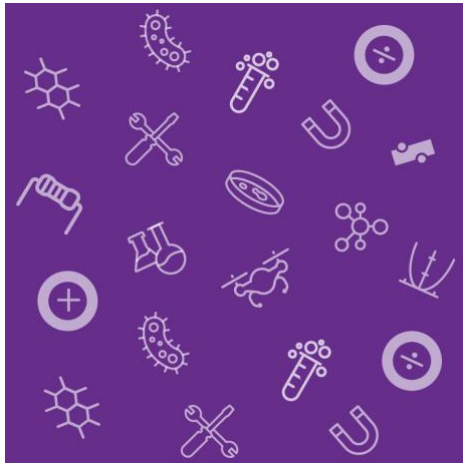
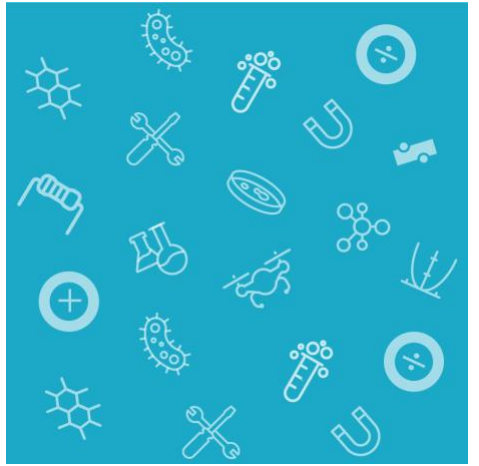


IT STARTS HERE. ★



ARMY EDUCATIONAL OUTREACH PROGRAM

GEMS

2018 Annual Program Evaluation Report Executive Summary

August 2019



1 | AEOP Consortium Contacts

U.S. Army Contacts

Matthew Willis, Ph.D.

Director, Laboratory Management
Office of the Assistant Secretary of the Army
Acquisition, Logistics, and Technology
matthew.p.willis.civ@mail.mil

Andrea Simmons

Army Educational Outreach Program (AEOP) Director
Office of the Deputy Secretary of the Army
Acquisition, Logistics, and Technology
andrea.e.simmons.ctr@mail.mil

AEOP Cooperative Agreement Manager

Christina Weber

AEOP Cooperative Agreement Manager
U.S. Army Combat Capabilities Development
Command (CCDC)
christina.l.weber.civ@mail.mil

Battelle Memorial Institute – Lead Organization

David Burns

Project Director, AEOP CA
Director of STEM Innovation Networks
burnsd@battelle.org

GEMS Program Administrators

Sue Whitsett

NSTA Director of AEOP
National Science Teachers Association (NSTA)
swhitsett@nsta.org

Zach Pektor

GEMS Program Administrator
National Science Teachers Association (NSTA)
zpekor@nsta.org

Evaluation Team Contacts – Purdue University

Carla C. Johnson, Ed.D.

Evaluation Director, AEOP CA
carlacjohnson@purdue.edu

Toni A. Sondergeld, Ph.D.

Assistant Director, AEOP CA
tonisondergeld@metriks.com

Janet B. Walton, Ph.D.

Assistant Director, AEOP CA
walton25@purdue.edu

Report GEMS_02_08302019 has been prepared for the AEOP Cooperative Agreement and the U.S. Army by Purdue University College of Education on behalf of Battelle Memorial Institute (Lead Organization) under award W911 SR-15-2-0001.

2 | Executive Summary

GEMS, administered NSTA on behalf of the AEOP, is a non-residential summer STEM enrichment program for elementary, middle, and high school students (herein referred to as students). GEMS is hosted by Army laboratories on site or in close coordination off site with the area Army laboratories (herein referred to as GEMS sites). The following overarching mission drives the GEMS program: to interest youth in STEM through a hands-on Army laboratory experience that utilizes inquiry-based learning and Near-Peer mentoring. GEMS is an entry point for a pipeline of AEOP opportunities affiliated with the U.S. Army research laboratories. The various GEMS sites are run independently, with NSTA providing support and guidance in program execution to local lab coordinators. Although they operate under a shared mission, GEMS sites are free to include different topics in their curricula that highlight the mission of the laboratory, and sites may set, in addition to the overall program goals, individual laboratory goals. Instead of prescribing a specific program-wide model and curriculum, individual sites are able to design curricula (using the hands-on, inquiry-based model) and procedures that make sense considering the specialties of each facility and available resources. GEMS programs run from one to four weeks in length.

