Army Educational Outreach Program

2016 Portfolio Evaluation Report

ARMY EDUCATIONAL OUTREACH PROGRAM

March 2017

U.S. Army Contacts

Jeffrey Singleton
Director of Basic Research
Office of the Assistant Secretary of the Army
Acquisition, Logistics, and Technology
(703) 697-0508
Jeffrey.d.singleton.civ@mail.mil

Andrea Simmons-Worthen
Army Educational Outreach Program Director on behalf of the Office of the Deputy
Secretary of the Army for Research and Technology
(703) 617-0202
andrea.e.simmons.ctr@mail.mil

AEOP Cooperative Agreement Manager

Louie Lopez
AEOP Cooperative Agreement Manager (CAM)
U.S. Army Research, Development, and
Engineering Command (RDECOM)
(410) 278-9858
louie.r.lopez.civ@mail.mil

Battelle Memorial Institute – Lead Organization

David Burns
Project Director, AEOP CA
Director of STEM Innovation Networks
(859) 322-7431
burnsd@battelle.org

PURDUE UNIVERSITY

Report AEOP_04_03232017 has been prepared for the AEOP Cooperative Agreement and the U.S. Army by the Purdue University College of Education on behalf of Battelle Memorial Institute (Lead Organization) under award W911 SR-15-2-0001.

Evaluation Team Contacts

Carla C. Johnson, Ed.D.
Evaluation Director, AEOP CA
Purdue University
(765) 494-0019
carlacjohnson@purdue.edu

Toni A. Sondergeld, Ph.D.
Asst. Evaluation Director, AEOP CA
Metriks Amerique
(419) 902-6898
tonisondergeld@metriks.com

Janet B. Walton, Ph.D.
Asst. Evaluation Director, AEOP CA
Purdue University
(765) 494-0019
walton25@purdue.edu

Erin E. Peters Burton, Ph.D.
Asst. Evaluation Director, AEOP CA
George Mason University
(419) 902-6898
erin.peters1@gmail.com

ARMY EDUCATIONAL OUTREACH PROGRAM

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Executive Summary

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–undergraduate programs while exposing participants 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, providing a management structure that collectively markets the portfolio among members, leveraging available resources, and providing expertise to ensure the programs provide the greatest return on investment in achieving the Army's STEM priorities and objectives toward a STEM literate citizenry, STEM savvy educators, and sustainable infrastructure.

AEOP Priorities

Priority 1: STEM Literate Citizenry.

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

Priority 2: STEM Savvy Educators.

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

Priority 3: Sustainable Infrastructure.

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

In FY16, the AEOP central application tool included 39,036 unique program participants, 30,972 were youth program participants and 8,463 were adult participants. Adult participants included Army Scientists and Engineers (S&Es) in various roles, such as mentors, judges, and presenters, and teachers participating in the new RESET program. The AEOP is in the process of transitioning to a centralized application tool and most programs utilized it for registration in FY16. Of the total participants in 2016, 488 students and 57 teachers were from DoDEA schools from the Pacific, Europe and the U.S. The number of unique youth program participants in 2016 (30,972) was lower than in 2015 (38,039).

2016 AEOP Participation Numbers			
		Youth	Adults
CII	Camp Invention Initiative	1185	104
CQL	College Qualified Leaders	236	162
eCM	eCYBERMISSION	20,607	3,389
GEMS	Gains in the Education of Mathematics & Science	2,427	345
HSAP	High School Apprenticeship Program	65	42
JSHS	Junior Science & Humanities Symposium	5,300	3,214
JSS	Junior Solar Sprint	585	222
REAP	Research & Engineering Apprenticeship Program	120	121
RESET	Research Experiences for STEM Educators and Teachers	NA	20
SEAP	Science & Engineering Apprentice Program	113	113

Unite	Unite	282	685
URAP	Undergraduate Research Apprenticeship Program	52	46
	Total 2016 AEOP Participants	**30,972**	**8,463**

In 2016 the AEOP portfolio included participation from various collaborating schools, laboratories, Army/DoD S&Es and other collaborating organizations. The AEOP involved participants from 3,607 K-12 schools (compared to 3,854 in FY15), including more than 978 Title I schools (compared to 1,276 in FY15). The portfolio of programs also involved 568 colleges/universities (compared to 462 in FY15), including at least 69 HBCUs/MSIs (compared to 116 in FY15). The AEOP programs self-reported 155 Army and DoD affiliated research laboratories and engineering centers or Army organizations involved in the work of the programs. The AEOP worked with 74 Army-funded laboratories at colleges/universities (compared to 64 in FY15). There were 1,287 Army and DoD S&Es who participated in 2016 programming (compared to 1,487 in FY15).

In regards to participation of the DoDEA and Army/DoD laboratories, there was a decrease as 488 students and 57 teachers from DoDEA schools in the Pacific, Europe and the U.S. that participated in the AEOP through the GEMS, eCM and JSHS programs (compared to 796 students and 65 teachers in FY15). Additionally, through the AEOP competition programs (eCYBERMISSION, JSHS, JSS) and Unite, the AEOP engaged and collaborated with 225 organizations external to schools and the Army and DoD laboratories (e.g., professional STEM organizations, businesses, Technology Student Association state delegations, etc.).

Number of 2016 Collaborating Schools, Laboratories, Army/DoD S&Es, and Other Organizations

	K-12 Schools		Colleges/Universities (represented by participants or serving as host sites)		Army and DoD Research Laboratories/ Army Agencies	Army-Funded University Laboratories	Army and DoD Scientists & Engineers (S&Es)	Other Collaborating Organizations
AEOP Program	Total	Title I	Total	HBCU/MIs				
Camp Invention (CII)*	16	14	NA†	NA†	10	NA†	NA†	NA†
College Qualified Leaders (CQL)	NA†	NA†	112	4	11	NA†	162	NA†
eCYBERMISSION (eCM)	547	294	153	___§	37	NA†	540	19
Gains in the Education of Mathematics and Science (GEMS)	907	230	50	4	14	NA†	215	NA†
High School Apprenticeship Program (HSAP)	53	13	35	16	NA†	35	NA††	NA†
Junior Science and Humanities Symposium (JSHS)	1,060	196	120	___§	56	NA†	234	189
Junior Solar Sprint (JSS)	609	61	NA†	NA†	2	NA†	5	2
Research and	104	45	42	19	NA†	NA†	NA†	NA†

Engineering Apprenticeship Program (REAP)								
Research Experiences for STEM Educators (RESET)	20	16	1	0	3	NA	6	5
Science and Engineering Apprentice Program (SEAP)	71	11	NA†	NA†	10	NA†	113	NA†
Unite	220	98‡	16	12	11	NA†	18	10
University Research Apprenticeship Program (URAP)	NA†	NA†	39	14	NA†	39	NA††	NA††
Total Sites	**3,607**	**978**	**562**	**69**	**155**	**74**	**1,287**	**225**

§ *Data not available.* † *Does not apply.*

‡ *Data from Unite reflects the number of participants from Title I schools rather than the number of Title I schools.*

The costs for the individual 2016 AEOP elements as well as the average cost per student for each program element are detailed in the table below. The cost of the AEOP summer apprenticeship programs ranged from $3,235 per apprentice (REAP) to $10,002 per apprentice (CQL). The higher cost of CQL reflects the longer duration of the program, which may take place in the summer or through portions of the academic year (sometimes lasting the entire year). The cost of 2016 AEOP competitions ranged from $147 per student (eCM) to $354 per student (JSHS). GEMS, which is typically a 1-week summer STEM enrichment activity that takes place at Army laboratories, had an average cost of $429 per student in 2016 while Unite, a 4-6 week summer STEM enrichment activity for students from historically underserved and underrepresented groups that takes place in an existing University pre-collegiate program, had an average cost of $1,988 per student.

2016 AEOP Costs		
	Program Cost	**Cost Per Student Participant**
CII	$271,564	$229
CQL	$2,360,394	$10,002
eCM	$3,038,180	$147
GEMS	$1,010,121	$416
HSAP	$235,746	$3,627
JSHS	$1,879,713	$354
JSS	$174,752	$223
REAP	$388,217	$3,235
RESET	$133,048	$6,652
SEAP	$379,998	$3,363
Unite	$560,682	$1,988
URAP	$202,703	$3,898

Data for the 2016 AEOP portfolio evaluation were collected and analyzed by Purdue University, the evaluation arm of the Lead Organization (LO) of the AEOP CA, Battelle Memorial Institute. With the support of the AEOP CA Consortium Members, Individual Program Administrators (IPAs), and Government POCs, evaluation studies for the CQL, eCM, GEMS, HSAP, JSHS, JSS, REAP, RESET SEAP, Unite, and URAP programs as well as an alumni evaluation were completed by the Purdue University team.

The FY16 AEOP program near-term evaluation utilized participant questionnaires, as well as focus groups and/or interviews with participants and adults who led educational activities or supervised research projects (herein called mentors). This report summarizes the 2016 evaluation of the AEOP portfolio. Eleven individual program evaluation reports are available under separate cover. Executive summaries for these eleven reports are attached as appendices to this document. This report includes a program overview, evaluation and assessment strategy, study sample, and evaluation findings. The final section offers evidence-based recommendations intended to inform decisions for future program development. In FY16 the AEOP mid to long-term longitudinal study of alumni began and initial findings from this evaluation are included in this summative report.

Summary of Findings

The FY16 AEOP near-term evaluation study collected data about participants, their perceptions of program processes, resources, and activities. Data were also collected regarding indicators of student impacts that relate to outcomes aligned with AEOP objectives, program objectives, and Federal guidance for evaluation of Federal STEM investments. In FY16 the AEOP began a mid to long-term study of alumni. A sample of alumni were asked to complete a questionnaire and interview focused on their interest, participation, and persistence in STEM as well as their knowledge of and interest in DoD and other STEM programs of study and careers. A summary of findings is provided in the Summary of Findings table on the next page.

Summary of Near Term Findings (Current FY16 Programs)	
Priority 1: STEM Literate Citizenry *Broaden, deepen, and diversify the pool of STEM talent in support of our Defense Industry Base.*	Finding #1: In FY16 the AEOP provided outreach to 30,972 youth participants through its comprehensive portfolio of program. This number represents a 19% overall decrease in number of participants compared to FY15 (38,039) and a 26% decrease from FY14 (41,802). This downward trend in participation mirrors a downward trend in applications as evidenced by the fact that in FY16 16% fewer applications were received than in FY15 and 25% fewer applications were received than in FY14. The decline in enrollment numbers for FY16 can be largely attributed to decline in participation for eCM, the largest AEOP in terms of enrollment. Participation in eCM declined by over 7,000 students from FY15 to FY16, a decrease of 25%. It is important to note that eCM had used different metrics (registration) to track participation and in FY16 moved to counting only those students who complete the competition as participants. Similarly, participation in JSS and JSHS declined in FY16. JSS participation declined from 891 participants in FY14 to 585 participants in FY16, representing a 34% drop in enrollment over this two-year period. JSHS enrollment declined from 5,829 in FY15 to 5,620 in FY16 (4% decrease). While the AEOP apprenticeship portfolio experienced overall growth in applicants, there has been a slight downward trend in placement rates since FY14, with 27% of applicants placed in FY16, 33% in FY15, and 31% in FY14. High school apprenticeships (HSAP, REAP, and SEAP) served a larger proportion of students in FY16 (25% placement rate) as compared to the past two years (17% placement rate in each year). This is partially attributable, however, to a 40% increase in URAP applications from FY15 (107) to FY16 (177). At the same time, placement in undergraduate apprenticeships (CQL and URAP) decreased markedly from 72% in FY15 to 45% in FY16. This was mostly due to AEOP phasing out the awarding of apprenticeships to graduate students in FY16 to make the focus of the program more aligned with the goals of broadening the STEM talent pool. Student STEM enrichment activities (GEMS and Unite) showed increases in enrollment over FY15 levels while acceptance rates remained relatively steady. In particular, Unite enrollment increased by 29%, bringing enrollment back to FY14 levels (282 participants in FY16 as compared to 200 in FY15 and 280 in FY14). GEMS experienced a 7% growth in enrollment since FY15 and 14% since FY14 (2,428 participants in FY16 as compared to 2,270 in FY15 and 2,095 in FY14). In sum, while there were some positive enrollment trends for FY16, there continues to be considerable unmet demand for AEOPs, with over 7,000 applicants who applied but were not accepted into programs. Finding #2: The AEOP continued to emphasize participation of underserved and underrepresented groups in associated apprenticeship, competition, and enrichment programs and progress was made toward increasing the participation of these groups in most programs in FY16. Female participation increased over FY15 levels in 6 programs (CQL, HSAP, JSS, SEAP, Unite, and URAP) and stayed constant in GEMS while somewhat fewer females participated in eCM and JSHS. Participation of students identifying with racial/ethnic minority groups grew as compared to FY15 levels for every program except for Unite. CQL increased participation of females (25% to 40%) and JSS included more racial and/or ethnic minorities (13% to 28%) in FY16 as compared to FY15. Notably, CQL racial/ethnic minority participation increased from 13% in FY15 to 26% in FY16, the HSAP program saw an increase from 29% racial/ethnic minority participation in FY15 to 67% in FY16, and SEAP racial/ethnic minority participation increased from 35% in FY15 to 54% in

	FY16. REAP, a program designed to target underserved and underrepresented groups, also served increasing numbers of students from racial/ethnic minority groups, with an increase from 65% in FY14 (overall demographic data not available for FY15) to 81% in FY16. Finding #3: In FY16, the majority of program participants overwhelmingly reported learning about STEM more frequently in AEOP than in school with the exception of students in JSS. The majority of program participants overwhelmingly reported engaging in STEM (doing) more frequently in AEOP than in school with the exception of JSHS regional participants. Finding #4: As in FY15, students participating in the AEOP programs in FY16 reported that the experience improved their STEM-specific and 21st Century STEM skills competencies. They also reported gains in their abilities to use the science and engineering practices described in the Next Generation Science Standards (NGSS), as well as increases in their STEM confidence and identity. Finding #5: The AEOP's efforts to expose students to DoD research resulted in most participants reporting knowledge of such. Nearly all AEOP programs' participants reported positive attitudes (more than 60% agreement) toward DoD STEM research and researchers. Mentors/Advisors in 8 of the programs (out of 10) reported more than 50% agreement that they discussed DoD STEM research and opportunities with participants. Finding #6: The AEOP exposed students to STEM careers, as well as Army and DoD STEM careers. Apprentice program participants reported the highest agreement with more than 60% agreeing that they learned about 3 or more STEM careers. Army lab-based apprentice programs had the highest agreement with learning about 3 or more Army/DoD STEM careers (61-85%), while other apprentice programs had between 25% to 41% agreement. STEM programs had the second best ratings of learning about STEM and Army/DoD STEM careers with 50% or more participants agreeing that they learned about 3 or more STEM careers. Competitions had the lowest agreement rate in this area, with 33-44% agreement regarding STEM careers overall and 18% agreement for JSHS and JSS regarding Army/DoD STEM careers. The exception to this was eCM NJ&EE participants who reported 91% agreement in regards to learning about 3 or more Army/DoD STEM careers. Finding #7: The AEOP programs served to sustain existing STEM educational and career aspirations of participants and to inspire new achievement, including intentions to pursue higher education and STEM careers. In addition, participants reported gains in interest in pursuing DoD STEM careers as a result of participation in AEOP.
Priority 2: STEM Savvy Educators *Support and empower educators with unique Army research and technology resources.*	Finding #1: AEOP mentors' reported use of effective mentoring strategies increased for most programs in FY16. These strategies include establishing the relevance of learning activities, supporting the diverse needs of students as learners, supporting student development of interpersonal and collaboration skills, supporting student engagement in authentic STEM activities, and supporting student STEM educational and career pathways. Finding #2: Across the AEOPs, most apprentices and students report being satisfied with

	their mentors and the quality of instruction they received. The level of agreement for participant satisfaction with mentors for some programs decreased from FY15 (CQL, SEAP, Unite, URAP).
Priority 3: Sustainable Infrastructure *Develop and implement a cohesive, coordinated, and sustainable STEM education outreach infrastructure across the Army.*	Finding #1: Despite increased investment and attention to external communications regarding AEOP opportunities in FY16, personal connections, including friends, teachers and/or professors, or someone who works at the university or school the participant attends continue to be the most frequently cited means of participant information about programs. Most agreed that past participants as well as the school, university, or professional organization newsletter, email or website were the primary means of learning about AEOP. The exceptions included SEAP and CQL, where participants noted that someone who works with the Department of Defense was their main source of program information, and eCM, where mentors indicated the AEOP website was their primary means of learning about the program. Finding #2: Most AEOP program participants were somewhat interested in participating in other AEOPs. In all programs, at least 28% of participants indicated being interested in participating in other AEOPs. Finding #3: AEOPs need to continue to work to improve participation in the AEOP evaluation in FY17. Despite improved participation by youth participants in the AEOP evaluation, response rates remained less than desirable in FY16. Mentor questionnaire participation was substantially lower than desired.

Summary of Mid to Long-Term Findings (Alumni of AEOP programs)	
Priority 1: STEM Literate Citizenry *Broaden, deepen, and diversify the pool of STEM talent in support of our Defense Industry Base.*	Finding #1: AEOP alumni (92%) indicated they were both interested in earning a STEM degree and pursuing a STEM career. Finding #2: AEOP alumni (82%) indicated interest in taking elective STEM courses, and 87% were interested in potential STEM projects/experiments in a university or professional setting. Further, 90% reported being interested in learning about new things in STEM. More than half (58%) of AEOP alumni reported that they are taking a STEM elective (not required) class or course (Table 43). Nearly half of AEOP alumni surveyed indicated they were pursuing a STEM degree (49%) and 14% are currently working in a STEM career. Finding #3: More than 80% reported occasional to frequent engagement in learning about new things in STEM. Additionally, 44% of alumni reported talking with family and friends about STEM frequently, 26% read or watch STEM non-fiction frequently, and 39% reported solving math/science puzzles frequently. Likewise, 40% of alumni reported participating or volunteering in STEM camps, clubs, or competitions and 47% indicted they had mentored or taught others about STEM. Findings indicate nearly half or more AEOP alumni are engaged in STEM activities on an occasional to frequent basis. Finding #4: AEOP alumni hold very positive views toward STEM (Chart 23). Over 90% of alumni feel successful in their STEM classes and 80% believe that all people can be successful in STEM. Nearly all (98%) alumni reported enjoying solving real-world problems and 96% believe that they can use STEM to help improve their community. More than 90% reported understanding how scientists and engineers work on real problems in STEM and 98% reported there are STEM careers that are a good fit with their interests. In sum, AEOP alumni hold very positive attitudes toward STEM. Finding #5: The vast majority of responding AEOP alumni (95%) reported growth in their STEM knowledge as a result of AEOP participation. More than 90% of alumni had positive attitudes regarding the work of the Army/DoD in STEM, including feeling the work is valuable to society and that the Army/DoD solves real-world problems as well as develops new, cutting edge technologies. AEOP alumni hold very positive views of Army/DoD STEM. Finding #6: Most alumni reported being aware of Army/DoD STEM careers (78%) and 96% reported interest in pursuing STEM careers, with 67% being interested in Army/DoD STEM careers specifically. Over three-quarters (78%) of alumni reported interest in learning more about Army/DoD careers focused on STEM research. AEOP alumni reported pursuit and attainment of STEM coursework in high school. Nearly half (46%) completed calculus, 52% completed an AP science course, and 72% completed chemistry (Table 44). Further, 24% reported taking an engineering course in high school and 64% completed physics. Finding #7: AEOP alumni who had graduated high school reported enrollment in STEM degree programs in post-secondary study. Of the 46% of respondents who had graduated from high school, 42% were enrolled in post-secondary study (Table 45). This included 4% who were enrolled in associate degree programs, 32% were enrolled in bachelor's degree

	programs, 7% in master's degree programs, and 3% in doctoral degree programs. Additionally, 3% were enrolled in technical training programs.
Priority 2: STEM Savvy Educators *Support and empower educators with unique Army research and technology resources.*	Finding #1: A large majority (92%) of responding alumni reported that their experience with their mentor was very positive. A similar majority (90%) reported that their learning was enhanced by their AEOP mentor. Nearly half of alumni (42%) reported that they had stayed in touch with their mentor following program participation and 86% of AEOP alumni indicated that AEOP mentors helped to influence/inform their future academic and career decisions.
Priority 3: Sustainable Infrastructure *Develop and implement a cohesive, coordinated, and sustainable STEM education outreach infrastructure across the Army.*	Finding #1: AEOP alumni (n=229) were asked to report on their awareness of other AEOPs. Over half (58%) shared that they were familiar with other AEOP programs and 78% of alumni reported being interested in participating in other AEOPs. Finding #2: AEOP Alumni were asked to report past participation in AEOPs as part of the evaluation. The program with the most participation by alumni was GEMS with 29% of respondents participating once, 12% twice, and 15% three or more times. Alumni respondents included past participants of all programs (eCM, JSS, GEMS, Unite, JSHS, SEAP, REAP, HSAP, CQL, and URAP). In addition, 1% of AEOP alumni reported receiving the NDSEG scholarship.

What current AEOP participants are saying…

*"**SEAP** this summer has been absolutely amazing! Not only did I gain useful research experience that colleges will be glad I have, but I also formed friendships with many people here. I got to ask scientists about their backgrounds and how they got interested in their STEM careers…SEAP definitely solidified my desire to become an engineer…Thanks so much AEOP!"* --SEAP Apprentice

*[Our **SEAP** student] was awesome. She texted me before the program to ask for information that could prepare her for the experience. She did not complain when doing the mundane and quickly got the work done…Definitely would repeat this summer."* --SEAP Mentor

*"**CQL** is an invaluable experience for college interns."* –CQL Mentor

"I have been with a fantastic team who treats me as a valuable peer, allowing me to design my own experiments and publish my own work." --**CQL** Apprentice

"The [**REAP**] *student I had was hard working and never hesitated to ask questions whenever she had any. I think she gained a good amount of knowledge working in the lab. Also she started reading and understanding the chemistry much more than I expected...It's a good experience."* --REAP Mentor

"I was very satisfied with my experience in [**HSAP**]. *I learned a lot about a very specific field, while at the same time learning skills that I will be able to use for a broad spectrum of fields later in life. I also learned a lot about my colleague's cultures, as some of them are foreign-born and there is always time to talk when waiting for measurements and tests to finish. I plan on recommending this program to everyone I know!"* --HSAP apprentice

"The [**URAP**] *program is valuable because it gives students the opportunity to gain research experience and receive financial compensation. The project I worked on was interesting, and I was able to learn about STEM and research from other members of the lab."* --URAP apprentice

"The **Unite** *program was an excellent opportunity not only to teach and introduce young students into the world of STEM and it's many opportunities. But also as a learning experience as a classroom assistant and educator to better approach students. Truly, an excellent experience both for students and teachers/instructors."* --Unite Mentor

"I feel much more confident and sure of pursuing a possible career using what I learned in [**Unite**]. *I would like to thank you for giving me the chance to be able to experience one of the best learning adventures of my life."* --Unite Student

"I greatly enjoyed having the opportunity to present my research in a formal setting and learning about the research that other students and professionals are doing." -- **JSHS** Student

*"***JSHS** *is the highlight of our year and the event our students look forward to more than any other. It is a high quality experience that has helped me build a strong research program in both middle and high school. We are very satisfied and look forward to continuing to engage in the future."* --JSHS Mentor

"Incredibly unique opportunity- [**eCM**] *was an amazing project which I plan to take in with me in my high school years as a baseline for my continued years of education in the STEM fields. I also gained/used creativity and leadership which are lifelong skills to have always."* -- eCM Student

"My kids had a blast doing **JSS***. This was the first time we competed in this event. My students failed miserably in our district event and that was the best part. They were very eager to get back to school and start working on solutions to problems they experienced…We will definitely continue competing in* **JSS***."* --JSS Mentor

"**GEMS** *was an excellent program which helped me discover more occupations I might be interested in. I experienced genuine hands-on experiments using professional equipment and procedures.* GEMS *helped me appreciate science more by exposing me to areas of open research and study."* --GEMS Student

"**GEMS** *has ignited my love and passion for science."* --GEMS Student

"[*In* **GEMS**,] *I get to interact with the young minds of the future. They're going to be our future scientists, our future engineers, doctors, lawyers…I get to interact with them and give them a military perspective of how we've gotten better as a whole because of technology."* --GEMS Mentor

Recommendations

1. **Increase and broaden participation in selected AEOP programs.** Overall enrollment in AEOP programs decreased by 7,066 in FY16 representing a total decrease of over 10,000 participants in the past two years (FY16, FY15). Most of the decline can be attributed to eCM, the largest AEOP program, in which enrollment declined by over 7,000 students. More effort should be invested into programs such as eCM, JSHS, and JSS that have the ability to grow within current funding structure. As suggested in FY15, a more concerted marketing campaign should be implemented for these programs. JSHS and JSS have the capacity to accept more

participants but are geographically constrained and distance to events may prohibit students in some communities from participating. JSHS and JSS should explore means of innovating the delivery of their programming at the regional level through the use of synchronous or asynchronous technologies.

