stem at the United States Naval Academy

March 2013

science
technology
engineering
mathematics

Persuading more young people to pursue careers in science, technology, engineering, and mathematics

And engaging our own midshipmen in quality STEM programs and outreach to the community.

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Aaron Arellano

Joyce Kim

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Quinton Calmus

midshipmen SPOTLIGHT

This January four midshipmen travelled to Tulsa, Oklahoma, to train and assist local teachers in a SeaPerch Build and competition. USNA has aligned with the Tulsa Alliance for Engineering to serve underrepresented schools. MIDN Arellano, Kim, Williams, and Calmus accompanied Profs Gwen Gray, Beth Mutch and Angela Moran of the STEM Office on the trip, interacting with 50 teachers and 60 students. About 40 teachers were trained in an earlier visit and the Alliance estimates the student impact in the thousands.

Jon Williams:

Name: Jon Williams
Company: 26
Hometown: Hyattsville, MD
Major: Physics & Math
MSTEM Position: President

"I have participated in SeaPearch Trainings and Competitions, the USA Science and Engineering Festival, the Astronaut Convocation, and Candidate Visit Panel Discussions.

The USA Science and Engineering Festival was my favorite event because our STEM booth had some fun activities and there was a bunch of other exciting things to do and well known people there like the MythBusters and Bill Nye the Science Guy.

STEM has been a fun way to pass on my knowledge to others and inspire them to learn more."

Astronauts visit USNA

A visit from NASA astronauts to USNA on January 14, 2013 made for an informative and engaging evening for over 30 local high school students, representing the 12 area high schools.

This annual convocation included NASA Administrator Charles Bolden (USNA '68) and astronauts Mike Lopez-Alegria (USNA '80), Stephen Bowen (USNA '86), Robert Cabana (USNA '71), and Frank Culbertson (USNA '71). The invited high school students began the evening by meeting and talking with the astronauts individually. The students had dinner and participated in organized discussion about the history and purpose of the United States space program.

These discussions were guided by STEM Midshipmen. Questions ranged from the practical – What are some material gains of space travel – to the abstract – Why should there be manned space travel?

The discussion served as intellectual stimulation prior to the convocation panel. All the speakers touched on the history of manned space flight, but the main focus of the presentation was the future. Questions of the role of commercial space flight were balanced with a desire for exploration and scientific discovery. Speakers touched on plans to travel back to the moon, land on an asteroid, and even eventually have a manned mission to Mars.

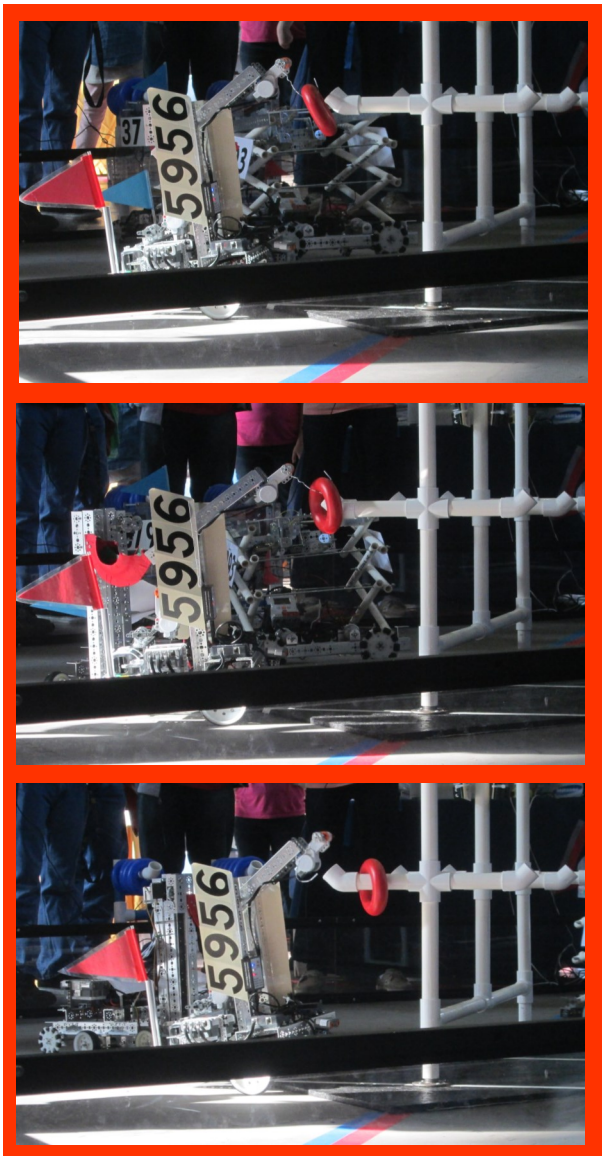
"Your generation will be a big part of this. We've demonstrated our ability to use technology to go places that nobody's ever gone before. We should continue to do that. Your generation will take us to these places."