The mentorship model also varies by GEMS site. Many of the GEMS sites use Army scientists and engineers (Army S&Es) to lead GEMS educational activities while other sites use Near-Peer Mentors (NPMs) as a key element in their instructional model. NPMs are developing scientists and engineers (college and high school students) who translate and communicate complex STEM content and their own STEM experiences to the younger GEMS participants. Many sites also leverage the expertise of in-service Resource Teachers (RTs). RTs assist Army S&Es and NPMs in translating STEM research, STEM concepts, and STEM practices into educational curricula as well as provide coaching and instructional supervision to NPMs. RTs also provide adaptive support to individual student participants to ensure maximal engagement and learning. Herein, Army S&Es, NPMs, and RTs are referred together as GEMS mentors except where it is appropriate to differentiate their roles and experiences.

All GEMS programs are designed to meet the following objectives:

1. To nurture interest and excitement in STEM for elementary, middle, and high school participants;
2. To nurture interest and excitement in STEM for mentor participants;
3. To implement STEM enrichment experiences using hands-on, inquiry-based, educational modules that enhance in-school learning;
4. To increase participant knowledge in targeted STEM areas and laboratory skills;
5. To increase the number of outreach participants inclusive of youth from groups historically underrepresented and underserved in STEM;

6. To encourage participants to pursue secondary and post-secondary education in STEM;
7. To educate participants about careers in STEM fields with a particular focus on STEM careers in Army laboratories; and
8. To provide information to participants about opportunities for STEM enrichment through advancing levels of GEMS as well as other AEOP initiatives.

In 2018, GEMS sites involved 18 Army research centers and laboratories operating in 11 states. GEMS provided outreach to 3,342 students at 15 sites.

GEMS 2018 Fast Facts	
Description	STEM Enrichment Activity - at Army laboratories, hands-on
Participant Population	5th-12th grade students (secondary audience: college undergraduate near-peer mentors, teachers)
Number of Applicants	5,486
Number of Participants	3,341
Number/Percentage U2 Participants	1,122 / 35%
Placement Rate	61%
Number of Adults	595
Number of Near-Peer Mentors	151
Number of Resource Teachers	68
Number of Army S&Es	366
Number of Army Research Laboratories	18
Number of K-12 Teachers	77
Number of K-12 Schools	1,165
Number of K-12 Schools – Title I	409
Number of Colleges/Universities	67
Number of HBCU/MSIs	2
Other Collaborating Organizations	11
Number of DoDEA Students	1
Number of DoDEA Teachers	0
Number of DoDEA Schools	1
Total Cost	\$1,456,996
Administrative/Overhead/Indirect/Procurement Fee Costs	\$250,898
Participant Stipends (Students, NPMs & RTs)	\$951,772
Supplies/Equipment/Transportation ODCs sent directly to Labs	\$191,771
Travel Costs Paid for S&E's	\$9,107.68
Cost Per Student Participant	\$436



Summary of Findings

The FY18 evaluation of GEMS collected data about participants; their perceptions of program processes, resources, and activities; and indicators of achievement in outcomes related to AEOP and program objectives. A summary of findings is provided in the following table.

Table 39. 2018 GEMS Evaluation Findings	
Priority #1: <i>Broaden, deepen, and diversify the pool of STEM talent in support of our Defense Industry Base</i>	
GEMS received more applicants and served more students in 2018 than in previous years and continued to reach students from populations historically underrepresented and underserved in STEM, suggesting that JSS's efforts to engage these groups has been met with some success.	Interest in GEMS continues to grow. A total of 5,500 student applications were submitted for 2018 GEMS programs, a 15% increase over 2017, and a 20% increase over 2016.
	GEMS broadened capacity to accommodate students again in FY18. GEMS served 3,342 students in 2018, a 15% increase over 2017 and a 27% increase over 2016.
	GEMS continued to engage students from underserved populations. Nearly half of GEMS participants (47%) were female, 38% identified themselves as White, 24% as Black or African American, 17% as Asian, and 9% as Hispanic or Latino. Over a third of students (35%) met the AEOP definition of underserved.
Students reported engaging in STEM practices during GEMS more frequently than in school; students from urban, rural, and frontier schools were more engaged than students from suburban schools.	GEMS engaged 14% to 76% participants in STEM practices on most days to every day.
	Students from urban, rural, and frontier schools reported significantly greater use of STEM practices compared to students from suburban schools (small effect size).
	Students reported significantly greater engagement in STEM practices in GEMS as compared to in school (medium effect size).
Students experienced gains in STEM knowledge during GEMS; underrepresented students reported greater knowledge gains than other students.	Nearly all responding students reported some level of STEM knowledge gains as a result of the GEMS program, and a majority of students (70% - 85%) reported that they learned "more than a little" or "learned a lot" in each area.
	U2 students reported significantly greater STEM knowledge gains than other student (small effect size).
Students experienced gains in their STEM competencies or	Half or more of students (55% - 82%) reported making gains in STEM competencies, with the exception of how to use computer models (42%) and

