Army Educational Outreach Program

STEM Teacher Program Initiative

2013 Annual Program Evaluation Report

ARMY EDUCATIONAL OUTREACH PROGRAM

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ARMY EDUCATIONAL OUTREACH PROGRAM

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Executive Summary

The STEM Teacher Program Initiative (STPI), managed by the University of New Hampshire (UNH), is an Army Educational Outreach Program (AEOP) that supports and empowers educators with Army research and technology resources. In partnership with Harford Community College (HCC) and Army Research Laboratory at Aberdeen Proving Ground (ARL-APG), STPI provides STEM content-based professional development and experiential learning environments for STEM teachers. Additionally, STPI develops relationships between STEM teachers and active/retired Army scientists and engineers (S&Es). STPI programming is focused on the STEM Teachers Academy (STA), a one-week summer STEM course, with sessions from Army S&Es.

In 2013, STA activities engaged Harford County and Cecil County teachers ranging from middle school to high school (6th-12th grades). During STA, teachers received instruction from HCC faculty, Army S&Es, and other local STEM experts in one of three disciplinary track themes—Biology/Chemistry, Engineering, or Earth/Environmental Science. 2013 STA activities also included a lesson planning strand that attended to pedagogical strategies of teaching science through levels of inquiry and engaging students in Scientific and Engineering Practices.[1] STA developers assume that after having an opportunity to apply their new learning in a team-based lesson planning project during STA, teachers will individually apply these learnings to their everyday lesson planning and teaching in their own classroom, as well as serve as leaders in their schools through collaboration with STEM professionals and teachers, offering professional development activities for their peers related to their STA learning, and contributing to school STEM literacy efforts. University of New Hampshire provides 2.0 Continuing Education Units to STA teachers.

This report documents the evaluation of STPI's primary activity, the STEM Teachers Academy. The evaluation addressed questions related to the program's strengths and challenges, perceived benefits to participants, and its overall effectiveness in meeting AEOP and program objectives. The assessment strategy for STPI included post-program questionnaire administered to 2013 STA teachers. A 9-month follow up questionnaire will be administered to 2013 STA teachers in the March-April timeframe. For the purposes of addressing teachers use of STA learning in their classrooms, the 9-month follow up questionnaire administered to 2012 STA teachers is reported here.

Table 1. 2013 STPI Fast Facts	
Major Participant Groups	Middle and high school STEM teachers
Teachers	43
Schools Served	17
Army S&Es	6
Army Research Laboratories	2
Univesity Partners	2
Total Cost	$38,375
Total Awards/Stipends	$12,114

[1] NGSS Lead States (2013) *Next Generation Science Standards*. Washington, D.C.,: National Academies Press; National Research Council (2011) *A Framework for K-12 Science Education*. Washington, D.C.,: National Academies Press

Summary of Findings

The FY13 evaluation of STPI collected data that provided information about STA teachers, their perceptions of program activities, benefits to teachers, and utility of STA learning and materials in their teaching context. The 9-month post-STA follow-up questionnaire for 2012 STA teachers provides additional information about teachers' actual use of STA learning in their teaching contexts. The findings summarized Table 2 are intended to highlight the overall effectiveness of STPI in meeting AEOP and program objectives and inform recommendations future programming.

Table 2. 2013 STPI Evaluation Findings	
Study Sample and Respondent Profiles	
Teacher participation in STA evaluation yielded variable confidence in the findings.	• The statistical reliability achieved for 2013 STA teachers approach an acceptable level and suggest adequate representativeness of the population. The larger margin of error for 2012 STA teachers suggests less representativeness. The 2012 STA teacher data contributes valuable perspective to understanding the impact of STA beyond the one-week summer institute, however, any findings should be cautiously generalized with consideration given to the margin of error.
STA attracts teachers with varied teaching contexts.	• STA teachers serve a range of middle and high school grade levels, teach courses across the fields of science, technology, and mathematics, and include beginning/early-, mid-, and late-career teachers.
STA has limited success with providing outreach to teachers that serve populations historically underserved in STEM.	• All teachers (100%) reported that they do not teach in Title-I schools. Historically, Title-I schools serve more students who are historically underserved and underrepresented in STEM (e.g., low-income and racial and ethnic minority groups) as compared to non-Title-I schools.
Actionable Evaluation Findings	
STA teachers value opportunities to collaborate with and learn from STEM professionals and teachers; STA topics such as incorporating inquiry, science and engineering practices, hands-on, and real-life applications of STEM are important issues for STEM literacy in schools.	• Teachers listed a number of program structures, resources, and activities with which they were most satisfied. Most frequently, teachers reported satisfaction with Aquaponics, collaborative work (e.g., lesson planning) with their peers, and expert presentations.
	• Teachers described a range of topics, tools, and strategies that would be most adaptable to their classroom lessons. Aquaponics (40%) and iTree (20%) were the most frequently cited.
	• Teachers most frequently reported that STA materials supporting the incorporation of inquiry lessons, scientific and engineering practices, and hands-on activities were most suitable and important for professional development activities and for supporting STEM literacy efforts at their school. Similarly, teachers also perceived that utilizing STEM professionals to better connect classroom learning to real-life STEM applications was important.
	• Teachers reported that the most valuable part of the lesson planning project/presentation were the opportunities to collaborate with other teachers (and across different grade levers) and STEM professionals.

Outcomes Evaluation Findings	
STA teachers perceived growth in their STEM literacy.	• Teachers' retrospective pre-post self-assessments suggest that teachers generally felt they gained understanding in concepts and practices, current research, and everyday issues and applications of the disciplines they studied in STA.
	• Most 2012 STA teachers (92-100%) credit STA with improving their knowledge, learning, or confidence in energy and environmental literacy.
STA teachers perceived growth in their understanding and confidence to engage students in inquiry and practices through STEM lessons and teaching.	• Teachers' retrospective pre-post self-assessments suggest that teachers generally felt they gained understanding of and confidence to apply discipline-specific laboratory activities and research projects, levels of inquiry, Scientific and Engineering practices to their teaching.
STA teachers intended to adapt their STA learning for their classroom contexts; some 2012 STA teachers reported doing so.	• The majority of teachers (80-91%) intended to apply their learning across the broad categories targeted in STA in their everyday lesson planning and teaching: teachers intend to incorporate concepts (88%), Scientific and Engineering Practices (82%), levels of inquiry (91%), and suggested laboratory activities and research projects (82%).
	• Many 2012 STA teachers applied their STA learning of energy and environmental literacy to their own teaching practice: teachers developed (energy, 84%; environmental, 85%) and implemented (environmental, 69%; energy, 84%) in the classroom.
STA teachers are encouraged to and have identified potential collaborations with STEM professionals; some 2012 STA teachers reported doing so.	• The majority of teachers (82%) reported that STA encouraged them to collaborate with STEM professionals. Three teachers identified possible collaborations with Harford County Government, Harford Science Society, and Senior Engineers.
	• Many 2012 STA teachers (54%) felt STA encouraged them to seek collaborative opportunities with STEM professionals; four teachers described working with scientists or engineers at Battelle, Aberdeen Proving Grounds, and the local college.
Fewer STA teachers intended to use their STA learning as teacher leaders in their schools; some 2012 STA teachers did collaborate across subjects and grades, provide PD activities, and advance STEM literacy at their schools.	• Many teachers (53-62%) intend to collaborate with other teachers at the school in their lesson planning endeavors. However, only 34% of teachers intend to share their learning with other teachers by providing professional development (PD) based on their experiences in STA.
	• While many teachers reported that STA provided them with materials to motivate STEM literacy (70%), fewer intend to analyze (35%) and/or lead (35%) STEM literacy efforts at their school.
	• Fewer 2012 STA teachers engaged other teachers in collaborative lesson planning (23-38%). Only 16% (2 teachers) reported planning and providing professional development activities to others.
STA teachers' awareness of AEOP opportunities varies; most teachers intend to encourage their students to participate in AEOP, but do not intend to incorporate them into lessons or extracurricular programs.	• Most STA teachers (59-84%, avg. 68%) reported receiving information about other AEOP initiatives during STA, but a significant proportion report having never heard of the individual AEOPs.
	• Only 3-7% of STA teachers intended to incorporate AEOP programming and resources into either their class lessons or their extracurricular activities, though a majority of teachers expressed their intent to encourage student participation.

2012 STA teachers did not consistently recognize or promote AEOP opportunities to their students in their schools.	• Most 2012 STA teachers did not encourage their school students to pursue AEOP opportunities. Of the teachers that did encourage student participation, 50% recommended GEMS, 25% recommended eCYBERMISSION, up to 18% recommended one of the high school apprenticeship programs, and 8% recommended JSHS. More notable is that many FY12 teachers claim to be unaware of individual AEOPs after STA (25%-83%, avg. 56%).

Recommendations

1. STPI's programming (the STEM Teachers Academy, STA) reaches communities in and around Harford Community College (Bel Air, MD). There is, however, an apparent dearth of Title 1 secondary schools in those communities. A teachers-in-residence program model should be considered in an effort to provide outreach to teachers (and ultimately impact underserved students) from Title 1 or other schools serving high proportions of underserved populations that are not within daily commuting distance from Harford Community College.

2. STPI supports the critical role that teachers assume in the mentoring STEM talent in-school. As such, it is poised to expand the AEOP mission of outreach to the classrooms and schools of participating teachers. STA content offerings focus on engaging teachers in current research and everyday applications of the field. As the STPI expands its reach to teachers outside of MD, it should endeavor to align these experiences with the realities of the classrooms, most notably, the dimensions of learning envisioned in the *Next Generation Science Standards (NGSS)*. The call for shared standards is evident in AEOP's Goal 2 objectives, and advances federal policy recommendations calling for widespread support of the NGSS standards movement by K-12 agencies, and by academic, non-profit, business and other sectors providing outreach to K-12 students and teachers (PCAST 2010). Such alignment would provide inspiring opportunities for students to learn about recent STEM advancement, and would attend to federal recommendations and those offered by teachers (e.g., recommendations for more careful attention to relevance of content to their teaching contexts, in terms of the scope of the subject matter selected and support in translation for grade level appropriateness.)

3. To provide the greatest return on an investment that aims to enhance K-12 teaching and learning through professional development, STPI programming should include an expectation of and a mechanism for supporting teachers' transfer of new STA learning to their classrooms and schools. In order to accomplish this goal, STA activities must ensure that
    - STEM content is relevant to participants' classroom and school contexts;
    - Teachers are provided with sufficient guidance—through content experts and through collaboration with teacher participants—for translating adult level STA learning to grade-level ideas and activities that align with standards teachers are held accountable to teaching;
    - Teachers are provided with scaffolds to support transfer of STA learning to the classroom—exemplary models of planning and instruction that intertwines the important dimensions of science and engineering they studied in STA with grade-appropriate expectations;
    - Academic year follow up that supports teachers in applying their STA learning to their classroom teaching and contributing to organizational change in their schools. Academic year activities might include collaborative lesson planning, collaborative study of student outcomes from enacted lessons, and

opportunities to develop professional development or other activities to advance STEM literacy beyond teachers' own classrooms.

4. Thus far, STPI's efforts have only endeavored to inform teachers, and through them, students of AEOP offerings. STPI is well positioned to address the Army's objectives of integration of AEOP elements and resources in classrooms. The Army might consider a shift in STPI programming that focus STA activities on helping teachers understand the potential contributions of AEOPs to their teaching contexts, and supporting the integration of AEOP elements and resources in classrooms and schools. Such a shift would potentially advance the AEOP objectives of shared standards for STEM, the integration of AEOP elements and resources with classroom curriculum, and attract more teachers and students to other AEOPs. The following vignette provides an illustration for such a model:

STA exists as a resident program during the summer institute, and leverages regional and/or national science teacher association meetings as opportunities for academic year activities with teachers. STPI markets STA programming to teachers and schools that serve underserved populations, nationwide or regionally. STPI ultimately serves students of those populations in their school-based learning through engagement with AEOP elements and resources. These experiences generate further interest and engagement in AEOP programs beyond the classroom.

STA teachers learn about a NGSS-aligned AEOP element and its resources during the summer institute, and, through academic year activities, are supported in incorporating that AEOP element or its resources into their classroom STEM lessons or extracurricular activities, and collaboratively studying the results of those efforts. For example, in the Junior Solar Sprint (JSS)-related track, teachers would participate in

1. *A Summer Institute during which teachers are provided with*
    - *Opportunities to work with and learn from Army STEM professionals engage teachers in learning about foundational principles and cutting edge Army research around solar energy, electrical and mechanical engineering, and the engineering design process;*
    - *Opportunities to work with and learn from AEOP educators (who have successfully incorporated JSS into their classroom and extracurricular activities) engage teachers in exploring the JSS curricular materials as learners, relating NGSS dimensions to those curricular materials (e.g., either identifying and/or adapting lessons for improved alignment to NGSS), learning about common student ideas related to the curricular materials, and identifying challenges of and possible solutions for implementing curricular materials in teachers' own contexts;*
    - *Opportunities to work with other STA teachers to initiate their capstone project, consisting of plans for implementing the AEOP element, including necessary adaptations of lessons to align with district curricula, supplies and materials needed (costs and source of funding), dates of proposed implementation, and how the implementation will be assessed.*
2. *Academic year sessions which would include*
    - *Opportunities to work with other STA teachers to finalize preparations for their enactment of the AEOP element or resource; and*
    - *Opportunities to collaboratively study their enactments of the AEOP resource or element through video clips of their classroom teaching and student work artifacts produced by the assessment proposed in their capstone.*
    - *Opportunities to volunteer for and/or participate with students in regional or national JSS events.*

5. The current evaluation of STPI primarily relies on teacher self-assessments of teacher outcomes (e.g., learning from STA, and intended and actual use of that learning in the classroom and school.) Currently, no objective measures of teacher and student outcomes are employed or measures that triangulate teacher reports with those of others in their schools; without such measures, the evaluation cannot make conclusive claims about the extent to which STA activities have effected teacher learning or practice, or, in turn, student learning. UNH and Army should consider how to establish and employ objective measures of teacher performance that align with AEOP and program priorities. Guskey[2] provides a hierarchical framework for the evaluation of teacher professional development, which includes assessing: 1) teacher reactions, 2) teacher learning, 3) organization support and change, 4) teacher use of new knowledge and skills, and 5) student learning outcomes. Also embedded in framework is a hierarchy of measures ranging from subjective self-report assessments to objective measures. STPI might consider, at a minimum, establishing objective measures of teacher learning (e.g., pre-post test of content or pedagogical content knowledge) associated with the STA content, resources, and activities. Ideally, the evaluation would also include teacher use (e.g., video/direct observation, or submission of lesson plans), and student outcomes (e.g., learning and affective outcomes aligned with AEOP and Army STEM objectives), especially if programming shifts to incorporate academic year follow-up that focuses on the implementation and study of classroom based interventions.

[2] Guskey, T. (1999) *Evaluating Professional Development*. Thousand Oaks, CA: Corwin Press.

Introduction

The Army Educational Outreach Program (AEOP) vision is to offer a collaborative and cohesive portfolio of Army-sponsored science, technology, engineering and mathematics (STEM) programs that effectively engage, inspire, and attract the next generation of STEM talent through K-college programs and expose them to Department of Defense (DoD) STEM careers. The consortium, formed by the Army Educational Outreach Program Cooperative Agreement (AEOP CA), supports the AEOP in this mission by engaging non-profit, industry, and academic partners with aligned interests, as well as a management structure that collectively markets the portfolio among members, leverages available resources, and provides expertise to ensure the programs provide the greatest return on investment in achieving the Army's STEM goals and objectives.

This report documents the evaluation of one of the AEOP elements, the STEM Teacher Program Initiative (STPI) administered on behalf of the Army by the University of New Hampshire. The evaluation of SPTI was performed by Virginia Tech, the Lead Organization (LO) in the AEOP CA consortium.

AEOP Goals

Goal 1: STEM Literate Citizenry.

- Broaden, deepen, and diversity the pool of STEM talent in support of our defense industry base.

Goal 2: STEM Savvy Educators.

- Support and empower educators with unique Army research and technology resources.

Goal 3: Sustainable Infrastructure.

- Develop and implement a cohesive, coordinated, and sustainable STEM education outreach infrastructure across the Army.

Program Overview

The STEM Teacher Program Initiative (STPI), managed by the University of New Hampshire (UNH), is an Army Educational Outreach Program (AEOP) that supports and empowers educators with Army research and technology resources. In partnership with Harford Community College (HCC) and Army Research Laboratory at Aberdeen Proving Ground (ARL-APG), STPI provides STEM content-based professional development and experiential learning environments for STEM teachers. Additionally, STPI develops relationships between STEM teachers and active/retired Army scientists and engineers (S&Es). STPI programming is focused on the STEM Teachers Academy (STA), a one-week summer STEM course, with sessions led by Army S&Es.

In 2013, STA activities engaged Harford County and Cecil County teachers ranging from middle school to high school (6th-12th grades). During STA, teachers received instruction from HCC faculty, Army S&Es, and other local STEM experts in one of three disciplinary track themes—Biology/Chemistry, Engineering, or Earth/Environmental Science. 2013 STA activities also included a lesson planning strand that attended to pedagogical strategies of teaching science through levels of inquiry and engaging students in Scientific and Engineering Practices.[3] STA developers assume that after having an opportunity

[3] NGSS Lead States (2013) *Next Generation Science Standards*. Washington, D.C.,: National Academies Press; National Research Council (2011) *A Framework for K-12 Science Education*. Washington, D.C.,: National Academies Press

to apply their new learning in a team-based lesson planning project during STA, teachers will individually apply these learnings to their everyday lesson planning and teaching in their own classroom, as well as serve as leaders in their schools through collaboration with STEM professionals and teachers, offering professional development activities for their peers related to their STA learning, and contributing to school STEM literacy efforts. University of New Hampshire provides 2.0 Continuing Education Units to STA teachers.

The following priorities were to guide STPI's 2013 programming according to the AEOP's Annual Program Plan:

1. To enhance K-12 STEM teaching and learning through STEM teacher professional development conducted with participation by ARMY scientists and engineers.
2. To inform teachers and through them, their students, of STEM occupations and career opportunities offered by the Army.
3. To inform teachers and through them, their students, of other STEM enrichment opportunities by the AEOP.
4. To increase participation in STEM opportunities by teachers who work in settings with a large number of students from groups that are historically underserved and underrepresented in STEM.

Evidence Based Program Change

The STPI programming consists primarily of the STEM Teachers Academy. Annually, goals for STA are re-evaluated based on needs of local schools and evaluation findings from the previous year. In response to the 2012 STPI evaluation and in the effort to effectively and efficiently meet AEOP and program objectives, UNH, HCC, and Army partners made the following changes/additions to 2013 STA activities:

1. Thematic areas will be retained, but with fewer STEM topics covered per thematic area. Thematic areas allow teachers to engage with topics that are most relevant to their classroom contexts. The reduction of topics is intended to allow for less lecture format and more hands-on activities for teachers that model best-practices in pedagogy.
2. A more substantial lesson planning strand was incorporated to provide opportunities for teachers to engage in collaborative lesson planning to support translation of STA content across subjects and grade levels, as well as incorporation of levels of inquiry and Scientific and Engineering Practices in those lessons.
3. Information about Army STEM careers and AEOP initiatives were offered during the opening session, during lunchtime presentations by Army S&Es, and in the closing presentation.

FY13 Evaluation At-A-Glance

Virginia Tech, in collaboration with UNH, HCC, and ARL partners, conducted an evaluation study of STPI. The logic model below presents a summary of the inputs, outputs, and outcomes we might anticipate for STA program, acknowledging that student outcomes are necessarily mediated by teacher outcomes (in other words, STPI does not directly engage students). These are strongly aligned with AEOP priorities. This logic model provided guidance for the overall STPI evaluation strategy, even though student outcomes are not a significant focus of the 2013 evaluation effort.

Inputs	Activities	Outputs	Outcomes (Short term)	Impact (Long Term)
• Army sponsorship • University of New Hampshire management of STPI • Harford Community College (HCC) and Army Research Laboratory (ARL) partners hosting 1-week STEM Teachers Academy (STA) • 43 local teachers • HCC, ARL, and other local STEM experts • 2.0 Continuing Education Credits • Centralized branding and comprehensive marketing of AEOP • Centralized evaluation	Engagement in "authentic" STEM experiences in biology/chemistry, engineering, and earth/environmental tracks, including learning about: -Concepts and practices -Laboratory activities -Current research -Everyday issues Collaborative lesson planning to incorporate -Levels of inquiry -Science and engineering practices	• Number and diversity of teachers participating in STA • Number of and Title-I status of schools served through teacher engagement • Increasing number of curricular resources distributed through PD • STA teachers, UNH, HCC, and ARL contributing to evaluation	• Increased teacher knowledge, skills, and abilities in STEM • Improved teacher approaches to teaching about STEM concepts, practices, and careers • Increased teacher collaboration and leadership for STEM literacy • Increased teacher *(and student)* awareness of and interest in other AEOP opportunities • Increased teacher *(and student)* awareness of and interest in Army/DoD STEM research and careers • Implementation of evidence-based recommendations to improve UNH's STPI offerings	• Increased teacher *(and student)* engagement in other AEOP opportunities and Army/DoD-sponsored programs • *Increased student pursuit of STEM coursework in secondary and post-secondary schooling* • *Increased student pursuit of STEM degrees* • *Increased student pursuit of STEM careers* • *Increased student pursuit of Army/DoD STEM careers* • Continuous improvement and sustainability of STPI

The STPI evaluation gathered information from teachers about STA's structures, resources, and activities, as well as their potential effects, in order to address key evaluation questions related to program strengths and challenges, benefits to participants, and overall effectiveness in meeting AEOP and program objectives.

Key Evaluation Questions

- To what extent did STA successfully outreach to teachers serving underserved populations?
- What aspects of the STA experience are working well? Which could be improved?
- To what extent did participation in STA:
  - Improve teachers' knowledge, skills, and abilities in STEM?
  - Improve teacher approaches to teaching about STEM concepts, practices, and careers in their classrooms?
  - Improve teacher collaboration and leadership in their schools?
  - Improve teacher awareness of Army STEM careers and AEOP opportunities?

Detailed information about methods and instrumentation, data collection, and analysis are described in the Evaluation Plan (Appendix A.). The 2013 STPI assessment included a post-STA questionnaire for 2013 STA teachers (Appendix B). The 9-month post-STA questionnaire for 2012 STA teachers is also reported here (Appendix C) to provide evidence for translation of STA experiences in the teaching context. Questionnaires were electronically distributed to participants through Harford Community College. Full data summaries are provided for questionnaires in Appendices B and C. Table 3 outlines the information collected from the post-STA questionnaire for 2013 STA teachers. Table 4 outlines the information gathered from the 9-month post-STA questionnaire for 2012 STA teachers.

Table 3. 2013 Post-STA Teacher Questionnaire	
Category	**Description**
Profile	Demographic information (gender, race/ethnicity), grade taught, subject(s) taught, years teaching, school taught at.
Satisfaction & Suggestions	Satisfaction and perceptions of utility (e.g., most adaptable to classroom lessons and teaching, most suitable for professional development, most helpful for analyzing/creating STEM literacy efforts)
AEOP Goal 2 Program efforts	**STEM Literacy:** Learning STEM (e.g., concepts and practices, current research, everyday issues in disciplinary-track)
	Classroom Practices: Understanding of STEM teaching strategies (e.g., content specific activities/projects, planning for levels of inquiry, Scientific and Engineering practices); confidence in and intent to incorporate STA learning in lessons and teaching
	Collaboration and Leadership: Intent to collaborate with Army STEM professionals and STEM teachers, to provide professional development at school, and to advance school STEM literacy efforts
	AEOP awareness: Self-reported awareness of AEOPs and intent to promote AEOP (e.g., encourage students, incorporate into classroom or extracurricular activities)

Table 4. 2013 9-Month Post-STA Teacher Questionnaire	
Category	**Description**
Profile	Demographic information (gender, race/ethnicity), grade taught, subject(s) taught, years teaching, school taught at.
Satisfaction & Suggestions	Satisfaction and perceptions of utility (e.g., most adaptable to classroom lessons and teaching, most suitable for professional development, most helpful for analyzing/creating energy literacy efforts)
AEOP Goal 2 Program efforts	**STEM Literacy:** Learning STEM (e.g., energy and environmental literacy)
	Classroom Practices: Intent and efforts to incorporate STA learning in lessons and teaching
	Collaboration and Leadership: Intent to and efforts toward collaboration with Army STEM professionals and STEM teachers, provide professional development at school, and advancing school energy/environmental literacy efforts
	AEOP awareness: Self-reported awareness of AEOPs and promotion of AEOPs to students

Study Sample

Questionnaires were provided to all STA teachers in electronic format using the Qualtrics® survey system hosted by Virginia Tech. Table 5 provides an analysis of teacher participation in questionnaires, including the response rates and statistical reliability achieved with each sample, as given by the margin of error at the 95% confidence level.