An examination of the AEOP portfolio overall reveals that there was some growth in the participation of underserved and underrepresented groups in FY16. Female participation increased in six programs (CQL, HSAP, JSS, SEAP, Unite, URAP). Additionally, students from racial/ethnic minorities (including Asian students) in all programs increased with the exception of Unite. It is recommended that the AEOPs continue to focus on recruiting students from underserved and underrepresented groups in FY17, as there remains much room for growth across the portfolio.

As was the case in FY15, our recommendation in FY16 is for site leads to continue to utilize the Cvent system for selecting participants for Army laboratory based programs (i.e. SEAP, CQL) to protect the competitiveness of securing coveted spots in highly popular apprentice programs with low placement rates.

2. **Examine more closely the mentoring relationships within CQL, SEAP, URAP, and Unite in FY17 to determine why there was a decrease in reported satisfaction in FY16.** There was a decrease in the apprentice satisfaction with mentors in FY16. This, coupled with the FY15 findings of lack of use of effective mentoring strategies, may reveal that more attention should be directed toward mentor effectiveness and quality/quantity of mentor/apprentice interactions.

3. **Improve marketing and grow awareness of AEOP.** Overall interest in participating in other AEOPs remained strong in FY16. However, participant knowledge of other AEOPs and marketing of the AEOP portfolio across AEOPs could be improved. It is clear from the FY15 and FY16 evaluations that efforts to expose participants to the various programs within the portfolio, including distributing the AEOP brochure and using AEOP program websites and the AEOP website, are not adequate. It is recommended that in FY17 (as recommended in FY15 as well) Battelle Memorial Institute (the LO) work in concert with Widmeyer and individual programs in the consortium to develop program materials (i.e., AEOP slide deck, activities to be used within programs as part of program content) that will purposefully and collectively provide participants with a clear understanding of the AEOP program opportunities. The focus of the AEOP consortium should be on providing participants with an awareness of the pipeline of AEOP programs and should explicitly focus on providing details of each program, application procedures, timelines, and benefits of participation so that participants can make informed decisions about future participation. Furthermore, as in FY15, in FY16 mentors reported little knowledge of the AEOP portfolio. Similar efforts should be made to prepare mentors and program staff with a variety of easily accessible materials and information that can be readily shared with students and other adults.

4. **Raise awareness of Army/DoD STEM careers and research.** AEOP made progress in FY16 within the Army lab-based programs in exposing participants to Army/DoD STEM careers and research. It is recommended that IPAs work across the portfolio to share strategies that work for accomplishing this task. Specifically the competition

programs and STEM programs should work to grow exposure and experiences for participants in this area in FY17 through guest speakers and Army S&E participation as well as through the use of consortium level developed resources.

5. **Improve participation in AEOP evaluation activities.** Overall participation in the AEOP evaluation for FY16 was less than desirable. The FY16 AEOP evaluation included an analysis of participation in questionnaires, the primary data collection method. While youth participation in the evaluation questionnaire reached over 50% in most programs (eCM NJ&EE, GEMS, HSAP, REAP, SEAP, Unite) mentor completion of the questionnaire was significantly lower, ranging from 30% for URAP to 6% for SEAP. However, the overall participation rate improved, with 6,329 youth and adult participants out of 39,552 completing the questionnaire. IPAs should make a concerted effort to continue to encourage participation in the AEOP evaluation, with particular focus on improving adult response rates. As in FY15, it is recommended that all AEOP programs provide on-site (as applicable) time during the program for both participants and mentors to complete the program questionnaires. Furthermore, since the questionnaire is the primary means of information regarding the progress of AEOP each year, we recommend making participation mandatory for all participants in AEOP programs.

   In FY16 site visit data collection was also challenging. Some program schedules did not accommodate conducting focus groups after participation in the programs/competitions. Additionally, despite program efforts to recruit students and mentors for interviews and focus groups, participation has been less than desired. For FY17, programs should work with the evaluation team to determine what supports and incentives will make site visit data collection processes more successful.

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-undergraduate 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, providing a management structure that collectively markets the portfolio among members, leveraging available resources, and providing expertise to ensure the programs provide the greatest return on investment in achieving the Army's STEM priorities and objectives toward a STEM literate citizenry, STEM savvy educators, and sustainable infrastructure.

AEOP Priorities

Priority 1: STEM Literate Citizenry.

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

Priority 2: STEM Savvy Educators.

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

Priority 3: Sustainable Infrastructure.

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

2016 Portfolio Overview

This report includes a detailed evaluation of the FY16 AEOP activities. A summary of individual program level data is outlined in Table 1 below which includes applicant and participant data, numbers of Army and DoD S&Es, participating K-12 schools and colleges/universities, and collaborating organizations including Army and DoD laboratories. Overall participant data summarized for youth and adults by program is presented in Table 2. Partner participation is outlined in Table 3 including the numbers collaborating schools, both K-12 and college/universities, as well as Army and DoD laboratories and S&Es. Program costs are detailed in Table 4.

In FY16 AEOP initiatives served 39,036 participants, representing a decrease from FY15 (45,595). Overall participation in FY16 AEOP activities included 8,463 adults, including 1,287 Army S&Es and other adults serving in roles including mentors for research apprenticeships (CQL, REAP, SEAP, and URAP), judges for competitions (eCM, JSS, and JSHS), and presenters in STEM enrichment activities (GEMS and Unite) as well as in Army/DoD STEM showcases at competitions (eCM and JSHS). There was a slight decrease in adult participants for the AEOP in FY16 as compared to FY15 (9,152 in FY15).

Table 1. 2016 AEOP Initiatives	
Camp Invention Initiative (CII) **Program Administrator: U.S. Army Corps of Engineers – Engineering Research & Development Center (ERDC)**	
Description	STEM Enrichment activity for K-6 students at selected host elementary sites near GEMS sites.
Number of Students	1,185
Number of Teachers, Volunteers, and other Adults	202
Number of Sites	16
Number of Army Research Laboratories	10
Total Cost	$271,564
Cost Per Student Participant	$229
College Qualified Leaders (CQL) **Program Administrator: Academy of Applied Science (AAS)**	
Description	STEM Apprenticeship Program – Summer or school year, at Army laboratories with Army S&E mentors
Participant Population	College undergraduate students
Number of Applicants	467
Number of Students (Apprentices)	236
Placement Rate	51%
Number of Mentors (Army S&Es and other adult mentors)	162
Number of Army Research Laboratories	11[†]
Number of Colleges/Universities	112
Number of HBCU/MIs	4
Total Cost	$2,360,394
Stipend Cost (Paid by participating Army laboratories)	$2,235,418
Administrative Cost to AAS	$124,976
Cost Per Student Participant	$10,002
eCYBERMISSION (eCM) **Program Administrator: National Science Teachers Association (NSTA)**	
Description	STEM Competition - Nationwide (including DoDEA schools), web-based, one national event
Participant Population	6th-9th grade students
Number of Applicants/Students	23,323 students registered; 20,607 State, 216 Regional Participants (of whom 86 were selected to attend the NJ&EE) with a total of 15,710 that submitted completed folders
Placement Rate	N/A (all students who register may participate
Submission Completion Rate	76.2%
Number of Adults (Team Advisors and Volunteers – incl. S&Es and Teachers)	3,389
Number of Team Advisors (Predominantly math and science teachers)	802
Number Volunteers (Ambassadors, Cyberguides, Virtual	2,047

Judges)	
Number of Army S&Es	540
Number of Army/DoD Research Laboratories	37
Number of K-12 Teachers (Team Advisors, including pre-service teachers)	727
Number of K-12 Schools	547
Number of K-12 Schools – Title I	294
Number of Colleges/Universities	153
Number of DoDEA Students	417
Number of DoDEA Teachers	21
Number of DoDEA Schools	15
Number of Other Collaborating Organizations	19
Total Cost	$3,038,180
Materials and Supplies	$187,233
Scholarships/Awards Cost	$747,194
Travel	$61,983
STEM Research Kits Cost	$168,435
Cost of National Event (NJ&EE)	$335,599
Administrative Cost to NSTA	$950,234
Cost Per Student Participant	$147
Gains in the Education of Mathematics & Science (GEMS) **Program Administrator: National Science Teachers Association (NSTA)**	
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	4,414
Number of Students	2,427
Placement Rate	55%
Total number of Adults	345
Number of Near-Peer Mentors	100
Number of Army S&Es	215
Number of Army Research Laboratories	14
Total number of K-12 Teachers	30
Total number of K-12 Schools	907
Number of K-12 Schools – Title I	230
Number of Colleges/Universities	50
Number of DoDEA Students	26
Number of DoDEA Teachers	6
Number of DoDEA Schools	5
Total Cost	$1,010,121
Participant Stipends (Students, NPMs, and RTs)	$706,411
Supplies/Equipment/Transportation	$144,031
Administrative Cost	$159,679

Cost Per Student Participant	$416
High School Apprenticeship Program (HSAP) **Program Administrator: Academy of Applied Science (AAS) and Army Research Office (ARO)**	
Description	STEM Apprenticeship Program – Summer, in Army-funded laboratories at colleges/universities nationwide, with college/university S&E mentors
Participant Population	11th-12th grade students
Number of Applicants	363
Number of Students (Apprentices)	65
Placement Rate	18%
Number of Adults (Mentors)	42
Number of College/University S&Es	42
Number of K-12 Schools	53
Number of Army-Funded College/University Laboratories	35
Number of College/Universities	35
Number of HBCU/MSIs	16
Total Cost	$235,746
Stipend Cost	$180,876
Cost Per Student Participant	$3,627
Junior Science & Humanities Symposium (JSHS) **Program Administrator: Academy of Applied Science (AAS)**	
Description	STEM Competition - Nationwide (incl. DoDEA schools), research symposium that includes 47 regional events and one national event
Participant Population	9th-12th grade students
Number of Applicants	8,900 students and 970 teachers
Number of Students	5,300 students competed in JSHS Regional and National
Placement Rate	60%
Number of Adults (Mentors, Regional Directors, Volunteers – incl. Teachers and S&Es)	3,214 + Mentors for students would increase total to >8,000
Number of Army and DoD S&Es	234
Number of Army/DoD Research Laboratories	56
Number of K-12 Teachers	970
Number of K-12 Schools	1,060
Number of K-12 Schools – Title I	196
Number of DoDEA Teachers	30
Number of DoDEA Students	45
Number College/University Personnel	1,979
Number of Colleges/Universities	120
Number of Other Collaborating Organizations	189
Total Cost	$1,879,713
Cost of Regional Symposia Support	$730,790
Cost of National Symposium	$386,240

Administrative Cost to AAS	$238,667 plus overhead
Cost of Scholarships/Awards	$403,000
Cost per Student Participant	$354
Junior Solar Sprint (JSS) **Program Administrator: Technology Student Association (TSA)**	
Description	STEM Competition - Solar car competition regional events at 3 Army laboratories and at 17 TSA state events, 1 national event hosted in conjunction with the TSA national conference
Participant Population	5th-8th grade students
Number of Applicants/Students	585
Placement Rate	N/A (all students who register are participants)
Number of Adults (Mentors and Volunteers – incl. Teachers and Army S&Es)	222
Number of Army S&Es	5
Number of Army/DoD Research Laboratories	32
Number of K-12 Schools	609
Number of K-12 Schools – Title I	61 (17 did not report)
Number of Other Collaborating Organizations	2 Army Research Labs – APG, ARDEC
Total Cost	$174,752
Scholarships/Awards Cost	$12,401
Administrative Cost to TSA	$162,351
Cost Per Student Participant	$223
Research & Engineering Apprenticeship Program (REAP) **Program Administrator: Academy of Applied Science (AAS)**	
Description	STEM Apprenticeship Program – Summer, at colleges/university laboratories, targeting students from groups historically underserved and underrepresented in STEM, college/university S&E mentors
Participant Population	Rising 10th, 11th, and 12th grade high school students, rising first-year college students from groups historically underserved and underrepresented in STEM
Number of Applicants	487
Number of Students (Apprentices)	120
Placement Rate	25%
Number of Adults (Mentors)	121
Number of College/Universities	42
Number of HBCU/MSIs	19
Total Cost	$388,217
Stipend Cost	$250,350
Administrative Cost to AAS	$137,880
Cost Per Student Participant	$3,235
Research Experiences for STEM Educators and Teachers (RESET) **Program Administrator: Tennessee Technological University (TTU)**	

Description	RESET provides a summer research experience at participating Army Laboratories and on-line for teachers and educators from "high need" areas across the nation. The goal is to reinforce teachers' content knowledge through research experiences and interactions with Army and DoD scientists and engineers and to support teacher participants as they translate this knowledge and experience into enhanced STEM research curricula for use in their classroom.
Participant Population	Middle school and high school STEM educators
Number of Applicants/Teachers	24 full, 1 partial
Number of RESET participants	20
Placement Rate (percentage)	20/24 = 83%
Submission Completion Rate	20 of 20 for Level I and Level II, Module 1; 6 of 6 for Level II; 18 of 20 for Level I and Level II, Module 2
Number of Army S&Es	6
Number of Army/DoD Research Laboratories	3
Number of K–12 Teachers	20
Number of K–12 Schools	20
Number of K–12 Schools — Title I	16
Number of Colleges/Universities	1
Number of Other Collaborating Organizations	5
Total Cost	$133,048
Cost Per Student Participant – total cost/# of student participants	$6,652
Science & Engineering Apprentice Program (SEAP) **Program Administrator: Academy for Applied Science (AAS)**	
Description	STEM Apprenticeship Program – Summer, at Army laboratories with Army S&E mentors
Participant Population	9th-12th grade students
Number of Applicants	690
Number of Students (Apprentices)	113
Placement Rate	16%
Number of Adults (Mentors)	113
Number of Army S&Es	113
Number of Army Research Laboratories	10
Number of K-12 Schools	71
Number of K-12 Schools – Title I	11
Total Cost	$379,998
Stipend Cost (Paid by participating Labs)	$320,157
Administrative Cost to AAS	$59,841
Cost Per Student Participant	$3,363
Unite **Program Administrator: Technology Student Association (TSA)**	

Description	STEM Enrichment Activity - Pre-collegiate, engineering summer program at university host sites, targeting students from groups historically underserved and underrepresented in STEM
Participant Population	Rising 9th – 12th grade students from groups historically underserved and underrepresented in STEM
Number of Applicants	685
Number of Students (Apprentices)	282
Placement Rate	41%
Number of Adults	285
Number of Army S&Es	18
Number of Army Agencies	6
Number of K-12 Teachers	37
Number of K-12 Schools	220
Number of K-12 Schools – Title I‡	98
Number of Colleges/Universities	16
Number of HBCU/MSIs	12
Total Cost	$560,682
Stipend Cost	$86,300
Administrative Cost to TSA	$71,620
Cost Per Student Participant	$1,988
Undergraduate Research Apprenticeship Program (URAP) **Program Administrator: Academy of Applied Science (AAS) and Army Research Office (ARO)**	
Description	STEM Apprenticeship Program – Summer, in Army-funded labs at colleges/universities nationwide, with college/university S&E mentors
Participant Population	College undergraduate students
Number of Applicants	177
Number of Students (Apprentices)	52
Placement Rate	29%
Number of Adults (Mentors)	46
Number of College/University S&Es	46
Number of Army-Funded College/University Laboratories	39
Number of College/Universities	39
Number of HBCU/MSIs	14
Total Cost	$202,703
Admin/Overhead Costs (Host Sites)	$49,303
Stipend Cost	$153,400
Cost Per Student Participant	$3,898

† *College/universities or Army/DoD Research Laboratories served as host sites for the AEOP element.*

‡ *Data from Unite reflects the number of participants from Title I schools rather than the number of Title I schools.*

AEOP participation numbers by individual program are presented in Table 2. There were 30,972 youth and 8,463 adult participants captured in 2016 AEOP activities, of which, 488 students and 57 teachers were from DoDEA schools (participating in eCM, GEMS, and JSHS). The majority of adults, including Army S&Es and K-12 teachers, volunteered with the eCM and JSHS STEM competitions as mentors, advisors, and judges. Three programs increased their participation of youth and/or mentors (CQL, GEMS, and HSAP) while other program participation remained steady or experienced slight declines.

Table 2. 2016 AEOP Participation Numbers

		Youth	Adults
CII	Camp Invention Initiative	1,185	104
CQL	College Qualified Leaders	236	162
eCM	eCYBERMISSION	20,607	3,389
GEMS	Gains in the Education of Mathematics & Science	2,428	345
HSAP	High School Apprenticeship Program	65	42
JSHS	Junior Science & Humanities Symposium	5,300	3,214
JSS	Junior Solar Sprint	585	222
REAP	Research & Engineering Apprenticeship Program	120	121
RESET	Research Experiences for STEM Educators and Teachers	N/A	20
SEAP	Science & Engineering Apprentice Program	113	113
Unite	Unite	282	685
URAP	Undergraduate Research Apprenticeship Program	52	46
	Total 2016 AEOP Participants	**30,972**	**8,463**

Partnerships are key to the success of the AEOP portfolio. In FY16, there was strong involvement of adult mentors, judges, and presenters within AEOP apprenticeship, competitions, and STEM programs across the country, with adults serving in these roles coming from DoD/Army laboratories, K-12 schools, and college/universities. In 2016, 1,282 of the 8,463 adults who participated in AEOP were Army and DoD S&Es who served in the important roles of mentor to student apprentices through the SEAP and CQL programs (275 S&Es); judges for the eCM, JSHS, and JSS competitions (779 S&Es); and presenters at the GEMS and Unite programs (226 S&Es). In FY16, five of the 11 AEOP initiatives (GEMS, JSS, SEAP, RESET and CQL) took place at Army laboratories. There were 88 college/university S&E's that mentored HSAP/URAP apprentices in 74 Army-funded laboratories at colleges/universities. A longstanding pillar of the AEOP portfolio is the leveraging of Army and DoD S&Es and Army and DoD laboratories, which places the AEOP in a class of its own compared to other STEM outreach initiatives.

In FY16 AEOP K-12 engagement was strong and represented a broad array of participants from around the globe. Youth and teachers representing 3,607 K-12 schools (of which 978 have Title I recognition) comprised the diverse registration base of FY16 AEOP participants. K-12 teachers are critical to the success of both the eCM and JSHS competitions, often engaging entire classrooms of students in the programs and serving as team advisors or mentors. In 2016, 727 K-12 teachers participated in eCM and 970 K-12 teachers participated in JSHS.

College/university S&Es, students, and other staff comprised the third group of collaborators for the 2015 AEOP programming. Colleges/universities across the U.S. are host sites for JSHS regional symposia (47), the Unite summer program (16), and both HSAP (35) and URAP (39) apprenticeship programs. The AEOP engaged with 557 colleges/universities in 2016, including 69 HBCU/MSIs.

Table 3. Number of 2016 Collaborating Schools, Laboratories, Army/DoD S&Es, and Other Organizations

AEOP Program	K-12 Schools		Colleges/Universities (represented by participants or serving as host sites)		Army and DoD Research Laboratories/ Army Agencies	Army-Funded University Laboratories	Army and DoD Scientists & Engineers (S&Es)	Other Collaborating Organizations
	Total	Title I	Total	HBCU/MIs				
Camp Invention (CII)*	16	14	NA†	NA†	10	NA†	NA†	NA†
College Qualified Leaders (CQL)	NA†	NA†	112	4	11	NA†	162	NA†
eCYBERMISSION (eCM)	547	294	153	___§	37	NA†	540	19
Gains in the Education of Mathematics and Science (GEMS)	907	230	50	4	14	NA†	215	NA†
High School Apprenticeship Program (HSAP)	53	13	35	16	NA†	35	NA††	NA†
Junior Science and Humanities Symposium (JSHS)	1,060	196	120	___§	56	NA†	234	189
Junior Solar Sprint (JSS)	609	61	NA†	NA†	2	NA†	5	2
Research and Engineering Apprenticeship Program (REAP)	104	45	42	19	NA†	NA†	NA†	NA†
Research Experiences for STEM Educators (RESET)	20	16	1	0	3	NA	6	5
Science and Engineering Apprentice Program (SEAP)	71	11	NA†	NA†	10	NA†	113	NA†
Unite	220	98‡	16	12	11	NA†	18	10
University Research Apprenticeship Program (URAP)	NA†	NA†	39	14	NA†	39	NA††	NA††
Total Sites	**3,607**	**978**	**568**	**69**	**155**	**74**	**1,287**	**225**

§ *Data not available.* † *Does not apply.*

** Camp Invention Initiative (CII) was not part of program evaluations in 2016.*

Associated costs for the implementation of the FY16 AEOP portfolio of programs are detailed in Table 4. The portfolio is broken into three categories of programming: competitions, programs, and apprenticeships. The cost of 2016 AEOP competitions ranged from $147 per student (eCM) to $354 per student (JSHS). The cost of STEM enrichment programs ranged from $364 per student for GEMS, typically a 1-week summer STEM experience in the Army labs, to $1,988 for Unite, a 4-6 week summer STEM experience for students from historically underserved and underrepresented groups. The cost of the AEOP summer apprenticeship programs ranged from $3,235 per apprentice (REAP) to $10,002 per apprentice (CQL). The higher cost of CQL reflects the longer duration of the program, which may take place in the summer or through portions of the academic year (sometimes lasting the entire year).

As in FY14 and FY15, the apprenticeship programs had the highest cost per participant while the competitions were the least costly of the AEOP elements on a per student basis for FY16. The variation in costs between programs is largely due to the cost of participant stipends, which are dependent upon the educational level of the student and duration of the program. Several programs appeared to be more efficient in FY16 than in FY15 based upon their slightly lower cost per student participant in FY16 (CQL, REAP, SEAP and Unite). Other programs experienced increases in cost per student participant ranging from 2% for GEMS to 35% for eCM.

Table 4. 2016 AEOP Costs

	Program Type	Program Cost	Cost Per Participant	Average Stipend Per Participant
CII	STEM Enrichment Program (grades K-6)	$266,625	$225	NA
CQL	STEM Apprenticeship Program (undergraduate/graduate)	$2,360,394	$10,002	$9,472
eCM	STEM Competition (grades 6-9)	$3,038,180	$147	NA†
GEMS	STEM Enrichment Program (grades 5-12)	$1,040,482	$429	$100
HSAP	STEM Apprenticeship Program (grades 9-12)	$235,746	$3,627	$2,783
JSHS	STEM Competition (grades 9-12)	$1,879,713	$354	NA†
JSS	STEM Competition (grades 5-8)	$174,752	$223	NA†
REAP	STEM Apprenticeship Program (grades 9-12)	$388,217	$3,235	$1,500
RESET	STEM Educator Program	$133,048	$6,652	Varies by level
SEAP	STEM Apprenticeship Program (grades 9-12)	$379,998	$3,363	$2,833
Unite	STEM Enrichment Program (grades 9-12)	$560,682	$1,988	$306
URAP	STEM Apprenticeship Program (undergraduate)	$202,703	$3,898	$2,950

† *Participants in AEOP competitions are not eligible for stipends.*

Evaluation Strategy

The 2016 AEOP portfolio evaluation was conducted by Purdue University, the lead for AEOP evaluation, 2015-2025. The evaluation was comprised of a two-pronged strategy. The first and primary focus of the evaluation was to assess current program year effectiveness for each of the eleven AEOP elements including: CQL, eCM, GEMS, HSAP, JSHS, JSS, REAP, RESET, SEAP, Unite, and URAP. The secondary focus of the evaluation in FY16 was the first year of the long-term alumni study. This component includes an examination of the mid to long-term outcomes of the AEOP.