<p>skills; these gains varied by students' demographic make-up.</p>	<p>how to present data in charts or graphs to find patterns or relationships (43%).</p> <p>As compared to the overall population of students, students who will be first generation college attenders reported significantly greater gains (small effect size), minority students reported significantly greater gains (small effect size), and students who received free or reduced price lunch reported significantly greater gains (small effect size) in STEM competencies.</p>
<p>Students experienced gains in their 21st Century Skills; gains varied by students' socio-economic status.</p>	<p>More than half of students (54% - 70%) reported that they gained more than a little or a lot in all 21st Century skills.</p> <p>Students who received free or reduced prices lunch reported significantly greater gains (small effect size) in 21st Century Skills as compared to students who did not receive free or reduced-price lunch.</p>
<p>Students reported that participating in GEMS impacted their STEM identities, or their interest in and feelings of capability about STEM.</p>	<p>After participating in GEMS, most students (67% - 91%) reported improvement in their STEM identities.</p> <p>No significant differences in STEM identity gains were found by U2 status or any demographic area examined.</p>
<p>Priority #2: <i>Support and empower educators with unique Army research and technology resources.</i></p>	
<p>Mentors reported using a range of mentoring strategies with students, although very few mentors.</p>	<p>A majority of mentors reported using most strategies associated with each area of effective mentoring, including:</p> <ul style="list-style-type: none"> • strategies to help make the learning activities in GEMS relevant to students (54%-96%) • strategies to support the diverse needs of students as learners (42% - 92%) • strategy associated with supporting students' development of collaboration and interpersonal skills (65% - 100%) • strategies to support student engagement in authentic STEM activities (85% - 96% with the exception of having students search for and review technical literature to support their work; 39% used this strategy <p>Responses were more varied for mentors' use of strategies to support students' STEM educational and career pathways (39% - 92%). Less frequently used strategies for this area included activities that may not be relevant for youngers students such as helping students build a professional network in a STEM field (39%), and helping students with their resume, application, personal statement, and/or interview preparations (42%)</p>
<p>Most students expressed high levels of satisfaction with their GEMS experiences,</p>	<p>Most students (75% - 91%) indicated that they were somewhat or very much satisfied with all GEMS program features (Table 24) except for field trips or laboratory tours, which 42% had not experienced.</p>

<p>although students also had a variety of suggestions for program improvement.</p>	<p>Students were overwhelmingly positive in their comments about their satisfaction in open-ended questions and in focus groups. Students particularly attributed their satisfaction to their learning, their interactions with mentors and peers, the career information they gained, their hands-on experiences, the networking opportunities, opportunities to improve public speaking skills, and the value of the NPMs as role models.</p>
<p>Mentors reported satisfaction with GEMS features and online supports and noted a number of strengths of GEMS. Mentors also made suggestions for program improvement.</p>	<p>Students made a wide variety of suggestions for program improvement. The most frequently suggested improvements were offering a larger variety and/or choice of activities and topics, providing more hands-on activities, providing longer GEMS programs, and providing more in-depth and/or challenging information and activities.</p> <p>A majority of mentors (62% - 100%) were at least somewhat satisfied with each feature of the GEMS program.</p> <p>Mentors responding to open-ended questions and participating in the focus group expressed satisfaction with the program and noted a number of strengths of GEMS including students' exposure to STEM, students' STEM learning, contact with Army S&Es, the career exposure GEMS provides for both student participants and NPMs, the hands-on experiences, and students' exposure to real-world research.</p> <p>Mentors suggested a range of program improvements. The most frequently mentioned improvements were to have more guest speakers or more time with guest speakers and suggestions for space and logistical improvements, such as providing better spaces for lab activities. Other suggestions included providing funding for more NPMs, creating networks between GEMS sites to share curriculum and best practices, and simplifying or shortening the student questionnaire.</p>
<p>Priority #3: <i>Develop and implement a cohesive, coordinated and sustainable STEM education outreach infrastructure across the Army</i></p>	
<p>The few students who provided information about how they learned about AEOP primarily cited past participation and personal connections; mentors reported similar sources of information.</p>	<p>GEMS participants learned about AEOP through past participation in GEMS (58%) primarily. This was followed by learning about GEMS/AEOP from friends (28%) and family members (35%).</p> <p>Focus group participants primarily cited personal relationships (family member or friend) as sources of information about GEMS, although several had learned about GEMS from a teacher or from a school email.</p> <p>The most commonly reported sources of information about AEOP for mentors were past participation in GEMS (42%) and a family member (42%). A third of mentors also cited the AEOP website (32%) and someone who works with the program (32%) as sources of information.</p>