The statistical reliability achieved for 2013 STA teachers suggest adequate representativeness of the population. The larger margin of error for 2012 STA teachers suggests less representativeness. The 2012 STA teacher data contributes valuable perspective to understanding the impact of STA beyond the one-week summer institute, however, any findings should be cautiously generalized with consideration given to the margin of error and triangulation with other data sources or types. Three 2013 STA Teachers were 2012 STA participants, and completed both questionnaires.

Table 5. 2013 STA Teacher Questionnaire Participation

Participant Group	Respondents (Sample)	Total Participants (Population)	Participation Rate	Margin of Error @ 95% Confidence[4]
2013 STA teachers	35	43	82%	±7.2%
2012 STA teachers (9-Month Post-STA)	13	52	25%	±23.8%

Respondent Profile

Demographics. Demographic information collected from 2013 and 2012 STA teachers is summarized in Table 6. Similar trends emerge from both data sets. More females than males completed the teacher questionnaires and most teachers (>90%) identified with race or ethnicity category of White or Caucasian. No STA teachers identified as American Indian or Alaskan Native, or as Hispanic or Latino.

Table 6. STA Teacher Demographics

Demographic Category	2013 STA Teachers (n = 35)		2012 STA Teachers (n = 13)	
Respondent Gender				
Female	23	66%	7	54%
Male	11	31%	6	46%
Choose not to report	1	3%	0	0%
Respondent Race or Ethnicity				
Asian or Pacific Islander	1	3%	0	0%
Black or African American	0	0%	1	8%
White or Caucasian	33	94%	12	92%
Choose not to report	1	3%	0	0%

[4] "Margin of error @ 95% confidence" means that 95% of the time, the true percentage of the population who would select an answer lies within the stated margin of error. For example, if 47% of the sample selects a response and the margin of error at 95% confidence is calculated to be 5%, if you had asked the question to the entire population, 95% of the time, between 42% (47-5) and 52% (47+5) would have selected that answer. A 2-5% margin of error is generally acceptable at the 95% confidence level.

Teaching Contexts. STA teachers were asked to describe their teaching context and these data are summarized in Table 7.

More STA teachers taught high school grades than taught middle school. Many teachers taught multiple grades, as reported in Appendix B. Teachers taught a range of courses within the major STEM fields and/or disciplines, with most teachers teaching biological and physical sciences. The data provided here reflect the number and proportion of teachers who reported teaching one or more courses in each of the major STEM fields and/or disciplines. The full range of subjects teachers reported are summarized in Appendix B. Six teachers reported teaching courses in multiple fields or disciplines, such as "pre-algebra and earth science," "earth, biology, environmental," or "chemistry, physics, and statistics." Teachers reported a range of teaching experience, reflecting beginning and early career (1-9 years, 48%), mid-career (10-21 years, 29%), and late-career (22-30 years, 21%) teachers.

Table 7. 2013 STA Teachers - Teaching Contexts

School Context	2013 STA Teachers (n = 31)		2012 STA Teachers (n = 13)	
Grade levels taught				
Middle School (grades 6-8)	9	29%	3	23%
High School (grades 9-12)	22	71%	9	69%
Subjects taught				
Biological Sciences	10	32%	4	30%
Physical Sciences	10	32%	3	23%
Earth and/or Space Sciences	7	23%	3	23%
Environmental Sciences	4	13%	2	15%
General Science	0	0%	2	15%
Mathematics	7	22%	2	15%
Technology	1	3%	1	8%
Number of years teaching				
1-3 years	5	16%		
4-9 years	10	32%		
10-15 years	5	16%		
16-21 years	4	13%		
22-30 years	5	16%		
30+ years	2	6%		

Reaching underserved populations. Title-I schools serve high numbers or proportions of students from low-income families. In Title-I schools, 40% or more of students qualify for free or reduced lunch or other federal assistance. Higher proportions of students from racial and ethnic minority groups are also common among Title-I schools, especially those serving poor urban communities. Students from low-income and certain racial and ethnic minority groups (e.g., American Indian or Native Alaskan, Black or African American, Hispanic or Latino) are historically considered to be underserved in STEM education and outreach. To ascertain the extent to which underserved populations may be served by STA teachers, teachers were asked to provide their school names and location.

2013 STA teachers represented 17 middle and high schools in total, all located in Harford and Cecil counties. According to the Maryland State Department of Education (MDE), Harford and Cecil counties have 13% and 20% of students who qualify for free or reduced lunch programs, respectively. None of the 2013 STA teachers represented a Title-I school, according to the MDE. From these data, we surmise that STA has limited success at best in reaching underserved populations through STA teachers.

Actionable Evaluation Findings

Actionable Program Evaluation is intended to provide assessment and evaluation of program processes, resources, and activities for the purpose of recommending improvements as the program moves forward. This section highlights information outlined in the Satisfaction and Suggestion, Goal 1, and Goal 2 sections of Table 4 as well as the Goal 1 and Goal 2 sections of Table 5.

Actionable Program Evaluation focuses on efforts impacting the long-term goal of JSS and the AEOP; to increase the future pool of talent capable of contributing to the nation's scientific and technology progress.

Perceptions of STA Activities

Assessments elicited teachers' perceptions of STA activities, including overall satisfaction with activities and perceived value in terms of adaptability to classroom lessons and teaching, for supporting professional development (PD) activities at school, and for advancing STEM literacy at school.

Overall Satisfaction. The 2013 teacher questionnaires asked open ended questions that elicited what portions of STA teachers were most and least satisfied with.

Many teachers expressed overall satisfaction with the program. STA teachers listed a number of program structures, resources, and activities with which they were most satisfied. Most frequently, teachers reported satisfaction with Aquaponics, collaborative work (e.g., lesson planning, with peers), and the contributions of STEM experts. Teachers were least satisfied with Biofuel cells, and the limited examples of model grade-level appropriate STEM lessons provided by STA facilitators and by peers.

Teachers' comments suggest that more careful consideration be given to the relevance of content to their teaching contexts, in terms of the scope of the subject matter selected and support in translation for grade level appropriateness; more careful consideration be given to the structuring and scaffolding of the lesson planning project; and an appropriate balance of opportunities to learn about the range of STEM content areas (e.g., more math) and opportunities to engage with colleagues in the lesson planning project.

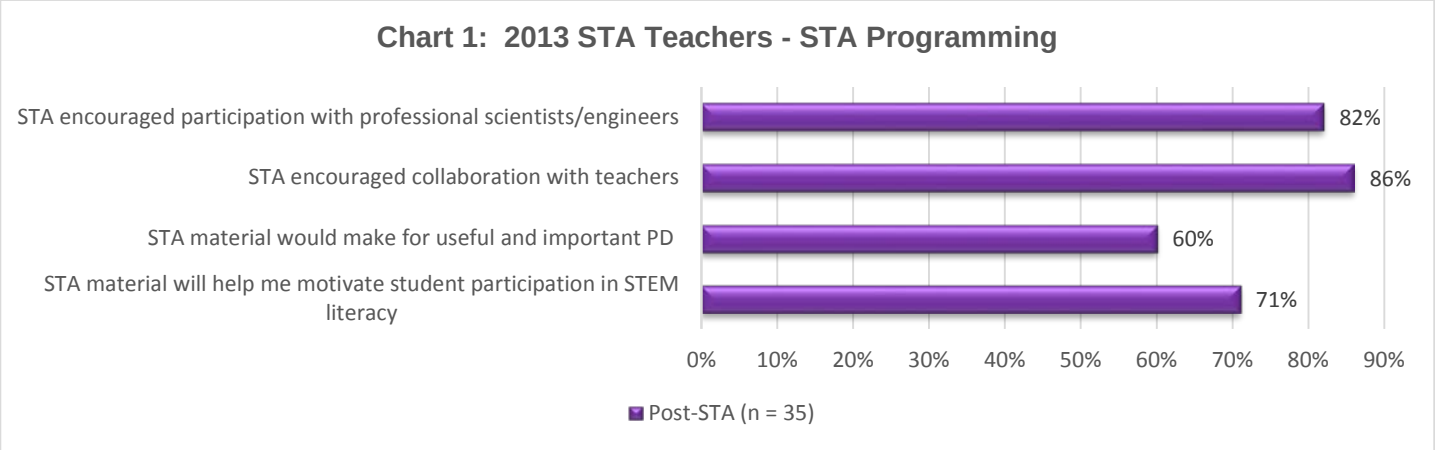
Value and utility of STA in classroom and school contexts. The 2013 teacher questionnaires asked open ended questions to elicit teachers' perceptions about the value and utility of STA in the classroom and school contexts:

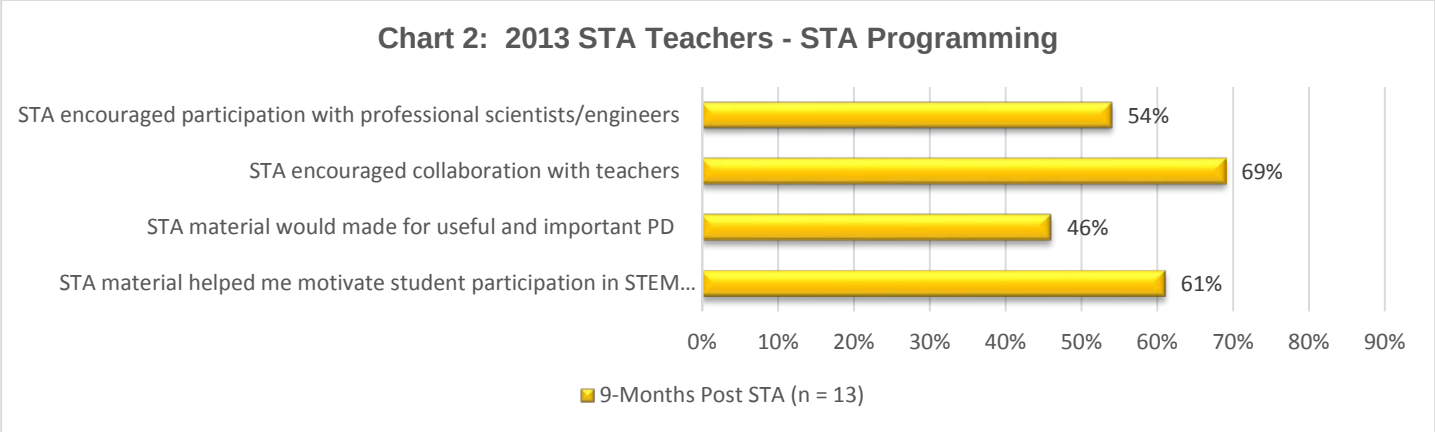
- What material did you learn from the STA that you believe is the most adaptable to your classroom lessons and teaching?
- What material from STA do you think is the most suitable and important for professional development activities at your school?
- What aspects of STA do you believe are most useful for analyzing/creating STEM literacy efforts at your school?

In addition, four forced-response items asked teachers the extent to which they agreed that STA encouraged collaboration with STEM professionals and teachers, STA material would make for useful and important PD, and STA material would help motivate students to participate in STEM literacy efforts in their schools. 2012 STA teachers were asked similar questions, framed to provide retrospective assessment.

Teachers described a range of topics, tools, and strategies that would be most adaptable to their classroom lessons. Aquaponics (40%) and iTree (20%) were the most frequently cited. These are summarized in Appendix B.

Charts 1 and 2 summarize responses from the four forced-response items. More teachers perceived that collaboration with other teachers was encouraged than was collaboration with professional scientists/engineers, however these differences are not statistically significant. Teachers generally agreed that STA material would support them in engaging students in STEM literacy. However, fewer teachers considered STA material useful for PD.





Teachers' responses to open-ended items provide further elaboration. Teachers most frequently reported that STA materials supporting the incorporation of inquiry lessons, Scientific and Engineering practices, and hands-on activities would be most suitable and important for professional development activities and for supporting STEM literacy efforts at their school. Similarly, teachers also perceived that utilizing STEM professionals to better connect classroom learning to real-life STEM applications was important.

2012 STA teachers reported that the STA materials most suitable for PD activities were lessons that were engaging and motivating to students, lessons that relate school science to outside world, and opportunities to learn about the

perspectives and research of engineers/scientists. Two teachers listed energy-related resources as suitable for PD. 2012 STA teachers explicitly or implicitly indicated that renewable energy resources (e.g., Renewable Energy Education Kit) were useful for analyzing/creating environmental sustainability efforts at school. STA teachers described efforts toward gaining Green school status: using STA information to consider energy efficient upgrades and/or application for Green school status, working on Green school status this or next year. Teachers also used STA materials to motivate students' participation in energy/environmental literacy beyond classroom walls. One teacher described engaging students in environmental literacy: building a demonstration garden the school yard for Conservation Landscaping and developing and students leading lessons at the school's annual environmental fair.

Outcomes Evaluation Findings

The evaluation of STPI included measurement of several outcomes relating to AEOP and program objectives aligned with AEOP Goal 2: STEM Savvy Educators. Toward AEOP Goal 2, the evaluation measured outcomes related to teachers' STEM literacy, classroom practices, collaboration and leadership in their schools, and AEOP awareness. These outcomes are consistent with three of Guskey's[5] five levels of evaluating professional development, including: participants' learning, participants' use of new knowledge and skills, and organization change. The 2013 Post-STA teacher questionnaire elicited STA teachers' intent to use of new knowledge in their classrooms and in their efforts to contribute to organization change (e.g., through collaboration and leadership); whereas the 2012 9-month Post-STA teacher questionnaire assessed STA teachers actual efforts toward the same. In both cases, teacher self-reporting was used. Self-assessments of learning generally provide accurate estimates of where learning has occurred, however, they generally do not provide an accurate estimate of how much learning has occurred. Objective measures are required for such determinations. Thus, teachers self-reports have not been validated with objective measures such as pre-post-tests, teaching artifacts, observations, or interviews with other school personnel.

STEM Literacy

The Army's central goal is to contribute to a STEM-literate citizenry through the AEOP offerings. STPI addresses this goal by enhancing K-12 STEM teaching and learning through STEM teacher professional development conducted with participation by ARMY scientists and engineers (STPI, Objective 1). Developing and expanding teachers' own STEM literacy undergirds this objective.

STA's 2013 programming attended to teachers' knowledge in three disciplinary tracks: Biology/Chemistry, Engineering, and Earth/Environmental Science. Topics of each disciplinary track, and the number of respondents for each track, are summarized in Table 8.

Table 8. 2013 STA Activities

Disciplinary Track	Topic	No. of Teacher Respondents
Chemistry/Biology	Energy alternatives to fossil fuel combustion Aquaculture as a means for sustainable food production	12
Engineering	Mechanics and mechanical engineering Electricity and electrical engineering Systems engineering Civil engineering	14
Earth/Environmental Science	Trees and tree canopies	9
	Total	**35**

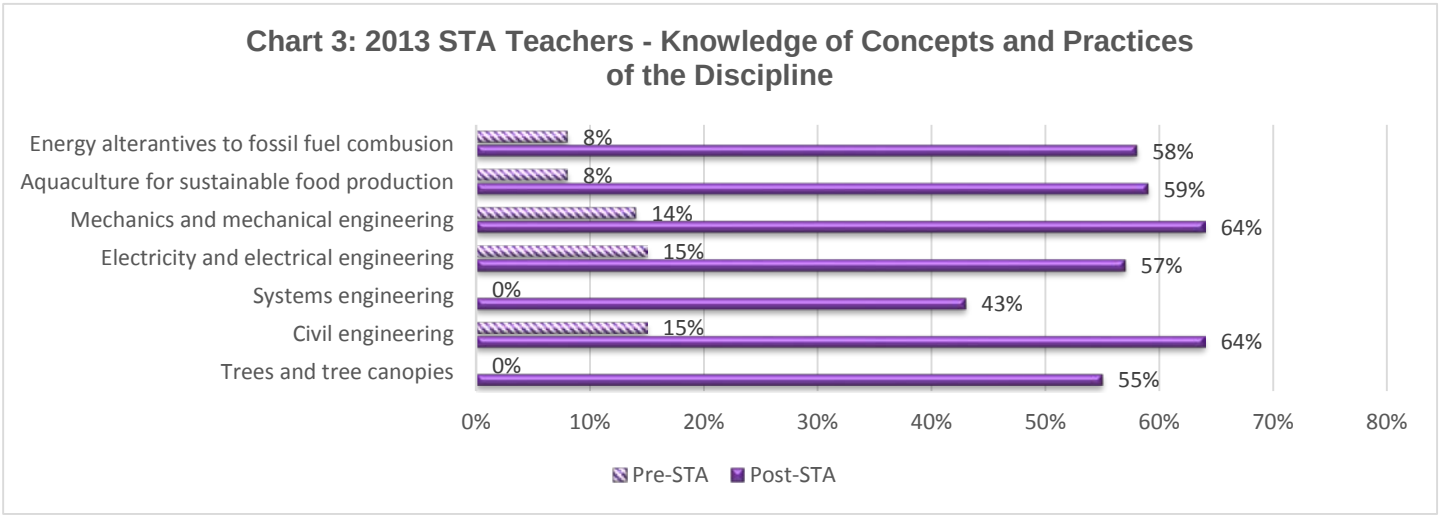
[5] [5] Guskey, T. (1999) *Evaluating Professional Development*. Thousand Oaks, CA: Corwin Press.

Each track addressed concepts and practices, lab activities for teaching, current research, and everyday issues related to the designated topic. The engineering track also included a treatment of mathematics related to each topic. Similar items were used in the questionnaire to elicit teachers' retrospective pre-post self-assessments of learning in each discipline track and topic (Table 9).

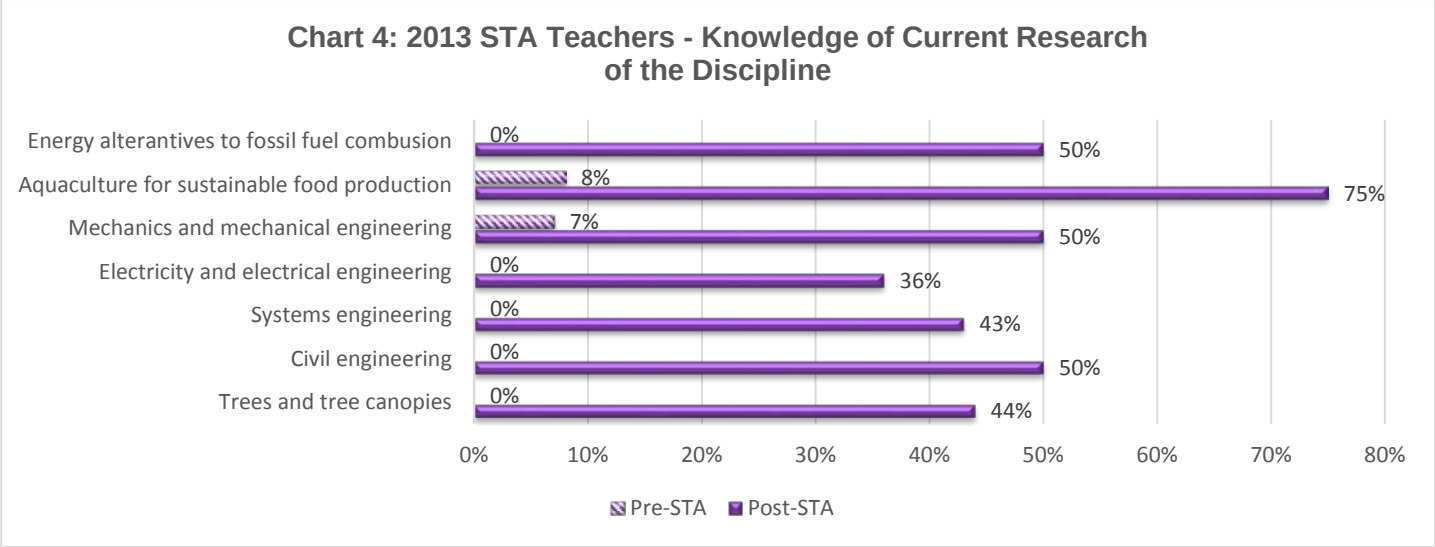
Table 9. 2013 Common Questionnaire Items
Concepts and practices in … [topic]
Mathematics used in …[topic]
Suggested lab activities/research projects for teaching students about…[topic][6]
Current research related to …[topic]
Everyday issues related to… [topic] concepts and practices

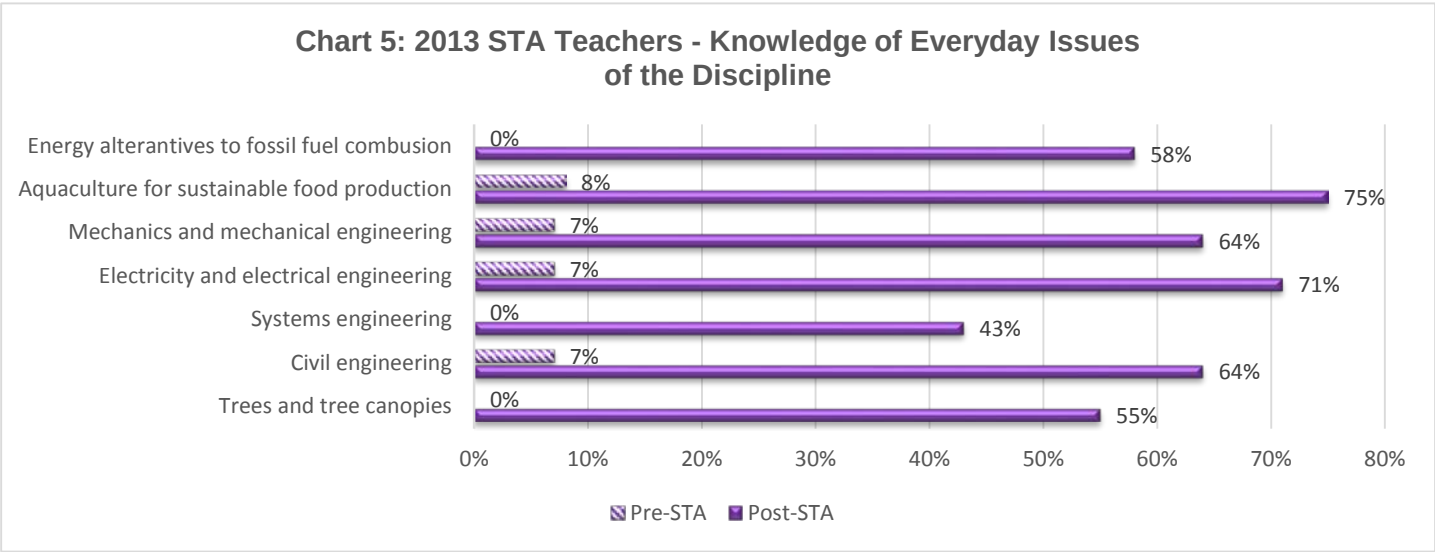
Teachers responded to topic-specific items related to their disciplinary track of choice on a 6-point frequency scale of 1 = "Minimal Understanding" to 6 = "Maximum Understanding." Charts 3-5 summarize the proportions of teachers reporting high levels of understanding (5 or 6 on the response scale) for knowledge of concepts and practices, current research, and everyday issues related to the topic, respectively. Items and full data are summarized in Appendix B.

As Charts 3-5 suggest, teachers generally felt they gained knowledge of the concepts and practices, current research, and everyday issues and applications associated with the disciplines and topics they studied in STA. Appendix C provides a statistical comparison of teachers retrospective pre and post self-assessments of knowledge. All retrospective-pre to post differences were statistically significant and large to very large in magnitude. As discussed previously, objective measures of learning are required to understand the real magnitude of STA's effect on teacher learning.