The evaluation team conducted all data collection for FY16 including questionnaire data for programs and alumni, site visits for selected programs, and focus group/individual interviews with selected program participants (both current and alumni). Purdue University conducted all data analysis and prepared all AEOP FY16 evaluation reports with the exception of the Camp Invention Initiative (CII). Purdue University assessed and evaluated eleven of the AEOP elements in collaboration with AEOP CA consortium members,[1] individual program administrators (IPAs), the Army Cooperative Agreement Managers (CAMs), and personnel responsible for implementing programs at specific sites (Command Level Coordinators, Lab Coordinators, Regional Directors, etc.). The 2016 AEOP evaluation was standardized across all programs with the exception of RESET to allow for the reporting of consistent information about program quality and impacts. Because FY16 was the first year of RESET program operation a formative approach, consisting of interviews with participants and information provided by the IPA, was utilized to evaluate the first year of the program. Elements of the data available through Camp Invention that were aligned with the overall AEOP portfolio evaluation are included for reference in this report.

[1] The 2015 AEOP CA consortium members included the Academy of Applied Science (AAS; JSHS, REAP), the American Society for Engineering Education (ASEE; GEMS, SEAP, CQL), the Technology Student Association (TSA; JSS, Unite), the National Science Teachers Association (NSTA: eCM), the University of New Hampshire (Science Teacher Program Initiative), and Virginia Tech (Lead Organization). HSAP and URAP are managed by the Army Research Office (ARO). The West Point Bridge Design Competition (WPBDC) was removed from the 2015 AEOP as the result of a mutual agreement between the PI of WPBDC and AEOP leadership. WPBDC has evolved in a way that its goals and objectives no longer aligned with those of the AEOP.

Table 5. AEOP Priorities and Objectives (2016)
PRIORITY ONE: STEM Literate Citizenry
Broaden, deepen, and diversify the pool of STEM talent in support of our Defense Industry Base.
Objectives
• Encourage and reward student participation in STEM opportunities.
• Inspire students to excel in science and mathematics.
• Increase participation of underserved populations in the AEOP.
• Expand the involvement of students in ongoing DoD research.
• Increase awareness of DoD STEM career opportunities.
PRIORITY TWO: STEM "Savvy" Educators
Support and empower educators with unique Army research and technology resources.
Objectives
• Partner with schools and teachers at local and state educational agencies for shared standards in science and mathematics.
• Use incentives to promote teacher participation in the AEOP.
• Provide online resources for educators to share best practices.
• Provide and expand mentor capacity of the Army's highly qualified scientists and engineers.
PRIORITY THREE: Sustainable Infrastructure
Develop and implement a cohesive, coordinated, and sustainable STEM education outreach infrastructure across the Army.
Objectives
• Develop and implement cohesive program metrics for each individual program and across all of the AEOP.
• Provide STEM educational opportunities for students at all stages of their K-12 education.
• Integrate programs in a central branding scheme, inclusive of a centralized website, for a strategic and comprehensive marketing strategy.
• Establish a competitive process for funding new STEM investments that align to the overall program strategy.

The 2016 evaluation was informed by AEOP objectives[2] (established in 2012) and by the objectives of individual AEOP elements. The evaluation studies were carried out using a logic model that proposes a pathway of influence for the AEOP, ultimately linking AEOP inputs and activities to intended outcomes that align with AEOP priorities and objectives as well as federal requirements for reporting on federal STEM investments. The logic model provides a framework for the near- and mid to long-term AEOP evaluation plan, ensuring that evaluation questions yield information that is valuable to the AEOP and that evaluation assessments include appropriate measures of intended outputs and outcomes that align with the AEOP's priorities and objectives and federal requirements. In 2016, the AEOP evaluation study focused predominantly on assessing the quality of current AEOP programs (near term). Additionally, in FY16 a longitudinal study of AEOP alumni began and findings regarding mid to long term impacts is also included in this report. Thus, data collection included questions about the benefits of participation to participants, program strengths and challenges, and overall effectiveness in meeting AEOP and program objectives. In addition, each program evaluation noted which recommendations from previous evaluations had been implemented (evidence-based change). Figure 1 provides a simple graphic depiction of the AEOP Evaluation logic model.

[2] The AEOP priorities and objectives have been updated for 2015 to include the addition of 1-f: Increase participants' awareness of AEOP's pipeline of opportunities; and 2-g: Increase educators' awareness of AEOP pipeline of opportunities.

Figure 1. AEOP Evaluation Logic Model

Inputs	Activities	Outputs	Outcomes (Near-term)	Impact (Mid- and Long-Term)
• US Army sponsorship • Broad roster of AEOP initiatives available for student engagement • IPAs providing coordination and oversight of programs • Operations conducted at Army/DoD research facilities, universities, schools, and local/regional and national competitions • Army/DoD and university S&Es, local and DoDEA/DoDDS educators, and other volunteers serving as STEM "mentors" • Online and on-site curricular resources • Stipends and awards for students and educator participants • Centralized branding and comprehensive marketing • Centralized evaluation and annual reporting	• Engagement in "authentic" STEM experiences through: • Curriculum-driven summer programs at Army research institutions and universities • Summer and academic year apprenticeship programs at Army research institutions and universities • Local/regional and national STEM competitions	• Increasing numbers and diversity of student participants • Increasing numbers and diversity of mentor participants • Increasing numbers and diversity of Army/DoD scientists and engineers engaged in programs • Increasing numbers of K-college schools served through participant engagement • Increasing number of curricular resources distributed through websites and program participation • Students, mentors, site coordinators, and IPAs contributing to evaluation	• Increased student interest and engagement in STEM (formal and informal) • Increased participant STEM skills, knowledge, abilities, and confidence • Increased participant knowledge of other AEOP opportunities • Increased participant knowledge of Army/DoD STEM research and careers • Implementation of evidence-based recommendations to improve programs	• Increased student participation in other AEOP opportunities and DoD scholarship/ fellowship programs • Increased student interest in and pursuit of STEM coursework in secondary and post-secondary schooling • Increased student interest in and pursuit of STEM degrees • Increased student interest in and pursuit of STEM careers • Increased student interest in and pursuit of Army/DoD STEM careers • Continuous improvement and sustainability of the AEOP

The 2016 AEOP near-term evaluation plan is summarized by program in Table 6. In short, most evaluations utilized participant questionnaires, as well as focus groups or interviews with the youth population (herein called students and apprentices) and adult participants who led educational activities or supervised research (herein called mentors).

Table 6. 2016 Near-Term AEOP Evaluation Strategy

AEOP Element	Assessment Tools	Program-Level Objectives
CQL	Program Evaluation: • Apprentice questionnaire • Mentor questionnaire • Apprentice focus groups • Mentor focus groups	• To nurture interest and provide research experience in STEM for college students. • To provide opportunities for continued association with the DoD laboratories and STEM enrichment of previous SEAP, GEMS, and other AEOP program participants as well as allow new college students the opportunity to engage with DoD laboratories. • To outreach to participants inclusive of youth from groups historically underrepresented and underserved in STEM. • To increase participant knowledge in targeted STEM areas and develop their research and laboratory skills as evidenced by mentor evaluation and the completion of presentations of research (poster, paper, oral presentation, etc.). • To educate participants about careers in STEM fields with a particular focus on STEM careers in DoD laboratories. • To acquaint participants with the activities of DoD laboratories in a way that encourages a positive image and supportive attitude towards our defense community. • To provide information to participants about opportunities for STEM enrichment and ways they can mentor younger STEM students through GEMS, eCYBERMISSION, and other AEOP opportunities.
eCM	Program Evaluation: • Student questionnaire • Mentor questionnaire • Student focus groups • Mentor focus group • NJ&EE observation	• Increase number of student and Team Advisor registrants and folder submissions. • Increase the number of participants from Title I schools. • Increase the number of volunteers and Army volunteers. • Increase Team Advisor retention rate and implement programs to exceed our target rate. • Increase number of classroom integrated programs. • Increase number of students from DoDEA schools. • Increase participants' awareness of other AEOP and DoD STEM opportunities and Army/DoD technologies and increase student interest in STEM learning and pursuit of STEM-related degrees.
GEMS	Program Evaluation: • Student questionnaire	• To nurture interest and excitement in STEM for middle and high school participants.

	• Mentor questionnaire • Student focus groups • Mentor focus groups • Site observations	• To nurture interest and excitement in STEM for mentor participants. • To implement STEM enrichment experiences through hands-on, inquiry-based educational modules that enhance in-school learning. • To increase participant knowledge in targeted STEM areas and laboratory skills. • To increase the number of outreach participants inclusive of youth from groups historically underrepresented and underserved in STEM. • To encourage participants to pursue secondary and post-secondary education in STEM. • To educate participants about careers in STEM fields with a particular focus on STEM careers in Army laboratories. • To provide information to participants about opportunities for STEM enrichment through advancing levels of GEMS as well as other AEOP initiatives.
HSAP	Program Evaluation: • Apprentice questionnaire • Mentor questionnaire • Apprentice interviews • Mentor focus group	• Expand apprenticeship opportunities for underserved populations in cooperation with HBCUs/MSIs and other affinity groups, and in cooperation with recruitment objectives of LPCs by disseminating program information to a broader and a more diverse audience. • Expand cross marketing and outreach of apprenticeship programs to include other AEOP programs to mentors and LPCs. • Encourage apprentices to continue pursuit of AEOP STEM/Army STEM careers • Encourage more students already in the AEOP pipeline to continue with an apprenticeship program • Increase participant's knowledge of other AEOP programs and STEM careers • Improve the overall participant and mentor apprenticeship experience.
JSHS	Regional Symposia Evaluation: • Student questionnaire • Mentor questionnaire • Student focus groups • Mentor focus groups National Symposium Evaluation: • Student questionnaire • Mentor questionnaire[3]	• To promote research and experimentation in STEM at the high school level. • To recognize the significance of research in human affairs and the importance of humane and ethical principles in the application of research results. • To search out talented youth and their teachers, recognize their accomplishments at symposia, and encourage their continued interest and participation in the sciences, mathematics, and engineering.

[3] A single mentor questionnaire was administered to all mentors, regardless of whether their student was selected for the National Symposium.

	• Student focus groups • Mentor focus group	• To recognize innovative and independent research projects of youth in regional and national symposia. • To expose students to academic and career opportunities in STEM and to the skills required for successful pursuit of STEM. • To expose students to STEM careers in Army and/or DoD laboratories. • To increase the future pool of talent capable of contributing to the nation's scientific and technological workforce.
JSS	Program Evaluation: • Student questionnaire • Mentor questionnaire • Student focus groups • Mentor focus groups	• Increase outreach to populations that are historically underserved and underrepresented in STEM. • Increase participants' awareness of Army/DoD STEM careers. • Increase participants' awareness of other AEOP opportunities. • To create a national infrastructure to manage local, regional, and national JSS events and increase participation. • To enhance training opportunities and resources for teachers/mentors. • To coordinate tracking and evaluation opportunities for student and teacher participation in JSS. • To leverage AEOP through cross-program marketing efforts.
REAP	Program Evaluation: • Apprentice questionnaire • Mentor questionnaire • Mentor interviews • Apprentice interviews	• To provide high school students from groups historically underrepresented and underserved in STEM, including alumni of the AEOP's Unite program, with an authentic science and engineering research experience. • To introduce students to the Army's interest in science and engineering research and the associated opportunities offered through the AEOP. • To provide participants with mentorship from a scientists or engineer for professional and academic development purposes. • To develop participants' skills to prepare them for competitive entry into science and engineering undergraduate programs.
RESET	Program Evaluation: • Participant interviews	• To increase teacher knowledge and access to research • To create digital professional learning community (D-PLC) for educators and mentors to share best practices. • To prepare teacher participants to create Legacy Cycle lessons based on DoD research and careers.
SEAP	Program Evaluation: • Apprentice questionnaire • Mentor questionnaire • Apprentice interviews • Mentor interviews	• To acquaint qualified high school students with activities of DoD laboratories through summer research and engineering experiences. • To provide students with opportunities and exposure to scientific and engineering practices and personnel not

		available in their school environments. • To expose those students to DoD research and engineering activities and goals in a way that encourages a positive image and supportive attitude toward our defense community. • To establish a pool of students preparing for careers in science and engineering with a view toward potential government service. • To prepare these students to serve as positive role models for their peers thereby encouraging other high school students to take more science and math courses. • To involve a larger percentage of students from previously underrepresented segments of our population, such as women, African-Americans and Hispanics, in pursuing science and engineering careers.
Unite	Program Evaluation: • Student questionnaire • Mentor questionnaire • Student focus groups • Mentor focus groups	• To effectively show participants the real word applications of math and science. • To raise participant confidence in the ability to participate in engineering activities. • To inspire participants to consider engineering majors in college. • To remove social barriers and negative attitudes about engineering. • To promote collaboration and problem solving in a team environment. • To expose participants to STEM careers in the Army and DoD. • To increase the number of STEM graduates to fill the projected shortfall of scientists and engineers in national and DoD careers.
URAP	Program Evaluation: • Apprentice questionnaire • Mentor questionnaire • Apprentice interviews • Mentor interviews	• Expand apprenticeship opportunities for underserved populations in cooperation with HBCUs/MSIs and other affinity groups, and in cooperation with recruitment objectives of LPCs by disseminating program information to a broader and a more diverse audience. • Expand cross marketing and outreach of apprenticeship programs to include other AEOP programs to mentors and LPCs. • Encourage apprentices to continue pursuit of AEOP STEM/Army STEM careers • Encourage more students already in the AEOP pipeline to continue with an apprenticeship program • Increase participant's knowledge of other AEOP programs and STEM careers • Improve the overall participant and mentor apprenticeship experience.

Evaluation instruments were iteratively reviewed and revised by individual program administrators (IPAs), the Army Cooperative Agreement Managers (CAMs), and evaluators. All instruments were approved by Purdue University's Institutional Review Board (IRB) for the protection of human research subjects. Additional details about Purdue University's measures and sampling, data collection and analyses, and reporting and dissemination are provided in Appendix A.

Study Sample

The FY16 AEOP near-term evaluation included an analysis of participation in questionnaires, the primary data collection method. The response rate and associated margin of error at the 95% confidence level for each sample were computed (see Table 7). As was the case in FY15, most of the margins of error for individual programs do not fall within the acceptable range (2-5%). This can be partially attributed to the fact that random sampling is not used for participation in the surveys. The large margin of error can indicate potential for response bias (that those who chose to respond to the questionnaire may not be representative of the entire population) and, consequently, results from questionnaire data should be viewed as preliminary indicators of program quality and impact and not as conclusive. It is interesting to note that youth participant response rates (14% to 92%) are generally much higher than for mentors (6% to 30%).

Table 7. 2016 AEOP Program Participant Questionnaire Participation

Program	2016 Questionnaire	Sample	Population	Participation Rate	Margin of Error @ 95% Confidence[4]
CQL	Apprentice	95	236	40%	±7.79%
	Mentor	16	162	10%	±23.33%
eCM	Overall Participants	2,926	20,607	14%	±1.68%
	NJ&EE Participants	79	86	92%	±3.16%
	Team Advisor	82	802	10%	±10.26%
GEMS	Student	1,802	2,427	74%	±1.17%
	Mentor (incl. NPM, RT, S&Es)	28	345	8%	±17.8%
HSAP	Apprentice	36	65	55%	±10.9%
	Mentor	11	95	12%	±27.9
JSHS	Regional Symposia Student	455	5,260	9%	±4.39%
	National Symposium Student	111	233	48%	±6.75%
	Mentor	109	939	12%	±8.83%
JSS	Student	83	585	14%	±9.97%
	Mentor	39	249	16%	±14.44%
REAP	Apprentice	103	120	85%	±3.65%
	Mentor	32	121	26%	±14.92%
SEAP	Apprentice	75	113	66%	±6.6%

[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, there is a 95% likelihood that between 42% and 52% would have selected that answer. A 2-5% margin of error is generally acceptable at the 95% confidence level. Note that the margin of error assumes random sampling was used for selecting respondents.

	Mentor	7	113	6%	±36.0%
Unite	Student	164	282	58%	±5.0%
	Mentor	44	285	15%	±13.6%
URAP	Apprentice	18	52	35%	±19.0%
	Mentor	14	46	30%	±23.0%
Alumni Study		237	**2,415**	10%	±6.05%
Total AEOP Questionnaire Participation		**6,329**	**39,552**	16%	

Focus groups and/or interviews were conducted with participants and mentors from each of the programs. Purposive sampling was used for assembling diverse focus groups when larger populations were available at a site. Convenience sampling was employed when small numbers of participants were available at a site. In total, 347 students, apprentices, and mentors participated in focus groups and interviews in 2016. Interviews were conducted with 36 AEOP program individuals, while focus groups were conducted with 311 students, apprentices, and mentors. Table 8 summarizes focus group and interview participation.

Table 8. 2016 AEOP Program Participant Focus Group and Interview Participation

Program	2016 Focus Group and Interview	Focus Group Sample	Interview Sample
CQL	Apprentice	19	
	Mentor	12	
eCM	NJ&EE Student	28	
	NJ&EE Team Advisor	23	
GEMS	Student	24	
	Mentor	11	
HSAP	Apprentice		8
	Mentor	3	
JSHS	Regional and National Symposium Participants	88	
	Competition Advisor/Mentor	27	
JSS	Student	25	
	Mentor	4	1
REAP	Apprentice		10
	Mentor		3
SEAP	Apprentice	16	
	Mentor	10	
Unite	Student	19	
	Mentor	2	
URAP	Apprentice		8
	Mentor		6
Alumni Study			22
Total AEOP Focus Group/Interview Participation		**311**	**36**

The FY16 AEOP mid to long-term evaluation included a new alumni survey and alumni interviews. As part of the alumni evaluation, 22 telephone interviews were held with alumni of various programs in the AEOP portfolio. Of those interviewed, 9 were GEMS alumni, ranging from age 11 to 16; 2 had served as GEMS near-peer mentors (NPMs), including a college sophomore and a recent college graduate; 5 were alumni of JSHS and ranged from a high school senior to a student enrolled in a medical degree program; 2 were former Unite participants, both current high school juniors; 1 was a former REAP participant, currently a high school senior; and 5 were former CQL apprentices, ranging from a college sophomore to a current Ph.D. student. Only two students reported participating in more than one AEOP (1 participated in GEMS as a student and as a GEMS NPM, and 1 as a CQL apprentice and as a GEMS NPM) and none reported being currently enrolled in an AEOP. The alumni respondent profile is included in Table 9.

Table 9. 2016 Alumni Respondent Profile

Demographic Category	Questionnaire Respondents	
Gender (*n*=237)		
Female	136	57%
Male	97	41%
Choose not to report	4	2%
Race/Ethnicity (*n*=239)		
Asian	55	23%
Black or African American	39	16%
Hispanic or Latino	16	7%
Native American or Alaska Native	5	2%
Native Hawaiian or Other Pacific Islander	0	0%
White	110	46%
Other race or ethnicity (specify)[†]	14	6%
Program Year (*n*=237)		
2016	34	15%
2015	112	48%
2014	58	24%
2013	20	8%
2012	13	5%
High School Graduation Year (*n*=230)		
Before 2012	11	5%
2012	11	5%
2013	17	7%
2014	22	10%
2015	12	5%
2016	30	13%
2017	37	16%
2018	35	15%
2019	55	24%

Evaluation Findings

The FY16 AEOP evaluation findings are organized within the three AEOP priorities and associated research questions to provide insight into portfolio progress toward achieving the desired outcomes of the AEOP. The priorities and research questions for the near-term (annually) are found in Table 10 and the mid to long-term (multiple years) research questions are detailed in Table 11.

Table 10. AEOP Priorities and Near-Term Research Questions (2016)
PRIORITY ONE: STEM Literate Citizenry
Broaden, deepen, and diversify the pool of STEM talent in support of our Defense Industry Base.
Research Question #1 - To what extent do participants report growth in interest and engagement in STEM?
Research Question #2 - To what extent do participants report increased STEM competencies STEM skills, knowledge, abilities, and confidence?
Research Question #3 - To what extent do participants and mentors report increased participant interest in STEM research and careers?
Research Question #4 - To what extent do participants and mentors report increased awareness of and interest in Army/DoD STEM research and careers?
Research Question #5 - To what extent do participants report increased enrollment, achievement, and completion of STEM degree programs?
PRIORITY TWO: STEM "Savvy" Educators
Support and empower educators with unique Army research and technology resources.
Research Question #6 - What is the impact of Scientists and Engineers (S&E) Mentors on AEOP participants?
Research Question #7 - To what extent do teacher participants report increased use of new approaches to teaching research concepts within STEM practices, and infusion of careers?
PRIORITY THREE: Sustainable Infrastructure
Develop and implement a cohesive, coordinated, and sustainable STEM education outreach infrastructure across the Army.
Research Question #8 - To what extent do participants report growth in awareness of and/or interest in AEOP opportunities?

Table 11. AEOP Priorities and Mid to Long Term Research Questions (2016)
PRIORITY ONE: STEM Literate Citizenry
Broaden, deepen, and diversify the pool of STEM talent in support of our Defense Industry Base.
Research Question #1 - To what extent do alumni report positive, sustained interest and engagement in STEM?
Research Question #2 - To what extent do alumni report positive attitudes toward STEM, and particularly Army/DoD STEM?
Research Question #3 - To what extent do alumni report pursuit of and achievement in STEM courses in secondary school, post-secondary STEM degrees, STEM careers, and Army/DoD STEM careers?
Research Question #4 - To what extent do alumni report awareness of and interest in STEM research and careers overall and for the Army/DoD specifically?
Research Question #5 – To what extent do alumni report an increase in STEM career participation and success overall, as well as within the Army/DoD specifically?
PRIORITY TWO: STEM "Savvy" Educators
Support and empower educators with unique Army research and technology resources.
Research Question #6 - What is the impact of Scientists and Engineers (S&E) Mentors on AEOP alumni?
Research Question #7 – Are there measurable changes in teacher approaches to teaching research concepts within STEM practices, and careers after participation in AEOP (RESET)?
PRIORITY THREE: Sustainable Infrastructure
Develop and implement a cohesive, coordinated, and sustainable STEM education outreach infrastructure across the Army.
Research Question #8 - To what extent do alumni report increased awareness of and/or interest in AEOP opportunities?
Research Question #9 - To what extent do alumni report participation in an AEOP program multiple times, in other AEOP elements, or in other DoD workforce development programs?

Near-Term Evaluation – Findings for FY16 AEOPs

Priority One: STEM Literate Citizenry

Findings from the FY16 AEOP evaluation reveal progress toward achieving a STEM Literate Citizenry with some continued challenges. Major trends that support the achievement of this AEOP priority along with evidence from assessment data that inform the findings are presented below by associated research question(s).

Research Question #1 - To what extent do participants report growth in interest and engagement in STEM?

AEOPs continued to engage a strong pool of diverse future STEM talent – over 30,000 participants. In FY16 the AEOP provided outreach to 30,972 youth participants through its comprehensive portfolio of programs. This number represents a 19% overall decrease in number of participants compared to FY 15 (38,039) and a 26% decrease from FY14 (41,802). This downward trend in participation mirrors a downward trend in applications as evidenced by the fact that in FY16 16% fewer applications were received than in FY15 and 25% fewer applications were received than in FY14. The decline in enrollment numbers for FY16 can be largely attributed to decline in participation for eCM, the largest AEOP in terms of enrollment. Participation in eCM declined by over 7,000 students from FY15 to FY16, a decrease of 25%.