<p>Students reported various motivations for participating in GEMS, including learning and having fun.</p>	<p>The relatively few students (n=57) who responded to a questionnaire items about their motivation for participating in GEMS cited a desire to learn something new or interesting (89%), an interest in STEM (93%), having fun (77%), and the opportunity to learn in ways not possible in school (75%). As motivators for participating in GEMS.</p>
<p>Few students had participated in any AEOP other than GEMS and many were interested in participating in other AEOPs in the future; few mentors discussed specific AEOPs other than GEMS and SMART with students.</p>	<p>Students in focus groups were motivated to participate in GEMS by their previous participation, and opportunities to learn about STEM topics, learn about careers and explore their interests, have hands-on experiences, have fun, and make friends.</p> <p>Of the relatively small number of students responding to a questionnaire item about their past participation in AEOPs (n=57), nearly two-thirds (63%) reported being a past GEMS participant and 11% said they had participated in Camp Invention. Participants reported no other AEOP participation.</p> <p>A large majority (89%) of respondents indicated being at least a little interested in participating in GEMS again and 73% indicated being at least somewhat interested in participating as NPMs in the future. While a third or more of students reported being interested in each AEOP listed (32% - 89%), many students (48% - 65%) had not heard of the other AEOPs. Relatively few indicated being “not at all” interested in future participation in any of the programs.</p> <p>Mentors most frequently discussed GEMS (81%) and GEMS NPMs (65%) with students, and almost half (46%) reported discussing SMART with students. More than half of mentors (62%) reported discussing AEOPs generally with students but without reference to any specific program.</p>
<p>Mentors reported that GEMS participation and administrative staff were useful for exposing students to AEOPs; many had not experienced other AEOP resources.</p>	<p>Participation in GEMS was most frequently rated as “somewhat” or “very much” useful (85%), along with GEMS program administrators or site coordinators (89%).</p> <p>While half of mentors (50%) indicated that the AEOP website was at least somewhat useful for this purpose, more (42%) had not experienced the website or the AEOP brochure (42%). Likewise, over half of mentors (54%) had not experienced AEOP on social media.</p>
<p>Students reported learning about STEM careers generally during their GEMS experiences and, to a somewhat lesser extent,</p>	<p>Nearly all students (96%) reported learning about at least one STEM job/career during GEMS, and most (52%) reported learning about five or more. A slightly smaller number (90%) reported learning about at least one DoD STEM job/career and 35% reported learning about 5 or more DoD STEM careers.</p>