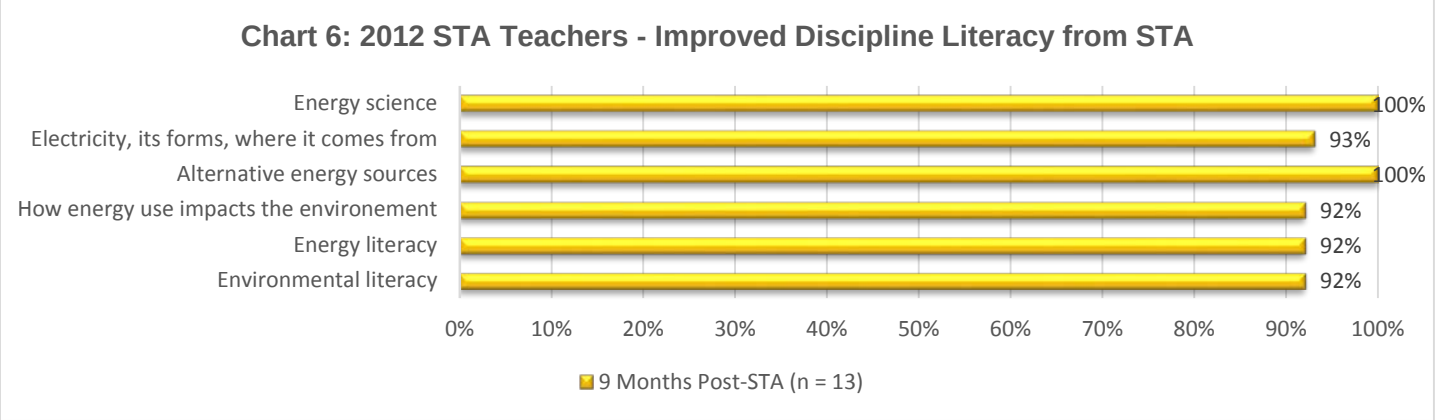
[6] Suggested lab activities/research projects for teaching will be reported in STEM Teaching Practices section.





2012 teachers also responded to topic-specific items related to their disciplinary literacy knowledge and confidence of choice on a 6-point frequency scale of 1 = “Strongly Disagree” to 6 = “Strongly Agree.” Chart 6 summarizes the proportions of teachers reporting high levels of agreement (5 or 6 on the response scale) that STA improved knowledge, providing new learning, and increased confidence in their disciplinary literacy. Items and full data are summarized in Appendix D.

Chart 6 illustrates that most 2012 STA teachers (92-100%) credit STA with improved knowledge, new learning, and increased confidence in their disciplinary literacy.



Overall, these data indicate that STA teachers perceive growth in STEM literacy as a result of participating in STA. While teachers' assertions have not been validated with objective measures, promoting STEM Literacy is a strength of STA.

Teaching Practices

STPI's objective is to enhance K-12 STEM teaching and learning through STEM teacher professional development conducted with participation by Army scientists and engineers (Objective 1). The 2013 STA activities included a lesson planning strand that incorporated laboratory activities and research projects they learned in their discipline-specific studies, and highlighted appropriate content-specific pedagogical practices (i.e., levels of inquiry and Scientific and Engineering Practices) recommended in recent K-12 standards movements. These efforts were in response to previous evaluation findings calling for more robust efforts to support teachers in translating STA learning into grade-level appropriate and pedagogically sound experiences for their students. Thus, it is important to understand the extent to which STA activities prepared teachers for translating STA learning into classroom practice, how teachers envision their STA learning impacting their professional practice, and the extent to which STA learning is actually translated into teaching when they go back to their classrooms.

Supporting lesson planning and teaching. Teachers responded to three sets of items related to the effect of participating in STA on their knowledge of discipline-specific laboratory activities and research projects for teaching (1 item each topic), understanding of inquiry and Scientific and Engineering Practices[7] (4 items), and their confidence to apply the same them to lesson planning and teaching (7 items). Teachers provided a self-assessment of their retrospective pre-post learning, and responded using 6-point frequency scales of 1 = "Minimal Understanding" to 6 = "Maximum Understanding" or 1 = "Not Confident" to 6 = "Very Confident." Charts 7-9 summarize the proportions of teachers reporting high levels of

[7] Scientific and Engineering Practices include asking questions and defining problems; developing and using models; planning and carrying out investigations; analyzing and interpreting data; using mathematics and computations thinking; constructing explanations and designing solutions; engaging in argument from evidence; obtaining, evaluating, and communicating information (e.g., NGSS Lead States, 2013).

knowledge, understanding, or confidence (5 or 6 on the response scale) related to inquiry and Scientific and Engineering Practices, respectively.

Chart 7: 2013 STA Teachers - Knowledge of Laboratory Activities/Research Projects for Teaching the Discipline

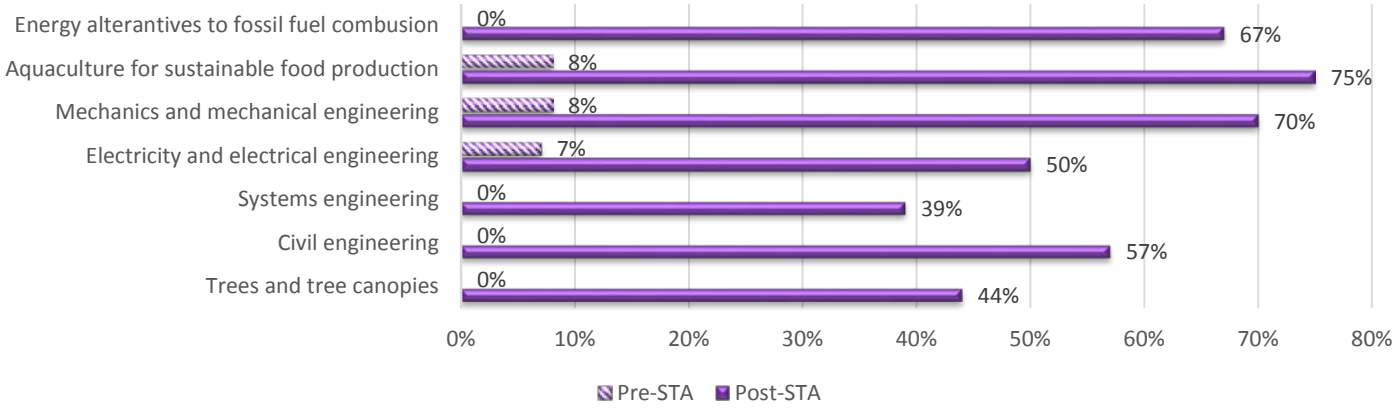


Chart 8: 2013 STA Teachers - Understanding Levels of Inquiry As Related to Classroom Teaching

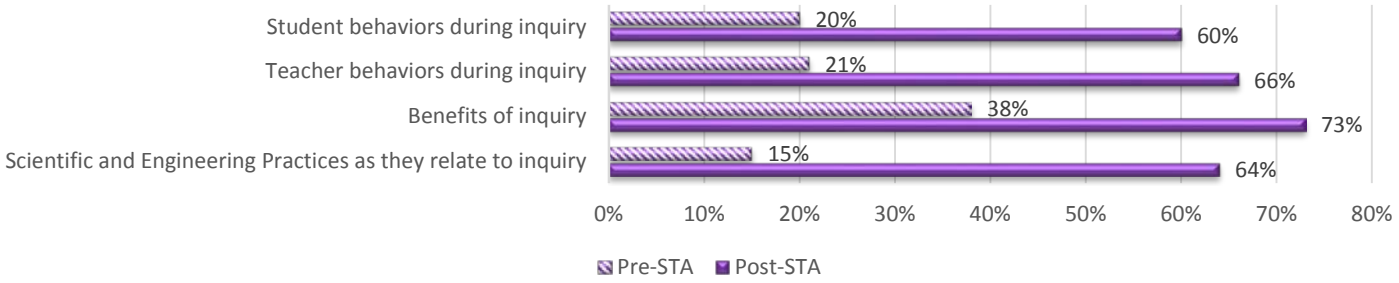
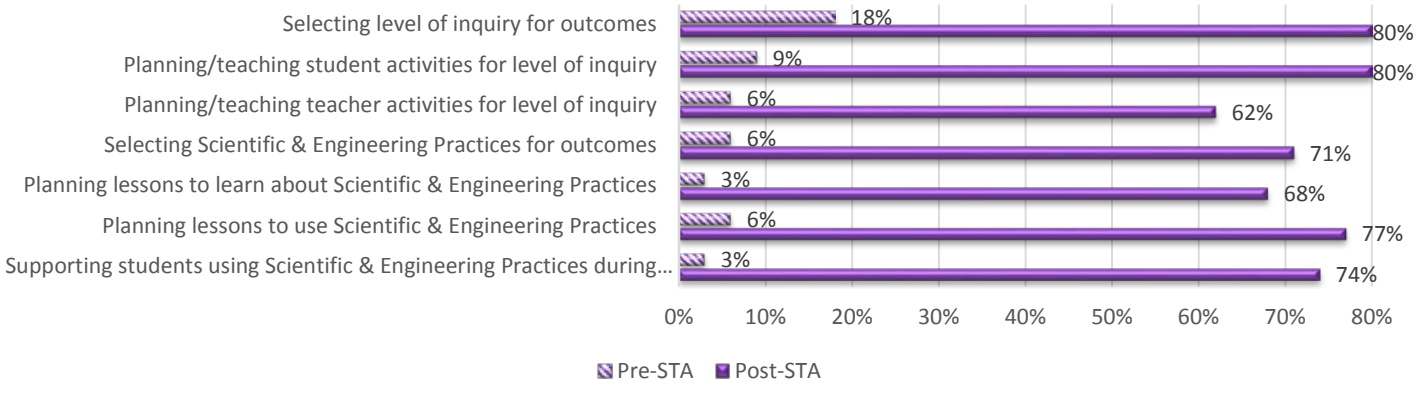


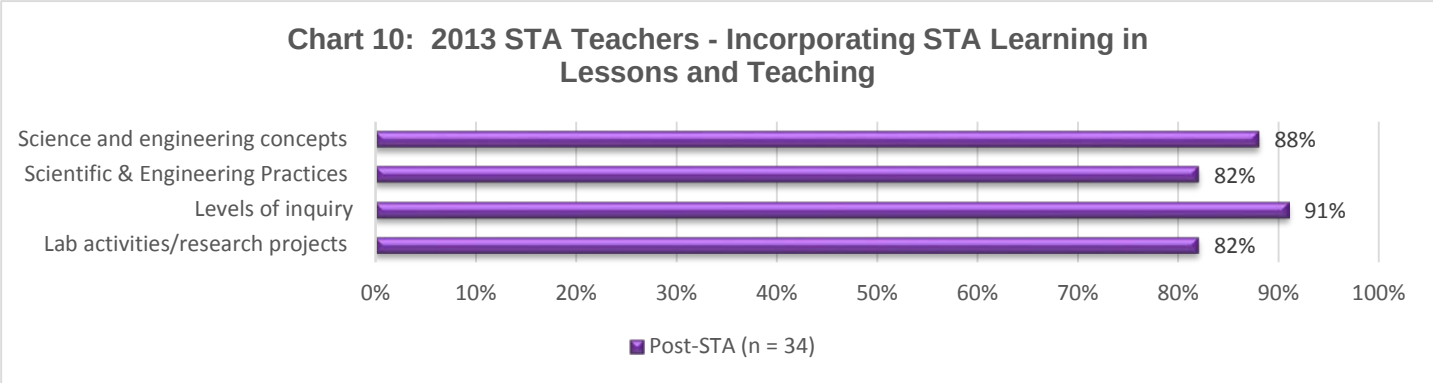
Chart 9: 2013 STA Teachers - Confidence Related to Classroom Teaching



Teachers' retrospective pre-post self-assessments suggest that teachers generally felt they gained understanding of and confidence to apply discipline-specific laboratory activities and research projects, levels of inquiry, Scientific and Engineering practices to their teaching. Lower proportions cited knowledge, understanding, or confidence related to engineering– and environmental-track laboratory activities, student and teacher behaviors during inquiry, and teacher activities to support inquiry.

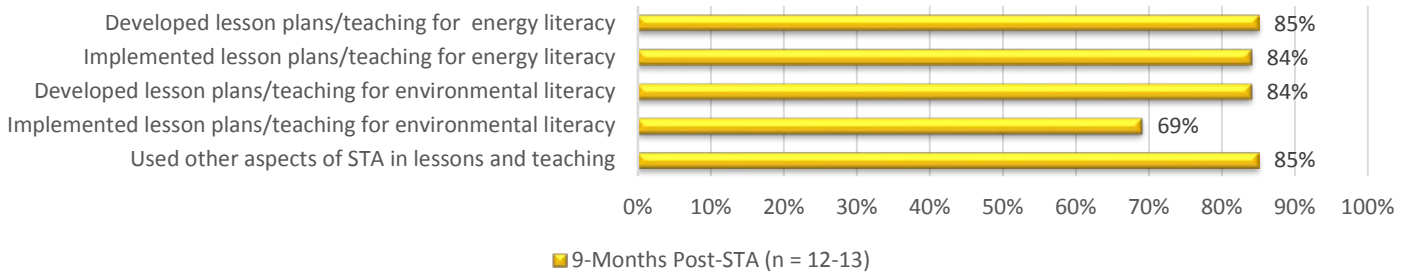
Incorporating STA in lesson planning and teaching. Teachers responded to four items to elicit whether and how teachers envisioned their STA learning would impact their professional practice. Teachers provided a self-assessment of their intent to incorporate aspects of their STA learning into classroom lessons and teaching, responding with a 6-point frequency scales of 1 = "Strongly Disagree" to 6 = "Strongly Agree." Chart 10 summarizes the proportions of teachers reporting high levels of agreement (5 or 6 on the response scale) related to incorporating science and engineering concepts, Scientific and Engineering Practices, levels of inquiry, and laboratory activities and research projects presented during STA.

Most teachers (82-91%) intended to apply their learning across the broad categories targeted in STA in their everyday lesson planning and teaching: teachers intend to incorporate concepts (88%), Scientific and Engineering Practices (82%), levels of inquiry (91%), and suggested laboratory activities and research projects (82%). Teachers clearly envisioned that their STA learning will impact their professional practice.



2012 STA teachers were asked similar questions, providing retrospective assessment of their efforts to translate disciplinary literacy knowledge to classroom teaching practice. Teachers responded on a 6-point frequency scale of 1 = "Strongly disagree" to 6 = "Strongly Agree." Chart 11 summarizes the proportions of teachers reporting high levels of agreement (5 or 6 on the response scale) that they translated their STA learning into classroom practice. Items and full data are summarized in Appendix D.

Chart 11: 2012 STA Teachers - Incorporating STA Learning in Lessons and Teaching



Many 2012 STA teachers applied their STA learning of energy and environmental literacy to their own teaching practice: teachers developed (energy, 84%; environmental, 85%) and implemented (environmental, 69%; energy, 84%) in the classroom.

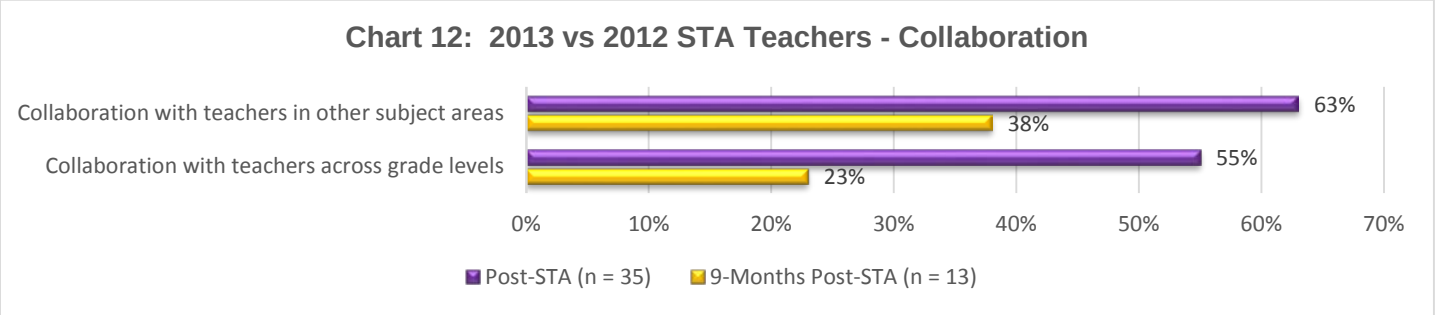
Clearly, STA provides its participants with more than just college-level content delivery. While teachers' assertions have not been validated with objective measures, teacher self-assessments suggest teachers feel equipped with resources, understandings and confidence to translate STA learning into classroom practice, intend to incorporate STA learning in their teaching, and many do so when they go back to their classrooms. A next step for STPI could be working with teachers to study their efforts and the potential effects of those efforts. STPI might consider how it could, through the provision of academic year activities for teachers, provide more opportunities to support teachers' incorporation of STA learning in their lessons and teaching, and studying student outcomes.

Collaboration and Leadership

Even when teachers gain a thorough understanding of STEM literacy and resources for translating to their classrooms, lack of organizational support and change is a frequently prevents uptake beyond the participating teacher's classroom walls. The STA program is structured to provide a model for how STA teachers might engage in collaborations with STEM professionals and with teachers across STEM disciplines and grade levels. STA teachers are encouraged not only to individually apply STA learning to their everyday lesson planning and teaching in their own classroom, but to leverage new collaborations from STA, or establish partnerships in their schools toward advancing STEM literacy. These efforts might include collaborating with STEM professionals and teachers, offering professional development (PD) activities at their schools, and advancing school STEM literacy efforts.

Collaborating with STEM professionals and teachers. STA teachers were asked about their intent to collaborate with professional scientists/engineers and teachers. An open ended item asked what collaborative opportunities with other teachers or professional scientists/engineers they identified through STA. Two items asked teachers the extent to which they intended to collaborate with other teachers, either across subjects or grade levels. Teachers responded to those two questions on a 6-point scale of 1 = "Strongly disagree" to 6 = "Strongly Agree." 2012 STA teachers were asked similar questions, framed to provide a retrospective assessment of their efforts toward collaborations with other teachers.

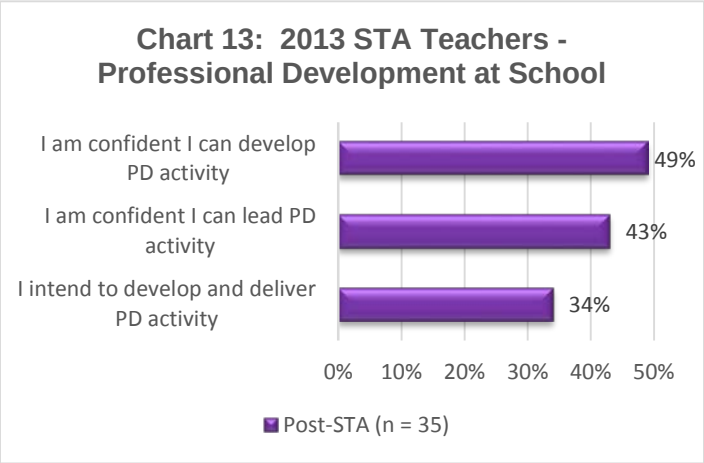
Chart 12 summarizes the proportions of 2013 and 2012 teachers reporting high levels of agreement (5 or 6 on the response scale) regarding their collaborations with other teachers. Items and full data are summarized in Appendices B and D, respectively.

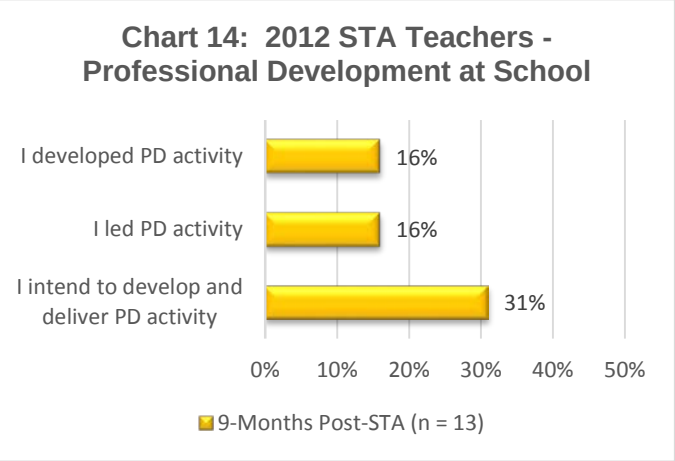


Recall that most teachers (82% of 2013 teachers, 69% of 2012 teachers) reported that STA encouraged them to collaborate with STEM professionals. When asked what collaborative opportunities with other teachers or professional scientists/engineers they identified through STA, five of the 2013 STA teachers described possible collaborations with local STEM professionals or organizations (e.g., local government/Department of Natural Resources, STEM professional societies, Senior Engineers, or the Army/AEOP) and how they might engage them in (e.g., discussing issues, developing presentations for STEM events, helping in the classroom). Several FY2012 STA teachers described ongoing collaboration with STEM professionals (e.g., from Battelle, from APG, from HCC) that included supporting classroom activities (e.g., technology-rich labs), events like STEM Night and Girls STEM Academy, and even facility tours.

According to Chart 12, fewer 2013 STA teachers (55-63%) intended to collaborate with other teachers in their lesson planning endeavors, and less than one third of 2012 STA teachers actually engaged in collaborative lesson planning with teachers across subjects or grade levels. Teachers reported a number of possible collaborations they identified through STA: 9 teachers suggested possible collaborations with other teachers, 2 teachers described possible collaborations with other departments in the school, and 4 teachers described how they might further develop and implement their STA lesson or research project in collaboration with other teachers. A few 2012 STA teachers reported collaborating with other teachers: adapting lessons with STA attendees back at school, sharing renewable energy kits with other classes, and working with teachers across subjects on certain lessons.

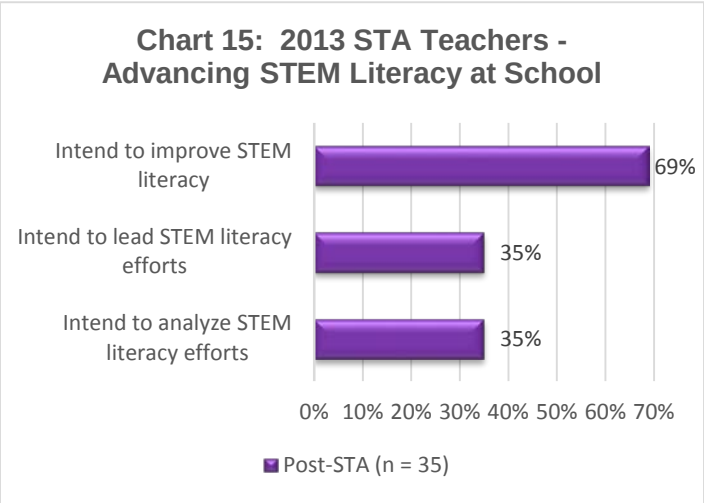
Professional development activities. STA teachers were asked about their confidence to develop and lead a PD activity, as well as their intent to develop and deliver a PD activity at school. Teachers responded on a 6-point scale of 1 = "Strongly disagree" to 6 = "Strongly Agree." 2012 STA teachers were asked similar questions, framed to provide a retrospective assessment of their efforts toward PD. Charts 13 and 14 summarize the proportions of teachers reporting high levels of agreement (5 or 6 on the response scale) about PD activities at school. Items and full data are summarized in Appendices B and D, respectively.

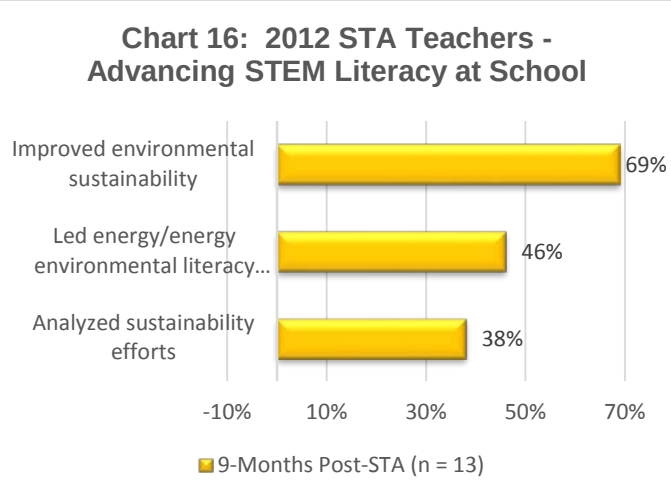




More than half of teachers felt that STA material was relevant for PD at school, however, less than 50% felt confident to develop or lead a PD activity. Only 34% of teachers intended to share their learning with other teachers by providing PD based on their experiences in STA. A smaller proportion of 2012 STA teachers felt that STA material was relevant for PD at school. Only 2 teachers (16%) had developed or led PD prior to completing this survey, and 31% of teachers still intended to do so.