Similarly, participation in JSS declined from 891 participants in FY14 to 585 participants in FY16, representing a 34% drop in enrollment over this two-year period. While the AEOP apprenticeship portfolio experienced overall growth in applicants, there has been a slight downward trend in placement rates since FY14, with 27% of applicants placed in FY16, 33% in FY15, and 31% in FY14. High school apprenticeships (HSAP, REAP, and SEAP) served a larger proportion of students in FY16 (25% placement rate) as compared to the past two years (17% placement rate in each year). At the same time, placement in undergraduate apprenticeships (CQL and URAP) decreased markedly from 72% in FY15 to 45% in FY16. This is partially attributable, however, to a 40% increase in URAP applications from FY15 (107) to FY16 (177). Student STEM enrichment activities (GEMS and Unite) showed increases in enrollment over FY15 levels while acceptance rates remained relatively steady. In particular, Unite enrollment increased by 29%, bringing enrollment back to FY14 levels (282 participants in FY16 as compared to 200 in FY15 and 280 in FY14). GEMS experienced a 7% growth in enrollment since FY15 and 14% since FY14 (2,428 participants in FY16 as compared to 2,270 in FY15 and 2,095 in FY14). In sum, while there were some positive enrollment trends for FY16, there continues to be considerable unmet demand for AEOPs, with over 7,000 applicants who applied but were not accepted into programs.

The AEOP portfolio consisted of STEM programs designed to nurture students' STEM interests and aspirations throughout their educational careers. AEOPs include STEM competitions (eCM, JSHS, and JSS), STEM enrichment activities (CII, GEMS and Unite), and STEM apprenticeship programs (CQL, HSAP, REAP, SEAP, and URAP). The GEMS Near-Peer Mentors (NPM) program also provided professional development to undergraduate student scientists and engineers (S&Es)-in-training, who lead educational activities for youth in the GEMS program, and RESET provided professional development experiences for STEM educators by offering on-line learning and on-site research experiences.

More than 4,000 K-12 teachers and about 1,500 Army and DoD S&Es engaged in AEOP programs as participants, led educational activities, supervised research, or served as competition advisors, judges, event hosts or other volunteers. These data do not reflect others who may have been impacted within the organizations of those participating in the AEOP. These data also do not reflect the potentially broader and undetermined impact of AEOP's online educational resources made freely available through eCM and JSS, or those resources available to GEMS NPMs and GEMS resource teachers.

In FY16 the AEOP received over 37,000 applications to individual programs, indicating continued strong interest in AEOP opportunities. It is noteable, however, that however, that the 37,399 applications received in FY16 represents a 16% decrease from FY15 levels, when 44,632 applications were received and a 25% decrease as compared to the 49,686 applications received in in FY14. In spite of this downward trend in applications, there continues to be considerable unmet need across the AEOP programs. In FY16, 30,972 participants were selected for inclusion in programs. This represents a 21% decrease in number of participants from FY15 when 37,574 students and participants were selected and continues a downward trend in enrollment since FY14 when 41,802 applicants were accommodated. Registration data indicate that many AEOP programs were filled to capacity while others had capacity for more participants but were unable to fill slots due to interest, funding, or lack of adequate programmatic support (e.g., mentors, volunteers). 2016 AEOP student and apprentice application numbers and placement rates are detailed in Table 12. As in previous years, eCM continues to be the largest program in the AEOP portfolio in terms of the number of participants (enrolling more than 50% of the total number of AEOP participants). eCM is a web-based STEM competition for 6th-9th grade youth that

is open to all who meet registration qualifications with no enrollment cap at this time. JSS, another STEM competition, was similarly open to all those who met registration qualifications and included 585 participants in FY16, a decline from the 636 participants in FY15 and the 891 participants in FY14.

In FY16 there continued to be variations in placement rates across the AEOP apprenticeship programs, enrichment activities, and the JSHS competition. The 2015 apprenticeships (CQL, HSAP, REAP, SEAP, and URAP) continued to be competitive, with placement rates ranging from 16% (SEAP) to 51% (CQL). Overall, there were 2,184 applicants to apprenticeship programs in FY16, a slight increase from the 2,042 applicants in FY15. Of those applying for apprenticeships in FY16, 586 were selected for participation (a 27% placement rate), representing a decline from FY15 when 684 or 33% of students were selected for apprenticeships as compared to a 31% placement rate in FY14. High school apprenticeships (HSAP, REAP, and SEAP) were most competitive with a combined placement rate of only 25%, although this represents an increase over the 17% placement rate in FY15 and FY14. At the same time, placement in undergraduate apprenticeships (CQL and URAP) fell to 45%, a marked decrease from the 72% placement rate in FY15 and the 57% placement rate in FY14.

Acceptance into 2016 AEOP STEM enrichment activities (Unite and GEMS) continued to be competitive with 53% of student applicants accepted into these programs. Acceptance rates remained constant at FY15 levels for GEMS and Unite, however, with 55% and 41% of applicants being selected for these programs. As with apprenticeships, the AEOP is limited in the number of students it can accept to GEMS and Unite by availability of resources including funding, space, and staff. The JSHS competition is similarly restricted in the number of students that it can accept to participate in regional symposia. In 2016, 60% of JSHS regional applicants were accepted to compete, a rate comparable with previous years (62% in FY15 and 55% in FY14), however this means that over 3,500 potential participants were turned away.

Table 12. 2016 AEOP Number of Youth Applications and Placement Rates

		Youth Applicants	Youth Participants	Placement Rate
CI	STEM Enrichment Activity	1,185	1,185	NA[†]
CQL	STEM Apprenticeship Program (undergrad)	467	236	51%
eCM	STEM Competition	20,607	20,607	NA[†]
GEMS	STEM Enrichment Activity	4,414	2,428	55%
HSAP	STEM Apprenticeship Program (high school)	363	65	18%
JSHS	STEM Competition	8,900	5,300	60%
JSS	STEM Competition	609	585	NA[†]
REAP	STEM Apprenticeship Program (high school)	487	120	25%
RESET	STEM Educator Program	24	20	83%
SEAP	STEM Apprenticeship Program (high school)	690	113	16%
Unite	STEM Enrichment Activity	685	282	41%
URAP	STEM Apprenticeship Program (undergrad)	177	52	29%
	Total	**37,399**	**30,972**	**-**

[†] *In 2016, all youth who met registration requirements for CI, eCM and JSS were able to participate.*

The AEOP continued to emphasize participation of underserved and underrepresented groups in associated apprenticeship, competition, and enrichment programs and progress was made toward increasing the participation of these groups in most programs in FY16. Female participation increased over FY15 levels in 6 programs (CQL, HSAP, JSS, SEAP, Unite, and URAP) and stayed constant in GEMS while somewhat fewer females participated in eCM and JSHS. Participation of students identifying with racial/ethnic minority groups grew (including Asian participants) as compared to FY15 levels for every program except for Unite. CQL increased participation of females and JSS included more racial and/or ethnic minorities. The decrease in participation of racial/ethnic minorities in Unite is a cause for concern since this program is designed to target groups underserved and historically underrepresented in STEM.

Table 13 summarizes participant demographics collected through registration records and questionnaires in 2014, 2015, and 2016. These data indicate that 2016 AEOP programs served participants identifying with groups that are historically underserved and underrepresented in STEM. Participation by females, a group historically underrepresented in STEM, increased from 2015 levels in several programs including CQL (40% in FY15, 44% in FY16), HSAP, (40% in FY15, 47% in FY15), SEAP (45% in FY15, 60% in FY16), Unite (45% in FY15, 52% in FY16), and JSS (27% in FY15, 38% in FY16). Likewise, participation by racial/ethnic minorities increased in 2016 for all programs for which comparison data is available with the exception of Unite (94% in FY15, 88% in FY16). Notably, CQL racial/ethnic minority participation increased from 13% in FY15 to 26% in FY16, the HSAP program saw an increase from 29% racial/ethnic minority participation in FY15 to 67% in FY16, and SEAP racial/ethnic minority participation increased from 35% in FY15 to 54% in FY16. REAP, a program designed to target underserved and underrepresented groups, also served increasing numbers of students from racial/ethnic minority groups, with an increase from 65% in FY14 (overall demographic data not available for FY15) to 81% in FY16.

Table 13. Student Demographics for 2014 - 2016

	Females			Racial & Ethnic Minorities			Free or Reduced-Price Lunch Eligible		
	2014	**2015**	**2016**	**2014**	**2015**	**2016**	**2014**	**2015**	**2016**
CQL	25%	40%	44%	18%	13%	26%	NA[††]	NA[††]	NA[††]
eCM	49%	49%	51%	15%[††††]	20%[††††]	43%	---[†]	16%[††††]	28%
GEMS	44%	45%	45%	45%	45%	59%	12%	11%	8%
HSAP	50%[†]	40%	47%	50%[†]	29%	67%	38%[†]	---[†]	---[†]
JSHS-R	69%	61%	60%	23%	23%	46%	19%	16%	14%
JSHS-N	58%	70%	54%	6%	22%	44%	7%	3%	10%
JSS	29%[†]	27%	38%	13%[†]	28%	39%	14%[†]	20%	NA
REAP	73%	61%[†††]	73%	65%	60%[†††]	81%	48%	42%[†††]	38%
SEAP	40%	45%	60%	21%	35%	54%	5%	5%	3%
Unite	66%	45%	52%	96%	94%	88%	34%	51%	100%
URAP	50%[†]	33%	39%	50%[†]	22%	23%	NA[††]	NA[††]	NA[††]

[†] *Data were not provided/collected from the specified program.*

[††] *Not applicable – college program.*

[†††] *REAP participant demographic data was not available. Reported percentages are from the 88 survey respondents.*

[††††] *Data only collected from state winners through the Cvent pilot.*

Since all AEOPs share the goal of diversifying participation, this progress in female and ethnic/minority participation should be celebrated. At the same time, however, it is concerning that Unite, a program designed specifically to target groups historically underserved and underrepresented in STEM lacked the robust growth in diversity demonstrated by other AEOPs. While participation by females showed a modest increase from FY15 (45%) to FY16 (52%) these levels remain lower than in FY14 when 66% of participants were females. Likewise, participation by racial/ethnic minorities in Unite appears to be on a downward trend, with participation decreasing from a high of 96% in FY14 to 88% in FY16.

Each program in the 2016 AEOP portfolio continued to implement program- and site-level mechanisms intended to attract participants from populations historically underserved and underrepresented in STEM. Across the AEOP, efforts included targeted marketing via electronic, print, phone, and in-person communications and/or partnerships with agencies and organizations serving underserved and underrepresented groups.

Programs in the AEOP portfolio continued to provide participants with more frequent exposure to real world, hands-on, and collaborative STEM activities than they are exposed to in their typical in-school experiences. A focus of the AEOP is to provide experiences that engage participants in exploring STEM topics, practices, and careers through real world, hands-on, and collaborative STEM activities that extend and enhance traditional school activities. To this end, participants were asked how often they were provided opportunities to learn about STEM in their school experiences and in their AEOP programs (individual items are shown in Table 14), using a five-point responses scale that ranged from "not at all" to "every day." The individual questionnaire items focused in this area were grouped into two composite variables (one for "in AEOP" and one for "in school"), which have the advantage of being more reliable than individual items. The composites have a minimum possible score of one and a maximum possible score of five.

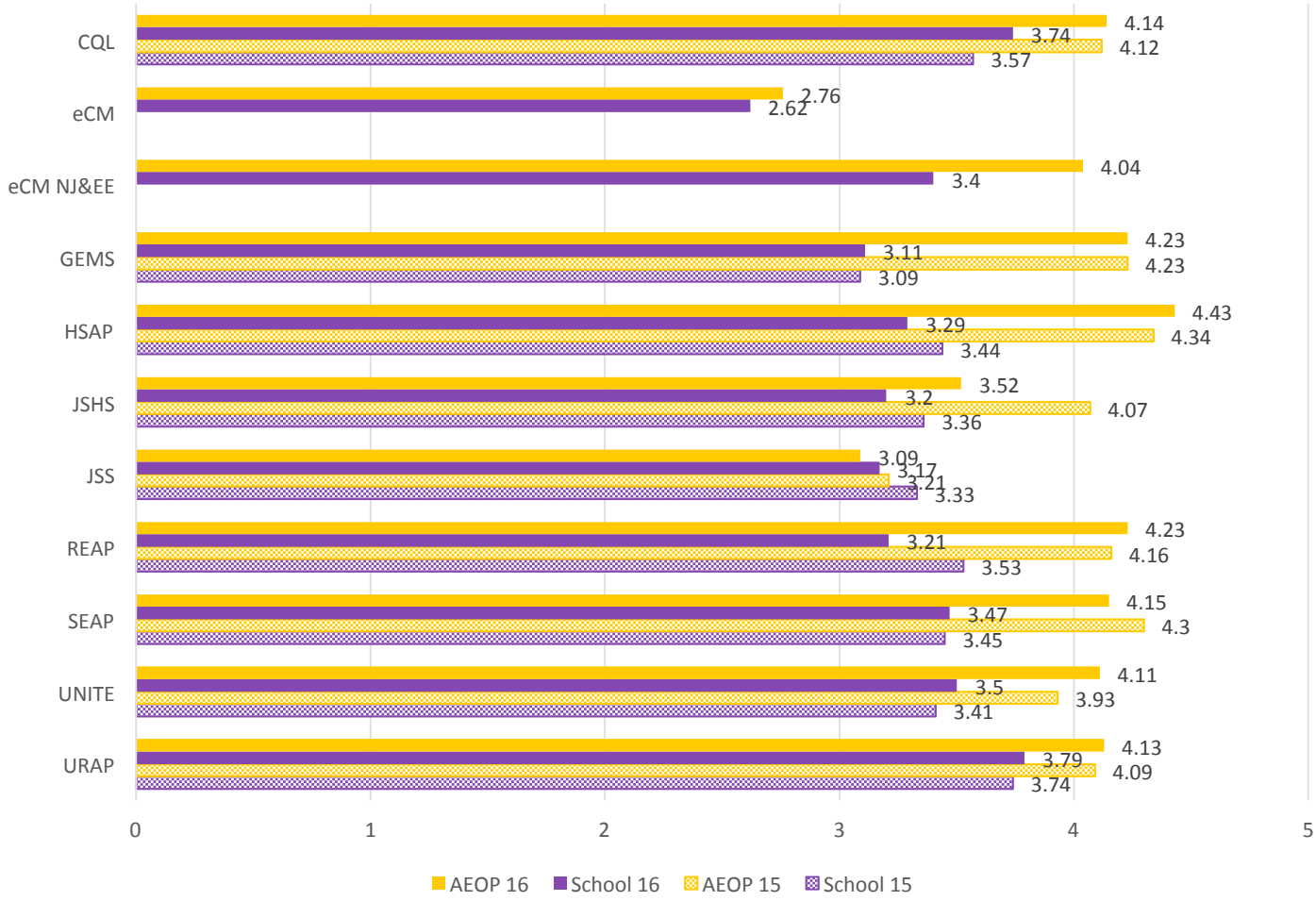
Table 14. Items that Form the Learning about STEM in School and Learning about STEM in AEOP Composites for CQL, HSAP, JSHS, REAP, SEAP, and URAP
1. Apply STEM knowledge to real life situations
2. Communicate with other students about STEM
3. Interact with scientists or engineers
4. Learn about new discoveries in STEM
5. Learn about different careers that use STEM
6. Learn about science, technology, engineering, or mathematics (STEM) topics that are new to you

Chart 1 displays the mean composite scores for participants learning about STEM in AEOP and school for FY15 and FY16.[5] For all except one program (JSS), results showed that AEOP students and apprentices reported learning significantly more about STEM in AEOP compared to school. Effect sizes ranged from small to large depending on program. [6,7] The effect sizes in FY16 were large in programs such as CQL, GEMS, eCM-National, HSAP, REAP, SEAP, Unite,

[5] The eCM 2015 questionnaire did not include these items, so composite scores could not be calculated.
[6] When comparing two means, the effect size "d" is calculated as the difference between the two means divided by the pooled standard deviation. Effect sizes of about 0.20 are typically considered small, 0.50 medium, and 0.80 large. Cohen, J. (1988). *Statistical power analysis for the behavioral sciences*. Hillside, NJ: Lawrence Erlbaum Associates.

and URAP, indicating that these programs offered participants STEM learning experiences that were substantially more intense and interactive than their in-school experiences.

Chart 1: Mean composite scores for Learning about STEM in School vs. AEOP



[7] Effect sizes: CQL, d = 1.20 standard deviations; R-ECM, d = 0.44 standard deviations; N-ECM = 1.66 standard deviations; GEMS, d = 2.24 standard deviations; HSAP, d = 2.62 standard deviations; JSHS, d = 0.59 standard deviations; REAP, d = 2.13 standard deviations; SEAP, d = 1.72 standard deviations; Unite, d = 1.15 standard deviations; and URAP, d = 1.24 standard deviations.

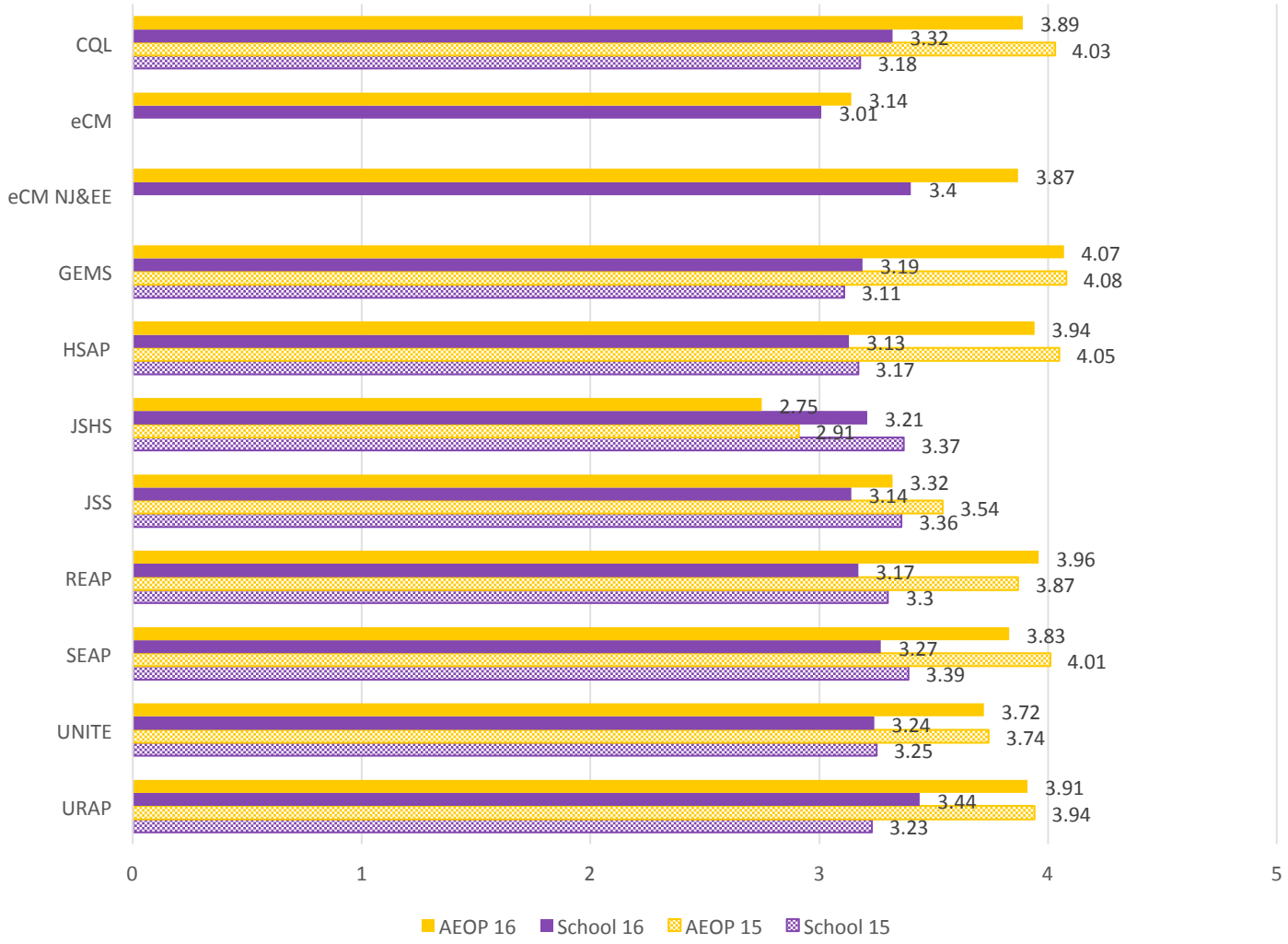
Participants were also asked about their perceptions of the frequency of opportunities to engage in STEM practices in their AEOP experience as compared to in school, which were also combined into composite variables. The items used to formulate the composite variables are shown in Table 15.

Table 15. Items that Form the Engaging in STEM Practices in School and Engaging in STEM Practices in AEOP Composites for CQL, HSAP, JSHS, REAP, SEAP, and URAP
1. Analyze data or information
2. Identify questions or problems to investigate
3. Carry out an investigation
4. Come up with creative explanations or solutions
5. Design an investigation
6. Draw conclusions from an investigation
7. Participate in hands-on STEM activities
8. Build or make a computer model
9. Use laboratory procedures and tools
10. Work as part of a team

Chart 2 displays the mean composite scores for all programs for FY15 and FY16. For the composite score of engaging in STEM practices, apprentices and students reported significant STEM engagement differences between AEOP programs and their normal classrooms with more engagement in AEOP programs. For all except one program (JSHS), results showed that AEOP students and apprentices reported engaging significantly more with STEM in AEOP compared to school. Significant differences ranged from small to large in effect sizes.[8] Effect sizes in FY16 were large in programs such as CQL, GEMS, eCM-National, HSAP, REAP, SEAP, Unite, and URAP, indicating that these programs offered participants STEM engagement experiences that were substantially more intense and interactive than their in-school experiences.

[8] Effect sizes: CQL, d = 1.58 standard deviations; R-ECM, d = 0.43 standard deviations; N-ECM = 1.34 standard deviations; GEMS, d = 1.96 standard deviations; HSAP, d = 2.04 standard deviations; JSS, d = 0.62 standard deviations; REAP, d = 1.82 standard deviations; SEAP, d = 1.18 standard deviations; Unite, d = 1.01 standard deviations; and URAP, d = 1.46 standard deviations.

Chart 2: Mean composite scores for Engaging in STEM practices in School vs. AEOP†



† *Response options for the items forming this composite were: 1 – Not at all, 2 – At least once, 3 – A few times, 4 – Most days, 5 – Every day.*

In focus groups and interviews as well as in questionnaire responses, apprentices, students, and mentors indicated that AEOPs consistently provided opportunities for participants to engage in authentic STEM activities that are more intensive than or not available in typical school experiences. Participants in all programs reported that students developed or expanded their STEM abilities and 21st Century STEM Skills while participating in AEOPs. This is illustrated in the following participant comments:

Actually being able to do research [and] to learn to use the atomic force microscope and actually have hands-on experience is the field is something that I'm just so happy to have…I don't have anything like it at school. (SEAP Apprentice)

What I like about [CQL] is that it's versatile, so I get experience in the lab, but at the same time I get experience out of the lab. I can see what I like more and figure out my career path based on those experiences. (CQL Apprentice)

Being able to work in a lab, work with professors, and work with students sort of made me realize what research really was. It's helped me gain experience using all of the equipment I've learned about in my books and my studies. It's helped me really just apply the knowledge I've gained, but also learned something else in being able to study things that pertain to a subject of interest just for me. (REAP Apprentice)

My one week at GEMS was very exciting. I learned a whole lot of new thing and they bring out the fun in it. When I first started I thought it would be like school but it turned out that it's about ten times better. They made it seem like we are real scientists. (GEMS Student)

[eCYBERMISSION] helped me develop my social, academic, and creativity skills. I was able to gain more knowledge and was exposed to multiple varying ideas from people that came from various backgrounds. (eCM Student)

JSHS is a great opportunity for our students to interact with peers who are conducting similar research, and to present their findings for scientists in order to receive feedback on how to improve their research moving forward. (JSHS Mentor)

Research Question #2 - To what extent do participants report increased STEM competencies STEM skills, knowledge, abilities, and confidence?

