008)*

Seeing women who have succeeded in STEM helps inspire and motivate girls, especially when they can relate to these role models as people with lives outside of the lab. Role models and mentors not only broaden girls' views of who does science, but expand girls' vision of what's possible in their own lives.