Advancing school STEM literacy. Three items asked STA teachers the extent to which they intend to advance STEM literacy at school. Teachers responded on a 6-point scale of 1 = "Strongly disagree" to 6 = "Strongly Agree." 2012 STA teachers were asked similar questions, framed to provide a retrospective assessment of their efforts toward energy literacy and environmental sustainability in particular. Charts 15 and 16 summarize the proportions of teachers reporting high levels of agreement (5 or 6 on the response scale). Items and full data are summarized in Appendices B and D, respectively. A fourth question asked about what aspects of STA would be or were most useful for analyzing/creating STEM literacy efforts at school.





Most STA teachers intend to contribute to improving STEM literacy at their schools (69%). Fewer STA teachers intend to lead (35%) or analyze (35%) STEM literacy efforts at their school. Recall that many teachers (71%) reported STA materials would help teachers motivate students' participation in STEM literacy efforts. Given teachers responses about what aspects of STA are most useful for such efforts (e.g., most frequently mentioned inquiry, real-world applications, hands on activities, materials to support curriculum) we might surmise that immediately after STA, teachers intent to improve STEM literacy is largely focused in their own classrooms and with their own students.

Many 2012 STA Teachers reported contributing to energy/environmental literacy (46%) and environmental sustainability (69%) in their school, and their open ended responses demonstrate that their efforts extend beyond the classroom. Four STA teachers described efforts toward gaining Green school status: using STA information to consider energy efficient upgrades and/or application for Green school status, working on Green school status this or next year. Teachers also used STA materials to motivate students' participation in energy/environmental literacy beyond classroom walls. One teacher described engaging students in environmental literacy efforts: students built a demonstration garden the school yard for Conservation Landscaping and developed and led lessons at the school's annual environmental fair.

Assessment data suggests that the primary mechanism for impacting their schools and students is through their application of STA learning to their lesson planning and teaching. Overall, the evaluation provides evidence that many, albeit far fewer, STA teachers endeavor to apply STA learning and materials to bring about organization change, through collaboration with STEM professionals and teachers, PD activities at school, and efforts to advance STEM literacy. Typical school structures and processes make such cross-subject and cross-grade level collaboration challenging. STA provides potentially unique opportunities for teachers to collaborate in these ways, which are otherwise difficult to accomplish, and STA teachers highly value these opportunities. STPI might consider how it could, through the provision of academic year activities for teachers, provide opportunities to support teacher collaboration in leadership.

AEOP Awareness and Promotion

The AEOP's Goal 2 STEM Savvy Educators envisions AEOP programming that not only exposes teachers to topics in Army science and engineering, but also exposes them to other AEOP offerings, encourages integration of AEOP elements in classrooms, and promotes further engagement of teachers and their students in AEOPs. STPI's STA is the only AEOP element that exclusively serves teachers, and as such, it is poised to expand the AEOP mission of outreach to the classrooms and schools of participating teachers. STPI endeavors to inform teachers and through them, their students, of other STEM enrichment opportunities by the AEOP (STPI Objective 3).

Army Educational Outreach Programs

- Junior Solar Sprint (JSS)
- Gains in Mathematics and Science Education (GEMS)
- West Point Bridge Design Competition (WPBDC)
- eCYBERMISSION (eCM)
- High School Apprenticeship Program (HSAP)
- Research and Engineering Apprenticeship Program (REAP)
- Science and Engineering Apprentices Program (SEAP)
- Undergraduate Research Apprenticeship Program (URAP)
- College Qualified Leaders (CQL)
- Science, Mathematics, & Research for Transformation (SMART) scholarship (Offered by DoD)
- National Defense Science and Engineering Graduate (NDSEG) (Offered by DoD)

The STPI evaluation assessments measured teachers' awareness of AEOP opportunities and their intent (or efforts, in the case of 2012 STA teachers) to promote AEOP in their classrooms and schools through incorporate AEOP educational resources in their lessons and extracurricular activities (e.g., JSS, eCM, WPBDC, and JSHS), and they can provide guidance and encouragement to students to explore AEOP opportunities on their own (e.g., summer programs like GEMS, UNITE; apprenticeships like REAP, SEAP, HSAP). Charts 17 and 18 summarize these data.

Chart 17 suggests that a majority of STA teachers are aware of and intend to promote AEOP to students, but not through integration with classroom curriculum or extracurricular activities. Most FY13 teachers (59-85%, avg. 68%) reported receiving information about other AEOP initiatives during STA and expressed their intent to encourage student participation. Only 3-7% of STA teachers report intent to incorporate AEOP programming and resources into either their class lessons or their extracurricular activities. A substantial proportion report having never heard of the individual AEOPs (12-41%).

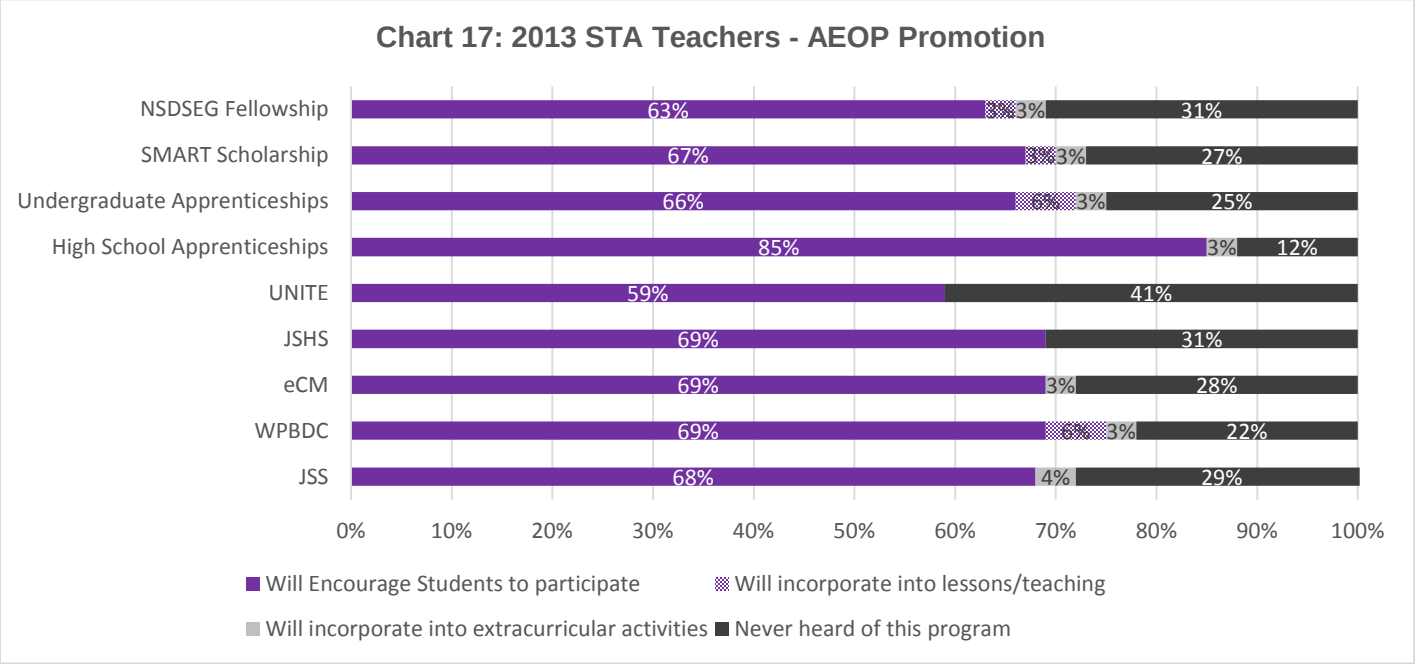
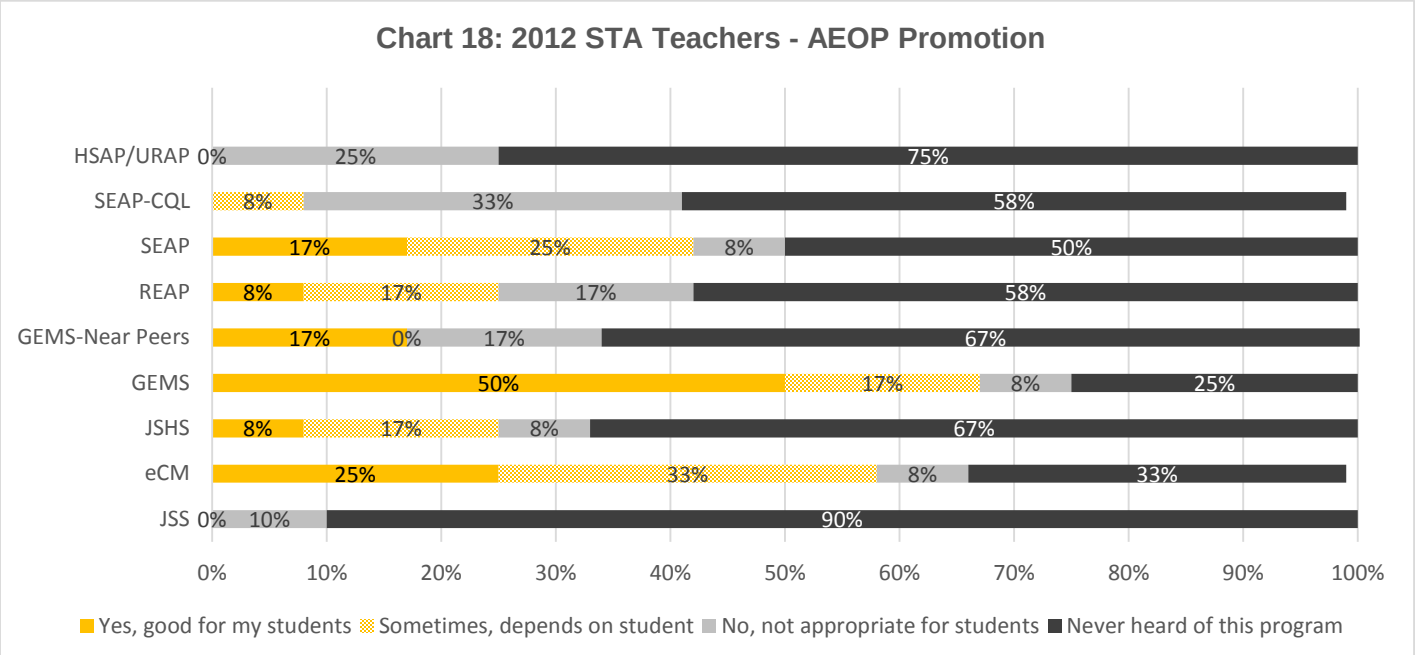


Chart 18 shows that most 2012 STA teachers were unaware of individual AEOPs 9-months after STA (25%-83%, avg. 56%). Some teachers were aware but did not find AEOPs appropriate enough to encourage their students to pursue; higher proportions considered undergraduate apprenticeship programs like CQL and URAP "not appropriate" for their students, reasonably so. Of the teachers that did encourage student participation in AEOP, they recommended GEMS (50%), eCYBERMISSION (25%), high school apprenticeship programs (8-17%), and JSHS (8%).



Immediately after STA, teachers have awareness of AEOP programs. Most teachers intend to encourage their students to participate in AEOP, but do not intend to incorporate them into lessons or extracurricular programs. Back in their classrooms and schools, however, fewer STA teachers promote AEOP opportunities to their students. These data suggest that while STPI has endeavored to inform teachers of STEM enrichment opportunities through AEOP, STPI has limited success in actually reaching the students of those teachers. Further, STA programming does not explicitly support integration of other AEOP elements in classrooms and schools, and teachers are, therefore, not included to do so. This is clearly an area for further improvement.

What Participants Are Saying

An overwhelming majority of the teachers surveyed spoke highly of their STA experiences, specifically with respect to the opportunities for collegial interactions with STEM professionals and with longitudinal teaching teams. The following quotations provide illustration of overall participant satisfaction:

- "STA gave me a deeper understanding of Engineering practices and its connection to science. As a result of this understanding I will be able to more confidently incorporate Engineering concepts into lessons that I already teach that will enhance the levels of inquiry to that of a higher level. This will change my role in the classroom to that of a moderator, guiding my students forward in their discovery of science concepts, rather than that of a "leader" that gives them what they need to understand the science concepts we are studying."
- "I loved the aquaponics presentation! It motivated me to create a high level inquiry based lesson that allows students to design their own aquaponics system using household items. I will definitely be implementing the ideas presented during this session. I am excited to do this lesson with my students and I think students will both enjoy and learn while using inquiry...win-win!"
- "This was a FANTASTIC workshop with many opportunities to collaborate with other teachers and learn about real world applications. The most valuable part of the experience were the lesson ideas and the opportunity to acquire materials to teach the lessons. I also valued the time and opportunity to develop a lesson with other teachers, and the help extended from the presenters and leaders of the academy."
- "Collaborating with peers and engineers helped me to understand how to incorporate STEM components into my classroom. I believe these components will be fun and engaging for the students."
- "It is nice to have the time to sit down and construct new plans. During the year, it is hard to find time to step out of the box and try something completely new. It will also be helpful to have access to other people's lessons plan that were created this week."
- "I enjoyed working cooperatively with other teachers. I am excited about the product we made and hope to incorporate it into my G.S. Biology class this year with a few modifications. I was also excited to hear about the student internship opportunities and competitions that are offered by AEOP. My G.S. students are highly motivated, high level students (pre-IB). Many of them may be interested in these opportunities."
- "Helped me to better appreciate the overall trajectory of STEM education from middle school to high school and identify weaknesses in previous science education and topics requiring repetition and reinforcement, especially in mathematics and basic scientific method."
- "This was one of the best professional opportunities I have ever had in my professional training. I knew of the potential impact upon my learning and thus the learning of my students -- this was my first opportunity to put what was a 'theory' into real life action. Our team consisted of science teachers in 6th, 7th, 8th grade and a math teacher in 6th grade. Powerful Opportunity -- thanks."
- "Overall, I am glad I decided to participate in STA. The most valuable part of the experience was showing me how to incorporate various levels of inquiry into my lessons. I have struggled with ways to do this over the past year with time and resource limitations. I am confident that I will be able to bring inquiry into many of my lessons."
- "Dr. Martin's aquaponics presentation was fabulous. There are so many angles that can be taken. We chose a very basic and generic template for our presentation, but I intend to extend it further for my G.S. students. I also appreciate the potential to link this topic to Environmental Literacy standards and possibly translate the idea into an Issue's Investigation. This topic can be connected to many topics in Biology, numerous Science standards, and STEM standards. Fabulous and doable."

Summary of Findings

The FY13 evaluation of STPI collected data that provided information about STA teachers, their perceptions of program activities, benefits to teachers, and utility in their teaching context. The 9-month follow up with 2012 STA teachers provides additional information about teachers' actual use of STA learning in their teaching contexts. The findings summarized Table 10 are intended to highlight the overall effectiveness of STPI in meeting AEOP and program objectives, and to inform future programming.

Table 10. 2013 STPI Evaluation Findings	
Study Sample and Respondent Profiles	
Teacher participation in STA evaluation yielded variable confidence in the findings.	• The statistical reliability achieved for 2013 STA teachers approach an acceptable level and suggest adequate representativeness of the population. The larger margin of error for 2012 STA teachers suggests less representativeness. The 2012 STA teacher data contributes valuable perspective to understanding the impact of STA beyond the one-week summer institute, however, any findings should be cautiously generalized with consideration given to the margin of error.
STA attracts teachers with varied teaching contexts.	• STA teachers serve a range of middle and high school grade levels, teach courses across the fields of science, technology, and mathematics, and include beginning/early-, mid-, and late-career teachers.
STA has limited success with providing outreach to teachers that serve populations historically underserved in STEM.	• All teachers (100%) reported that they do not teach in Title-I schools. Historically, Title-I schools serve more students who are historically underserved and underrepresented in STEM (e.g., low-income and racial and ethnic minority groups) as compared to non-Title-I schools.
Actionable Evaluation Findings	
STA teachers value opportunities to collaborate with and learn from STEM professionals and teachers; STA topics such as incorporating inquiry, science and engineering practices, hands-on, and real-life applications of STEM are important issues for STEM literacy in schools.	• Teachers listed a number of program structures, resources, and activities with which they were most satisfied. Most frequently, teachers reported satisfaction with Aquaponics, collaborative work (e.g., lesson planning) with their peers, and expert presentations.
	• Teachers described a range of topics, tools, and strategies that would be most adaptable to their classroom lessons. Aquaponics (40%) and iTree (20%) were the most frequently cited.
	• Teachers most frequently reported that STA materials supporting the incorporation of inquiry lessons, scientific and engineering practices, and hands-on activities were most suitable and important for professional development activities and for supporting STEM literacy efforts at their school. Similarly, teachers also perceived that utilizing STEM professionals to better connect classroom learning to real-life STEM applications was important.
	• Teachers reported that the most valuable part of the lesson planning project/presentation were the opportunities to collaborate with other teachers (and across different grade levers) and STEM professionals.

Outcomes Evaluation Findings	
STA teachers perceived growth in their STEM literacy.	• Teachers' retrospective pre-post self-assessments suggest that teachers generally felt they gained understanding in concepts and practices, current research, and everyday issues and applications of the disciplines they studied in STA.
	• Most 2012 STA teachers (92-100%) credit STA with improving their knowledge, learning, or confidence in energy and environmental literacy.
STA teachers perceived growth in their understanding and confidence to engage students in inquiry and practices through STEM lessons and teaching.	• Teachers' retrospective pre-post self-assessments suggest that teachers generally felt they gained understanding of and confidence to apply discipline-specific laboratory activities and research projects, levels of inquiry, Scientific and Engineering practices to their teaching.
STA teachers intended to adapt their STA learning for their classroom contexts; some 2012 STA teachers reported doing so.	• The majority of teachers (80-91%) intended to apply their learning across the broad categories targeted in STA in their everyday lesson planning and teaching: teachers intend to incorporate concepts (88%), Scientific and Engineering Practices (82%), levels of inquiry (91%), and suggested laboratory activities and research projects (82%).
	• Many 2012 STA teachers applied their STA learning of energy and environmental literacy to their own teaching practice: teachers developed (energy, 84%; environmental, 85%) and implemented (environmental, 69%; energy, 84%) in the classroom.
STA teachers are encouraged to and have identified potential collaborations with STEM professionals; some 2012 STA teachers reported doing so.	• The majority of teachers (82%) reported that STA encouraged them to collaborate with STEM professionals. Three teachers identified possible collaborations with Harford County Government, Harford Science Society, and Senior Engineers.
	• Many 2012 STA teachers (54%) felt STA encouraged them to seek collaborative opportunities with STEM professionals; four teachers described working with scientists or engineers at Battelle, Aberdeen Proving Grounds, and the local college.
Fewer STA teachers intended to use their STA learning as teacher leaders in their schools; some 2012 STA teachers did collaborate across subjects and grades, provide PD activities, and advance STEM literacy at their schools.	• Many teachers (53-62%) intend to collaborate with other teachers at the school in their lesson planning endeavors. However, only 34% of teachers intend to share their learning with other teachers by providing professional development (PD) based on their experiences in STA.
	• While many teachers reported that STA provided them with materials to motivate STEM literacy (70%), fewer intend to analyze (35%) and/or lead (35%) STEM literacy efforts at their school.
	• Fewer 2012 STA teachers engaged other teachers in collaborative lesson planning (23-38%). Only 16% (2 teachers) reported planning and providing professional development activities to others.
STA teachers' awareness of AEOP opportunities varies; most teachers intend to encourage their students to participate in AEOP, but do not intend to incorporate them into lessons or extracurricular programs.	• Most STA teachers (59-84%, avg. 68%) reported receiving information about other AEOP initiatives during STA, but a significant proportion report having never heard of the individual AEOPs.
	• Only 3-7% of STA teachers intended to incorporate AEOP programming and resources into either their class lessons or their extracurricular activities, though a majority of teachers expressed their intent to encourage student participation.

2012 STA teachers did not consistently recognize or promote AEOP opportunities to their students in their schools.	• Most 2012 STA teachers did not encourage their school students to pursue AEOP opportunities. Of the teachers that did encourage student participation, 50% recommended GEMS, 25% recommended eCYBERMISSION, up to 18% recommended one of the high school apprenticeship programs, and 8% recommended JSHS. More notable is that many FY12 teachers claim to be unaware of individual AEOPs after STA (25%-83%, avg. 56%).

Recommendations

1. STPI's programming (the STEM Teachers Academy, STA) reaches communities in and around Harford Community College (Bel Air, MD). There is, however, an apparent dearth of Title 1 secondary schools in those communities. A teachers-in-residence program model should be considered in an effort to provide outreach to teachers (and ultimately impact underserved students) from Title 1 or other schools serving high proportions of underserved populations that are not within daily commuting distance from Harford Community College.

2. STPI supports the critical role that teachers assume in the mentoring STEM talent in-school. As such, it is poised to expand the AEOP mission of outreach to the classrooms and schools of participating teachers. STA content offerings focus on engaging teachers in current research and everyday applications of the field. As the STPI expands its reach to teachers outside of MD, it should endeavor to align these experiences with the realities of the classrooms, most notably, the dimensions of learning envisioned in the *Next Generation Science Standards (NGSS)*. The call for shared standards is evident in AEOP's Goal 2 objectives, and advances federal policy recommendations calling for widespread support of the NGSS standards movement by K-12 agencies, and by academic, non-profit, business and other sectors providing outreach to K-12 students and teachers (PCAST 2010). Such alignment would provide inspiring opportunities for students to learn about recent STEM advancement, and would attend to federal recommendations and those offered by teachers (e.g., recommendations for more careful attention to relevance of content to their teaching contexts, in terms of the scope of the subject matter selected and support in translation for grade level appropriateness.)

3. To provide the greatest return on an investment that aims to enhance K-12 teaching and learning through professional development, STPI programming should include an expectation of and a mechanism for supporting teachers' transfer of new STA learning to their classrooms and schools. In order to accomplish this goal, STA activities must ensure that
    a. STEM content is relevant to participants' classroom and school contexts;
    b. Teachers are provided with sufficient guidance—through content experts and through collaboration with teacher participants—for translating adult level STA learning to grade-level ideas and activities that align with standards teachers are held accountable to teaching;
    c. Teachers are provided with scaffolds to support transfer of STA learning to the classroom—exemplary models of planning and instruction that intertwines the important dimensions of science and engineering they studied in STA with grade-appropriate expectations;
    d. Academic year follow up that supports teachers in applying their STA learning to their classroom teaching and contributing to organizational change in their schools. Academic year activities might include collaborative lesson planning, collaborative study of student outcomes from enacted lessons, and opportunities to develop professional development or other activities to advance STEM literacy beyond teachers' own classrooms.

4. Thus far, STPI's efforts have only endeavored to inform teachers, and through them, students of AEOP offerings. STPI is well positioned to address the Army's objectives of integration of AEOP elements and resources in classrooms. UNH and the Army might consider a significant shift in STPI programming, that focus STA activities on helping teachers understand the potential contributions of AEOPs to their teaching contexts, and supporting the integration of AEOP elements and resources in classrooms and schools. Such a shift would potentially advance the

AEOP objectives of shared standards for STEM, the integration of AEOP elements and resources with classroom curriculum, and attract more teachers and students to other AEOPs. The following vignette provides an illustration for such a model:

STA exists as a resident program during the summer institute, and leverages regional and/or national science teacher association meetings as opportunities for academic year activities with teachers. STPI markets STA programming to teachers and schools that serve underserved populations, nationwide or regionally. STPI ultimately serves students of those populations in their school-based learning through engagement with AEOP elements and resources. These experiences generate further interest and engagement in AEOP programs beyond the classroom.