Pictured above: High School Students and STEM Midshipmen who participated in the evening's events.

robotics tournament

On January 12, 2013, the U.S. Naval Academy hosted an all day STEM initiative to showcase the innovation, research, and robotics designs of regional teams based on rubrics from not-for-profit FIRST (For Inspiration and Recognition of Science and Technology), an Organization founded to inspire young people's interest and participation in science and technology. There were over 200 participants from regional schools, and over 25 Midshipmen volunteers.

There were several robotics competitions occurring that Saturday. Younger students participated in the LEGO First Robotics League, where they learned basic programming and design while being mentored by students in the sciences (including midshipmen.) There were 26 teams of K-3rd graders and 7 teams of 4th—8th graders. Each team research a specific topic and build a model from LEGOs which included a moving part and at least one of example of a "simple machine."



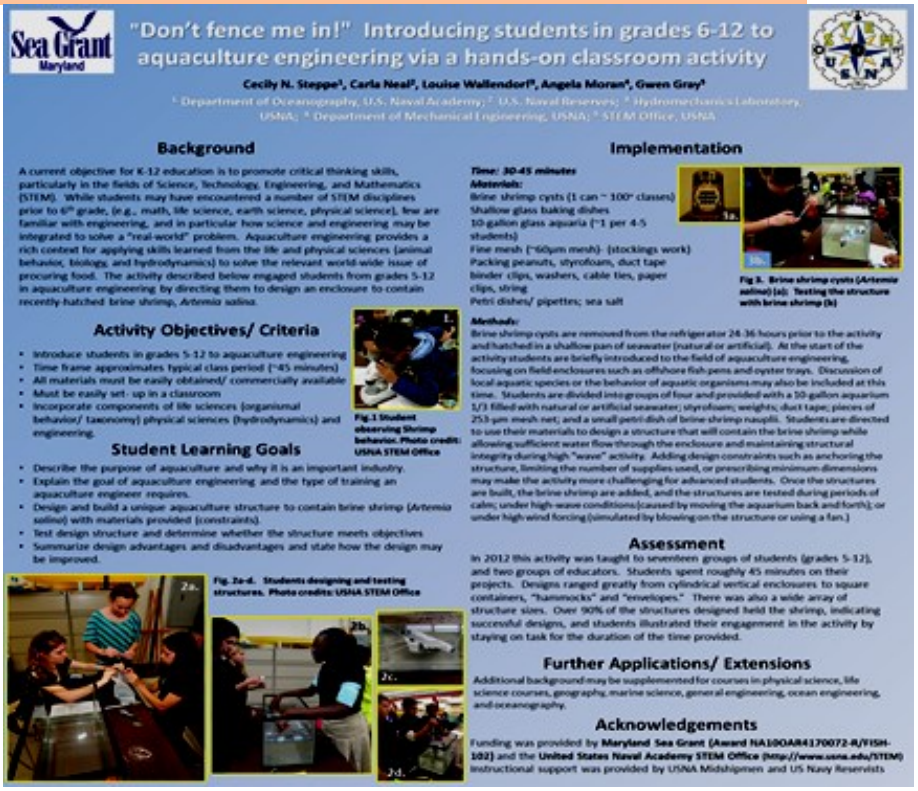
28 teams of high school students came to the event to demonstrate and test the robots they had built, designed, and programmed over the course of several months leading up to the competition. The challenge had several components: (1) an autonomous challenge, where the robots had to be pre-programmed to navigate a particular scenario, (2) a timed challenge mode where teams competed against one another to move rings to particular locations, and (3) teams were judged on design. Pictured to the left is the successful completion of one of the challenges.

faculty travel

Our STEM Mascot

STEM Professors Mark Murray, Pat Moran and Angela Moran spent a long weekend at the naval station in Pensacola, training SeaCadet Leaders, NJROTS leaders, 4H Club Directors and Navy League Volunteers on Underwater Robotics design and build methods. Completed robots were tested in the water survival tank. The trip also included a tour of the National Flight Academy, an immersion experience for students on a simulated aircraft carrier and discussion on Navy collaborations.

Poster presented by STEM Professor Cecily Steppe at the World Aquaculture Society Meeting In February, reflecting the Aqua - culture Engineering module created for STEM camps.