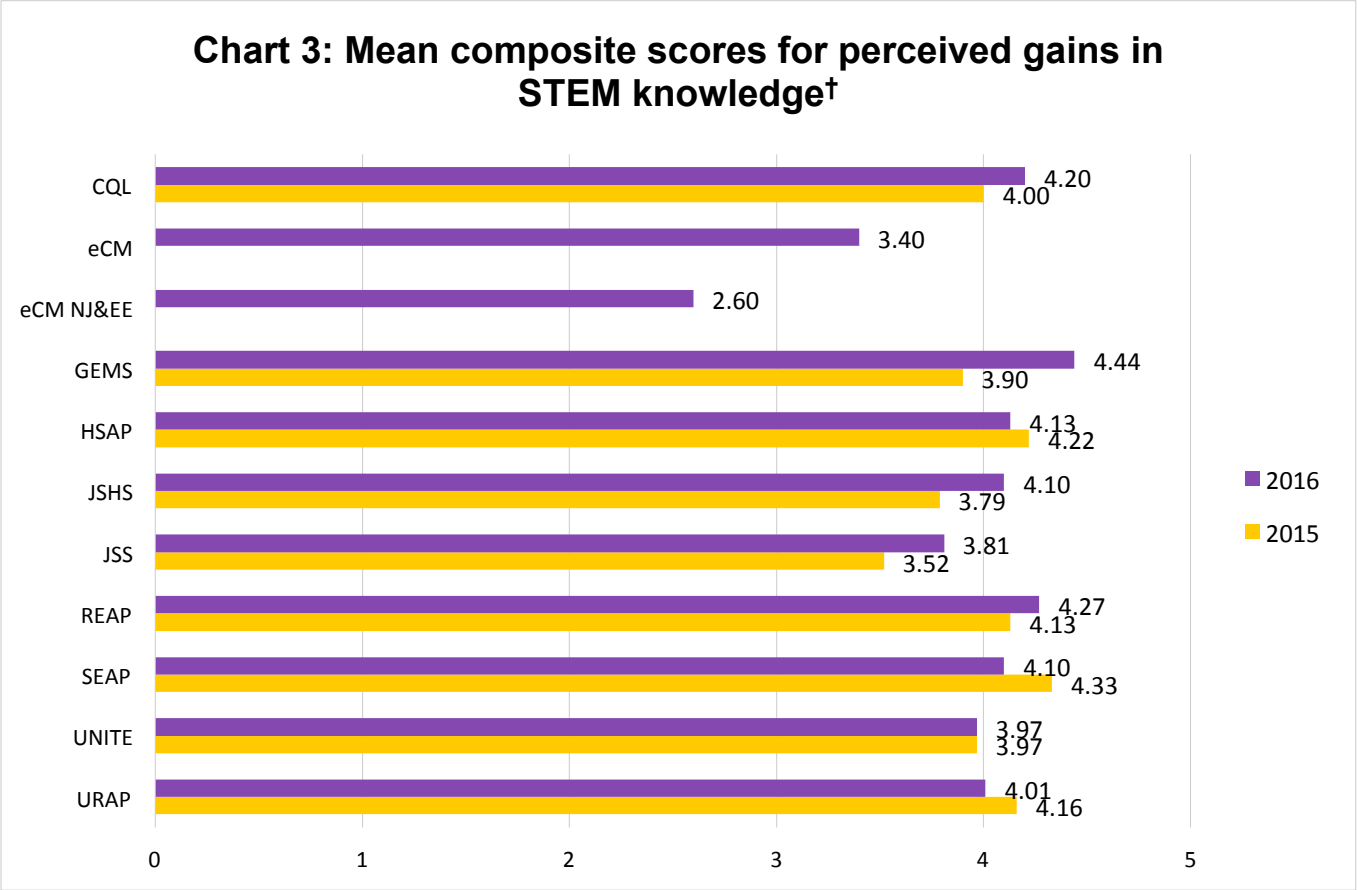
Participants continued to report that their AEOP experiences improved their STEM-specific and 21st Century STEM skills competencies. They also reported gains in their abilities to use the science and engineering practices described in the Next Generation Science Standards (NGSS), and reported gains in their STEM confidence and identity.

A focus of AEOP programming is to develop participants' STEM knowledge, skills, and abilities, as well as their 21st Century Skills, and to develop their abilities to appropriately apply these skills. Because deepening students' and apprentices' STEM knowledge and skills are key factors in increasing the likelihood that they will pursue STEM further in their education and/or careers, the FY16 evaluation examined students' and apprentices' perceptions of gains in their STEM-specific and 21st Century STEM Skills as a result of participating in AEOPs, as well as the impacts of participation on their confidence in STEM and STEM identities.[9]

[9] Chang, M. J., Sharkness, J., Hurtado, S. and Newman, C. B. (2014), What matters in college for retaining aspiring scientists and engineers from underrepresented racial groups. J. Res. Sci. Teach., 51: 555–580.

Table 16 displays the five questionnaire items that collectively form the composite for participants' perceptions of gains in STEM knowledge. Participants rated their perceived gains using a 5-point scale from "no gain" to "extreme gain." Findings indicate that participants from all programs perceived some level of gain in their STEM knowledge after participating in AEOPs (Chart 3).

Table 16. Items that form the Perceived Gains in STEM Knowledge Composite for CQL, HSAP, JSHS, REAP, SEAP, Unite and URAP
1. Knowledge of how scientists and engineers work on real problems in STEM
2. In depth knowledge of a STEM topic(s)
3. Knowledge of research conducted on a STEM topic or field
4. Knowledge of research processes, ethics, and rules for conduct in STEM
5. Knowledge of what everyday research work is like in STEM



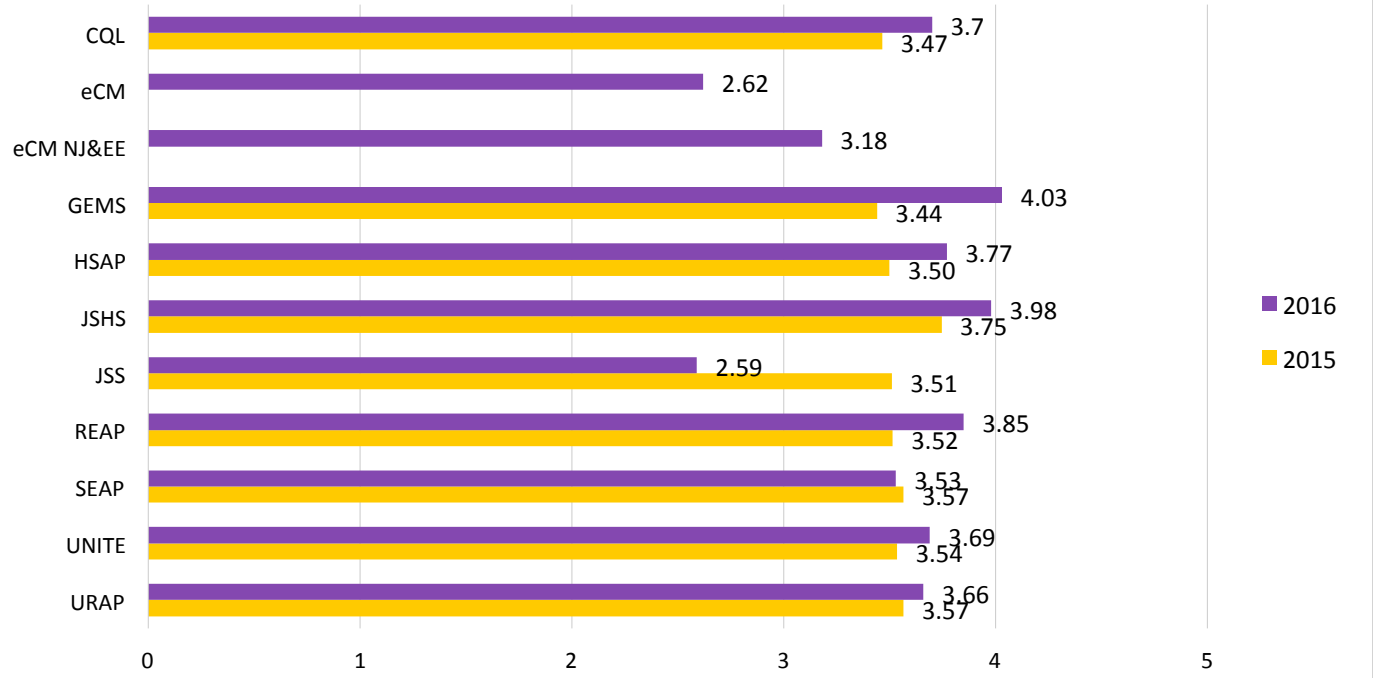
† *Response options for the items forming this composite were: 1 – No gain, 2 – A little gain, 3 – Some gain, 4 – Large gain, 5 – Extremely large gain.*

The FY16 evaluation also investigated the impact of participation on participants' abilities to use the STEM practices described in the NGSS[10]. Participants whose projects involved science were asked to describe their gains on items related to science practices; those with projects focusing on engineering were asked about engineering practices.[11] Table 17 provides an overview of the STEM practices assessed for AEOP participants. All programs (with the exception of JSS) demonstrated growth on this composite for FY16.

Table 17. Items that form the Perceived Gains in STEM Practices Composite
1. Asking a question that can be answered with one or more scientific experiments
2. Using knowledge and creativity to suggest a testable explanation (hypothesis) for an observation
3. Making a model of an object or system showing its parts and how they work
4. Designing procedures for an experiment that are appropriate for the question to be answered
5. Identifying the limitations of the methods and tools used for data collection
6. Carrying out procedures for an investigation and recording data accurately
7. Using computer models of objects or systems to test cause and effect relationships
8. Organizing data in charts or graphs to find patterns and relationships
9. Considering different interpretations of data when deciding the data answer a question
10. Supporting an explanation for an observation with data from experiments
11. Supporting an explanation with relevant scientific, mathematical, and/or engineering knowledge
12. Identifying the strengths and limitation of explanations in terms of how well they describe or predict observations
13. Defending an argument that conveys how an explanation best decribes an observation
14. Identifying the strengths and limitations of explanations in terms of how well they describe or predict observations
15. Integrating information from technical or scientific texts and other media to support your explanation of an observation
16. Communicating about your experiments and explanations in different ways (through talking, writing, graphics, or mathematics

10 http://www.nextgenscience.org/sites/default/files/Appendix%20F%20%20Science%20and%20Engineering%20Practices%20in%20the%20NGSS%20-%20FINAL%20060513.pdf

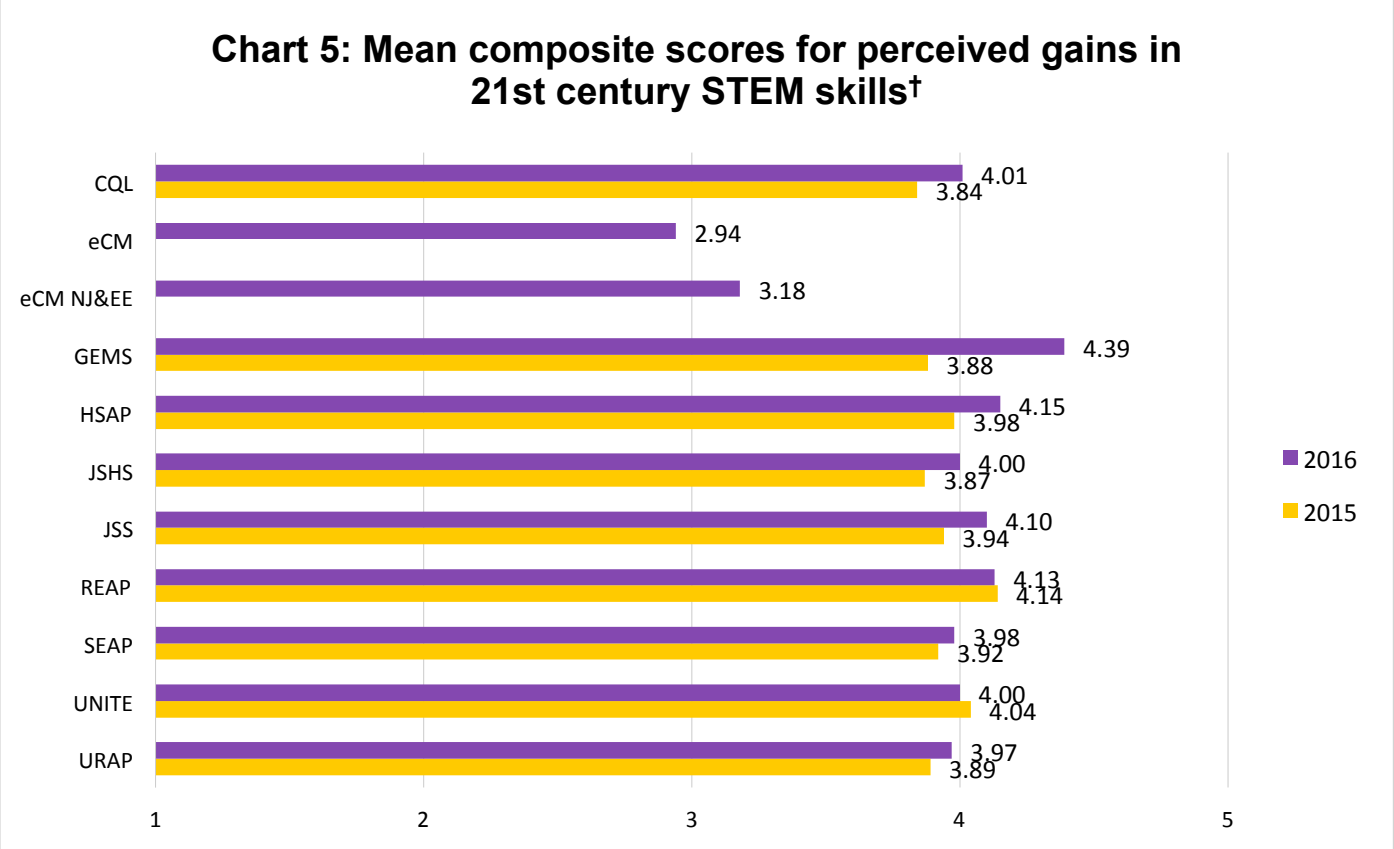
Chart 4: Mean composite scores for perceived gains in STEM Practices†



In FY16, participants were also asked about the impact of AEOP participation on their 21st Century Skills – those skills that are deemed necessary across a wide variety of fields. The items comprising the Perceived Gains in 21st Century Skills Composite are outlined in Table 18. The findings displayed in Chart 5 include the mean composite scores for each program for both FY15 and FY16. Participants in CQL, GEMS, HSAP, JSHS, JSS and Unite reported large gains overall. Participants in all other programs reported some level of gain in their 21st Century Skills as a result of participating in AEOP and, with the exception of REAP and Unite, participants' reports of gains were higher than in FY15.

Table 18. Items that form the Perceived Gains in 21st Century STEM Skills Composite for CQL, JSHS, REAP, SEAP, URAP, HSAP, GEMS, JSS, and Unite
1. Sticking with a task until it is finished
2. Making changes when things do not go as planned
3. Working well with students from all backgrounds
4. Including others' perspectives when making decisions
5. Communicating effectively with others
6. Viewing failure as an opportunity to learn

† *These two items were not included on the GEMS, JSS, and Unite versions of the survey.*

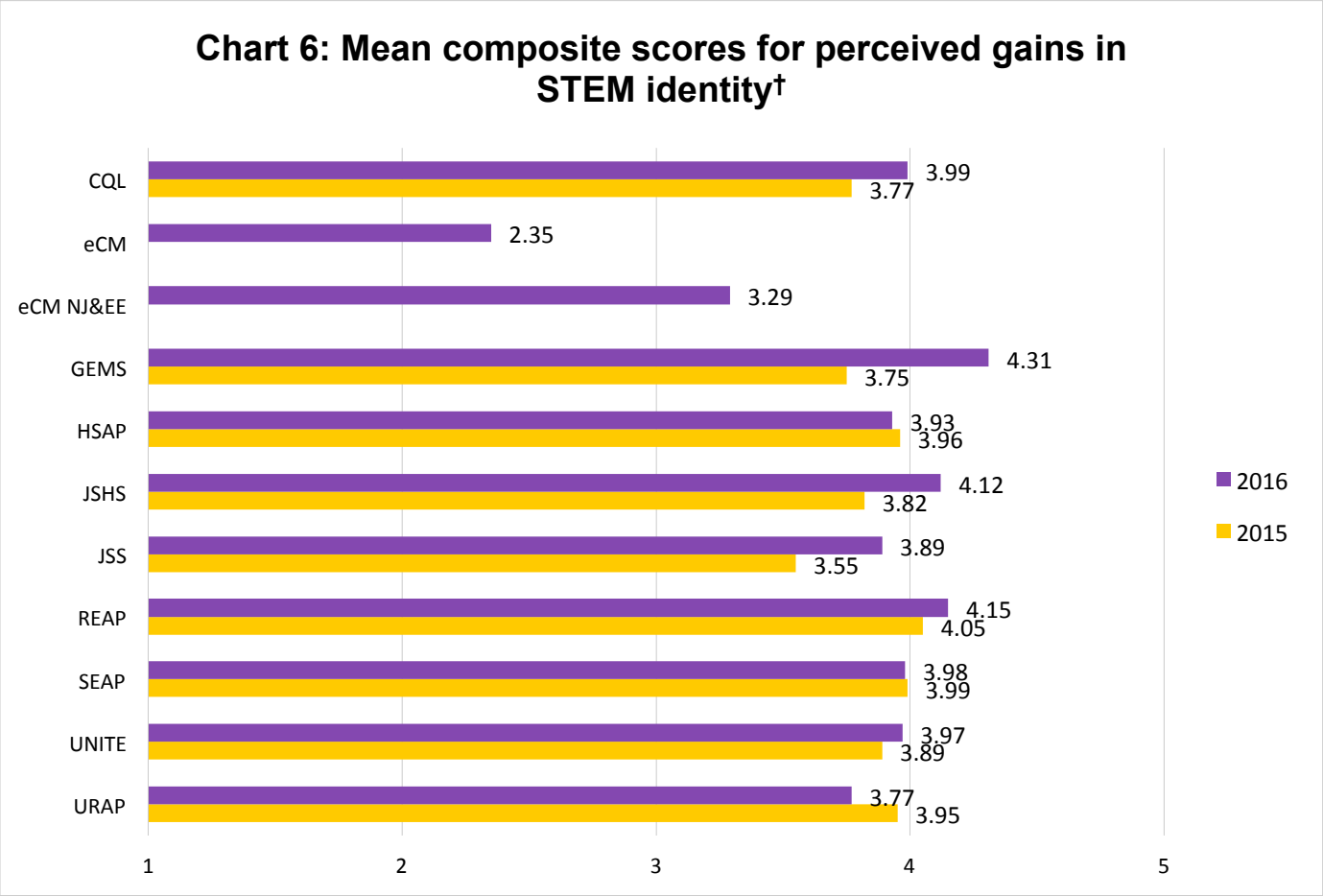


† *Response options for the items forming this composite were: 1 – No gain, 2 – A little gain, 3 – Some gain, 4 – Large gain, 5 – Extremely large gain.*

The FY16 evaluation also explored participants' STEM identity development – a construct similar to self-confidence or self-efficacy in STEM. Participants were asked about the extent to which their program experiences enhanced their STEM identities via a series of nine items that comprise the Perceived Gains in STEM Identity composite (Table 19). Findings for both FY15 and FY16 are displayed in Chart 6 and indicated that all participants experienced some level of gain in their STEM identities. The largest STEM identity gains were reported in GEMS, REAP, and JSHS.

Table 19. Items that form the Perceived Gains in STEM Identity Composite for CQL, JSHS, REAP, SEAP, URAP, HSAP, GEMS, JSS, and Unite
1. Interest in a new STEM topic or field
2. Deciding on a path to pursue a STEM career
3. Sense of accomplishing something in STEM
4. Feeling prepared for more challenging STEM activities
5. Thinking creatively about a STEM project or activity[†]
6. Desire to build relationships with mentors who work in STEM
7. Connecting a STEM topic or field to my personal values

[†] *Not included on the CQL, JSHS, REAP, SEAP, URAP, HSAP versions of the survey*



[†] *Response options for the items forming this composite were: 1 – No gain, 2 – A little gain, 3 – Some gain, 4 – Large gain, 5 – Extremely large gain.*

In addition to the above items, participants were also asked to rate the extent of their agreement with items describing program impacts related to their STEM confidence and interest. These items also asked about their interest in taking additional STEM classes in school, pursuing STEM activities outside of school, and their confidence in their STEM

knowledge, skills, and abilities. Table 20 displays the results for these items for both FY15 and FY16 and shows that a majority of students agreed that the program in which they participated contributed at to the impact described. Most notably, the vast majority of students in each program (with the exception of eCM regional participants[12]) agreed that the program had impacted their confidence in their STEM knowledge, skills, and abilities (a range of 79%-98% agreement). A large majority of participants in all programs (with the exception of eCM regional participants) also agreed that participation in the AEOP contributed to their interest in participating in STEM activities outside of school requirements (a range of 67%-89%). Likewise, a majority of participants (with the exception of eCM regional participants) indicated that their AEOP participation their interest in taking STEM classes in school (a range of 61% to 80%). It is also noteworthy that the percentage of students agreeing that their AEOP participation contributed to their STEM confidence and interest increased over FY15 levels overall for CQL, GEMS, and Unite.

Table 20. Students Agreeing that the Program Contributed to their STEM Confidence and Interest.

	Year	CQL	eCM	eCM NJ&EE	GEMS	HSAP	JSHS	JSS	REAP	SEAP	Unite	URAP
I am more confident in my STEM knowledge, skills, and abilities.	2015	91%	69%	---	91%	94%	79%	79%	96%	97%	90%	93%
	2016	**98%**	**54%**	**83%**	**93%**	**97%**	**78%**	**79%**	**94%**	**94%**	**94%**	**90%**
I am more interested in participating in STEM activities outside of school requirements.	2015	75%	46%	---	82%	80%	72%	66%	89%	81%	85%	82%
	2016	**86%**	**41%**	**76%**	**85%**	**75%**	**72%**	**73%**	**86%**	**89%**	**89%**	**85%**
I am more interested in taking STEM classes in school.	2015	55%	52%	---	76%	69%	61%	71%	81%	69%	81%	59%
	2016	**76%**	**42%**	**68%**	**80%**	**69%**	**61%**	**71%**	**76%**	**71%**	**81%**	**60%**

Findings from all programs indicated that participation in AEOPs impacted apprentices' and students' perceived STEM knowledge, ability to engage in STEM practices, 21st Century STEM skills, and STEM identity. These impacts were also evident in focus groups, interviews, and participants' responses to open-ended questionnaire items. For example:

> *My CQL experience has been great; I've learned so much and been challenged everyday in my internship. I've worked with technologies that I have never really known were out there, and it has added to my knowledge of assets to be utilized later in my career. There has not been a day that I woke up and did not look forward to going into the office and doing work. (*CQL Apprentice)

> *I feel like I'm learning a lot not just about the lab, lab etiquette, how different procedures work, and how to work with scientists. I'm also learning a lot about the job.* (SEAP Apprentice)

> *I love my Unite experience. I feel like I know more now and now I know what college I really want to go because of the college visits we took. I loved the hands on experience; we did a lot of building … I learned a lot about team work too.* (Unite Student)

[12] eCM national student responses (eCM NJ&EE) are substantially different from regional student responses (denoted as eCM).

JSHS is a great opportunity for our students to interact with peers who are conducting similar research, and to present their findings for scientists in order to receive feedback on how to improve their research moving forward. (JSHS Mentor)

[e-Cybermission] was an eye opening experience; it helped me develop my social, academic, and creativity skills. I was able to gain more knowledge and was exposed to multiple varying ideas from people that came from various backgrounds. I am glad my team and I were able to attend this competition. (eCM Student)

GEMS lets me see what it feels like to do research and be a part of the scientific community. (GEMS Student)

Research Question #4 - To what extent do participants and mentors report increased awareness of and interest in Army/DoD STEM research and careers?

The AEOP's efforts to engage students in and/or expose them to DoD research continue to be a challenge met with mixed results. While students reported positive attitudes toward DoD STEM research and researchers, findings related to mentors discussing DoD STEM research and STEM opportunities in the DoD with apprentices and students varied widely across programs. In FY16 the AEOP continued to highlight DoD STEM research through program activities that engage participants in or provide meaningful exposure to DoD research. Table 21 summarizes some of these efforts in 2016.