STA teachers learn about a NGSS-aligned AEOP element and its resources during the summer institute, and, through academic year activities, are supported in incorporating that AEOP element or its resources into their classroom STEM lessons or extracurricular activities, and collaboratively studying the results of those efforts. For example, in the Junior Solar Sprint (JSS)-related track, teachers would participate in

3. *A Summer Institute during which teachers are provided with*
    - *Opportunities to work with and learn from Army STEM professionals engage teachers in learning about foundational principles and cutting edge Army research around solar energy, electrical and mechanical engineering, and the engineering design process;*
    - *Opportunities to work with and learn from AEOP educators (who have successfully incorporated JSS into their classroom and extracurricular activities) engage teachers in exploring the JSS curricular materials as learners, relating NGSS dimensions to those curricular materials (e.g., either identifying and/or adapting lessons for improved alignment to NGSS), learning about common student ideas related to the curricular materials, and identifying challenges of and possible solutions for implementing curricular materials in teachers' own contexts;*
    - *Opportunities to work with other STA teachers to initiate their capstone project, consisting of plans for implementing the AEOP element, including necessary adaptations of lessons to align with district curricula, supplies and materials needed (costs and source of funding), dates of proposed implementation, and how the implementation will be assessed.*
4. *Academic year sessions which would include*
    - *Opportunities to work with other STA teachers to finalize preparations for their enactment of the AEOP element or resource; and*
    - *Opportunities to collaboratively study their enactments of the AEOP resource or element through video clips of their classroom teaching and student work artifacts produced by the assessment proposed in their capstone.*
    - *Opportunities to volunteer for and/or participate with students in regional or national JSS events.*

5. The current evaluation of STPI primarily relies on teacher self-assessments of teacher outcomes (e.g., learning from STA, and intended and actual use of that learning in the classroom and school.) Currently, no objective measures of teacher and student outcomes are employed or measures that triangulate teacher reports with those of others in their schools; without such measures, the evaluation cannot make conclusive claims about the extent to which STA activities have effected teacher learning or practice, or, in turn, student learning. UNH and Army should consider how to establish and employ objective measures of teacher performance that align with AEOP and program priorities. Guskey[8] provides a hierarchical framework for the evaluation of teacher professional development, which includes assessing: 1) teacher reactions, 2) teacher learning, 3) organization support and change, 4) teacher use of new knowledge and skills, and 5) student learning outcomes. Also embedded in framework is a hierarchy of measures ranging from subjective self-report assessments to objective measures. STPI might consider, at a minimum, establishing objective measures of teacher learning (e.g., pre-post test of content or pedagogical content knowledge) associated with the STA content, resources, and activities. Ideally, the evaluation would also include teacher use (e.g., video/direct observation, or submission of lesson plans), and student outcomes (e.g., learning and affective outcomes aligned with AEOP and Army STEM objectives), especially if programming shifts to incorporate academic year follow-up that focuses on the implementation and study of classroom based interventions.

[8] Guskey, T. (1999) *Evaluating Professional Development*. Thousand Oaks, CA: Corwin Press.

Appendices

2

Appendix A:
FY13 STPI Evaluation Plan

Key Evaluation Questions

The STPI evaluation gathered information from teachers about STA's structures, resources, and activities, as well as their potential effects, in order to address key evaluation questions related to program strengths and challenges, benefits to participants, and overall effectiveness in meeting AEOP and program objectives:

- To what extent did STA successfully outreach to teachers serving underserved populations?
- What aspects of the STA experience are working well? Which could be improved?
- To what extent did participation in STA:
  - Improve teachers' knowledge, skills, and abilities in STEM?
  - Improve teacher approaches to teaching about STEM concepts, practices, and careers in their classrooms?
  - Improve teacher collaboration and leadership in their schools?
  - Improve teacher awareness of Army STEM careers and AEOP opportunities?

Methods and Instruments

The FY2013 evaluation used a mixed methods approach[1] to allow for broad generalization and for deeper focusing of the evaluation. This mixed methods approach employed quantitative measures to assess level of agreement or satisfaction, as well as qualitative measures, such as open or constructed-response items in the questionnaire that provided less structured items for assessing perceived value, satisfaction, or suggestions for improvement.

The assessment strategy for STPI included post-STA questionnaires, which included a number of items requiring teachers to assess their current understandings and confidence and retrospectively assess the same before participating in the STA.

Data Collection and Sampling

Data collection efforts for 2013 occurred from July to August, following STA program activities. The 2013 STPI assessment included a post-STA questionnaire for 2013 STA teachers (Appendix B). The 2013 post-STA assessment included a number of retrospective pre-STA to post-STA items, in order to identify the potential effects of STA on teachers' understanding and confidence of STEM and STEM teaching practices. The 9-month post-STA questionnaire for 2012 STA teachers (Appendix C) provided evidence for teachers' translation of STA experiences in the teaching context. Questionnaires were electronically distributed to teacher participants through Harford Community College and employed convenience sampling. Online questionnaires were opened for data collection for a minimum of 10 days after program activities concluded.

Data Analyses

Quantitative and qualitative data were compiled and analyzed after all data collection concluded.

[1] Creswell, 2003; Quinn 2001; Greene & Caracelli, 1997

Evaluators summarized quantitative data with descriptive statistics such as numbers of respondents, frequencies and proportions of responses, average response when responses categories are assigned to a 6-point scale (e.g., 1 = "Strongly Disagree" to 6 = "Strongly Agree"), and standard deviations.

All data collected from 2013 teachers are summarized in Appendix B. Data from 2012 STA teachers are summarized in Appendix D. Charts used within this report narrative provide visual representations and comparisons of these data, unless otherwise noted. This allows the reviewer to easily apply the determined margin of error for each participant groups' questionnaire responses. For visual simplicity of charts, "Somewhat Disagree" and "Somewhat Agree" (and similar categories) are aggregated as "Neutral" responses.

Evaluators conducted inferential statistics on retrospective pre-STA to post-STA to study any changes in participants that could demonstrate the potential effect of their participation in STPI. Retrospective pre-STA to post-STA comparisons from 2013 STA teacher data are summarized in Appendix C. Tables used within the report narrative generally summarize these comparisons and report the results of significance testing[2] for identifying statistically and practically significant changes.

Statistical significance indicates whether a result is different than chance alone. Statistical significance is determined with t, McNemar, ANOVA, or Tukey's tests, with significance defined at $p < 0.05$. Practical significance, also known as effect size, indicates how weak or strong an effect is and is usually studied in relation to statistical significance. Practical significance is determined with Cohen's *d* or Pearson's *r*, with *d* or *r* of .250, which is considered weak but "substantively important" at $p < 0.05$.[3] Statistically and/or practically significant findings are noted as "statistical" or "significant" in the report narrative with footnotes providing details about results of statistical tests. However, given the small number of respondents in STA and especially in each disciplinary track, these findings should be taken as potential indicators of effect and potentially promising activities for sites to explore in more depth; they should not be taken as a rigorous measure of the effectiveness of the programs' structures, processes, or activities.

Evaluators analyzed constructed-response questionnaire data for emergent themes. These data are then summarized by theme and by frequency of participants addressing a theme. When possible, two raters analyze each complete qualitative data set. When not possible, a portion of the data set are analyzed by both raters to determine and ensure inter-rater reliability. Thus, the summary of themes and frequency represent consensus ratings.

To the extent possible, findings were triangulated across data sources (2013 and 2012 STA teachers), data types (quantitative and qualitative data from questionnaires) and different evaluators conducting the analyses and reporting. This triangulation enhances the credibility of findings synthesized from single data

[2] 2012 evaluation reports did not conduct significance testing on changes. The word "significant" was used incorrectly to describe changes that were perceived to be large. However, without significance testing, we cannot be sure which changes were real or due to chance, nor can we assess the strength of the effect causing the real changes.
[3] U.S. Department of Education, What Work's Clearinghouse Procedures and Standards Handbook, accessed June 30 http://ies.ed.gov/ncee/wwc/pdf/reference_resources/wwc_procedures_v3_0_draft_standards_handbook.pdf

sources or data types. For example, evaluators cite major trends from the qualitative data—emergent themes with high frequencies in respondents addressing them—to provide additional evidence of, explanation for, or illustrations of quantitative data. We have posed plausible explanations when divergence between data sources or types is evident; any such explanations are worthy of further exploration in the full study and, potentially, in future evaluation efforts. Periodically, less unique perspectives are reported and identified as such when they provide illustration that captures the spirit of STPI or AEOP objectives.

Appendix B:
2013 Post-STA Teacher Questionnaire and Data Summary

STEM Teachers Program Initiative: STEM Teachers Academy Participant Questionnaire

Thank you for your participation in this study about the 2013 STEM Teaching Academy (STA). The following assessment of participants will collect information about you and your STA experiences. The results of this assessment will be used to help us improve our program and to create evaluation reports for the organizations that support STA.

About this assessment:

- This research protocol has been approved for use with human subjects by the Virginia Tech IRB office. Although this assessment is not anonymous, it is CONFIDENTIAL; prior to analysis and reporting, responses will be de-identified and no one will be able to connect your responses to your name.
- Additionally, only AEOP evaluation personnel will have access to completed forms and personal information will be stored securely.
- It is completely VOLUNTARY; you are not required to participate and you can withdraw at any time. If you provide your email address, the AEOP may contact you in the future to ask about your STA experience and how you have used it in the future.
- We do hope that you will complete the assessment because your responses will give STA valuable information for improvement and for generating reports for our supporting organizations.

By choosing to click the ">>" button below and complete this assessment, you are providing your consent to participate in the STA research/evaluation study

If you have any additional questions or concerns, please contact one of the following people:

Tanner Bateman, Virginia Tech
Senior Project Associate, AEOPCA
(540) 231-4540, tbateman@vt.edu

Rebecca Kruse, Virginia Tech
Evaluation Director, AEOPCA
(540) 315-5807, rkruse75@vt.edu

Steve Hale, University of New Hampshire
STA, Program Manager
(603) 862-4758, steve.hale@unh.edu

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Please fill out the personal information below (optional):

First Name: _____

Last Name: _____

Email Address: _____

What grade level do you teach? (e.g., 9, 10, 11, or 12): _____, grade.

What subject(s) do you teach? (e.g., biology, botany, etc.): _____.

How many years have you been teaching? _____, years.

What track did you participate in during the 2013 STEM Teachers Academy (STA)?

***Questions later in the survey are displayed based on respondents' answers to this item**

- ❍ Biology/Chemistry - Bio Fuels Cells and Aquaculture
- ❍ Engineering
- ❍ Earth/Environmental Science

Which of the following best describes you?

- ❍ Male
- ❍ Female
- ❍ Choose not to report

Which of the following best describes your ethnicity/race?

- ❍ American Indian or Alaska Native
- ❍ Asian or Pacific Islander
- ❍ Black or African American
- ❍ Hispanic or Latino
- ❍ White or Caucasian
- ❍ Some other ethnicity/race: _____
- ❍ Choose not to report

Please fill in the following information about your school:

What is the name of the school at which you teach? _____.

City: _____.

State: _____.

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2013 Post-STA Teacher Questionnaire and Data Summary

Use the scale provided to indicate your level of agreement with each of the following statements:

	Strongly Disagree	Disagree	Somewhat Disagree	Somewhat Agree	Agree	Strongly Agree
I intend to develop lesson plans and teachings that incorporate science and engineering concepts presented during the STA.	❍	❍	❍	❍	❍	❍
I intend to develop lesson plans and teaching that incorporate the Scientific and Engineering Practices (NRC, 2011) presented during the STA	❍	❍	❍	❍	❍	❍
I intend to develop lesson plans and teaching that incorporate levels of inquiry that were presented during the STA	❍	❍	❍	❍	❍	❍
I intend to develop lesson plans and teaching that incorporate suggested lab activities/research projects presented during the STA	❍	❍	❍	❍	❍	❍

What material did you learn from the STA that you believe is the most adaptable to your classroom lessons and teachings?

Appendix B:
2013 Post-STA Teacher Questionnaire and Data Summary

Use the scale provided to indicate your level of agreement with each of the following statements:

	Strongly Disagree	Disagree	Somewhat Disagree	Somewhat Agree	Agree	Strongly Agree
To bring STEM literacy to my school, I will need to collaborate with teachers across subjects and grade levels	❍	❍	❍	❍	❍	❍
I will use concepts from STA to develop lesson plans with teachers in other subject areas	❍	❍	❍	❍	❍	❍
I will use concepts from STA to collaborate with teachers across grade levels in order to develop curricula that spans multiple grade-years	❍	❍	❍	❍	❍	❍
The STA program encouraged me to seek out collaborative relationships with other teachers	❍	❍	❍	❍	❍	❍
The STA program encouraged me to seek out collaborative opportunities with professional scientists/engineers	❍	❍	❍	❍	❍	❍

What collaborative opportunities with other teachers at your school or professional scientists/engineers have you identified after participating in STA?

Appendix B:

2013 Post-STA Teacher Questionnaire and Data Summary

Use the scale provided to indicate your level of agreement with each of the following statements:

	Strongly Disagree	Disagree	Somewhat Disagree	Somewhat Agree	Agree	Strongly Agree
The material presented to me at STA would make for a very useful and important professional development activity at my school	❍	❍	❍	❍	❍	❍
After STA, I am confident that I can develop an effective professional development activity	❍	❍	❍	❍	❍	❍
After STA, I am confident that I can lead an effective professional development activity for teachers at my school	❍	❍	❍	❍	❍	❍
I intend to develop and deliver a professional development activity at my school	❍	❍	❍	❍	❍	❍

What material from STA do you think is the most suitable and important for professional development activities at your school?

Appendix B:
2013 Post-STA Teacher Questionnaire and Data Summary

Use the scale provided to indicate your level of agreement with each of the following statements:

	Strongly Disagree	Disagree	Somewhat Disagree	Somewhat Agree	Agree	Strongly Agree
After STA, I intend to improve the STEM literacy of my school	❍	❍	❍	❍	❍	❍
After STA, I intend to lead STEM literacy efforts at my school	❍	❍	❍	❍	❍	❍
Using material from STA, I intend to analyze STEM literacy efforts at my school	❍	❍	❍	❍	❍	❍
STA gave me material that will help me motivate students to participate in STEM literacy activities	❍	❍	❍	❍	❍	❍

What aspects of STA do you believe are most useful for analyzing/creating STEM literacy efforts at your school?

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Please rate your level of understanding of each of the following both PRIOR to participating in the STA and AFTER participating in the STA:

	PRIOR to participating in the STA						AFTER participating in the STA					
	1 = Minimal Understanding	2	3	4	5	6 = Maximal Understanding	1 = Minimal Understanding	2	3	4	5	6 = Maximal Understanding
The behaviors typical of students at different levels of inquiry	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
The behaviors typical of teachers at different levels of inquiry	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
The benefits of using different levels of inquiry	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
The Scientific and Engineering Practices (NRC, 2011), as they relate to inquiry	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍

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Please rate your level of confidence doing each of the following both PRIOR to participating in the STA and AFTER participating in the STA:

	PRIOR to participating in the STA						AFTER participating in the STA					
	1 = Not Confident	2	3	4	5	6 = Very Confident	1 = Not Confident	2	3	4	5	6 = Very Confident
Selecting a level of inquiry given the lesson objectives/desired outcomes	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Planning or teaching student activities for a given level of inquiry	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Planning or teaching teacher activities for a given level of inquiry	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Selecting appropriate Scientific and Engineering Practices given the lesson objectives/desired outcomes	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Planning lessons that incorporate opportunities for students to learn about Scientific and Engineering Practices	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Planning lessons that incorporate opportunities for students to use Scientific and Engineering Practices	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Supporting students in using Scientific and Engineering Practices (NRC, 2011) as they participate in inquiry	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍

Appendix B:
2013 Post-STA Teacher Questionnaire and Data Summary

***Only presented to those respondents who indicated that they took the "Biology/Chemistry" track in the STA.**
Please rate your level of understanding of each of the following both PRIOR to participating in the STA and AFTER participating in the STA:

	PRIOR to participating in the STA						AFTER participating in the STA					
	1 = Minimal Understanding	2	3	4	5	6 = Maximal Understanding	1 = Minimal Understanding	2	3	4	5	6 = Maximal Understanding
Concepts and practices related to energy alternatives to fossil fuel combustion	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Suggested lab activities/research projects for teaching students about energy	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Current research related to energy alternatives to fossil fuel combustion	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Everyday issues related to energy alternatives to fossil fuel combustion	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍

***Only presented to those respondents who indicated that they took the "Biology/Chemistry" track in the STA.**
Please rate your level of understanding of each of the following both PRIOR to participating in the STA and AFTER participating in the STA:

	PRIOR to participating in the STA						AFTER participating in the STA					
	1 = Minimal Understanding	2	3	4	5	6 = Maximal Understanding	1 = Minimal Understanding	2	3	4	5	6 = Maximal Understanding
Concepts and practices related to aquaculture as means for sustainable food production	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Suggested lab activities/research projects for teaching students about sustainable food production concepts and practices	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Current research related to aquaculture as means for sustainable food production	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Everyday issues related to aquaculture as means for sustainable food production	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍

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***Only presented to those respondents who indicated that they took the "Engineering" track in the STA.**

Please rate your level of understanding of each of the following both PRIOR to participating in the STA and AFTER participating in the STA:

	PRIOR to participating in the STA						AFTER participating in the STA					
	1 = Minimal Understanding	2	3	4	5	6 = Maximal Understanding	1 = Minimal Understanding	2	3	4	5	6 = Maximal Understanding
Concepts and practices in mechanics and mechanical engineering (e.g., forces, simple machines, stress and material failure)	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Mathematics used in mechanics and mechanical engineering	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Suggested lab activities/research projects for teaching students about mechanics and mechanical engineering concepts and practices	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Current research related to mechanics and mechanical engineering	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Everyday issues related to mechanics and mechanical engineering concepts and practices	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍

***Only presented to those respondents who indicated that they took the "Engineering" track in the STA.**

Please rate your level of understanding of each of the following both PRIOR to participating in the STA and AFTER participating in the STA:

	PRIOR to participating in the STA						AFTER participating in the STA					
	1 = Minimal Understanding	2	3	4	5	6 = Maximal Understanding	1 = Minimal Understanding	2	3	4	5	6 = Maximal Understanding
Concepts and practices used in electricity and electrical engineering	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Basic mathematics used in electricity and electrical engineering	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Suggested lab activities/research projects for teaching students about electricity and electrical engineering concepts and practices	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Current research related to electricity and electrical engineering	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Everyday issues related to electricity and electrical engineering concepts and practices	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍

Appendix B:
2013 Post-STA Teacher Questionnaire and Data Summary

***Only presented to those respondents who indicated that they took the "Engineering" track in the STA.**
Please rate your level of understanding of each of the following both PRIOR to participating in the STA and AFTER participating in the STA:

	PRIOR to participating in the STA						AFTER participating in the STA					
	1 = Minimal Understanding	2	3	4	5	6 = Maximal Understanding	1 = Minimal Understanding	2	3	4	5	6 = Maximal Understanding
Concepts and practices used in systems engineering	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Basic mathematics used in systems engineering	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Suggested lab activities/research projects for teaching students about systems engineering concepts and practices	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Current research related to systems engineering	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Everyday issues related to systems engineering concepts and practices	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍

***Only presented to those respondents who indicated that they took the "Engineering" track in the STA.**
Please rate your level of understanding of each of the following both PRIOR to participating in the STA and AFTER participating in the STA:

	PRIOR to participating in the STA						AFTER participating in the STA					
	1 = Minimal Understanding	2	3	4	5	6 = Maximal Understanding	1 = Minimal Understanding	2	3	4	5	6 = Maximal Understanding
Concepts and practices used in civil engineering	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Basic mathematics used in civil engineering	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Suggested lab activities/research projects for teaching students about civil engineering concepts and practices	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Current research related to civil engineering	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Everyday applications of civil engineering concepts and practices	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍

Appendix B:
2013 Post-STA Teacher Questionnaire and Data Summary

***Only presented to those respondents who indicated that they took the "Earth/Environmental Science" track in the STA.**

Please rate your level of understanding of each of the following both PRIOR to participating in the STA and AFTER participating in the STA:

	PRIOR to participating in the STA						AFTER participating in the STA					
	1 = Minimal Understanding	2	3	4	5	6 = Maximal Understanding	1 = Minimal Understanding	2	3	4	5	6 = Maximal Understanding
Concepts and practices related to the study of trees and tree canopies	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Suggested lab activities/research projects for teaching students about trees and tree canopies	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Current research related to trees and tree canopies	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Everyday issues related to trees and tree canopies	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍

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During the STA, were you provided with information about any of the following AEOP programs? Will you encourage your students to participate and/or integrate these programs into your classroom?

	Yes - I learned about this program and will encourage students to participate	Yes - and I plan to incorporate this program into my class lessons / teachings	Yes - and I plan to incorporate this program into extracurricular activities	I have never heard about this program
Junior Solar Sprint (JSS): A solar-car building and race for 6th – 8th grade	❍	❍	❍	❍
Junior Science and Humanities Symposium (JSHS): A high school STEM research competition	❍	❍	❍	❍
UNITE: An engineering summer program for high school students from underserved groups	❍	❍	❍	❍
West Point Bridge Contest: A computer-based engineering design competition for 6th-12th grade	❍	❍	❍	❍
eCYBERMISSION: A web-based science, technology, engineering, and mathematics (STEM) competition for 6th-9th grade	❍	❍	❍	❍
High School Internships : Internships in Army research laboratories and University laboratories throughout the U.S.; the Science and Engineering Apprenticeship Program (SEAP), the Research and Engineering Apprenticeship Program (REAP), and the U.S. Army High School Apprenticeship Program (HSAP).	❍	❍	❍	❍
College Internships: At Army laboratories and University laboratories throughout the country; College Qualified Leaders (CQL) and the U.S. Army Undergraduate Research Apprenticeship Program (URAP).	❍	❍	❍	❍
The Science, Mathematics And Research for Transformation (SMART) scholarship offered by the Department of Defense (DoD) for students pursuing degrees in STEM	❍	❍	❍	❍
The National Defense Science and Engineering Graduate (NDSEG) fellowship offered by the Department of Defense	❍	❍	❍	❍

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In a couple of sentences, tell us about your overall satisfaction with the STA Lesson Planning Project/Presentation: What was the most valuable part of that experience?

What material from STA did you learn the most from?

What portion(s) of STA were you MOST SATISFIED with?

What portion(s) of STA were you LEAST SATISFIED with?

Thank you for your input and remember that your responses are completely confidential.

If you have any questions or concerns, please email:

Rebecca Kruse – rkruse75@vt.edu or Tanner Bateman – tbateman@vt.edu

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What grade level do you teach?		
	Freq.	**%**
One grade in middle school	8	26%
Two grades in middle school	1	3%
Three grades in middle school	0	0%
One grade in high school	4	13%
Two grades in high school	3	10%
Three grades in high school	4	13%
Four grades in high school	11	35%
Total	31	100%

What subject(s) do you teach? (n = 31)		
	Freq.	**%**
Biology	8	17%
Earth science	6	13%
Chemistry	4	8%
Environmental science	4	8%
Physical science	4	8%
Algebra	3	6%
Physics	3	6%
Statistics	3	6%
Marine science	2	4%
Math	2	4%
Zoology	2	4%
Anatomy	1	2%
Astronomy	1	2%
Plant science	1	2%
Pre-algebra	1	2%
Pre-calculus	1	2%
Space science	1	2%
Technology education	1	2%
Total	48	100%

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How many years have you been teaching?		
	Freq.	**%**
1 – 3 years	5	16%
4 – 6 years	4	13%
7 – 9 years	6	19%
10 – 12 years	3	10%
13 -15 years	2	6%
16 – 18 years	2	6%
19 – 21 years	2	6%
22 – 24 years	2	6%
25 – 27 years	2	6%
28 – 30 years	1	3%
31+ years	2	6%
Total	31	100%

Note. Average time spent as a teacher = 13.2 years

What track did you participate in during the 2013 STEM Teachers Academy (STA)?		
	Freq.	**%**
Biology/Chemistry - Bio Fuels Cells and Aquaculture	13	35%
Engineering	15	41%
Earth/Environmental Science	9	24%
Total	37	100%

Gender		
	Freq.	**%**
Male	11	31%
Female	23	66%
Choose not to report	1	3%
Total	35	100%

Race/Ethnicity		
	Freq.	**%**
American Indian or Alaskan Native	0	0%
Asian or Pacific Islander	1	3%
Black or African American	0	0%
Hispanic or Latino	0	0%
White/Caucasian	33	94%
Other	0	0%
Choose not to report	1	3%
Total	35	100%

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Please fill in the following information about your school: What is the name of the school at which you teach?					
List of Items	**Freq.**	**%**	**List of Items**	**Freq.**	**%**
North Harford High School	6	17%	**Bel Air High School**	1	3%
John Carroll Catholic High School	4	11%	**Bel Air Middle School**	1	3%
Edgewood High School	3	9%	**Edgewood Middle School**	1	3%
Joppatowne High School	3	9%	**Elktion Middle School**	1	3%
C Milton Wright High School	2	6%	**Harford Christian School**	1	3%
Fallston Middle	2	6%	**Harford Technical High School**	1	3%
Patterson Mill High School	2	6%	**Havre de Grace High School**	1	3%
Southampton Middle School	2	6%	**Havre de Grace Middle school**	1	3%
Aberdeen High School	1	3%	**North Harford Middle School**	1	3%
Aberdeen Middle School	1	3%			
			Total	35	100%

Please fill in the following information about your school: City		
	Freq.	**%**
Bel Air	13	37%
Pylesville	7	20%
Edgewood	4	11%
Joppa	3	9%
Aberdeen	2	6%
Fallston	2	6%
Havre de Grace	2	6%
Darlington	1	3%
Elkton	1	3%
Total	35	100%

Please fill in the following information about your school: State		
	Freq.	**%**
Maryland	35	100%
Total	35	100%

Appendix B:
2013 Post-STA Teacher Questionnaire and Data Summary

Use the scale provided to indicate your level of agreement with each of the following statements: (n = 34)								
	1	**2**	**3**	**4**	**5**	**6**	**Avg.**	**SD**
I intend to develop lesson plans and teachings that incorporate science and engineering concepts presented during the STA.	1 (3%)	1 (3%)	1 (3%)	1 (3%)	15 (44%)	15 (44%)	**5.15**	1.16
I intend to develop lesson plans and teaching that incorporate the Scientific and Engineering Practices (NRC, 2011) presented during the STA	1 (3%)	0 (0%)	0 (0%)	5 (15%)	16 (47%)	12 (35%)	**5.09**	1.00
I intend to develop lesson plans and teaching that incorporate levels of inquiry that were presented during the STA	1 (3%)	0 (0%)	0 (0%)	2 (6%)	13 (38%)	18 (53%)	**5.35**	0.98
I intend to develop lesson plans and teaching that incorporate suggested lab activities/research projects presented during the STA	1 (3%)	0 (0%)	0 (0%)	5 (15%)	9 (27%)	18 (55%)	**5.27**	1.07
Note. Items used the following response scale 1 = "*Strongly Disagree,*" 2 = "*Disagree,*" 3 = *"Somewhat Disagree,*" 4 = "*Somewhat Agree*," 5 = "*Agree*," 6 = "*Strongly Agree*".								