Sea Grant Maryland

"Don't fence me in!" Introducing students in grades 6-12 to aquaculture engineering via a hands-on classroom activity

Cecily N. Steppe[1], Carla Neal[2], Louise Wallendorf[3], Angela Moran[4], Gwen Gray[3]

[1] Department of Oceanography, U.S. Naval Academy; [2] U.S. Naval Reserves; [3] Hydromechanics Laboratory, USNA; [4] Department of Mechanical Engineering, USNA; [5] STEM Office, USNA

Background

A current objective for K-12 education is to promote critical thinking skills, particularly in the fields of Science, Technology, Engineering, and Mathematics (STEM). While students may have encountered a number of STEM disciplines prior to 6th grade, (e.g., math, life science, earth science, physical science), few are familiar with engineering, and in particular how science and engineering may be integrated to solve a "real-world" problem. Aquaculture engineering provides a rich context for applying skills learned from the life and physical sciences (animal behavior, biology, and hydrodynamics) to solve the relevant world-wide issue of procuring food. The activity described below engaged students from grades 5-12 in aquaculture engineering by directing them to design an enclosure to contain recently-hatched brine shrimp, *Artemia salina*.

Activity Objectives/ Criteria

- Introduce students in grades 5-12 to aquaculture engineering
- Time frame approximates typical class period (~45 minutes)
- All materials must be easily obtained/ commercially available
- Must be easily set- up in a classroom
- Incorporate components of life sciences (organismal behavior/ taxonomy) physical sciences (hydrodynamics) and engineering.

Fig.1 Student observing Shrimp behavior. Photo credit: USNA STEM Office

Student Learning Goals

- Describe the purpose of aquaculture and why it is an important industry.
- Explain the goal of aquaculture engineering and the type of training an aquaculture engineer requires.
- Design and build a unique aquaculture structure to contain brine shrimp (*Artemia salina*) with materials provided (constraints).
- Test design structure and determine whether the structure meets objectives
- Summarize design advantages and disadvantages and state how the design may be improved.

Fig. 2a-d. Students designing and testing structures. Photo credits: USNA STEM Office

Implementation

Time: 30-45 minutes

Materials:

Brine shrimp cysts (1 can ~ 100 classes)
Shallow glass baking dishes
10-gallon glass aquaria (~1 per 4-5 students)
Fine mesh (~60µm mesh)- (stockings work)
Packing peanuts, styrofoams, duct tape
binder clips, washers, cable ties, paper clips, string
Petri dishes/ pipettes; sea salt

Fig 3. Brine shrimp cysts (*Artemia salina*) (a); Testing the structure with brine shrimp (b)

Methods:

Brine shrimp cysts are removed from the refrigerator 24-36 hours prior to the activity and hatched in a shallow pan of seawater (natural or artificial). At the start of the activity students are briefly introduced to the field of aquaculture engineering, focusing on field enclosures such as offshore fish pens and oyster trays. Discussion of local aquatic species or the behavior of aquatic organisms may also be included at this time. Students are divided into groups of four and provided with a 10-gallon aquarium 1/3 filled with natural or artificial seawater; styrofoam; weights; duct tape; pieces of 253-µm mesh net; and a small petri dish of brine shrimp nauplii. Students are directed to use their materials to design a structure that will contain the brine shrimp while allowing sufficient water flow through the enclosure and maintaining structural integrity during high "wave" activity. Adding design constraints such as anchoring the structure, limiting the number of supplies used, or prescribing minimum dimensions may make the activity more challenging for advanced students. Once the structures are built, the brine shrimp are added, and the structures are tested during periods of calm; under high-wave conditions (caused by moving the aquarium back and forth); or under high-wind forcing (simulated by blowing on the structure or using a fan.)

Assessment

In 2012 this activity was taught to seventeen groups of students (grades 5-12), and two groups of educators. Students spent roughly 45 minutes on their projects. Designs ranged greatly from cylindrical vertical enclosures to square containers, "hammocks" and "envelopes." There was also a wide array of structure sizes. Over 90% of the structures designed held the shrimp, indicating successful designs, and students illustrated their engagement in the activity by staying on task for the duration of the time provided.

Further Applications/ Extensions

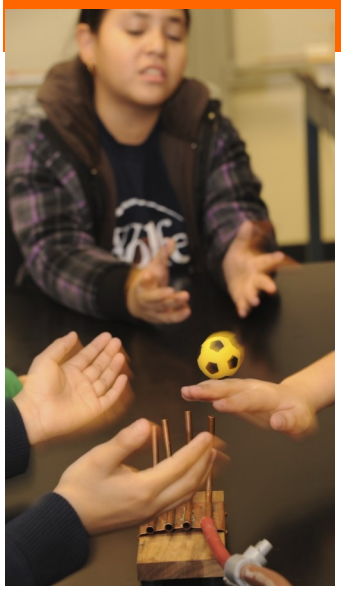
Additional background may be supplemented for courses in physical science, life science courses, geography, marine science, general engineering, ocean engineering, and oceanography.