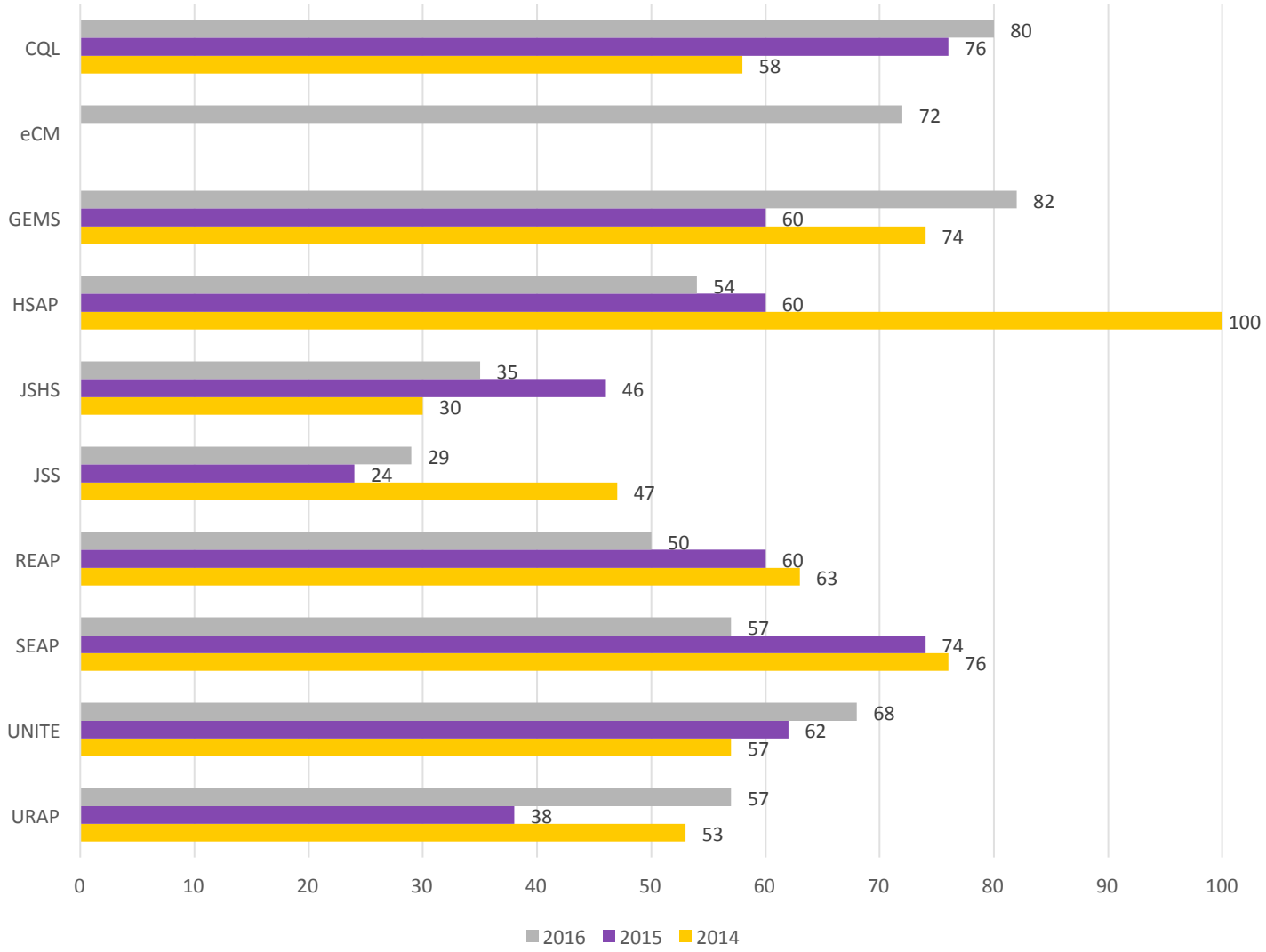
Table 21. 2016 Participant Engagement in and Exposure to DoD Research

AEOP	Engagement in DoD Research
CQL, SEAP	**349** high school and undergraduate or graduate participants (**113 for SEAP, 236 for CQL**) serving as apprentices on DoD research projects at Army or DoD research laboratories.
HSAP, URAP	**117** (**65 for HSAP, 52 for URAP**) high school and undergraduate participants serving as apprentices on Army research projects at college/university research laboratories.
GEMS	**2,428** elementary, middle and high school participants, and **30** K-12 teachers were engaged in DoD research through GEMS activities hosted by Army research laboratories.
AEOP	**Exposure to DoD Research**
eCM	**86** participants and their **22** team advisors (in-service teachers) were exposed to DoD research through the National Judging & Educational Event activities. NJ&EE programming included STEM Tech Expo and invited speakers who highlighted DoD research. Army Corner, highlighting Army STEM research and careers, and was publically accessible at the eCM website.
JSHS	**233** participants and their **34** teachers were exposed to DoD research through the National Symposium activities. National JSHS programming included DoD S&Es, who served as national judges, speakers and presenters who highlighted DoD research. **5,260** students were exposed to DoD research through DoD S&Es who engage at regional JSHS symposia.
Unite	**282** high school participants and **285** program mentors participated in field trips and speakers that included learning about the work of DoD STEM personnel and/or DoD research facilities.
JSS	**585** participants in regional competitions and **240** participants in the national competition were exposed to DoD research through JSS activities facilitated by **5** Army S&Es.

Apprenticeship programs, including CQL, HSAP, SEAP, and URAP, engage participants in DoD research projects, providing opportunities for apprentices to make meaningful contributions as they develop professionally through their mentored research experiences. The AEOP also offers STEM enrichment activities that provide hands-on, interactive experiences to students. In GEMS, for example, DoD S&Es, or NPMs under the mentorship of S&Es, translate DoD research into grade-level appropriate educational activities, allowing GEMS participants to engage in real-world research through the questions and problems addressed by DoD researchers and their research. A number of AEOP programs also implemented activities to expose more participants to the DoD's STEM research interests. These activities highlighted cutting-edge research and careers through DoD STEM-expos, laboratory tours, expert panels, and professional development activities linking school curricular topics to DoD research.

The mentor–student and mentor-apprentice relationships formed in AEOP may also be a key source of participant information about the DoD and STEM research in the DoD. The mentor questionnaire asked mentors to report whether they discussed STEM opportunities in the DoD and other government agencies with apprentices and students in order to support their STEM educational and career pathways. Results for this item for 2014, 2015, and 2016 are displayed in Chart 7, which shows that there is substantial variation in mentor responses across programs and across program years. Increasing numbers of mentors reported providing this information to students and apprentices in GEMS, CQL, Unite, and URAP in FY16 (range of 57%-82%), however there were declines in the number of mentors discussing DoD STEM opportunities in FY16 as compared to previous years in HSAP, JSHS, JSS, REAP, and SEAP (range of 29%-54%). There appears to be room for improvement in this area across all programs.

Chart 7: Percent of Mentors in Apprenticeship Programs Who Report Discussing DoD STEM Opportunities with Apprentices



In spite of the widely varying mentor reports of discussing STEM opportunities within the DoD, participant attitudes toward Army/DoD research and researchers are consistently positive. The proportion of respondents who indicated that they agreed or strongly agreed to questionnaire items is provided in Table 22. The majority of participants in all programs, with the exception of eCM regional students, agree that Army/DoD research and researchers advance science and engineering fields (range of 66%-100%), develop new cutting edge technologies (range of 62%-97%), and that DoD research is valuable to society (range of 68%-96%). These finding are similar to those from 2015.

As in FY14 and FY15, comparisons of participant responses from AEOP programs at DoD research laboratories (CQL, GEMS, and SEAP), DoD-sponsored college/university laboratories (HSAP and URAP), and non-DoD affiliated college/university laboratories and settings (REAP and Unite) suggest that experiences at DoD research laboratories and DoD-sponsored college/university laboratories generated greater understandings of and positive attitudes toward DoD research than those held in non-DoD affiliated university laboratories and other settings. While the nature of programs precludes all students from being physically present at DoD research labs or DoD-sponsored college/university labs, strategies and experiences utilized by these DoD laboratory-affiliated programs should be examined and, where possible, scaled up and used with other AEOP elements to strengthen participant knowledge of DoD STEM research.

Table 22. AEOP Participants' Agreeing with Various Statements about DoD STEM Research

	Year	CQL	eCM	eCM NJ&EE	GEMS	HSAP	JSHS-R	JSS	REAP	SEAP	Unite	URAP
DoD researchers advance science and engineering fields	2015	98%	---	---	81%	73%	74%	60%	71%	94%	78%	100%
	2016	**100%**	**45%**	**97%**	**84%**	**100%**	**68%**	**66%**	**79%**	**94%**	**84%**	**90%**
DoD researchers develop new, cutting edge technologies	2015	95%	---	---	80%	76%	73%	60%	74%	90%	81%	100%
	2016	**92%**	**46%**	**97%**	**83%**	**97%**	**67%**	**62%**	**79%**	**89%**	**83%**	**90%**
DoD researchers solve real-world problems	2015	93%	---	---	83%	73%	77%	60%	70%	92%	81%	100%
	2016	**98%**	**49%**	**96%**	**87%**	**92%**	**71%**	**70%**	**80%**	**96%**	**81%**	**85%**
DoD research is valuable to society	2015	93%	---	---	81%	70%	75%	60%	73%	96%	82%	100%
	2016	**96%**	**48%**	**94%**	**85%**	**92%**	**68%**	**70%**	**80%**	**97%**	**81%**	**85%**

The AEOP exposed students and apprentices to Army and DoD STEM careers, and participating in programs increased their interest in pursuing DoD STEM careers although some programs were more effective (e.g., CQL, SEAP, national eCM, Unite, and URAP) at doing so than others (e.g., HSAP, regional eCM, JSHS-R, JSS, REAP). Direct engagement with Army and DoD STEM researchers and/or facilities during program activities is the most promising practice for informing participants about specific jobs/careers. Mentors in many programs did not find AEOP electronic and print resources to be useful for exposing apprentices and students to STEM DoD careers, although findings suggest that these resources are used differently across program.

Efforts to expose participants to the Army and DoD's STEM research also serve to emphasize a variety of STEM careers, including those with the Army and DoD, that use and apply the types of knowledge, skills, and abilities students learn through program activities. Program evaluations assessed how many careers participants learned about during program activities. These data for FY15 and FY16 are summarized in Charts 8 and 9.

Research Question #3 - To what extent do participants and mentors report increased participant interest in STEM research and careers?

Participants reported increased interest in STEM research and careers after participation in FY16 AEOP programs. Chart 8 illustrates that a majority of 2016 AEOP participants (range of 60%-91%) reported learning about 3 or more STEM jobs or careers in all programs except regional eCM (33%), R-JSHS (41%), and JSS (44%). Fewer students reported learning about a similar number of Army and DoD STEM careers, however. Chart 9 displays percentages of AEOP participants who reported learning about 3 or more Army/DoD STEM careers. In all programs (with the exception of eCM where response rates were identical for both items), fewer students learned about Army/DoD STEM careers than about STEM careers in general (a range of 18%-85%). This suggests that Army/DoD STEM careers may not have been emphasized as often and/or as well as STEM careers in general. As in FY15, comparisons of responses from participants in AEOPs taking place at Army research laboratories (CQL, GEMS, and SEAP), Army-sponsored university laboratories (HSAP and URAP), and non-Army affiliated settings (JSHS-R, TSA-based JSS regionals, REAP, and Unite) reveal that generally greater proportions of FY16 AEOP participants in these settings learn about Army and DoD STEM careers than their counterparts at Army-sponsored or non-Army affiliated university laboratories. This seems to reflect the fact that, not surprisingly, participants at Army research laboratories have substantial exposure to Army and DoD STEM professionals in their daily work. Unite, a program held in a non-Army affiliated setting, is an exception to this, however, with 60% of students indicating that they learned about 3 or more Army/DoD STEM careers. Likewise, students at the national eCM event reported overwhelmingly (91%) that they learned about 3 or more Army/DoD STEM careers. Programs may wish to examine and scale up practices used in programs that report high levels of awareness about Army/DoD STEM careers, with an emphasis on practices used in programs held in non-Army affiliated settings that may be easily transferrable to a variety of program settings.

Chart 8: Students Reporting Learning about 3 or More STEM Jobs/Careers in their Program

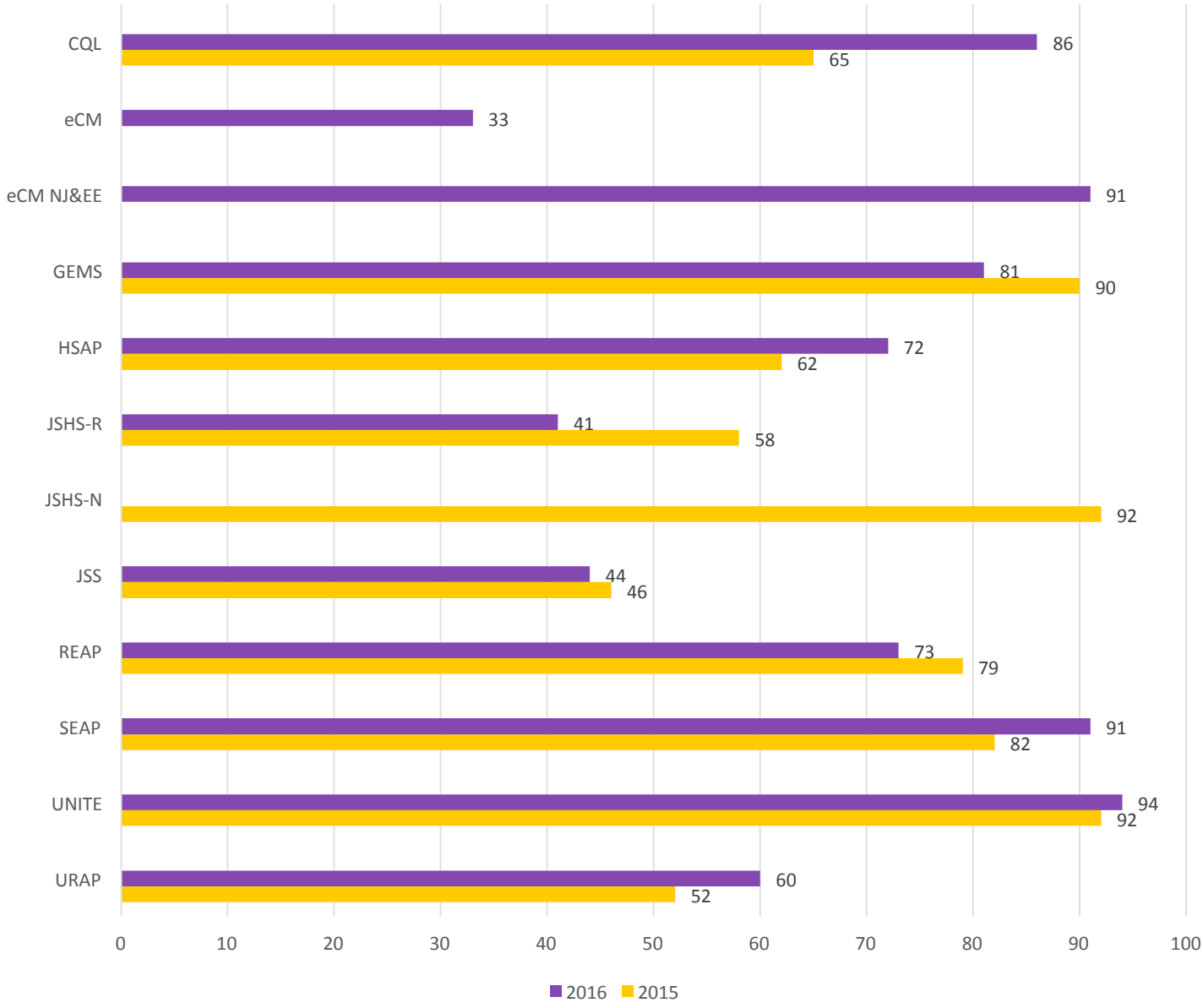
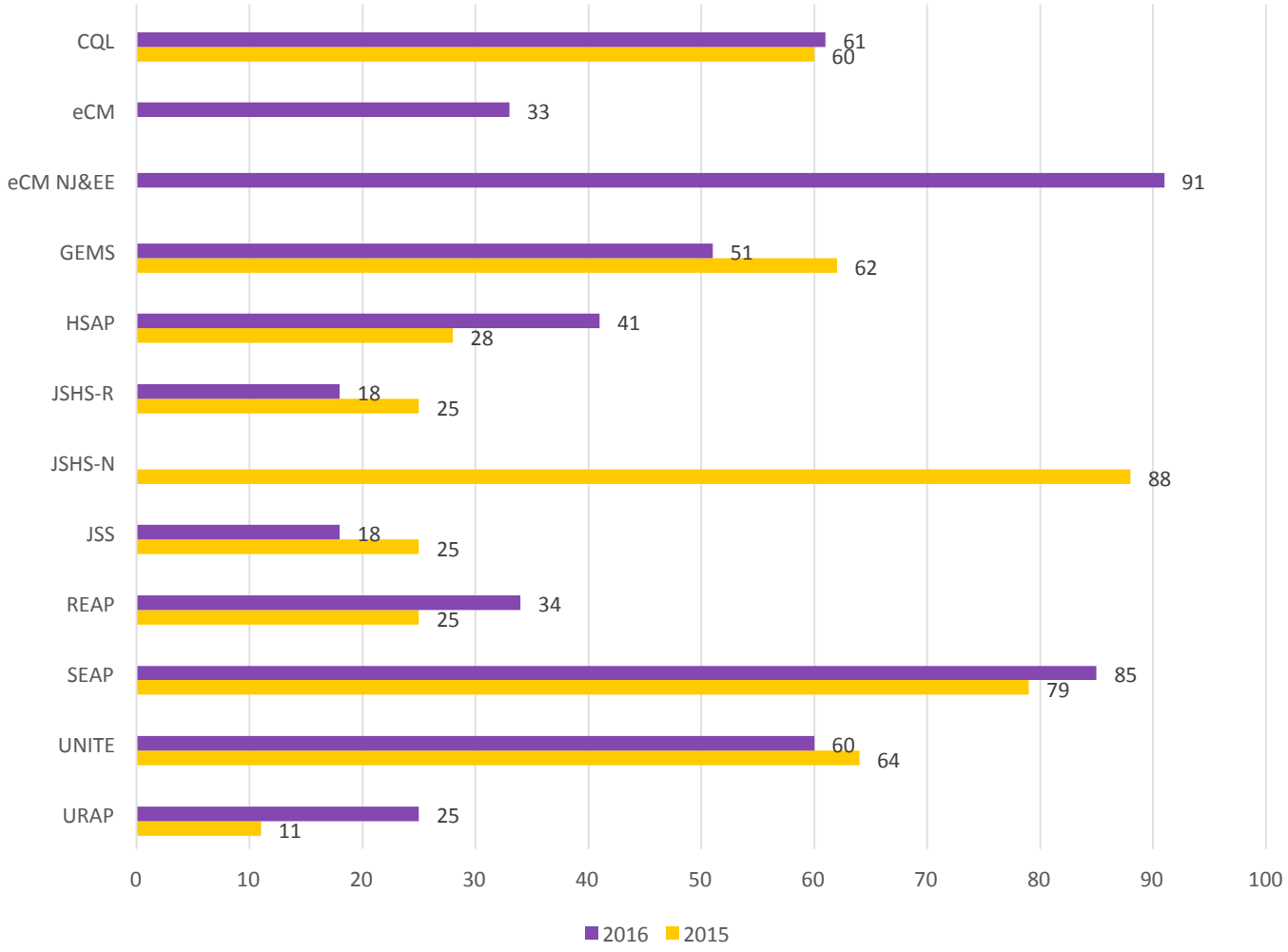
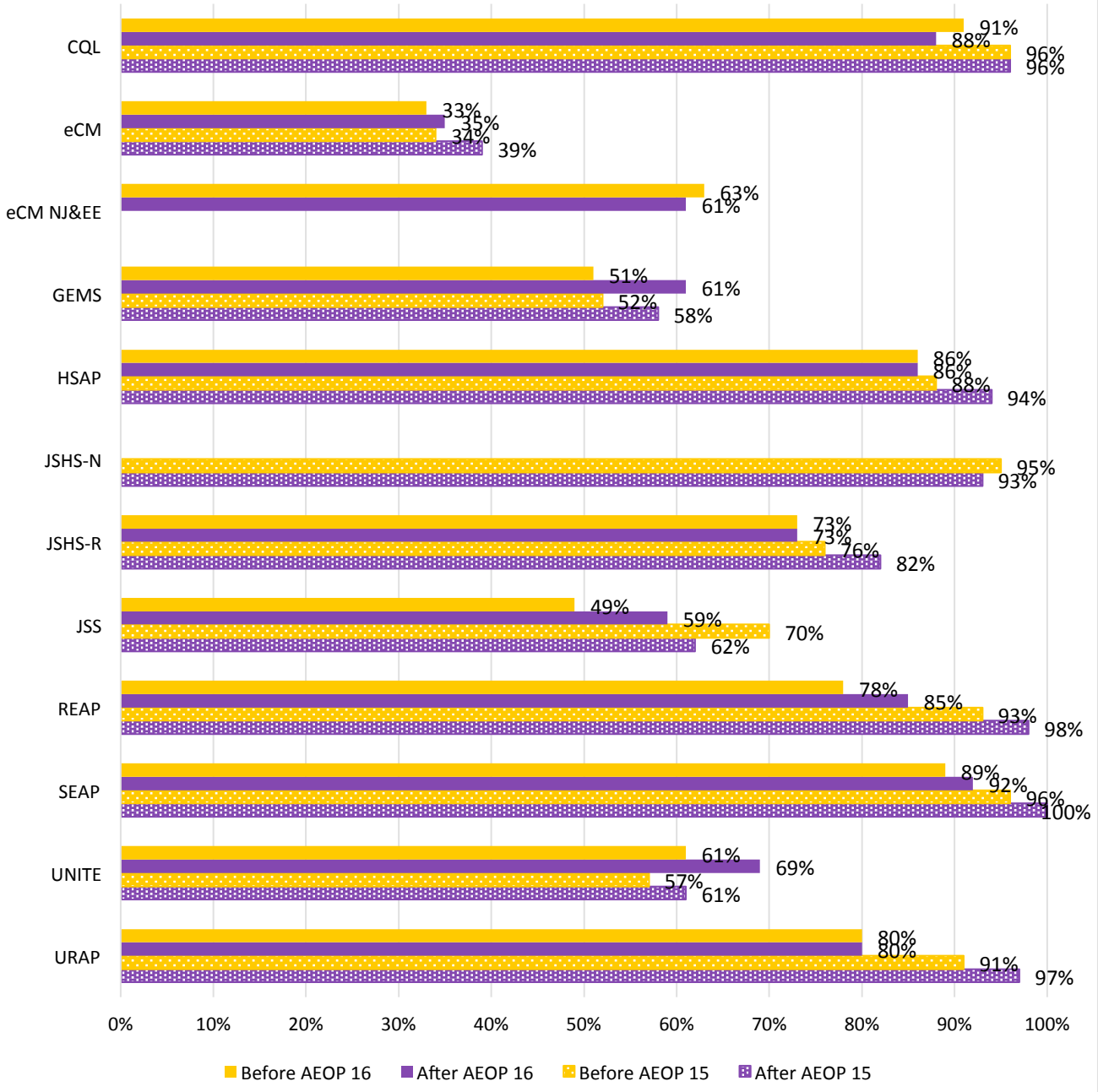


Chart 9: Students Reporting Learning about 3 or More DoD STEM Jobs/Careers in their Program