What material did you learn from the STA that you believe is the most adaptable to your classroom lessons and teachings? (n = 25)					
List of Items	**Freq.**	**%**	**List of Items**	**Freq.**	**%**
Aquaponics	10	40%	**Mechanical engineering**	2	8%
iTree	5	20%	**Aeronautic design**	1	4%
Incorporating Inquiry into lesson plans	3	12%	**Fuel cells**	1	4%
Electronic circuits	2	8%	**Torque and stationary bicycle**	1	4%
Bridge design	2	8%	**Impulse and the egg drop**	1	4%
Alternative energy sources	2	8%	**Engineering perspective**	1	4%
US Geological Services	2	8%	**Applications of Trigonometry**	1	4%
Modeling units of measurement	2	8%	**Impervious surfaces**	1	4%
Remote sensing	2	8%	**Homogenization of Maryland streams**	1	4%
			Total	**40**	100%

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2013 Post-STA Teacher Questionnaire and Data Summary

Use the scale provided to indicate your level of agreement with each of the following statements: (n = 35)								
	1	**2**	**3**	**4**	**5**	**6**	**Avg.**	**SD**
To bring STEM literacy to my school, I will need to collaborate with teachers across subjects and grade levels	1 (3%)	3 (9%)	0 (0%)	3 (9%)	23 (66%)	5 (14%)	**4.69**	1.18
I will use concepts from STA to develop lesson plans with teachers in other subject areas	1 (3%)	2 (6%)	0 (0%)	10 (29%)	19 (54%)	3 (9%)	**4.51**	1.07
I will use concepts from STA to collaborate with teachers across grade levels in order to develop curricula that spans multiple grade-years	1 (3%)	2 (6%)	1 (3%)	12 (34%)	16 (46%)	3 (9%)	**4.40**	1.09
The STA program encouraged me to seek out collaborative relationships with other teachers	1 (3%)	0 (0%)	0 (0%)	4 (11%)	21 (60%)	9 (26%)	**5.03**	0.92
The STA program encouraged me to seek out collaborative opportunities with professional scientists/engineers	1 (3%)	0 (0%)	0 (0%)	5 (14%)	18 (51%)	11 (31%)	**5.06**	0.97
Note. Items used the following response scale 1 = "*Strongly Disagree,*" 2 = "*Disagree,*" 3 = *"Somewhat Disagree,"* 4 = "*Somewhat Agree*," 5 = "*Agree*," 6 = "*Strongly Agree*".								

What collaborative opportunities with other teachers at your school or professional scientists/engineers have you identified after participating in STA? (n = 23)			
Broad Theme	Narrow Theme(s)	**Freq.**	**Example Response(s)**
Collaborating with other individuals		**13**	
	Collaboration with other teachers	9	• "I have already begun talking with the history teacher on my team about incorporating an engineering component into our service learning project."
	Collaboration with other departments	2	• "Collaborating with the technology department is the first one that came to mind. It would be nice to have those students aid in the design of these concepts and ideas."
	Collaboration with government	1	• "Discussing issues with the DNR and Harford County Government."
	Collaboration with formal societies	1	• "Work with Harford Senior Science Society to develop presentations for STEM Day."
STEM Pathway		**7**	
	Bring professionals into the school	3	• "I have and will continue to work with all the subject areas in my schools. I was happy to learn about the Senior Engineers that can help in the classroom and the AEOP available to the students."
	Create and implement lesson plans	3	• "I will be seeking opportunities to develop lessons with the math teacher on my team. The lesson that I developed while at the STA program incorporated science concepts and higher level math concepts (from Algebra to Calculus) together."
	Incorporating STEM into classes	1	• "I have already begun talking with the history teacher on my team about incorporating an engineering component into our service learning project."

Appendix B:
2013 Post-STA Teacher Questionnaire and Data Summary

Use the scale provided to indicate your level of agreement with each of the following statements: (n = 35)								
	1	**2**	**3**	**4**	**5**	**6**	**Avg.**	**SD**
The material presented to me at STA would make for a very useful and important professional development activity at my school	1 (3%)	0 (0%)	3 (9%)	9 (27%)	12 (36%)	8 (24%)	**4.67**	1.14
After STA, I am confident that I can develop an effective professional development activity	1 (3%)	1 (3%)	1 (3%)	15 (43%)	9 (26%)	8 (23%)	**4.54**	1.15
After STA, I am confident that I can lead an effective professional development activity for teachers at my school	1 (3%)	1 (3%)	2 (6%)	16 (47%)	9 (26%)	6 (17%)	**4.40**	1.12
I intend to develop and deliver a professional development activity at my school	2 (6%)	2 (6%)	6 (18%)	12 (37%)	9 (27%)	2 (7%)	**3.91**	1.23
Note. Items used the following response scale 1 = "*Strongly Disagree*," 2 = "*Disagree*," 3 = "*Somewhat Disagree*," 4 = "*Somewhat Agree*," 5 = "*Agree*," 6 = "*Strongly Agree*".								

What material from STA do you think is the most suitable and important for professional development activities at your school? (n = 22)		
List of Suggestions	**Freq.**	**Example Response(s)**
Incorporation of inquiry into formal lesson plans	5	• "The discussion of inquiry based lessons utilizing math and engineering practices where applicable."
Hands-on activities and demonstrations	5	• "Hands on examples and activities relevant to the teachers' subject and grade level."
Professionals in the classroom	3	• "Utilization of professionals in the field as resources for the classroom." • "Having professionals that work in fields related to your curriculum would be a huge benefit to incorporate and bring into schools for professional development."
Focus on interdisciplinary subjects	2	• "Any material that allows non-science teachers to see the connections to their classroom. This will open up doors for cross-curricular projects and partnerships."
Overview of the program	2	• "I think an overview if the program would be helpful to make more teachers aware of the program would be a good start."
Aquaculture	2	• "Aquaculture- It has a variety of subjects that can be incorporated and help our school with its "green" status."
iTree	1	• "iTree [material]"
Impervious surfaces	1	• "Impervious surfaces [material]"
Environmental track	1	• "All of the data presented in the environmental track would be most beneficial"

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Use the scale provided to indicate your level of agreement with each of the following statements: (n=35)								
	1	**2**	**3**	**4**	**5**	**6**	**Avg.**	**SD**
After STA, I intend to improve the STEM literacy of my school	1 (3%)	0 (0%)	0 (0%)	10 (29%)	17 (49%)	7 (20%)	**4.8**	0.96
After STA, I intend to lead STEM literacy efforts at my school	1 (3%)	1 (3%)	1 (3%)	20 (57%)	9 (26%)	3 (9%)	**4.26**	0.98
Using material from STA, I intend to analyze STEM literacy efforts at my school	1 (3%)	1 (3%)	4 (12%)	16 (47%)	9 (26%)	3 (9%)	**4.18**	1.06
STA gave me material that will help me motivate students to participate in STEM literacy activities	1 (3%)	0 (0%)	2 (6%)	7 (20%)	12 (34%)	13 (37%)	**4.94**	1.14
Note. Items used the following response scale 1 = "*Strongly Disagree*," 2 = "*Disagree*," 3 = "*Somewhat Disagree*," 4 = "*Somewhat Agree*," 5 = "*Agree*," 6 = "*Strongly Agree*".								

What aspects of STA do you believe are most useful for analyzing/creating STEM literacy efforts at your school? (n = 17)

List of Items	Freq.	Example Response(s)
Incorporation of inquiry into lesson plans	3	• "Bringing information about levels of inquiry would be an area where STEM literacy could be improved."
Examples of real world use of material	3	• "Real-life professionals working in the field of science related to curriculum to see how content relates to real-world problem solving/STEM related activities - like bridge design"
Engineer presentations	2	• "Professional engineers doing a presentation."
Hands-on research activities	2	• "The hands on activities that were presented in the breakout sessions."
Supplying materials	2	• "…we have the opportunity to obtain some of the supplies needed for the lessons created at STA by this program."
Providing effective mentoring	2	• "I would be willing to provide leadership, if asked." • "I intend to share and help others with the STEM knowledge that I gained."
Learning how to analyze data	1	• "I think the ability to analyze data to discover patterns in observed changes provides a deeper meaning to the data and allows the students to make predictions based upon the observed patterns."
Academic research activities	1	• "Building knowledge of the teachers."
Connections to organizations and professionals	1	• "I think that [the] connections to outside organizations and professionals are vital."
Exposure to other perspectives	1	• "Being exposed to different ideas and perspectives. It was very interesting to discuss STEM with different grade levels and content areas."
Providing students with opportunity	1	• "It helps bring a sense of importance to the material and allows interested students to explore other options such as internships."

Appendix B:
2013 Post-STA Teacher Questionnaire and Data Summary

All teachers:

What is your level of understanding for each of the following categories PRIOR to participating in the STA? (n = 35)								
	1	**2**	**3**	**4**	**5**	**6**	**Avg.**	**SD**
The behaviors typical of students at different levels of inquiry	1 (3%)	5 (14%)	12 (34%)	10 (29%)	7 (20%)	0 (0%)	**3.49**	1.07
The behaviors typical of teachers at different levels of inquiry	2 (6%)	7 (21%)	5 (15%)	13 (38%)	7 (21%)	0 (0%)	**3.47**	1.21
The benefits of using different levels of inquiry	1 (3%)	4 (12%)	10 (29%)	6 (18%)	13 (38%)	0 (0%)	**3.76**	1.18
The Scientific and Engineering Practices (NRC, 2011), as they relate to inquiry	4 (12%)	4 (12%)	13 (38%)	8 (24%)	5 (15%)	0 (0%)	**3.18**	1.19
Note. Items used the following response scale 1 = "*Minimal understanding,*" 6 = "*Maximum understanding*".								

What is your level of understanding for each of the following categories AFTER participating in the STA? (n = 30)								
	1	**2**	**3**	**4**	**5**	**6**	**Avg.**	**SD**
The behaviors typical of students at different levels of inquiry	0 (0%)	0 (0%)	3 (10%)	9 (30%)	14 (47%)	4 (13%)	**4.67**	0.82
The behaviors typical of teachers at different levels of inquiry	1 (3%)	2 (7%)	0 (0%)	7 (23%)	16 (53%)	4 (13%)	**4.61**	1.12
The benefits of using different levels of inquiry	0 (0%)	0 (0%)	2 (7%)	6 (20%)	15 (50%)	7 (23%)	**4.88**	0.89
The Scientific and Engineering Practices (NRC, 2011), as they relate to inquiry	1 (3%)	1 (3%)	2 (7%)	7 (23%)	17 (57%)	2 (7%)	**4.52**	1.06
Note. Items used the following response scale 1 = "*Minimal understanding,*" 6 = "*Maximum understanding*".								

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2013 Post-STA Teacher Questionnaire and Data Summary

All teachers:

What is your level of confidence for each of the following items PRIOR to participating in the STA? (n = 34)								
	1	**2**	**3**	**4**	**5**	**6**	**Avg.**	**SD**
Selecting a level of inquiry given the lesson objectives/desired outcomes	4 (12%)	3 (9%)	11 (32%)	10 (29%)	6 (18%)	0 (0%)	**3.32**	1.22
Planning or teaching student activities for a given level of inquiry	3 (9%)	4 (12%)	9 (26%)	15 (44%)	3 (9%)	0 (0%)	**3.32**	1.09
Planning or teaching teacher activities for a given level of inquiry	4 (12%)	8 (24%)	9 (26%)	11 (32%)	2 (6%)	0 (0%)	**2.97**	1.14
Selecting appropriate Scientific and Engineering Practices given the lesson objectives/desired outcomes	4 (12%)	5 (15%)	12 (35%)	11 (32%)	2 (6%)	0 (0%)	**3.06**	1.10
Planning lessons that incorporate opportunities for students to learn about Scientific and Engineering Practices	4 (12%)	8 (24%)	9 (27%)	11 (33%)	1 (3%)	0 (0%)	**2.91**	1.10
Planning lessons that incorporate opportunities for students to use Scientific and Engineering Practices	4 (12%)	6 (18%)	9 (26%)	13 (38%)	2 (6%)	0 (0%)	**3.09**	1.14
Supporting students in using Scientific and Engineering Practices (NRC, 2011) as they participate in inquiry	4 (12%)	8 (24%)	10 (29%)	11 (32%)	1 (3%)	0 (0%)	**2.91**	1.08
Note. Items used the following response scale 1 = "*Not Confident,*" 6 = "*Very Confident*".								

What is your level of confidence for each of the following items AFTER participating in the STA? (n = 34)								
	1	**2**	**3**	**4**	**5**	**6**	**Avg.**	**SD**
Selecting a level of inquiry given the lesson objectives/desired outcomes	0 (0%)	1 (3%)	1 (3%)	5 (15%)	23 (68%)	4 (12%)	**4.82**	0.80
Planning or teaching student activities for a given level of inquiry	0 (0%)	1 (3%)	0 (0%)	6 (18%)	24 (71%)	3 (9%)	**4.82**	0.72
Planning or teaching teacher activities for a given level of inquiry	0 (0%)	1 (3%)	4 (12%)	8 (24%)	19 (56%)	2 (6%)	**4.50**	0.90
Selecting appropriate Scientific and Engineering Practices given the lesson objectives/desired outcomes	0 (0%)	2 (6%)	2 (6%)	6 (18%)	21 (62%)	3 (9%)	**4.62**	0.95
Planning lessons that incorporate opportunities for students to learn about Scientific and Engineering Practices	0 (0%)	2 (6%)	1 (3%)	8 (24%)	21 (62%)	2 (6%)	**4.59**	0.89
Planning lessons that incorporate opportunities for students to use Scientific and Engineering Practices	0 (0%)	1 (3%)	1 (3%)	6 (18%)	22 (65%)	4 (12%)	**4.79**	0.81
Supporting students in using Scientific and Engineering Practices (NRC, 2011) as they participate in inquiry	0 (0%)	2 (6%)	1 (3%)	6 (18%)	21 (62%)	4 (12%)	**4.71**	0.94
Note. Items used the following response scale 1 = "*Not Confident,*" 6 = "*Very Confident*".								

Appendix B:
2013 Post-STA Teacher Questionnaire and Data Summary

Biology/Chemistry - Bio Fuels Cells and Aquaculture Teachers:

What is your level of understanding for each of the following categories PRIOR to participating in the STA? (n = 12)								
	1	**2**	**3**	**4**	**5**	**6**	**Avg.**	**SD**
Concepts and practices related to energy alternatives to fossil fuel combustion	2 (17%)	2 (17%)	3 (25%)	4 (33%)	1 (8%)	0 (0%)	**3.00**	1.28
Suggested lab activities/research projects for teaching students about energy	2 (17%)	2 (17%)	4 (33%)	4 (33%)	0 (0%)	0 (0%)	**2.83**	1.11
Current research related to energy alternatives to fossil fuel combustion	3 (25%)	2 (17%)	3 (25%)	4 (33%)	0 (0%)	0 (0%)	**2.67**	1.23
Everyday issues related to energy alternatives to fossil fuel combustion	2 (17%)	1 (8%)	3 (25%)	5 (42%)	1 (8%)	0 (0%)	**3.17**	1.27
Note. Items used the following response scale 1 = "*Minimal understanding,*" 6 = "*Maximum understanding*".								

What is your level of understanding for each of the following categories AFTER participating in the STA? (n = 12)								
	1	**2**	**3**	**4**	**5**	**6**	**Avg.**	**SD**
Concepts and practices related to energy alternatives to fossil fuel combustion	1 (8%)	1 (8%)	0 (0%)	3 (25%)	6 (50%)	1 (8%)	**4.25**	1.42
Suggested lab activities/research projects for teaching students about energy	1 (8%)	1 (8%)	0 (0%)	2 (17%)	8 (67%)	0 (0%)	**4.25**	1.36
Current research related to energy alternatives to fossil fuel combustion	1 (8%)	1 (8%)	1 (8%)	3 (25%)	6 (50%)	0 (0%)	**4.00**	1.35
Everyday issues related to energy alternatives to fossil fuel combustion	1 (8%)	1 (8%)	0 (0%)	3 (25%)	7 (58%)	0 (0%)	**4.17**	1.34
Note. Items used the following response scale 1 = "*Minimal understanding,*" 6 = "*Maximum understanding*".								

What is your level of understanding for each of the following categories PRIOR to participating in the STA? (n = 12)								
	1	**2**	**3**	**4**	**5**	**6**	**Avg.**	**SD**
Concepts and practices related to aquaculture as means for sustainable food production	8 (67%)	2 (17%)	1 (8%)	0 (0%)	1 (8%)	0 (0%)	**1.67**	1.23
Suggested lab activities/research projects for teaching students about sustainable food production concepts and practices	7 (58%)	3 (25%)	0 (0%)	1 (8%)	1 (8%)	0 (0%)	**1.83**	1.34
Current research related to aquaculture as means for sustainable food production	8 (67%)	2 (17%)	1 (8%)	0 (0%)	1 (8%)	0 (0%)	**1.67**	1.23
Everyday issues related to aquaculture as means for sustainable food production	7 (58%)	3 (25%)	0 (0%)	1 (8%)	1 (8%)	0 (0%)	**1.83**	1.34
Note. Items used the following response scale 1 = "*Minimal understanding,*" 6 = "*Maximum understanding*".								

Appendix B:
2013 Post-STA Teacher Questionnaire and Data Summary

What is your level of understanding for each of the following categories AFTER participating in the STA? (n = 12)								
	1	**2**	**3**	**4**	**5**	**6**	**Avg.**	**SD**
Concepts and practices related to aquaculture as means for sustainable food production	0 (0%)	0 (0%)	0 (0%)	5 (42%)	5 (42%)	2 (17%)	**4.75**	0.75
Suggested lab activities/research projects for teaching students about sustainable food production concepts and practices	0 (0%)	0 (0%)	0 (0%)	3 (25%)	7 (58%)	2 (17%)	**4.92**	0.67
Current research related to aquaculture as means for sustainable food production	0 (0%)	0 (0%)	0 (0%)	3 (25%)	7 (58%)	2 (17%)	**4.92**	0.67
Everyday issues related to aquaculture as means for sustainable food production	0 (0%)	0 (0%)	0 (0%)	3 (25%)	7 (58%)	2 (17%)	**4.92**	0.67
Note. Items used the following response scale 1 = "*Minimal understanding,*" 6 = "*Maximum understanding*".								

Appendix B:
2013 Post-STA Teacher Questionnaire and Data Summary

Engineering teachers:

What is your level of understanding for each of the following categories PRIOR to participating in the STA? (n = 14)								
	1	**2**	**3**	**4**	**5**	**6**	**Avg.**	**SD**
Concepts and practices in mechanics and mechanical engineering (e.g., forces, simple machines, stress and material failure)	3 (21%)	3 (21%)	2 (14%)	4 (29%)	1 (7%)	1 (7%)	**3.00**	1.57
Mathematics used in mechanics and mechanical engineering	1 (7%)	5 (36%)	4 (29%)	3 (21%)	0 (0%)	1 (7%)	**2.93**	1.27
Suggested lab activities/research projects for teaching students about mechanics and mechanical engineering concepts and practices	3 (23%)	3 (23%)	2 (15%)	4 (31%)	1 (8%)	0 (0%)	**2.77**	1.36
Current research related to mechanics and mechanical engineering	4 (29%)	4 (29%)	2 (14%)	3 (21%)	1 (7%)	0 (0%)	**2.50**	1.34
Everyday issues related to mechanics and mechanical engineering concepts and practices	3 (21%)	4 (29%)	2 (14%)	4 (29%)	1 (7%)	0 (0%)	**2.71**	1.33
Note. Items used the following response scale 1 = "*Minimal understanding,*" 6 = "*Maximum understanding*".								

What is your level of understanding for each of the following categories AFTER participating in the STA? (n = 14)								
	1	**2**	**3**	**4**	**5**	**6**	**Avg.**	**SD**
Concepts and practices in mechanics and mechanical engineering (e.g., forces, simple machines, stress and material failure)	0 (0%)	1 (7%)	1 (7%)	3 (21%)	7 (50%)	2 (14%)	**4.57**	1.09
Mathematics used in mechanics and mechanical engineering	0 (0%)	0 (0%)	1 (7%)	5 (36%)	6 (43%)	2 (14%)	**4.64**	0.84
Suggested lab activities/research projects for teaching students about mechanics and mechanical engineering concepts and practices	0 (0%)	1 (8%)	0 (0%)	3 (23%)	8 (62%)	1 (8%)	**4.62**	0.96
Current research related to mechanics and mechanical engineering	0 (0%)	2 (14%)	2 (14%)	3 (21%)	6 (43%)	1 (7%)	**4.14**	1.23
Everyday issues related to mechanics and mechanical engineering concepts and practices	1 (7%)	1 (7%)	0 (0%)	3 (21%)	9 (64%)	0 (0%)	**4.29**	1.27
Note. Items used the following response scale 1 = "*Minimal understanding,*" 6 = "*Maximum understanding*".								

Appendix B:
2013 Post-STA Teacher Questionnaire and Data Summary

What is your level of understanding for each of the following categories PRIOR to participating in the STA? (n = 14)								
	1	**2**	**3**	**4**	**5**	**6**	**Avg.**	**SD**
Concepts and practices used in electricity and electrical engineering	3 (21%)	4 (29%)	2 (14%)	3 (21%)	0 (0%)	2 (14%)	**2.93**	1.69
Basic mathematics used in electricity and electrical engineering	1 (7%)	4 (29%)	3 (21%)	5 (36%)	0 (0%)	1 (7%)	**3.14**	1.29
Suggested lab activities/research projects for teaching students about electricity and electrical engineering concepts and practices	4 (29%)	2 (14%)	4 (29%)	3 (21%)	1 (7%)	0 (0%)	**2.64**	1.34
Current research related to electricity and electrical engineering	4 (29%)	5 (36%)	3 (21%)	2 (14%)	0 (0%)	0 (0%)	**2.21**	1.05
Everyday issues related to electricity and electrical engineering concepts and practices	4 (29%)	3 (21%)	3 (21%)	3 (21%)	1 (7%)	0 (0%)	**2.57**	1.34
Note. Items used the following response scale 1 = "*Minimal understanding,*" 6 = "*Maximum understanding*".								

What is your level of understanding for each of the following categories AFTER participating in the STA? (n = 14)								
	1	**2**	**3**	**4**	**5**	**6**	**Avg.**	**SD**
Concepts and practices used in electricity and electrical engineering	0 (0%)	2 (14%)	2 (14%)	2 (14%)	6 (43%)	2 (14%)	**4.29**	1.33
Basic mathematics used in electricity and electrical engineering	0 (0%)	2 (14%)	1 (7%)	2 (14%)	7 (50%)	2 (14%)	**4.43**	1.28
Suggested lab activities/research projects for teaching students about electricity and electrical engineering concepts and practices	0 (0%)	2 (14%)	2 (14%)	3 (21%)	6 (43%)	1 (7%)	**4.14**	1.23
Current research related to electricity and electrical engineering	0 (0%)	4 (29%)	2 (14%)	3 (21%)	4 (29%)	1 (7%)	**3.71**	1.38
Everyday issues related to electricity and electrical engineering concepts and practices	1 (7%)	1 (7%)	0 (0%)	2 (14%)	9 (64%)	1 (7%)	**4.43**	1.34
Note. Items used the following response scale 1 = "*Minimal understanding,*" 6 = "*Maximum understanding*".								