<p>about STEM careers within the Army or DoD; students had learned about these careers primarily from their first-hand experiences.</p>	<p>Most students participating in focus groups reported learning about DoD STEM careers to some extent during their GEMS experiences. They cited being physically present at a DoD site and exposure to military personnel, tours, and making real-life connections with their program activities as the primary sources of career information.</p>
<p>Mentors reported that GEMS participation, administrative staff, and career events were useful for exposing students to DoD STEM careers; many had not experienced other AEOP resources.</p>	<p>Mentors were most likely to rate participation in GEMS as at least somewhat useful for exposing students to DoD STEM careers (85%). A large majority of mentors (73%) also indicated that the GEMS program administrator or site coordinator was somewhat or very much useful, and 62% indicated that invited speakers or “career” events were somewhat or very much useful for this purpose.</p> <p>Over half of mentors had not experienced AEOP on social media (58%), and over a third had not experienced the AEOP brochure (42%) and the AEOP website (35%).</p>
<p>Students had positive perceptions of DoD researchers and research after participating in GEMS.</p>	<p>Large majorities of students (76% - 87%) agreed or strongly agreed with each statement about DoD researchers and research, suggesting that they have positive opinions about DoD researchers and research. Very few students disagreed with any statement (3% - 7%).</p>
<p>Students reported being more likely to engage in STEM activities after participating in GEMS; females and minority students were more likely to report changes in their likelihood of future engagement.</p>	<p>A majority of students (51% - 71%) indicated that they were more likely or much more likely to engage in each activity about which they were asked. Others (23% - 41%) reported no change in the likelihood that they would engage in the activities listed.</p> <p>Females (small effect size) and minority students (small effect size) reported significantly more likelihood of future engagement as compared to male and non-minority students.</p>
<p>Students reported aspiring to at least finish college after participating in GEMS.</p>	<p>A large majority of students (94%) reported wanting to at least finish college (get a bachelor’s degree), and over half (57%) indicated that they aspired to continue their education after college after participating in GEMS.</p>
<p>GEMS had positive impacts on students in areas of their STEM learning, interest, appreciation for STEM research, and interest in STEM careers; students who attended schools in urban, rural, or frontier areas</p>	<p>Most students (61% - 90%) reported that GEMS contributed to each area of impact about which they were asked. Areas for which the largest percentages of students reported impact included their interest in pursuing a STEM career (90%), their awareness of Army or DoD STEM research and careers (87%), and their appreciation of Army or DoD STEM research (88%).</p> <p>Students who attended urban, rural, or frontier schools reported significantly greater impact from participating in GEMS (small effect size) than those attending suburban schools.</p>



experienced greater impacts than other students.	
--	--

Responsiveness to FY17 Evaluation Recommendations

AEOP Priority: Broaden, deepen, and diversify the pool of STEM talent in support of our Defense Industry Base

FY17 Finding: As in FY16, GEMS student participants continued to report that their primary source of information about GEMS was personal connections which emphasizes the quality of experience that students have in the program that motivates them to tell others about the program. However, this does exclude students who may not have connections to current or past participants. Given the large proportions of students who learned about GEMS through family, friends, and past participants of the program, the recommendation is repeated for FY17 to take measures to diversify the applicant and participant pool and to ensure that students without personal connections to sites have access to the GEMS program.

GEMS FY18 Efforts and Outcomes: Recruitment of students without personal connections was supported by LPC outreach activities, consortium partners' social and email media marketing activities, AEOP website content management and CI marketing activities.

LPCs consistently conduct outreach activities at local schools and after-school activities, especially at schools that serve underserved students. LPCs often combine those efforts with lab-based STEM initiatives that are outside of AEOP funding. For example, LPCs in Vicksburg, Miss., are actively involved in after-school robotics activities, and LPCs at Aberdeen, Md., support a weekly, school-time STEM-enrichment program for eighth-grade students in a nearby county.

Consortium social and email media marketing activities are designed to reach underserved communities, as Widmeyer Communication and MetriKs Amérique operate under the same goals. The IPA works to align the work of local GEMS and CI programs with the work of Widmeyer Communication and MetriKs Amérique. The IPA works to raise awareness of consortium efforts, like the Alumni Program, during meetings and site visits.

CI locations are chosen by their access to underserved communities and, in this way, build opportunities for those without personal connections to the local lab.

AEOP Priority: Support and empower educators with unique Army research and technology resources

FY17 Finding: In FY17, GEMS participants and mentors both echoed findings that have been prevalent across the AEOP portfolio. Only a very few numbers of participants and mentors are accessing and/or utilizing AEOP social media, including the website. In regard to GEMS, only 40% had accessed the AEOP website. It is important for GEMS to play a role in working with the consortium overall to determine the strategy and plan for use of social media within and across the AEOPs.

GEMS FY18 Efforts and Outcomes: The IPA continued to work alongside consortium members to support social media engagement. Members of the Widmeyer marketing team said in interviews that the IPA has often exceeded their expectations. The IPA communicates important milestones, local points of contacts, and other program events to Widmeyer Communication. The IPA communicates participation and alumni status to MetriKs Amérique. The IPA promotes consortium opportunities, like the Alumni Spotlights, to LPCs, CLCs, and NIHF.