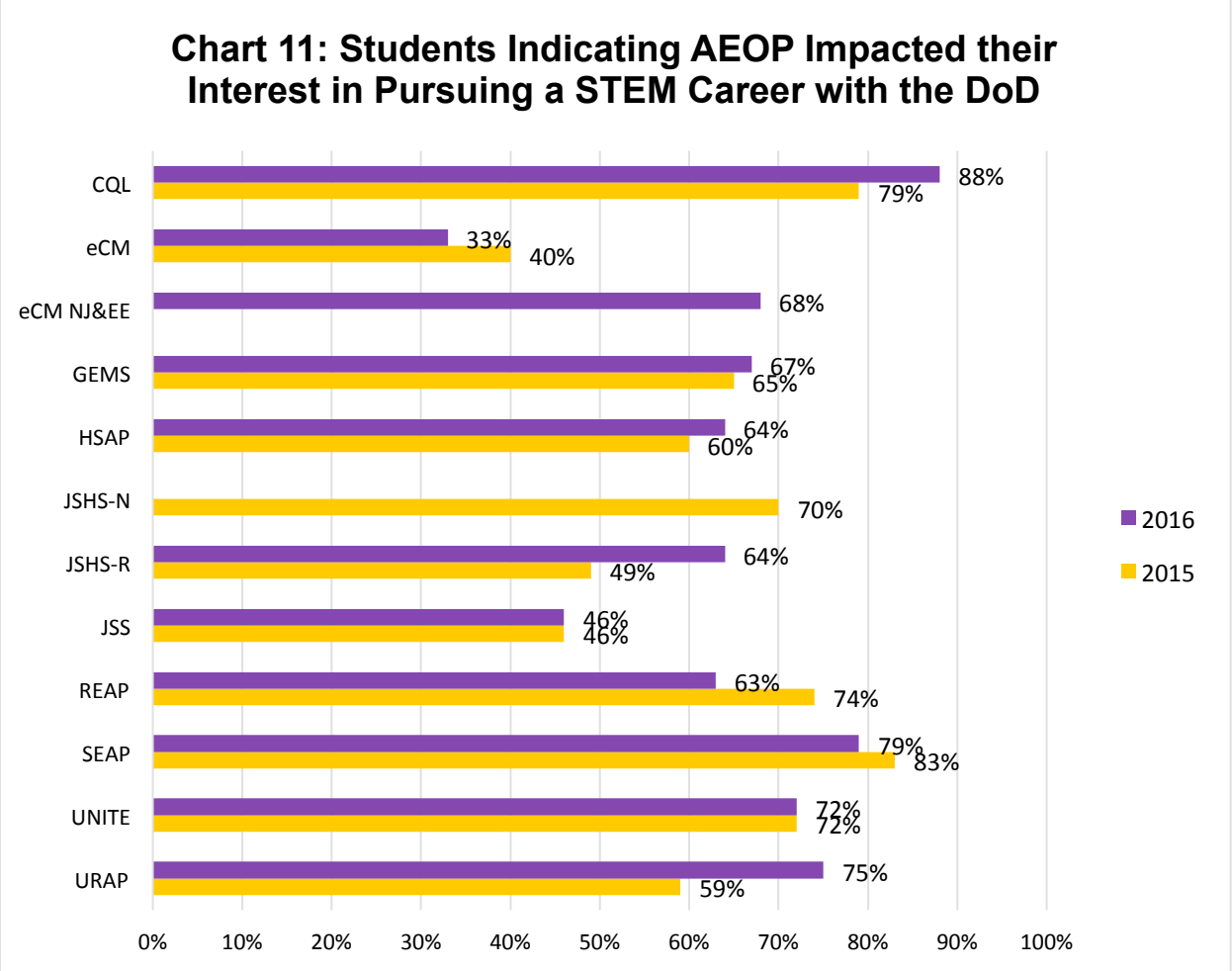
Students and apprentices were also asked to gauge the influence of their AEOP experience on their career aspirations, both before and after participating in the AEOP program. The data were coded into STEM-related and non-STEM-related careers. As can be seen in Chart 10, findings varied across programs for career aspirations. While most program participants in some programs reported increased interest in STEM careers after participation (GEMS, regional eCM, JSS, REAP, SEAP, and Unite), participants in other programs (HSAP, JSHS, and URAP) reported no shifts in aspirations from before to after program participation. In two other programs (CQL and national eCM) participants reported a slightly decreased interest in their aspirations to STEM careers after AEOP participation. In spite of this, a majority of participants across all programs, with the exception of regional eCM, reported aspiring to STEM careers both before and after participating in the AEOP.

Chart 10: AEOP Students Planning to Work in a STEM or STEM-Related Career



The 2016 evaluation also assessed participant awareness of and interest in STEM careers in general and with the DoD. Despite findings indicating that participants learned about fewer Army and DoD STEM careers compared to STEM careers in general, the majority of participants in all programs (with the exception of regional eCM students) reported that they were more aware of DoD STEM research and careers as a result of their AEOP participation (a range of 53% to 96%). Likewise, most 2016 AEOP participants in all programs (with the exception of regional eCM students) also credited the programs with increasing their interest in pursuing a STEM career (range of 61%-86%). Fewer students credited their AEOP participation with an increased interest in pursuing an Army/DoD STEM career, although a majority of students in several programs indicated that their participation in the AEOP resulted in an increase in this career aspiration. For example 88% of CQL apprentices, 79% of SEAP apprentices, 75% of URAP apprentices, 72% of Unite students, and 68% of national eCM students indicated that their program participation increased their interest in a STEM career with the DoD. These findings indicate that apprentices in programs held in Army/DoD laboratories are most likely to leave their experience more interested in pursuing a DoD STEM career. Participants in all programs also reported having a greater appreciation of DoD STEM research and careers as a result of their AEOP experiences, including over 85% of participants in several programs (CQL, national eCM, GEMS HSAP, REAP, SEAP, Unite and URAP).

The FY16 evaluation also examined AEOP participant interest in pursuing a STEM career with the DoD and the impact of their AEOP experience on that interest (Chart 11). In most programs, a majority of participants reported that participating in the AEOP increased their interest in pursuing a DoD STEM career. Three-quarters or more of apprentices in CQL (88%), SEAP (79%), and URAP (75%) reported that their AEOP apprenticeship increased their interest in a DoD STEM career, while over half of participants in national eCM, GEMS, HSAP, JSHS-R, REAP, and Unite (a range of 63%-72%) indicated that their AEOP participation increased their interest. Students in regional eCM and JSS were least likely to indicate that their participation impacted their interest in a DoD STEM career (33% and 46% respectively). Again, participants in programs hosted at Army laboratories or at Army-funded college/university laboratories reported the greatest impacts on their interest in DoD STEM careers.



Participants in the apprenticeship programs were asked about their interest in DoD STEM careers in both 2014 and 2015 as well as in 2016. As can be seen in Table 23, more than half of responding apprentices reported interest in DoD STEM careers for 2016 (a range of 63%-88%), and all programs show an upward trend in interest from 2014-2016 with the exception of HSAP, where interest declined from 83% to 60% from FY14 to FY15 and grew slightly to 64% in FY16.

Table 23. Apprentices' Interest in DoD STEM Careers 2014 - 2016

	2014	2015	2016
CQL	74%	77%	88%
HSAP	83%	60%	64%
REAP	49%	68%	63%
SEAP	68%	83%	79%
URAP	59%	59%	75%

In all AEOP programs, youth and adult participants reported that programs afforded students opportunities to clarify, explore, and/or advance their STEM education and career pathways. In open-ended questionnaire responses and focus

groups, students and apprentices affirmed that participating in AEOPs supported or increased their interest in STEM careers. Likewise, mentors expressed their belief that AEOPs are valuable for providing career information, both in STEM fields in general and in Army/DoD STEM more specifically. For example, participants said:

> *I have learned a lot about research and its environment at a professional level. It gave me an idea of what I would like to do after I graduate this coming year.* (CQL Apprentice)

> *CQL is an invaluable experience for college interns. It gives them first hand exposures to real world problems important to the Army, and also gives them an invaluable opportunity of working with scientists and engineers in the field to determine if they would like a career with a DoD.* (CQL Mentor)

> *I think Unite is good for students who are trying to make decisions on their future careers. Most of the people here want to be engineers, but upon getting here, they found out, "OK. Maybe I should try out something else. Maybe Biology or something." I feel it is good for people who at that point at which they are making their decision on what they want to study in the future.* (Unite Mentor)

> *Unite activities and experience helped me get a closer look to what working with STEM is like. Because of this, I can now choose my career more wisely, already having experience in working with other fields and topics.* (Unite Student)

> *I have found a new appreciation for STEM career[s]. I have always wanted to be a surgeon but now I also want to create new ideas and be more a part of the research program.* (eCM Student)

Table 24. Students Agreeing AEOP Affected Their Attitudes Toward STEM Careers

	Year	CQL	eCM	eCM NJ&EE	GEMS	HSAP	JSHS-R	JSS	REAP	SEAP	Unite	URAP
I am more interested in pursuing a career in STEM	2015	64%	---	---	73%	80%	69%	56%	93%	81%	80%	63%
	2016	**86%**	**39%**	**70%**	**77%**	**61%**	**64%**	**65%**	**73%**	**70%**	**81%**	**68%**
I am more aware of DoD STEM research and careers	2015	93%	---	---	81%	68%	59%	55%	80%	90%	78%	74%
	2016	**96%**	**39%**	**77%**	**83%**	**75%**	**53%**	**56%**	**77%**	**97%**	**82%**	**75%**
I have a greater appreciation of Army or DoD STEM research	2015	91%	---	---	83%	89%	61%	53%	82%	94%	77%	82%
	2016	**100%**	**42%**	**80%**	**85%**	**89%**	**56%**	**58%**	**83%**	**97%**	**81%**	**90%**
I am more interested in pursuing a STEM career with the DoD	2015	77%	---	---	65%	60%	49%	46%	74%	83%	72%	59%
	2016	**88%**	**33%**	**68%**	**29%**	**64%**	**42%**	**46%**	**63%**	**79%**	**72%**	**75%**

Since 2014, the AEOP has focused on supporting mentors with resources to expose participants to DoD STEM careers. As part of the FY16 evaluation, mentors were asked to indicate which of these resources were useful to them. Table 25 presents findings for FY15 and FY16 which indicate that, across all programs, simply participating in the program was most useful for exposing participants to DoD STEM careers (a range of 50%-93% of mentors agreeing that this was useful). Mentors were also asked to indicate whether various AEOP resources were useful in these efforts, and, as Table 24 indicates, responses varied widely across programs. For example, while over three-quarters of HSAP mentors found the AEOP website useful, only 10% of JSHS mentors reported that the website was a useful resource, and while 69% of HSAP mentors found the AEOP brochure useful, no CQL or SEAP mentors reported that the brochure helped them to expose apprentices to DoD STEM careers. A large majority of mentors in several programs, including GEMS, HSAP, JSHS, Unite, and URAP found site administrators or coordinators to be useful resources (range of 71%-89%). A large majority of GEMS mentors (89%) found invited speakers or career events useful in exposing students to DoD STEM careers, although relatively few mentors in any other program except for Unite (70%), found this to be a useful resource. Although there was wide variation in responses across programs, as in FY15 few mentors in any program found the It Starts Here! magazine useful.

Table 25. Resources that Mentors Found Useful for Exposing Apprentices and Students to DoD STEM Careers

Resource	Year	CQL	eCM	GEMS	HSAP	JSHS	JSS	REAP	SEAP	Unite	URAP
Program Administrator Website (TSA, ASEE, AAS, etc.)	2015	NA	---	NA	60%	34%	95%	53%	NA	27%	56%
	2016	**NA**	**85%**	**NA**	**62%**	**15%**	**89%**	**31%**	**NA**	**36%**	**64%**
AEOP website	2015	41%	---	56%	60%	11%	32%	76%	38%	45%	56%
	2016	**20%**	**24%**	**54%**	**77%**	**10%**	**35%**	**59%**	**0%**	**59%**	**64%**
AEOP social media	2015	15%	---	17%	21%	4%	5%	25%	4%	25%	19%
	2016	**0%**	**9%**	**14%**	**31%**	**3%**	**5%**	**19%**	**0%**	**27%**	**0%**
AEOP brochure	2015	21%	---	41%	43%	9%	29%	62%	25%	39%	26%
	2016	**0%**	**9%**	**50%**	**69%**	**13%**	**11%**	**47%**	**0%**	**56%**	**43%**
It Starts Here! Magazine	2015	6%	---	3%	NA%	4%	5%	22%	0%	27%	6%
	2016	**0%**	**2%**	**11%**	**39%**	**4%**	**0%**	**13%**	**0%**	**32%**	**8%**
Program administrator or site coordinator	2015	76%	---	83%	47%	34%	28%	78%	63%	71%	50%
	2016	**33%**	**40%**	**89%**	**77%**	**76%**	**11%**	**63%**	**43%**	**71%**	**71%**
Invited speakers or “career” events	2015	29%	---	73%	21%	31%	10%	39%	33%	77%	37%
	2016	**27%**	**11%**	**89%**	**23%**	**49%**	**3%**	**25%**	**14%**	**70%**	**8%**
Participation in program	2015	76%	---	89%	93%	56%	73%	83%	75%	83%	81%
	2016	**80%**	**86%**	**89%**	**92%**	**93%**	**70%**	**81%**	**50%**	**80%**	**79%**

Evaluation findings continue to indicate that AEOP mentors in some programs have limited awareness of Army and DoD STEM careers and often lack resources about these careers and the range of AEOPs. As a result, mentors have limited capacity to educate participants about Army and DoD STEM careers and other AEOPs.

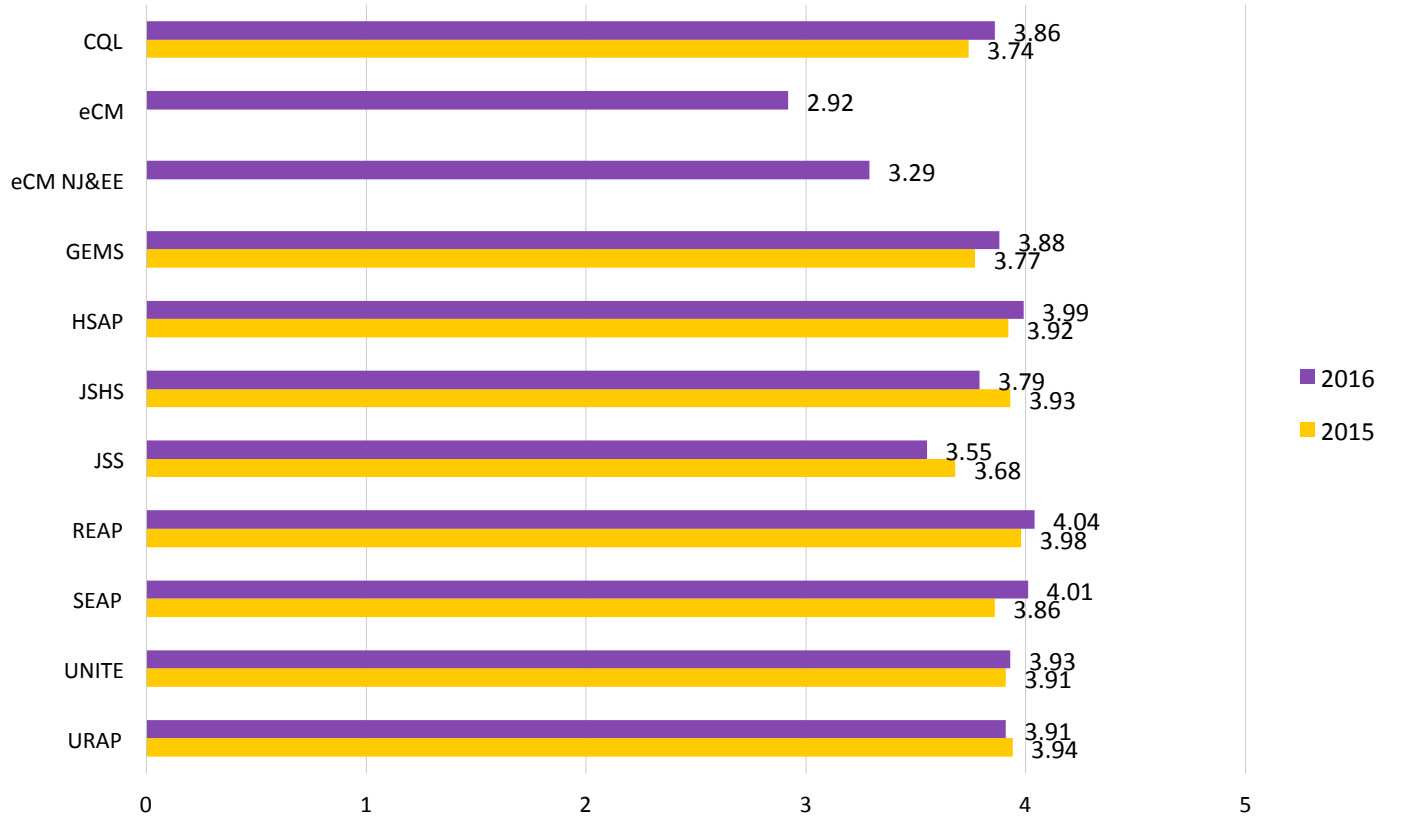
Research Question #5 - To what extent do participants report increased enrollment, achievement, and completion of STEM degree programs?

FY16 AEOP programs served to sustain existing STEM educational and career aspirations of participants and to inspire intentions to pursue post-baccalaureate education. In addition, participants reported gains in interest in pursuing DoD STEM careers as a result of their AEOP participation, although the magnitude of these effects varied across programs.

The FY16 evaluation also explored AEOP participant engagement in STEM activities outside of AEOP or scheduled school classes. The Intentions to Engage in STEM Activities composite (Table 26) included items that asked about things participants may do at home, with family, in clubs, in the community, and in other settings. Findings suggest that participants in AEOP programs had slightly increased levels of interest in these types of activities as compared to their interest before participating in the AEOP. Chart 12 displays the mean composite scores for the apprentices and students across the AEOP programs, and indicates that REAP and SEAP students were most likely to increase their engagement in STEM activities after their AEOP experiences.

Table 26. Items that form the Intentions to Engage in STEM Activity Composite for CQL, GEMS, HSAP, JSHS, JSS, REAP, SEAP, Unite, URAP
1. Watch or read non-fiction STEM
2. Tinker (play) with a mechanical or electrical device
3. Work on solving mathematical or scientific puzzles
4. Use a computer to design or program something
5. Talk with friends or family about STEM
6. Mentor or teach other students about STEM
7. Help with a community service project that relates to STEM
8. Participate in a STEM camp, club, or competition
9. Take an elective (not required) STEM class
10. Work on a STEM project or experiment in a university or professional setting

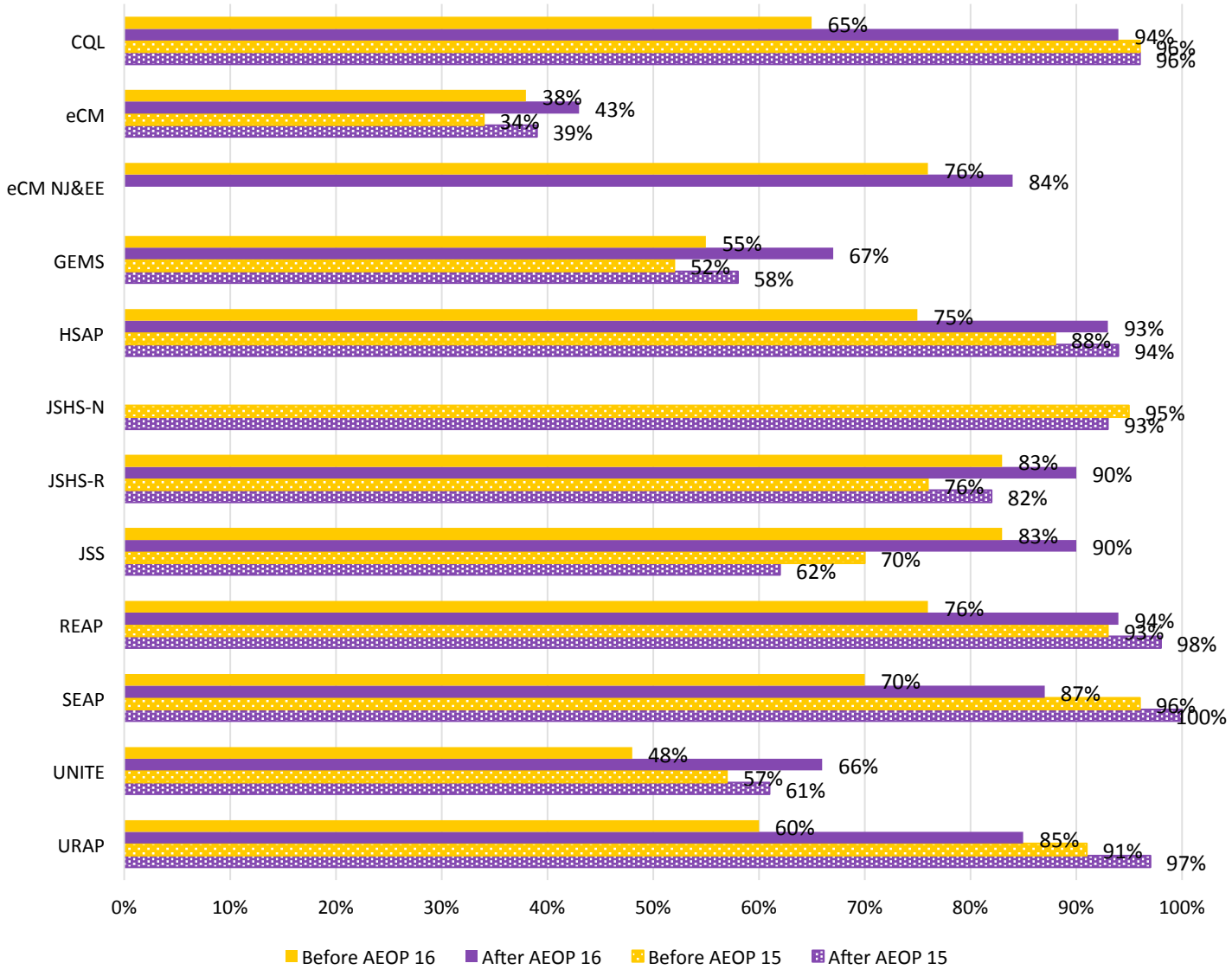
Chart 12: Mean Composite Scores for Intentions to Engage in STEM Activities as a Result of AEOP†



† *Response options for the items forming this composite were: 1 – Much less likely, 2 – Less likely, 3 – About the same before and after, 4 – More likely, 5 – Much more likely.*

The FY16 evaluation included an examination of students' aspirations to extend their education beyond a bachelor's degree both before and after AEOP participation. These data for FY15 and FY16 are displayed in Chart 13. All FY16 participants in all programs reported an increased desire to pursue post-bachelor's degree study. The greatest increases in education aspirations (more than 10% growth in agreement) were for participants in CQL, GEMS, HSAP, REAP, SEAP, Unite, and URAP.

Chart 13: Percent of Students Planning to Continue their Education Beyond a Bachelor's Degree



Priority Two: STEM Savvy Educators

Mentors play a critical role in the AEOP program, designing and facilitating learning activities, delivering content through instruction, supervising and supporting collaboration and teamwork, providing one-on-one support, chaperoning, advising on educational and career paths, and generally serving as STEM role models. The 2016 AEOP evaluation examined the extent to which adults serving in these capacities used research-based strategies for mentoring, as well as the extent to which apprentices and students were satisfied with their mentors.

Research Question #6 - What is the impact of Scientists and Engineers (S&E) Mentors on AEOP participants?

Most AEOP mentors reported using a range of effective mentoring strategies in FY16, including establishing the relevance of learning activities, supporting the diverse needs of students as learners, supporting student development of interpersonal and collaboration skills, supporting student engagement in authentic STEM activities, and supporting student STEM educational and career pathways. Use of mentoring strategies varied across programs, with JSS mentors being least likely to report using these strategies. Mentors across programs were most likely to report using strategies to engage students in authentic STEM activities (range of 83%-96%) and least likely to report using strategies to support their students' STEM educational and career pathways (range of 43%-78%). In spite of the variations, large proportions of mentors in all programs reported using mentoring strategies with their students and apprentices.