What is your level of understanding for each of the following categories PRIOR to participating in the STA? (n = 14)								
	1	**2**	**3**	**4**	**5**	**6**	**Avg.**	**SD**
Concepts and practices used in systems engineering	4 (29%)	4 (29%)	4 (29%)	2 (14%)	0 (0%)	0 (0%)	**2.29**	1.07
Basic mathematics used in systems engineering	2 (14%)	5 (36%)	5 (36%)	2 (14%)	0 (0%)	0 (0%)	**2.50**	0.94
Suggested lab activities/research projects for teaching students about systems engineering concepts and practices	4 (29%)	4 (29%)	3 (21%)	3 (21%)	0 (0%)	0 (0%)	**2.36**	1.15
Current research related to systems engineering	5 (36%)	3 (21%)	5 (36%)	1 (7%)	0 (0%)	0 (0%)	**2.14**	1.03
Everyday issues related to systems engineering concepts and practices	3 (21%)	5 (36%)	5 (36%)	1 (7%)	0 (0%)	0 (0%)	**2.29**	0.91
Note. Items used the following response scale 1 = "*Minimal understanding,*" 6 = "*Maximum understanding*".								

Appendix B:
2013 Post-STA Teacher Questionnaire and Data Summary

What is your level of understanding for each of the following categories AFTER participating in the STA? (n = 14)								
	1	**2**	**3**	**4**	**5**	**6**	**Avg.**	**SD**
Concepts and practices used in systems engineering	0 (0%)	1 (7%)	4 (29%)	3 (21%)	5 (36%)	1 (7%)	**4.07**	1.14
Basic mathematics used in systems engineering	0 (0%)	2 (14%)	2 (14%)	4 (29%)	5 (36%)	1 (7%)	**4.07**	1.21
Suggested lab activities/research projects for teaching students about systems engineering concepts and practices	0 (0%)	1 (8%)	3 (23%)	4 (31%)	4 (31%)	1 (8%)	**4.08**	1.12
Current research related to systems engineering	0 (0%)	4 (29%)	1 (7%)	3 (21%)	5 (36%)	1 (7%)	**3.86**	1.41
Everyday issues related to systems engineering concepts and practices	0 (0%)	2 (14%)	2 (14%)	4 (29%)	5 (36%)	1 (7%)	**4.07**	1.21
Note. Items used the following response scale 1 = "*Minimal understanding,*" 6 = "*Maximum understanding*".								

What is your level of understanding for each of the following categories PRIOR to participating in the STA? (n = 14)								
	1	**2**	**3**	**4**	**5**	**6**	**Avg.**	**SD**
Concepts and practices used in civil engineering	4 (31%)	3 (23%)	3 (23%)	1 (8%)	2 (15%)	0 (0%)	**2.54**	1.45
Basic mathematics used in civil engineering	3 (21%)	6 (43%)	2 (14%)	1 (7%)	2 (14%)	0 (0%)	**2.50**	1.34
Suggested lab activities/research projects for teaching students about civil engineering concepts and practices	5 (36%)	5 (36%)	2 (14%)	2 (14%)	0 (0%)	0 (0%)	**2.07**	1.07
Current research related to civil engineering	7 (50%)	3 (21%)	2 (14%)	2 (14%)	0 (0%)	0 (0%)	**1.93**	1.14
Everyday applications of civil engineering concepts and practices	4 (29%)	6 (43%)	1 (7%)	2 (14%)	1 (7%)	0 (0%)	**2.29**	1.27
Note. Items used the following response scale 1 = "*Minimal understanding,*" 6 = "*Maximum understanding*".								

What is your level of understanding for each of the following categories AFTER participating in the STA? (n=14)								
	1	**2**	**3**	**4**	**5**	**6**	**Avg.**	**SD**
Concepts and practices used in civil engineering	0 (0%)	1 (7%)	2 (14%)	2 (14%)	7 (50%)	2 (14%)	**4.50**	1.16
Basic mathematics used in civil engineering	0 (0%)	2 (14%)	2 (14%)	1 (7%)	7 (50%)	2 (14%)	**4.36**	1.34
Suggested lab activities/research projects for teaching students about civil engineering concepts and practices	0 (0%)	1 (7%)	1 (7%)	4 (29%)	6 (43%)	2 (14%)	**4.50**	1.09
Current research related to civil engineering	0 (0%)	3 (21%)	3 (21%)	1 (7%)	5 (36%)	2 (14%)	**4.00**	1.47
Everyday applications of civil engineering concepts and practices	1 (7%)	1 (7%)	2 (14%)	1 (7%)	7 (50%)	2 (14%)	**4.29**	1.49
Note. Items used the following response scale 1 = "*Minimal understanding,*" 6 = "*Maximum understanding*".								

Appendix B:
2013 Post-STA Teacher Questionnaire and Data Summary

Earth/Environmental Science teachers:

What is your level of understanding for each of the following categories PRIOR to participating in the STA? (n = 9)								
	1	**2**	**3**	**4**	**5**	**6**	**Avg.**	**SD**
Concepts and practices related to the study of trees and tree canopies	5 (56%)	1 (11%)	2 (22%)	1 (11%)	0 (0%)	0 (0%)	**1.89**	1.17
Suggested lab activities/research projects for teaching students about trees and tree canopies	5 (56%)	1 (11%)	1 (11%)	1 (11%)	1 (11%)	0 (0%)	**2.11**	1.54
Current research related to trees and tree canopies	5 (56%)	1 (11%)	2 (22%)	1 (11%)	0 (0%)	0 (0%)	**1.89**	1.17
Everyday issues related to trees and tree canopies	4 (44%)	2 (22%)	2 (22%)	1 (11%)	0 (0%)	0 (0%)	**2.00**	1.12
Note. Items used the following response scale 1 = "*Minimal understanding,*" 6 = "*Maximum understanding*".								

What is your level of understanding for each of the following categories AFTER participating in the STA? (n = 9)								
	1	**2**	**3**	**4**	**5**	**6**	**Avg.**	**SD**
Concepts and practices related to the study of trees and tree canopies	0 (0%)	0 (0%)	0 (0%)	4 (44%)	4 (44%)	1 (11%)	**4.67**	0.71
Suggested lab activities/research projects for teaching students about trees and tree canopies	0 (0%)	0 (0%)	1 (11%)	4 (44%)	3 (33%)	1 (11%)	**4.44**	0.88
Current research related to trees and tree canopies	0 (0%)	0 (0%)	0 (0%)	5 (56%)	3 (33%)	1 (11%)	**4.56**	0.73
Everyday issues related to trees and tree canopies	0 (0%)	0 (0%)	0 (0%)	4 (44%)	4 (44%)	1 (11%)	**4.67**	0.71
Note. Items used the following response scale 1 = "*Minimal understanding,*" 6 = "*Maximum understanding*".								

Appendix B:
2013 Post-STA Teacher Questionnaire and Data Summary

During the STA, were you provided with information about any of the following AEOP programs? Will you encourage your students to participate and/or integrate these programs into your classroom?				
	Yes - I learned about this program and will encourage students to participate	Yes - and I plan to incorporate this program into my class lessons / teachings	Yes - and I plan to incorporate this program into extracurricular activities	I have never heard about this program
Junior Solar Sprint (JSS)	19 (68%)	0 (0%)	1 (4%)	8 (29%)
Junior Science and Humanities Symposium (JSHS)	22 (69%)	0 (0%)	0 (0%)	10 (31%)
UNITE	19 (59%)	0 (0%)	0 (0%)	13 (41%)
West Point Bridge Design Competition (WPBDC)	22 (69%)	2 (6%)	1 (3%)	7 (22%)
eCYBERMISSION (eCM)	22 (69%)	0 (0%)	1 (3%)	9 (28%)
High School Internships (SEAP, REAP, HSAP)	29 (85%)	0 (0%)	1 (3%)	4 (12%)
College Internships (CQL & URAP)	21 (66%)	2 (6%)	1 (3%)	8 (25%)
The Science, Mathematics And Research for Transformation (SMART) scholarship offered by the Department of Defense (DoD) for students pursuing degrees in STEM	22 (67%)	1 (3%)	1 (3%)	9 (27%)
The National Defense Science and Engineering Graduate (NDSEG) fellowship offered by the Department of Defense	20 (63%)	1 (3%)	1 (3%)	10 (31%)

Appendix B:
2013 Post-STA Teacher Questionnaire and Data Summary

In a couple of sentences, tell us about your overall satisfaction with the STA Lesson Planning Project/Presentation: What was the most valuable part of that experience? (n = 33)			
Broad Theme	Narrow Theme(s)	**Freq.**	**Example Response(s)**
Academic Research Activities		**17**	
	Collaboration with other teachers	14	• "Collaborating with peers and engineers helped me to understand how to incorporate STEM components into my classroom. I believe these components will be fun and engaging for the students."
	Networking with peers	2	• "Forming relationships with other teachers and especially with professionals in the STEM fields."
	Interacting with STEM professional	1	• "…interacting with the Engineers was great."
General Satisfaction		**12**	
	Enjoyed the experience	6	• "I really enjoyed the STEM Academy."
	Speakers were excellent	4	• "The most valuable part of the experience is or was having knowledgeable and engaging presenters."
	Great opportunity	2	• "Having the opportunity to work with science teachers and different levels of teachers was amazing. I learned a great deal about inquiry and will definitely change the way I teach."
STEM Pathway		**7**	
	Learning ways to incorporate STEM into lessons	5	• "…the underlying concept of incorporating mathematics and engineering content into my lessons has given me an impetus to changing and hopefully, improving the lessons we currently offer in the planetarium."
	AEOP opportunities	1	• "I was also excited to hear about the student internship opportunities and competitions that are offered by AEOP."
	Seeing the trajectory of STEM education	1	• "[STA] helped me to better appreciate the overall trajectory of STEM education from middle school to high school and identify weaknesses in previous science education and topics requiring repetition and reinforcement."
Hands-on / Laboratory Research Experiences		**3**	
	Hands on activities	2	• "It was helpful to learn about hands-on activities and inquiry type lessons to use with students."
	Creating lesson plans	1	• "The most valuable part of the experience were the lesson ideas and the opportunity to acquire materials to teach the lessons."

Appendix B:
2013 Post-STA Teacher Questionnaire and Data Summary

What material from STA did you learn the most from? (n = 33)					
List of Items	**Freq.**	**%**	**List of Items**	**Freq.**	**%**
Aquaponics	12	36%	**Using engineering to solve real world problems**	2	6%
Hands on activities	4	12%	**Remote sensing**	2	6%
Presentations	4	12%	**iTree**	2	6%
Professional Engineers	3	9%	**Bridge design**	2	6%
Aerodynamics	2	6%	**Engineering overview**	1	3%
Electrical Engineering	2	6%	**Environment Track**	1	3%
Incorporation of inquiry into lesson plans	2	6%	**Impervious surfaces**	1	3%
			Total	**40**	**100%**

What portion(s) of STA were you most satisfied with? (n = 31)			
Type	Portion(s)	Freq.	Example Response(s)
Activities in STA		**13**	
	Professional presentations	4	• "Being able to observe what the presenter was describing in the real world brought greater veracity to their presentations.'
	Lesson planning	4	• "I'd have to say the lesson planning project/presentation was the most valuable and most satisfying."
	Lunches and food provided	2	• "The lunches provide were also excellent and greatly appreciated!"
	Hands-on activities	2	• "I was most satisfied with the actual hands on aspect."
	Exploration of websites	1	• "The time given for individual exploration of the websites was very helpful."
Facets of STA		**13**	
	Overall program	6	• "I enjoyed all aspects of STA and learned a lot"
	Collaboration with peers	2	• "This year we had more teacher collaboration time."
	Networking	1	• "I was most satisfied with being able to network with teachers in different grade level and content areas. It was nice to share ideas and learn from one another."
	Lesson presentations	1	• "…hearing other grade levels and subject areas present lessons."
	Work with others	1	• "I was the most satisfied with […] the opportunity to work with others to create an issues investigation. "
	Experts involved	1	• "I am satisfied with the caliber of experts brought in to help with content knowledge."
	Availability of material	1	• "I love that all the presentation powerpoints and resources will be available to us all year long via Blackboard.'
Individual topics discussed		**12**	

	Aquaponics	8	• "Actually doing the labs and building the battery and Aquaponics tank was the most rewarding part of the program."
	iTree	1	• "[I am most satisfied with the] iTree presentations."
	DNR	1	• "[I am most satisfied with the] DNR presentation."
	Demonstrations of topics	1	• "Demonstrations on Torque, Collisions, Aerodynamics"
	Engineering challenges	1	• "Engineering challenges showed to us by the scientists."

What portion(s) of STA were you least satisfied with? (n = 32)

List of Items	Freq.	Example Response(s)
Biofuel cells presentation was too long or not beneficial	8	• "The biology/chemistry track has a whole day devoted to fuel cells. I felt that a lot of this material would be hard to incorporate." • "I did not feel as though I benefited from the biofuel cell presentation. It would be very hard to connect most of this information to my grade level (7)/curriculum (biology). It was entirely too long and mostly about physics."
Limited less plans	6	• "I would like to have seen examples of model STEM lessons that have already been developed and are in use. These would provide concrete examples of what effective STEM lessons look like." • "I would have liked to see a wider variety of lesson topics from my colleagues."
Needed more time to interact with engineers	2	• "More time with the Engineers/presenters and their activities less time with lesson plans."
Mathematics topic was lacking	2	• "I was not satisfied with the mathematics involved.[…] There are several formulas that could have been integrated to bring the science into the math classrooms for algebra and low level classes."
Receiving redundant material	1	• "…the least satisfying would have been in receiving information that I'm already experienced in."
Additional lab component added to electricity topic	1	• "Presentation on Electricity lacked a demonstration/lab component."
Some presentations were too long	1	• "The presentations could have been timed."
Flow of presentation	1	• "Presentation of stream flow."

Appendix C:
2013 STA Retrospective pre-STA to Post-STA Comparison Data Summary

All teachers:

What is your level of understanding for each of the following categories? (n = 35, 30)							
Item	**Pre-STA Avg. (SD)**	**Post-STA Avg. (SD)**	**n**	**Mean Diff.**	**Std. Dev.**	***p***	***d***
The behaviors typical of students at different levels of inquiry	3.49 (1.07)	4.67 (.82)	35/30	**1.18***	.96	0.00	1.23
The behaviors typical of teachers at different levels of inquiry	3.47 (1.21)	4.61 (1.12)	35/30	**1.14***	1.17	0.00	.97
The benefits of using different levels of inquiry	3.76 (1.18)	4.88 (.89)	35/30	**1.12***	1/06	0.00	1.06
The Scientific and Engineering Practices (NRC, 2011), as they relate to inquiry	3.18 (1.19)	4.52 (1.06)	35/30	**1.34***	1.13	0.00	1.18

Note. *** = p < .05; **n = number of cases; **Mean Diff.** = independent pairs difference post-STA to pre-STA; **Std. Dev.** = pooled standard deviation; ***p*** = independent samples t-test (two-tailed); ***d*** = Cohen's *d* (effect size).

What is your level of understanding for each of the following categories? (n = 34)							
Item	**Pre-STA Avg. (SD)**	**Post-STA Avg. (SD)**	**n**	**Mean Diff.**	**Std. Dev.**	***p***	***d***
Selecting a level of inquiry given the lesson objectives/desired outcomes	3.32 (1.22)	4.82 (.80)	34	**1.50***	1.03	.00	1.45
Planning or teaching student activities for a given level of inquiry	3.32 (1.09)	4.82 (.72)	34	**1.50***	.92	.00	1.62
Planning or teaching teacher activities for a given level of inquiry	2.97 (1.14)	4.50 (.90)	34	**1.53***	1.03	.00	1.49
Selecting appropriate Scientific and Engineering Practices given the lesson objectives/desired outcomes	3.06 (1.10)	4.62 (/95)	34	**1.56***	1.03	.00	1.52
Planning lessons that incorporate opportunities for students to learn about Scientific and Engineering Practices	2.91 (1.10)	4.59 (.89)	34	**1.68***	1.00	.00	1.68
Planning lessons that incorporate opportunities for students to use Scientific and Engineering Practices	3.09 (1.14)	4.79 (.81)	34	**1.70***	.99	.00	1.72
Supporting students in using Scientific and Engineering Practices (NRC, 2011) as they participate in inquiry	2.91 (1.08)	4.71 (.94)	34	**1.80***	.21	.00	1.78

Note. *** = p < .05; **n = number of cases; **Mean Diff.** = independent pairs difference post-STA to pre-STA; **Std. Dev.** = pooled standard deviation; ***p*** = independent samples t-test (two-tailed); ***d*** = Cohen's *d* (effect size).

Appendix C:
2013 STA Retrospective pre-STA to Post-STA Comparison Data Summary

Biology/Chemistry - Bio Fuels Cells and Aquaculture Teachers:

What is your level of understanding for each of the following categories? (n = 12)							
Item	**Pre-STA Avg. (SD)**	**Post-STA Avg. (SD)**	**n**	**Mean Diff.**	**Std. Dev.**	***p***	***d***
Concepts and practices related to energy alternatives to fossil fuel combustion	3.00 (1.28)	4.25 (1.42)	12	**1.25***	1.35	.03	.92
Suggested lab activities/research projects for teaching students about energy	2.83 (1.11)	4.25 (1.36)	12	**1.42***	1.24	.01	1.14
Current research related to energy alternatives to fossil fuel combustion	2.67 (1.23)	4.00 (1.35)	12	**1.33***	1.29	.02	1.03
Everyday issues related to energy alternatives to fossil fuel combustion	3.17 (1.27)	4.17 (1.34)	12	**1.00**	1.31	.07	.77

Note. *** = p < .05; **n = number of cases; **Mean Diff.** = independent pairs difference post-STA to pre-STA; **Std. Dev.** = pooled standard deviation; ***p*** = independent samples t-test (two-tailed); ***d*** = Cohen's *d* (effect size).

What is your level of understanding for each of the following categories? (n = 12)							
Item	**Pre-STA Avg. (SD)**	**Post-STA Avg. (SD)**	**n**	**Mean Diff.**	**Std. Dev.**	***p***	***d***
Concepts and practices related to aquaculture as means for sustainable food production	1.67 (1.23)	4.75 (.75)	12	**3.08***	1.02	.00	3.02
Suggested lab activities/research projects for teaching students about sustainable food production concepts and practices	1.83 (1.34)	4.92 (.67)	12	**3.09***	1.06	.00	2.92
Current research related to aquaculture as means for sustainable food production	1.67 (1.23)	4.92 (.67)	12	**3.25***	.99	.00	3.28
Everyday issues related to aquaculture as means for sustainable food production	1.83 (1.34)	4.92 (.67)	12	**3.09***	1.06	.00	2.92

Note. *** = p < .05; **n = number of cases; **Mean Diff.** = independent pairs difference post-STA to pre-STA; **Std. Dev.** = pooled standard deviation; ***p*** = independent samples t-test (two-tailed); ***d*** = Cohen's *d* (effect size).

Appendix C:
2013 STA Retrospective pre-STA to Post-STA Comparison Data Summary

Engineering teachers:

What is your level of understanding for each of the following categories? (n = 14)							
Item	**Pre-STA Avg. (SD)**	**Post-STA Avg. (SD)**	**n**	**Mean Diff.**	**Std. Dev.**	***p***	***d***
Concepts and practices in mechanics and mechanical engineering (e.g., forces, simple machines, stress and material failure)	3.00 (1.57)	4.57 (1.09)	14	**1.57***	1.35	.00	1.16
Mathematics used in mechanics and mechanical engineering	2.93 (1.27)	4.64 (.84)	14	**1.71***	1.08	.00	1.59
Suggested lab activities/research projects for teaching students about mechanics and mechanical engineering concepts and practices	2.77 (1.36)	4.62 (.96)	14	**1.85***	1.18	.00	1.57
Current research related to mechanics and mechanical engineering	2.50 (1.34)	4.14 (1.23)	14	**1.64***	1.29	.00	1.28
Everyday issues related to mechanics and mechanical engineering concepts and practices	2.71 (1.33)	4.29 (1.27)	14	**1.58***	1.30	.00	1.22

Note. *** = p < .05; **n = number of cases; **Mean Diff.** = independent pairs difference post-STA to pre-STA; **Std. Dev.** = pooled standard deviation; ***p*** = independent samples t-test (two-tailed); ***d*** = Cohen's *d* (effect size).

What is your level of understanding for each of the following categories? (n = 14)							
Item	**Pre-STA Avg. (SD)**	**Post-STA Avg. (SD)**	**n**	**Mean Diff.**	**Std. Dev.**	***p***	***d***
Concepts and practices used in electricity and electrical engineering	2.93 (1.69)	4.29 (1.33)	14	**1.36***	1.52	.03	.89
Basic mathematics used in electricity and electrical engineering	3.14 (1.29)	4.43 (1.28)	14	**1.29***	1.29	.03	1.00
Suggested lab activities/research projects for teaching students about electricity and electrical engineering concepts and practices	2.64 (1.34)	4.14 (1.23)	14	**1.50***	1.29	.01	1.17
Current research related to electricity and electrical engineering	2.21 (1.05)	3.71 (1.38)	14	**1.50***	1.23	.00	1.22
Everyday issues related to electricity and electrical engineering concepts and practices	2.57 (1.34)	4.43 (1.34)	14	**1.86***	1.34	.00	1.39

Note. *** = p < .05; **n = number of cases; **Mean Diff.** = independent pairs difference post-STA to pre-STA; **Std. Dev.** = pooled standard deviation; ***p*** = independent samples t-test (two-tailed); ***d*** = Cohen's *d* (effect size).

Appendix C:
2013 STA Retrospective pre-STA to Post-STA Comparison Data Summary

What is your level of understanding for each of the following categories? (n = 14)							
Item	**Pre-STA Avg. (SD)**	**Post-STA Avg. (SD)**	**n**	**Mean Diff.**	**Std. Dev.**	***p***	***d***
Concepts and practices used in systems engineering	2.29 (1.07)	4.07 (1.14)	14	**1.78***	1.11	.00	1.61
Basic mathematics used in systems engineering	2.50 (.94)	4.07 (1.21)	14	**1.57***	1.08	.00	1.45
Suggested lab activities/research projects for teaching students about systems engineering concepts and practices	2.36 (1.15)	4.08 (1.12)	14	**1.72***	1.14	.00	1.52
Current research related to systems engineering	2.14 (1.03)	3.86 (1.41)	14	**1.72***	1.23	.00	1.39
Everyday issues related to systems engineering concepts and practices	2.29 (.91)	4.07 (1.21)	14	**1.78***	1.07	.00	1.66

Note. *** = p < .05; **n = number of matched cases; **Mean Diff.** = paired difference post-STA to pre-STA; **Std. Dev.** = paired standard deviation; ***p*** = paired samples t-test (two-tailed); ***d*** = Cohen's *d* (effect size).

What is your level of understanding for each of the following categories? (n = 13)							
Item	**Pre-STA Avg. (SD)**	**Post-STA Avg. (SD)**	**n**	**Mean Diff.**	**Std. Dev.**	***p***	***d***
Concepts and practices used in civil engineering	2.54 (1.45)	4.50 (1.16)	13	**1.96***	1.31	.00	1.49
Basic mathematics used in civil engineering	2.50 (1.34)	4.36 (1.34)	13	**1.86***	1.34	.00	1.39
Suggested lab activities/research projects for teaching students about civil engineering concepts and practices	2.07 (1.07)	4.50 (1.09)	13	**2.43***	1.08	.00	2.25
Current research related to civil engineering	1.93 (1.14)	4.00 (1.47)	13	**2.07***	1.32	.00	1.57
Everyday applications of civil engineering concepts and practices	2.29 (1.27)	4.29 (1.49)	13	**2.00***	1.38	.00	1.40

Note. *** = p < .05; **n = number of matched cases; **Mean Diff.** = paired difference post-STA to pre-STA; **Std. Dev.** = paired standard deviation; ***p*** = paired samples t-test (two-tailed); ***d*** = Cohen's *d* (effect size).