AEOP Priority: Develop and implement a cohesive, coordinated and sustainable STEM education outreach infrastructure across the Army

FY17 Finding: A majority of student participants reported they had not learned about other AEOPs that would be next in their pipeline of opportunities, including JSS (48%), eCM (68%), and JSHS (72%). More than half of mentors reported only generally discussing AEOPs with participants. GEMS should invest additional effort in FY18 to provide sites with resources to use to introduce and teach participants about AEOPs in more than a one-time manner. A virtual alumni panel or using NPMs to teach GEMS participants would be good strategies to consider.

GEMS FY18 Efforts and Outcomes: The IPA continued to work with LPCs to evaluate the successfulness of different tools to support NPM and participant awareness. The “What’s Next?” flyer created by Widmeyer was well received by LPC, RT, NPM, and participants, according to reports during IPA site visits. Changes to the AEOP website, also led by Widmeyer, were also reported as helpful assets for NPM awareness of AEOP programming.

Recommendations for FY19 Program Improvement/Growth

Evaluation findings indicate that FY18 was a very successful year for the GEMS program. Both applications to the program and participation increased for the year. Students consistently reported the impact of GEMS on their STEM knowledge, skills, interests, and future desires to participate in STEM. GEMS participants reported meaningful learning in regard to STEM careers and STEM careers within the DoD/Army specifically. In fact, 75% of participants were more interested in earning STEM degrees after participating in GEMS.



While the successes for GEMS detailed above are commendable, there are some areas that remain with potential for growth and/or improvement. The evaluation team therefore offers the following recommendations for FY18 and beyond.

AEOP Priority: Broaden, deepen, and diversify the pool of STEM talent in support of our Defense Industry Base

The primary method that GEMS participants in FY18 reported learning about GEMS or AEOP was through past participation (58%) in either GEMS or Camp Invention. This was followed by learning about GEMS/AEOP through family members 25% and friends 28%. It appears that GEMS participants continue to come from the pipeline approach. As in FY17 and previous years, we strongly recommend that GEMS work to include more new students to AEOP from groups outside the DoD and current programming (Camp Invention) in the program.

Only about a third (35%) of students in GEMS in FY18 were from underserved groups. It is also recommended that NSTA work with GEMS sites to continue to grow this percentage to provide more opportunities for students possibly outside the DoD realm a chance to experience the program and grow their knowledge of GEMS, AEOP, and DoD.

AEOP Priority: Support and empower educators with unique Army research and technology resources

1. GEMS mentors reported only 39% to 96% usage of the effective mentoring strategies. This reveals that mentors are either choosing not to implement best-practice or are not equipped with the appropriate training to utilize the strategies with their participants. It is recommended that GEMS develop and implement a required training for mentors (delivered virtually) that is completed at least once when beginning to work with the program in FY19 and beyond.
2. As in FY17, GEMS participants and mentors both echoed findings that have been prevalent across the AEOP portfolio. Only a very few number of participants and mentors are accessing and/or utilizing AEOP social media, including the website. In regard to GEMS, 35% had not accessed the AEOP website and 58% had not experienced the AEOP social media outlets. It is recommended again in FY19 that GEMS to play a role in working with the consortium overall to determine the strategy and plan for use of social media within and across the AEOPs.
3. In FY18, GEMS students suggested that the program could be improved with more student choice, hands-on activities, and more challenging content. This is important feedback from participants that should be followed up on. It is recommended that NSTA conduct an examination of GEMS curricula used across sites and determine if there is a need to provide some guidance and/or

standardized cross-program activities that all GEMS program participants experience to establish more continuity of experiences and to guide more of the quality-control for GEMS.

AEOP Priority: Develop and implement a cohesive, coordinated, and sustainable STEM education outreach infrastructure across the Army

1. As in FY17, many students 48-65% had not heard of other AEOP programs. Further, more than half of mentors (62%) reported discussing AEOPs generally, but not regarding any specific program. This means 38% did not discuss other AEOPs at all. It is recommended that NSTA work with GEMS sites to provide required guidance and activities for GEMS participants to learn about other appropriate AEOPs.
2. Only 35% of GEMS participants reported learning about five or more DoD STEM careers, compared to 90% who learned about at least one. It seems that a program hosted at a DoD laboratory would have more of a central focus on exposing students to a variety of DoD STEM careers. It is recommended that NSTA examine GEMS curricula and inquire with sites regarding their focus on DoD STEM careers as part of their programming and determine if more guidance is necessary to enable all participants to learn about five or more.

To view the rest of the report:

[GEMS Evaluation Report Narrative Part 2](#)

[GEMS Evaluation Report Appendices Part 3](#)