Acknowledgements

Funding was provided by **Maryland Sea Grant (Award NA10OAR4170072-R/FISH-102)** and the **United States Naval Academy STEM Office (http://www.usna.edu/STEM)**. Instructional support was provided by USNA Midshipmen and US Navy Reservists

mini-STEM East Baltimore

100 5th grade students from three different East Baltimore elementary schools traveled to USNA for a mini-STEM on Friday, February 8, 2013. Students experienced hands on project-based modules in Cryptography, Storm-Chasing, Oceaneering, Biometrics, Aquatic Engineering, 3D Design, Fluids, & Robotics!



mini-STEM Philadelphia

The USNA STEM Office hosted a Polar themed mini-STEM for students from five different Middle Schools and High Schools from the Philadelphia area on Friday, February 22, 2013. The mini-STEM offered a chance for several mids to prepare the STEM outreach portion of their upcoming Spring Break research trip to Barrow, Alaska, as part of the USNA Polar Program under the direction of LCDR John Woods. Activities ranged from discussion of the Sea Level Rise, designing buoys, driving SeaPerch through Arctic ice, and engineering challenges which included alternative energy sources and strategies.

SeaPerch/NOAA

Ocean Exploration Workshop

Saturday, February 23, 2013 saw a joint presentation of the SEAPERCH/NOAA Ocean Exploration Workshop by the USNA STEM Office and the National Oceanic and Atmospheric Administration (NOAA – specifically the Office of Ocean Exploration and Research.) This workshop was developed to be both hands-on and informative for teachers and STEM Educators. Thirty (30) teachers – local and from outside Maryland – attended the event where they learned about the NOAA Deep Ocean Explorer unit as well as how to build SeaPerch ROVs.

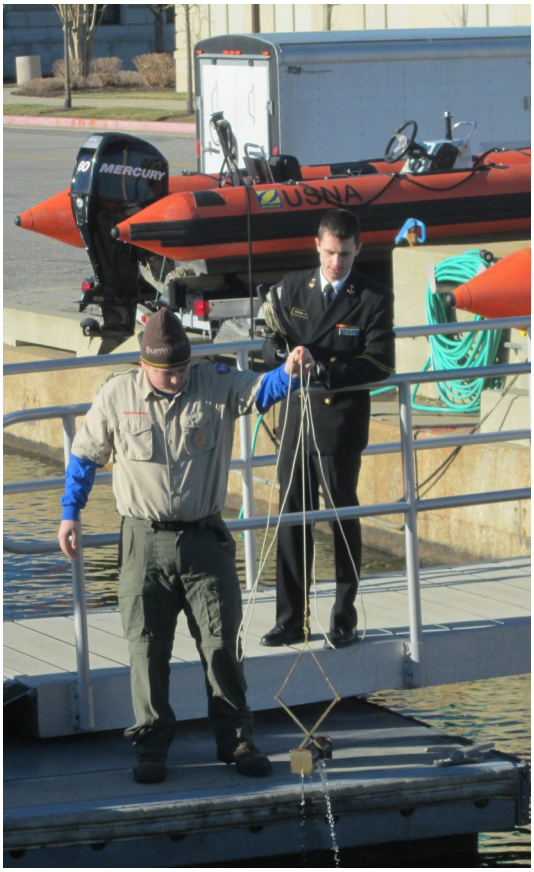
The SeaPerch ROV build was a speed build initiation training. Teachers were instructed on everything from circuit soldering, to the mechanical build of the body of the ROV from PVC pipe, to the wiring of motors and placement of propellors. All of the participants left the workshop with their own SeaPerch and an advanced knowledge of how to teach their students to build their very own underwater tethered robots.

NOAA led the exploration portion of the workshop with discussions ranging from the reasons for ocean exploration to the kinds of technologies that are used to explore the deep ocean. Speakers highlighted the need for exploration to map the water column using tethered ROVs (similar to SeaPerch) due to the fact that currently only 5% of the ocean floor has been thoroughly mapped.

This was the first partnership between NOAA and the USNA STEM Office There is much excitement and hope for more opportunities for partnership in the future.

boyscouts earn STEM Merit Badges

USNA National Eagle Scouts and the STEM Office hosted around 350 scouts for a merit badge weekend on January 19, 2013. In addition to leadership and camping activities, midshipmen and faculty offered 14 STEM merit badges including aviation, computers, engineering, and medicine.



what's next?

- Girls' STEM Day in March
- Science Fairs
- Competitions

Don't forget to look for our special "Spring Break STEM Style"

newsletter highlighting midshipmen STEM spring break adventures and challenges.

In the meantime follow us on the web and LCDR Woods wants to remind you to "like" the USNA STEM Office on Facebook!