Appendix C:
2013 STA Retrospective pre-STA to Post-STA Comparison Data Summary

Earth/Environmental Science teachers:

What is your level of understanding for each of the following categories? (n = 12)							
Item	**Pre-STA Avg. (SD)**	**Post-STA Avg. (SD)**	**n**	**Mean Diff.**	**Std. Dev.**	***p***	***d***
Concepts and practices related to the study of trees and tree canopies	1.89 (1.17)	4.67 (.71)	12	**2.78***	0.97	0.00	2.87
Suggested lab activities/research projects for teaching students about trees and tree canopies	2.11 (1.54)	4.44 (.88)	12	**2.33***	1.25	0.00	1.86
Current research related to trees and tree canopies	1.89 (1.17)	4.56 (.73)	12	**2.67***	0.98	0.00	2.74
Everyday issues related to trees and tree canopies	2.00 (1.12)	4.67 (.71)	12	**2.67***	0.94	0.00	2.85

Note. *** = p < .05; **n = number of matched cases; **Mean Diff.** = paired difference post-STA to pre-STA; **Std. Dev.** = paired standard deviation; ***p*** = paired samples t-test (two-tailed); ***d*** = Cohen's *d* (effect size).

Appendix D:
2012 9 Month Post-STA Teacher Questionnaire and Data Summary

Army Educational Outreach Program (AEOP) Evaluation/Research Informed Consent:

Thank you for your participation in this study about the 2012 STEM Teaching Academy (STA) that you attended last August. The following assessment of participants will collect information about you and your STA experiences. The results of this assessment will be used to help us improve our program and to create evaluation reports for the organizations that support STA.

About this assessment:

- This research protocol has been approved for use with human subjects by the Virginia Tech IRB office.
- Although this assessment is not anonymous, it is CONFIDENTIAL; prior to analysis and reporting, responses will be de-identified and no one will be able to connect your responses to your name. Additionally, only AEOP evaluation personnel will have access to completed forms and personal information will be stored securely.
- It is completely VOLUNTARY; you are not required to participate and you can withdraw at any time.
- If you provide your email address, the AEOP may contact you in the future to ask about your STA experience and how you have used it in the future.
- We do hope that you will complete the assessment because your responses will give STA valuable information for improvement and for generating reports for our supporting organizations.

*****By choosing to click the ">>" button below and complete this assessment, you are providing your consent to participate in the STA research/evaluation study*****

If you have any additional questions or concerns, please contact one of the following people:

Tanner Bateman, Virginia Tech
Senior Project Associate, YSCOA
(540) 231-4540
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Steve Hale, University of New Hampshire
STA, Program Manager
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Appendix D:
2012 9 Month Post-STA Teacher Questionnaire and Data Summary

Please fill out the personal information below:
First Name:
Last Name:
Email Address:
Birth Month:
Birth Year:
What grade level do you teach? (e.g., 9, 10, 11, or 12):
What subject do you teach? (e.g., biology, botany, etc.):

In what type of school do you teach?
- ❍ Public
- ❍ Magnet
- ❍ Charter
- ❍ Private
- ❍ Other (specify): _____

What is your gender?
- ❍ Male
- ❍ Female
- ❍ Choose not to answer

Are you Hispanic or Latino?
- ❍ Yes
- ❍ No

Which of the following best describes your race/ethnicity?
- ❍ White/Caucasian
- ❍ African American/Black
- ❍ Asian
- ❍ Native American
- ❍ Choose not to answer
- ❍ Other (specify): _____

Appendix D:

2012 9 Month Post-STA Teacher Questionnaire and Data Summary

Use the scale provided to indicate your level of agreement with each of the following statements:

	Strongly Disagree	Disagree	Somewhat Disagree	Somewhat Agree	Agree	Strongly Agree
I intend to develop lesson plans and teachings around energy literacy within my classes	❍	❍	❍	❍	❍	❍
I did develop lesson plans and teachings around energy literacy for my classes	❍	❍	❍	❍	❍	❍
I implemented lesson plans and teaching around energy literacy for my classes	❍	❍	❍	❍	❍	❍
I intend to develop lesson plans and teachings around environmental literacy within my classes	❍	❍	❍	❍	❍	❍
I did develop lesson plans and teachings around environmental literacy for my classes	❍	❍	❍	❍	❍	❍
I implemented lesson plans and teachings around environmental literacy for my classes	❍	❍	❍	❍	❍	❍
I have used other aspects of the STA to develop lesson plans and teachings for my classes	❍	❍	❍	❍	❍	❍

What material from STA was the most adaptable to your classroom lessons and teachings?

Appendix D:
2012 9 Month Post-STA Teacher Questionnaire and Data Summary

Use the scale provided to indicate your level of agreement with each of the following statements:

	Strongly Disagree	Disagree	Somewhat Disagree	Somewhat Agree	Agree	Strongly Agree
I brought environmental and energy literacy to my school by collaborating with teachers across subjects and grade levels	❍	❍	❍	❍	❍	❍
I used concepts from STA to develop lesson plans with teachers in other subject areas	❍	❍	❍	❍	❍	❍
I used concepts from STA to collaborate with teachers across grade levels and developed curricula that spans multiple grade-years	❍	❍	❍	❍	❍	❍
The STA program encouraged me to seek out collaborative relationships with other teachers	❍	❍	❍	❍	❍	❍
The STA program encouraged me to seek out collaborative opportunities with professional scientists/engineers	❍	❍	❍	❍	❍	❍

Please describe any collaborative effort with other teachers or professional scientists/engineers that you engaged in after participating in the STA:

Please describe any lesson plans or partnerships with other teachers or professional scientists/engineers that you developed using material from the STA:

Appendix D:
2012 9 Month Post-STA Teacher Questionnaire and Data Summary

Use the scale provided to indicate your level of agreement with each of the following statements:

	Strongly Disagree	Disagree	Somewhat Disagree	Somewhat Agree	Agree	Strongly Agree
The material presented to me at STA was very useful in developing professional development activities at my school	❍	❍	❍	❍	❍	❍
I intend to develop and deliver a professional development activity at my school	❍	❍	❍	❍	❍	❍
After STA, I developed an effective professional development activity at my school	❍	❍	❍	❍	❍	❍
After STA, I lead an effective professional development activity for teachers at my school	❍	❍	❍	❍	❍	❍

What material from STA was most suitable and important for professional development activities at your school?

Appendix D:
2012 9 Month Post-STA Teacher Questionnaire and Data Summary

Use the scale provided to indicate your level of agreement with each of the following statements:

	Strongly Disagree	Disagree	Somewhat Disagree	Somewhat Agree	Agree	Strongly Agree
After STA, I have tried to improve the environmental sustainability of my school	❍	❍	❍	❍	❍	❍
After STA, I have tried to lead energy and environmental literacy efforts at my school	❍	❍	❍	❍	❍	❍
Using material from STA, I analyzed the sustainability efforts at my school	❍	❍	❍	❍	❍	❍
STA gave me material that helped me motivate students to participate in energy and environmental literacy activities	❍	❍	❍	❍	❍	❍

Appendix D:
2012 9 Month Post-STA Teacher Questionnaire and Data Summary

What aspects of STA were the most useful for analyzing/creating environmental sustainability efforts at your school?

Appendix D:

2012 9 Month Post-STA Teacher Questionnaire and Data Summary

Use the scale provided to indicate your level of agreement with each of the following statements:

	Strongly Disagree	Disagree	Somewhat Disagree	Somewhat Agree	Agree	Strongly Agree
After the STEM Teaching Academy (STA), I am more knowledgeable about energy science	❍	❍	❍	❍	❍	❍
I learned a lot about electricity, its forms, and where it comes from at STA	❍	❍	❍	❍	❍	❍
I learned about many different alternative energy sources through STA	❍	❍	❍	❍	❍	❍
I have a much clearer idea of how energy use impacts the environment after STA	❍	❍	❍	❍	❍	❍
In general, I am much more confident in my energy literacy after participating in STA	❍	❍	❍	❍	❍	❍
I am more confident in my environmental literacy after participating in STA	❍	❍	❍	❍	❍	❍

What material from STA did you learn the most from?

Appendix D:
2012 9 Month Post-STA Teacher Questionnaire and Data Summary

Do you encourage your students to pursue the following programs?

	No, it is not appropriate	Sometimes, depending upon the student	Yes, this is a good program for my students	I've never heard of this program
JSS - Junior Solar Sprint	❍	❍	❍	❍
GEMS - Gains in the Education of Math and Science	❍	❍	❍	❍
GEMS - Near Peers	❍	❍	❍	❍
eCYBERMISSION	❍	❍	❍	❍
JSHS - Junior Science and Humanities Symposium	❍	❍	❍	❍
SEAP - Science and Engineering Apprenticeship Program	❍	❍	❍	❍
SEAP-CQL - College Qualified Leaders	❍	❍	❍	❍
HSAP/URAP - High School or Undergraduate Apprenticeship Program	❍	❍	❍	❍
REAP - Research in Engineering Apprenticeship Program	❍	❍	❍	❍

Did you earn Continuing Education Credits (CEUs) from the University of New Hampshire after participating in the STEM Teacher Academy?

❍ Yes
❍ No
❍ Other (specify): _____

The STEM Teacher Academy is going to be offered in your area again this year (2013) from July 29th - July 31st. Knowing this, are you interested in participating in the STEM Teacher Academy again?

❍ Yes
❍ No
❍ Other (specify): _____

Including this year, are there any special topics that you would like to see covered in future iterations of the STEM Teacher Academy? Please tell us about them:

Appendix D:
2012 9 Month Post-STA Teacher Questionnaire and Data Summary

What grade level do you teach?		
	Freq.	%
One grade in middle school	3	23%
Two grades in middle school	0	0%
Three grades in middle school	0	0%
One grade in high school	1	8%
Two grades in high school	3	23%
Three grades in high school	4	30%
Four grades in high school	1	8%
All grades	1	8%
Total	13	100%

What subject(s) do you teach? (n = 13)		
	Freq.	%
Biology	4	18%
Earth science	2	9%
Environmental science	2	9%
Marine science	2	9%
Zoology	2	9%
General science	2	9%
Algebra	2	9%
Chemistry	1	4%
Physical science	1	4%
Physics	1	4%
Math	1	4%
Anatomy	1	4%
Astronomy	1	4%
Technology education	1	4%
Total	23	100%

In what type of school do you teach?		
	Freq.	%
Public	10	77%
Magnet	0	0%
Charter	0	0%
Private	3	23%
Other	0	0%
Total	13	100%

Appendix D:
2012 9 Month Post-STA Teacher Questionnaire and Data Summary

Gender		
	Freq.	**%**
Male	6	46%
Female	7	54%
Choose not to report	0	0%
Total	13	100%

Race/Ethnicity		
	Freq.	**%**
American Indian or Alaskan Native	0	0%
Asian or Pacific Islander	0	3%
Black or African American	1	8%
Hispanic or Latino	0	0%
White/Caucasian	12	92%
Other	0	0%
Choose not to report	0	0%
Total	13	100%

Appendix D:
2012 9 Month Post-STA Teacher Questionnaire and Data Summary

Use the scale provided to indicate your level of agreement with each of the following statements: (n = 12-13)								
	1	**2**	**3**	**4**	**5**	**6**	**Avg.**	**SD**
I intend to develop lesson plans and teachings around energy literacy	0 (0%)	0 (0%)	1 (8%)	1 (8%)	8 (62%)	3 (23%)	**5.00**	.82
I did develop lesson plans and teaching around energy literacy for my classes	0 (0%)	0 (0%)	0 (0%)	2 (15%)	7 (54%)	4 (31%)	**5.15**	.68
I implemented lesson plans and teaching around energy literacy for my classes	0 (0%)	0 (0%)	0 (0%)	2 (15%)	6 (46%)	5 (38%)	**5.23**	.73
I intend to develop lesson plans around environmental literacy within my classes	0 (0%)	0 (0%)	1 (8%)	0 (0%)	7 (54%)	5 (38%)	**5.23**	.83
I did develop lesson plans and teaching around environmental literacy for my classes	0 (0%)	1 (8%)	0 (0%)	1 (8%)	5 (38%)	6 (46%)	**5.15**	1.14
I implemented lesson plans and teaching around environmental literacy for my classes	0 (0%)	1 (8%)	0 (0%)	2 (15%)	4 (31%)	5 (38%)	**5.00**	1.21
I have used other aspects of the STA to develop lesson plans and teachings for my classes	0 (0%)	0 (0%)	1 (8%)	1 (8%)	7 (54%)	4 (31%)	**5.08**	.86
Note. Items used the following response scale 1 = "*Strongly Disagree*," 2 = "*Disagree*," 3 = "*Somewhat Disagree*," 4 = "*Somewhat Agree*," 5 = "*Agree*," 6 = "*Strongly Agree*".								

What material from the 2012 STA was the most adaptable to your classroom lessons and teachings? (n = 9)
List of Items
Renewable energy resources
Powerpoints and hands on energy supplies
The energy section and the renewable energy education kit
Green building, atmosphere, chemistry lessons, solar panels
The renewable energy kits where used with my environmental science II classes. The solar panels were a better quality and really worked.
Background content and the demonstrations/lectures on the latest technologies
Information on energy sources, power generation, how the Conowingo Dam works
The lesson plan I developed with fellow students on hydrofracking. I was able to use it in my environmental science curriculum and I employed new techniques I learned from my group members
The statistics and info gathered from the sessions and field trip experiences

Appendix D:
2012 9 Month Post-STA Teacher Questionnaire and Data Summary

Use the scale provided to indicate your level of agreement with each of the following statements: (n = 13)								
	1	**2**	**3**	**4**	**5**	**6**	**Avg.**	**SD**
I brought environmental and energy literacy to my school by collaborating with teachers across subjects and grade levels	0 (0%)	3 (23%)	1 (8%)	3 (23%)	3 (23%)	3 (23%)	**4.15**	1.52
I used concepts from STA to develop lesson plans with teachers in other subject areas	0 (0%)	2 (15%)	4 (31%)	2 (15%)	3 (23%)	2 (15%)	**3.92**	1.38
I used concepts from STA to collaborate with teachers across grade levels and developed curricula that spans multiple grade-years	0 (0%)	6 (46%)	1 (8%)	3 (23%)	1 (8%)	2 (15%)	**3.38**	1.56
The STA program encouraged me to seek out collaborative relationships with other teachers	0 (0%)	1 (8%)	2 (15%)	1 (8%)	5 (38%)	4 (31%)	**4.69**	1.32
The STA program encouraged me to seek out collaborative opportunities with professional scientists/engineers	1 (8%)	2 (15%)	1 (8%)	3 (23%)	4 (31%)	3 (23%)	**4.38**	1.39
Note. Items used the following response scale 1 = "*Strongly Disagree*," 2 = "*Disagree*," 3 = "*Somewhat Disagree*," 4 = "*Somewhat Agree*," 5 = "*Agree*," 6 = "*Strongly Agree*".								

Please describe any collaborative effort with other teachers or professional scientists/engineers that you engaged in after participating in the STA. (n = 9)
List of Items
Three of the five teachers in our PLC attended the STA. We talked about it on several occasions and adapted a few lessons.
Worked with Math Teacher on a horsepower activity and Physic Teacher on simple machine activity.
We shared the renewable energy kits with other classes.
Sharing of info at department meetings and general discussions
We worked with Battelle, and meteorologists from APG to enhance our classes. We had a Stem night at Battelle, and several of my students visited their facility during a school day.
I worked with Lee Butler throughout the year to create technologically rich labs that became a very involved project.
We at John Carroll started a relationship with Battelle and some of their scientists and engineers this year. We had two events with them - a panel discussion of scientists and engineers who talked to our STEM Academy girls about their careers and a Cyber Night where scientists did activities with our students related to computers and technology.
I brought my science class on the green building tour at the College that I took while a student at the STEM Academy.
Developed lessons that engaged students in understanding war soldiers experiences with renewable energy resources in the field of combat.

Appendix D:
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Use the scale provided to indicate your level of agreement with each of the following statements: (n = 13)								
	1	**2**	**3**	**4**	**5**	**6**	**Avg.**	**SD**
The material presented to me at STA was very useful in developing professional development activities at my school	0 (0%)	2 (15%)	2 (15%)	3 (23%)	4 (31%)	2 (15%)	**4.15**	1.34
I intend to develop and deliver a professional development activity at my school	0 (0%)	5 (38%)	3 (23%)	1 (8%)	3 (23%)	1 (8%)	**3.38**	1.45
After STA, I developed effective professional development activity at my school	1 (8%)	5 (38%)	4 (31%)	1 (8%)	1 (8%)	1 (8%)	**2.92**	1.38
After STA, I lead an effective professional development activity at my school	1 (8%)	9 (69%)	1 (8%)	0 (0%)	1 (8%)	1 (8%)	**2.54**	1.39
Note. Items used the following response scale 1 = "*Strongly Disagree*," 2 = "*Disagree*," 3 = "*Somewhat Disagree*," 4 = "*Somewhat Agree*," 5 = "*Agree*," 6 = "*Strongly Agree*".								

What materials from STA was most suitable and important for professional development activities at your school? (n = 6)
List of Items
Involving students in meaningful lessons that are engaging and motivating; relating lessons to the outside world; using sustainable energy resources provided. Allowing students to participate in engaging presentations from engineers/scientists in fields of study that follow my curriculum.
Basic Science and Energy continues to be helpful.
I enjoyed getting the information and perspectives from the engineers and scientists.
We demonstrated the aforementioned paper car crash lab to the Harford County science teachers at a Professional Development meeting.
Anything on energy sources and conservation
I did no formal PD but did collaborate with other teachers.

Appendix D:
2012 9 Month Post-STA Teacher Questionnaire and Data Summary

Use the scale provided to indicate your level of agreement with each of the following statements: (n=13)								
	1	**2**	**3**	**4**	**5**	**6**	**Avg.**	**SD**
After STA, I have tried to improve the environmental sustainability of my school	0 (0%)	0 (0%)	1 (8%)	3 (23%)	6 (46%)	3 (23%)	**4.85**	.90
After STA, I have tried to lead energy and environmental literacy efforts at my school	0 (0%)	3 (23%)	1 (8%)	3 (23%)	3 (23%)	3 (23%)	**4.15**	1.52
Using material from STA, I analyzed the sustainability efforts at my school	0 (0%)	1 (8%)	3 (23%)	4 (31%)	2 (15%)	3 (23%)	**4.23**	1.30
STA gave me material that helped me motivate students to participate in energy and environmental literacy activities	0 (0%)	1 (8%)	1 (8%)	3 (23%)	2 (15%)	6 (46%)	**4.85**	1.34
Note. Items used the following response scale 1 = "*Strongly Disagree*," 2 = "*Disagree*," 3 = "*Somewhat Disagree*," 4 = "*Somewhat Agree*," 5 = "*Agree*," 6 = "*Strongly Agree*".								

What aspects of STA were the most useful for analyzing/creating environmental sustainability efforts at your school (n = 8)
List of Items
Renewable energy resource info.; Havre de Grace Middle School will be receiving energy efficient upgrades during the summer of 2013.
The Renewable Energy Education Kit was great.
We used the environmental information to consider applying for Green school status.
We designed and built a demonstration garden for Conservation Landscaping, in which our students demolished, redesigned, wrote a grant, constructed, and planted this garden in our courtyard at Southampton Middle. Students also wrote and performed various lessons at the annual Environmental Fair. Southampton is a Maryland Green School.
I just didn't have time this year to participate in environmental sustainability work - it was a busy year! We do plan on working on our Green School status this next year though.
The green building tour.
Data and statistics to share, info about programs in progress
We worked toward and achieved Maryland Green School status.

Appendix D:
2012 9 Month Post-STA Teacher Questionnaire and Data Summary

Use the scale provided to indicate your level of agreement with each of the following statements: (n = 13)								
Item	**1**	**2**	**3**	**4**	**5**	**6**	**Avg.**	**SD**
After STA, I am more knowledgeable about energy science	0 (0%)	0 (0%)	0 (0%)	0 (0%)	4 (31%)	9 (69%)	**5.69**	.48
I learned a lot about electricity, its forms and where it comes from at STA	0 (0%)	0 (0%)	0 (0%)	1 (8%)	8 (62%)	4 (31%)	**5.23**	.60
I learned about many different alternative energy sources through STA	0 (0%)	0 (0%)	0 (0%)	0 (0%)	5 (38%)	8 (62%)	**5.62**	.51
I have a much clearer idea of how energy use impacts the environment after STA	0 (0%)	0 (0%)	0 (0%)	1 (8%)	9 (69%)	3 (23%)	**5.15**	.55
In general, I am more confident in my energy literacy after participating in STA	0 (0%)	0 (0%)	0 (0%)	1 (8%)	5 (38%)	7 (54%)	**5.46**	.66
I am more confident in my environmental literacy after participating in STA	0 (0%)	0 (0%)	0 (0%)	1 (8%)	5 (38%)	7 (54%)	**5.46**	.66
Note. Items used the following response scale 1 = "*Strongly Disagree*," 2 = 1"*Disagr5ee*," 3 = "*Somewhat Disagree*," 4 = "*Somewhat Agree*," 5 = "*Agree*," 6 = "*Strongly Agree*".								

What material from STA did you learn the most from? (n = 6)
List of Items
How to efficiently provide electricity to schools/homes using renewable energy.
Fuel cells and the solar cells used by the US Army.
I liked it all, particularly about the green efforts at HCC, and the waste to energy program at APG
The scientists/engineers who came to talk about their research.
Green building tour.
Tours of the HCC campus and Conowingo dam, some of the small "class" sessions

Please describe any lesson plans or partnerships with other teachers or professional scientists/engineers that you developed using material from the STA? (n = 6)
List of Items
Worked with Math Teacher on a horsepower activity and Physic Teacher on simple machine activity.
We developed a paper car crash inquiry design lab in which students used my Vernier LabQuest sensors to measure forces and speed. High speed video of the car crash was synchronized to the force graph and the students were able to analyze their car crash with force data and video unfurling before their eyes.
I'm sorry to say that I did not develop formal lesson plans with others teachers.

Appendix D:
2012 9 Month Post-STA Teacher Questionnaire and Data Summary

	No—Not appropriate for my students	Sometimes—Depends on the student	Yes—This is a good program for my students	I have never heard of this program
Junior Solar Sprint (JSS)	1 (10%)	0 (0%)	0 (0%)	10 (90%)
Junior Science & Humanities Symposium (JSHS)	1 (8%)	2 (17%)	1 (8%)	8 (67%)
eCYBERMISSION (eCM)	1 (8%)	4 (33%)	3 (25%)	4 (33%)
Gains in Education of Mathematics and Science (GEMS)	1 (8%)	2 (17%)	6 (50%)	3 (25%)
GEMS Near Peers	2 (17%)	0 (0%)	2 (17%)	8 (67%)
Research and Engineering Apprenticeship Program (REAP)	2 (17%)	2 (17%)	1 (8%)	7 (58%)
Science and Engineering Apprenticeship Program (SEAP)	1 (8%)	3 (25%)	2 (17%)	6 (50%)
SEAP College Qualified Leaders (CQL)	4 (33%)	1 (8%)	0 (0%)	7 (58%)
High School Apprenticeship Program (HSAP)/ Undergraduate Research Apprenticeship Program (URAP)	3 (25%)	0 (0%)	0 (0%)	9 (75%)

Appendix D:
2012 9 Month Post-STA Teacher Questionnaire and Data Summary

Did you earn Continuing Education Credits (CEUs) from the University of New Hampshire after participation in the STEM Teacher Academy?		
	Freq.	**%**
No	6	46%
Yes	6	46%
Other	1	8%
Total	**13**	**100%**

Note. Other = "2 Inservice MSDE credits"

The STEM Teacher Academy is going to be offered in your area again this year from July 29th – 31st. Knowing this, are you interested in participating in the STEM Teacher Academy again?		
	Freq.	**%**
No	2	17%
Yes	9	75%
Other	1	8%
Total	**0**	**100%**

Note. Other = "I cannot, I have a prior internship responsibility this year, but hopefully another future event."

Including this year, are there any special topics that you would like to see covered in future iterations of the STEM Teacher Academy? (n = 7)
List of Items
Alternative energy ideas and use of power.
Topics in meteorology, weather forecasting, emergency preparedness—coordination with MEMA and FEMA
Using data from real-time environmental sensors to perform research. For example: Use weather data and USGS sediment deposition data to see if there is a correlation. I want kids to perform scientific inquiry with real data.
Forensic science-my students are interested in this and we may try to offer a class in two years.
Additional focus on math and engineering components. Specific scientists who are willing to come into the classroom, and examples of what they would present and how.
Leading edge technology pushing for greater efficiency for the various alternative energy sources. Info about programs that can be done by students (and teachers) in our schools to increase awareness or incorporate alternative energy on our campuses.
In questions, it mentioned several programs for students. How do we find out and inform our students about these programs.