Mentors were asked on the questionnaire to report use of effective mentoring strategies with participants. These strategies comprised five main areas of effective mentoring:[13]

1. Establishing the relevance of learning activities;
2. Supporting the diverse needs of students as learners;
3. Supporting students' development of collaboration and interpersonal skills;
4. Supporting students' engagement in "authentic" STEM activities; and
5. Supporting students' STEM educational and career pathways.[14]

For each area, items were combined into composite variables. The items that comprise the Establishing the Relevance of Learning Activities composite are shown in Table 27, and mean composite scores for this variable are shown in Chart 14. For FY16, fewer mentors reported using these strategies in 3 programs (CQL, HSAP, and REAP) than in FY15, however for the other programs (GEMS, JSHS, JSS, , REAP, Unite, and URAP), more mentors reported using such strategies in FY16 as compared to FY15 and, in fact, a majority of mentors in all programs reported using these strategies (range of 56%-88%). Inconsistent use of these mentoring strategies across programs may indicate a need for some type of onboarding, guidelines, or training for mentors to ensure they are cognizant of best practice mentoring strategies and implementing them with their students and apprentices. A comparison of scores from FY15 and FY16 is found in table 28.

[13] Mentoring strategies examined in the evaluation were best practices identified in various articles including:

Maltese, A. V., & Tai, R. H. (2011). Pipeline persistence: Examining the association of educational experiences with earned degrees in STEM among US students. *Science Education*, *95*(5), 877-907.

Ornstein, A. (2006). The frequency of hands-on experimentation and student attitudes toward science: A statistically significant relation (2005-51-Ornstein). *Journal of Science Education and Technology*, *15*(3-4), 285-297.

Sadler, P. M., Sonnert, G., Hazari, Z., & Tai, R. (2012). Stability and volatility of STEM career interest in high school: A gender study. *Science Education*, *96*(3), 411-427.

[14] The student survey asked about a subset of these instructional and mentoring strategies used in the program. Overall, student responses paint a similar picture of the types of practices mentors reported using in 2015. Student data on mentor instructional and mentoring strategies can be found in the individual program reports.

Table 27. Items that form the Establishing the Relevance of Learning Activities Composite for CQL, GEMS, HSAP, JSHS, JSS, REAP, Unite, and URAP
1. Become familiar with my student(s) background and interests at the beginning of the program
2. Giving students real-life problems to investigate or solve
3. Selecting readings or activities that relate to students' backgrounds
4. Encouraging students to suggest new readings, activities, or projects
5. Helping students become aware of the role(s) STEM plays in their everyday lives
6. Helping students understand how STEM can help them improve their community
7. Asking students to relate real-life events or activities to topics covered in the program

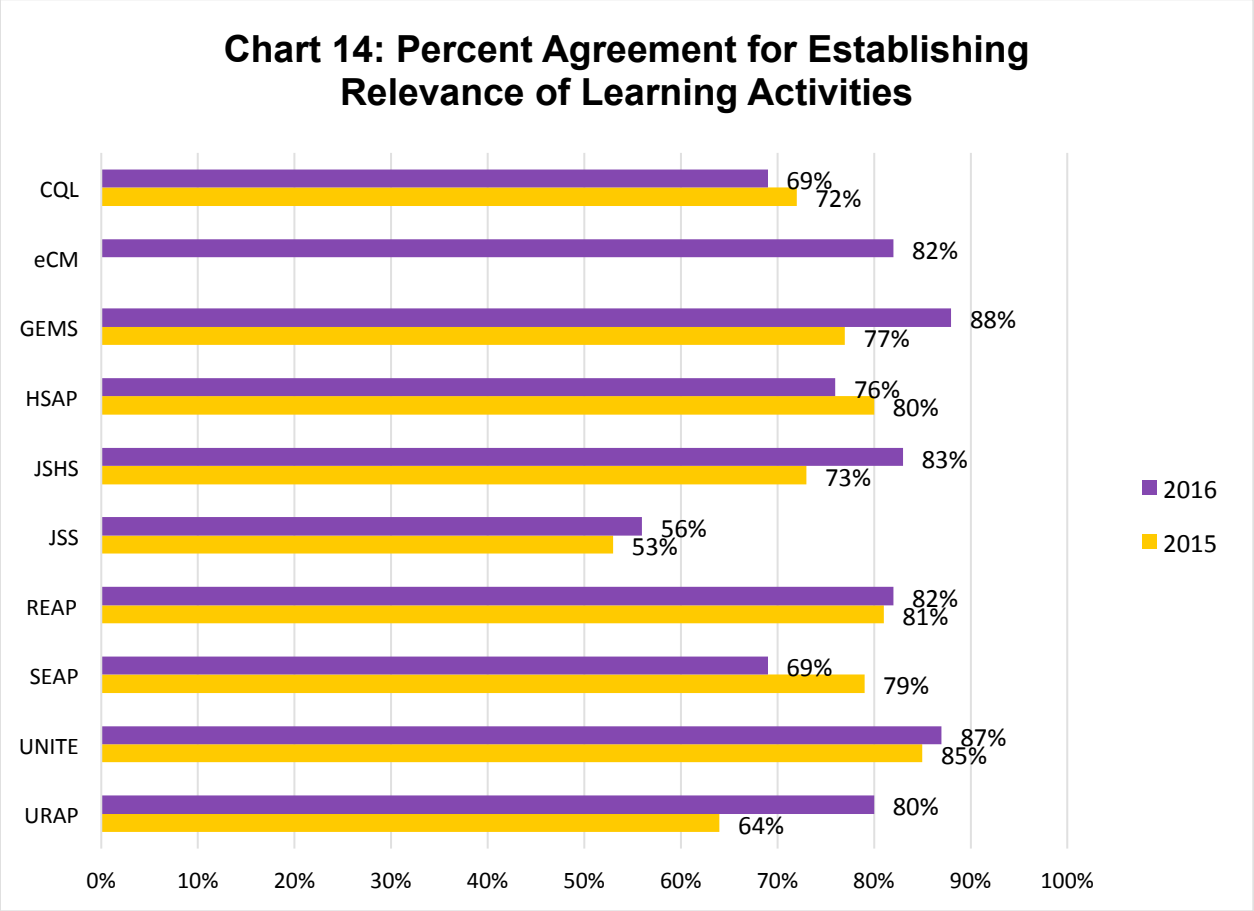


Table 28. Mentor Overall Percent Agreement for Establishing the Relevance of Learning Activities in 2015 - 2016		
	2015 Composite % Agreement	2016 Composite % Agreement
CQL	72%	69%
eCM	---	82%
GEMS	77%	88%
HSAP	80%	76%
JSHS	73%	83%
JSS	53%	56%
REAP	81%	82%
SEAP	79%	69%
Unite	85%	87%
URAP	64%	80%

Similarly, the items comprising the Supporting the Diverse Needs of Students as Learners composite are shown in Table 28, and mean composite scores are shown in Chart 15 and Table 29. Again, in FY16 there was a decline in the reports of the use of these mentoring strategies in some programs (CQL, HSAP, JSS, REAP and SEAP) as compared to FY15 reports while Unite mentors reported using these strategies at the same levels (82%) in both years. More mentors in GEMS, JSHS, and URAP reported using these strategies in FY16 and over half of mentors in all programs used strategies to support the diverse needs of students as learners (57%-82%) in FY16. A comparison of scores from FY15 and FY16 is found in table 30.

Table 29. Items that form the Supporting the Diverse Needs of Students as Learners Composite for CQL GEMS, HSAP, JSHS, JSS, REAP, SEAP, Unite, and URAP
1. Identify the different learning styles that my student(s) may have at the beginning of their program
2. Interact with students and other personnel the same way regardless of their background
3. Use a variety of teaching and/or mentoring activities to meet the needs of all students
4. Integrating ideas from education literature to teach/mentor students from groups underrepresented in STEM
5. Providing extra readings, activities, or learning support fro students who lack essential background knowledge or skills
6. Directing students to other individuals or programs for additional support as needed
7. Highlighting under-representation of women and racial and ethnic minority populations in STEM and/or their contributions in STEM

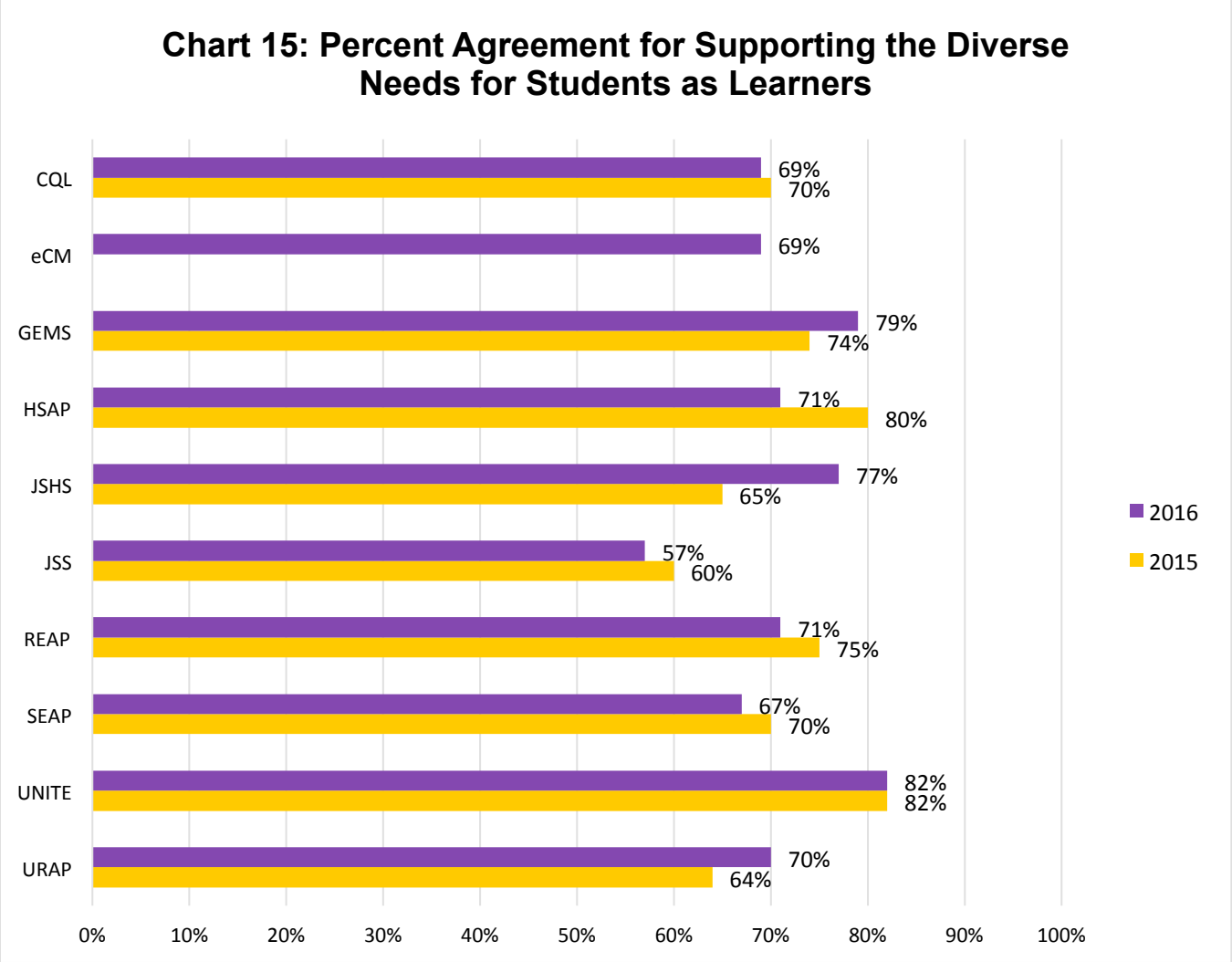


Table 30. Mentor Overall Percent Agreement for Supporting the Diverse Needs of Students as Learners in 2015 - 2016		
	2015 Composite % Agreement	**2016 Composite % Agreement**
CQL	70%	69%
eCM	---	69%
GEMS	74%	79%
HSAP	80%	71%
JSHS	65%	77%
JSS	60%	57%
REAP	75%	71%
SEAP	70%	67%
Unite	82%	82%
URAP	64%	70%

The third area of mentoring is comprised of strategies that together form the composite Supporting Student Development of Collaboration and Interpersonal Skills (Table 31 and Chart 16). The number of mentors using these strategies declined from FY15 levels in both CQL and Unite although they increased in all other programs except for SEAP where mentor reports remained constant at FY15 levels. A large majority of mentors in all programs reported using these strategies (range of 73%-94%). A comparison of scores from FY15 and FY16 is found in table 32.

Table 31. Items that form the Supporting Student Development of Collaboration and Interpersonal Skills Composite for CQL, GEMS, HSAP, JSHS, JSS, REAP, SEAP, Unite, and URAP
1. Having student(s) tell others about their backgrounds and interests
2. Having student(s) explain difficult ideas to others
3. Having student(s) listen to the ideas of others with an open mind
4. Having student(s) exchange ideas with others whose backgrounds or viewpoints are different from their own
5. Having student(s) give and receive constructive feedback with others
6. Having my student(s) work on collaborative activities or projects as a member of a team
7. Allowing my student(s) to resolve conflicts and reach agreement within their team

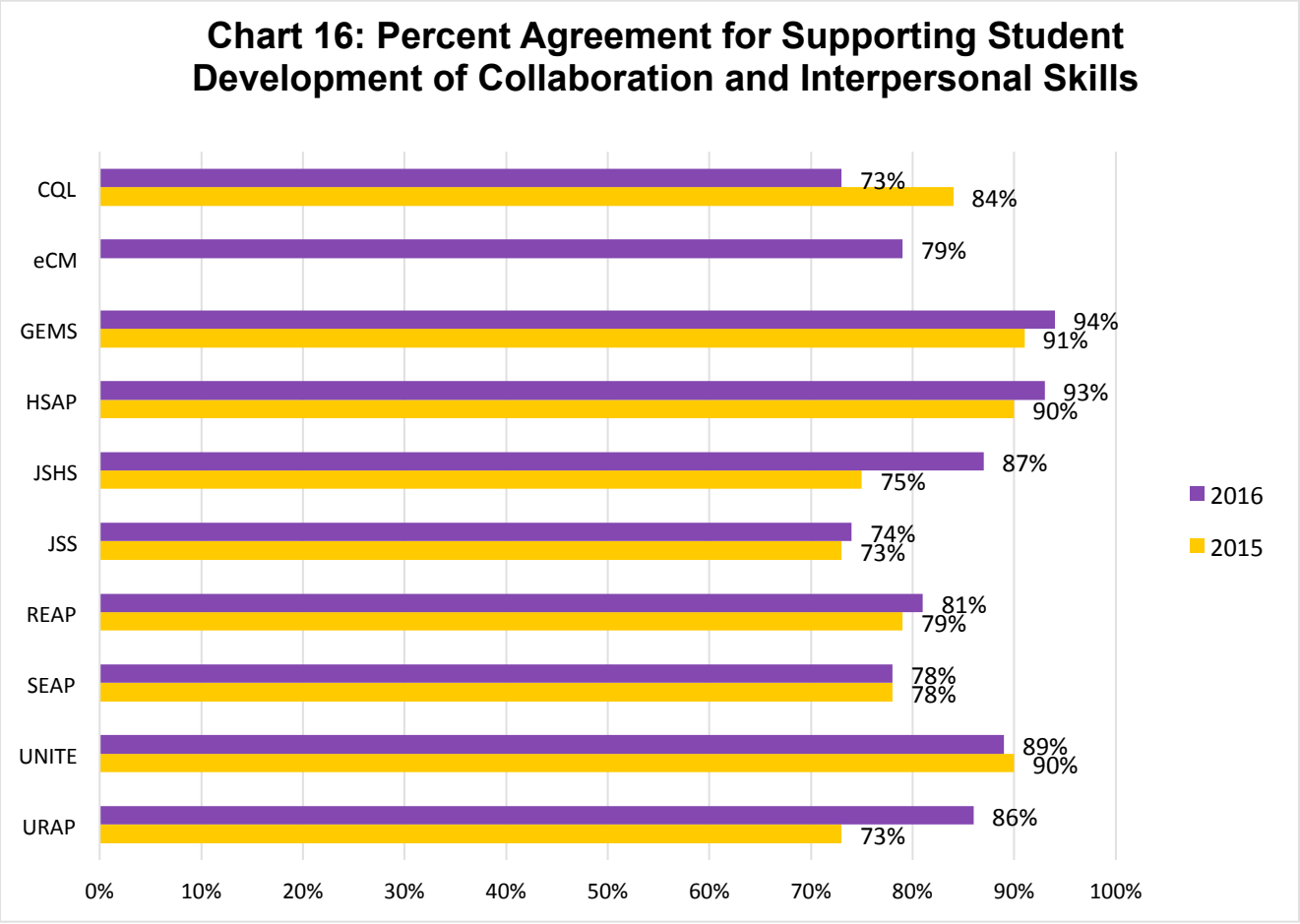


Table 32. Mentor Overall Percent Agreement for Supporting Student Development of Collaboration and Interpersonal Skills in 2015 - 2016		
	2015 Composite % Agreement	2016 Composite % Agreement
CQL	84%	73%
eCM	---	79%
GEMS	91%	94%
HSAP	90%	93%
JSHS	75%	87%
JSS	73%	74%
REAP	79%	81%
SEAP	78%	78%
Unite	90%	89%
URAP	73%	86%

The fourth set of mentoring strategies focused on supporting student engagement in "authentic" STEM activities; the items comprising the composite for these strategies are shown in Table 33 and the mean composites for each program are displayed in Chart 17. As with the other mentoring strategy composites, this composite indicates that mentor use of these strategies declined slightly for some programs (CQL, HSAP, JSS, and REA) as compared to FY15 and increased slightly for others (GEMS, JSHS, SEAP, Unite, and REAP). Across programs, however, a large majority of mentors reported using strategies to support student engagement in authentic STEM activities (range of 83%-96%). A comparison of FY15 and FY16 scores for this composite is provided in Table 34.

Table 33. Items that form the Supporting Student Engagement in "Authentic" STEM Activities Composite for CQL, GEMS, HSAP, JSHS, JSS, REAP, SEAP, Unite, and URAP
1. Teaching (or assigning readings) about specific STEM subject matter
2. Having my student(s) search for and review technical research to support their work
3. Demonstrating laboratory/field techniques, procedures, and tools for my student(s)
4. Supervising my student(s) while they practice STEM research skills
5. Providing my student(s) with constructive feedback to improve their STEM competencies
6. Allowing students to work independently to improve their self-management abilities
7. Encouraging students to learn collaboratively (team projects, team meetings, journal clubs, etc.)
8. Encouraging students to seek support from other team members

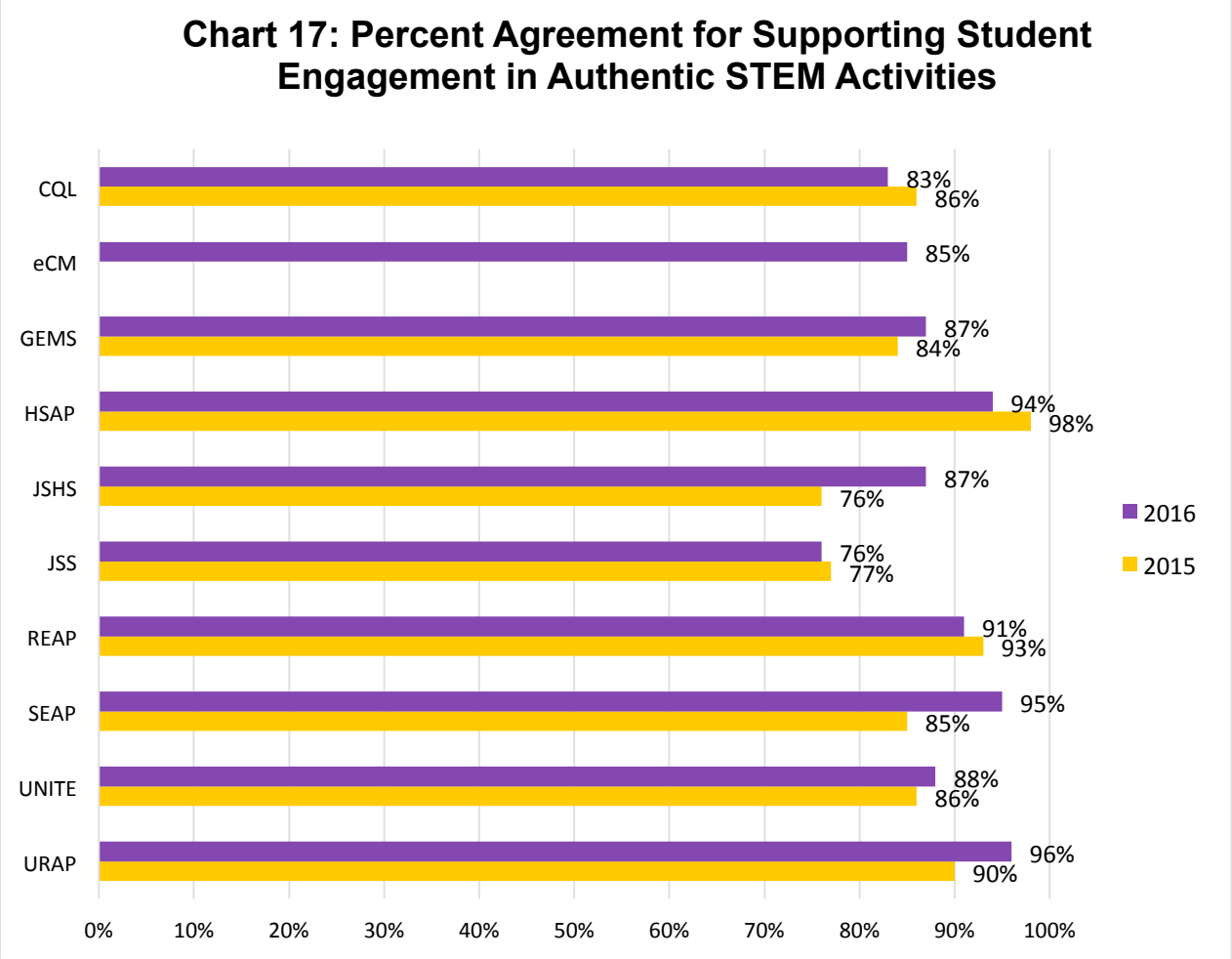


Table 34. Mentor Overall Percent Agreement for Supporting Student Engagement in Authentic STEM Activities in 2015 - 2016		
	2015 Composite % Agreement	**2016 Composite % Agreement**
CQL	86%	83%
eCM	---	85%
GEMS	84%	87%
HSAP	98%	94%
JSHS	76%	87%
JSS	77%	76%
REAP	93%	91%
SEAP	85%	95%
Unite	86%	88%
URAP	90%	96%

The final set of mentoring strategies focused on supporting students' STEM educational and career pathways. The items comprising this composite are shown in Table 35, and mean composite scores are shown in Chart 18. Again, mentor reports of using these strategies varied across programs and in comparison to FY15 reports. Fewer mentors in CQL, HSAP, JSS, and REAP reported using these strategies as compared to FY15 while more mentors in GEMS, JSHS, Unite, and URAP used these strategies in FY16 as compared to FY15. Findings indicate that mentors used these strategies somewhat less frequently than the other mentoring strategies they were asked about (range of 43%-78%). Table 36 provides a comparison for FY15 and FY16 of the composite scores for mentor strategies to support students' STEM educational and career pathways.

Table 35. Items that form the Supporting Student STEM Educational and Career Pathways Composite for CQL, GEMS, HSAP, JSHS, JSS, REAP, SEAP, Unite, and URAP
1. Asking my student(s) about their educational and/or career goals
2. Recommending extracurricular programs that align with students' goals
3. Providing guidance about educational pathways that would prepare student(s) for a STEM career
4. Recommending Army Educational Outreach Programs that align with students' educational goals
5. Discussing STEM career opportunities within the DoD or other government agencies
6. Discussing STEM career opportunities in private industry or academia
7. Discussing the economic, political, ethical, and/or social context of a STEM career
8. Recommending student and professional organizations in STEM to my student(s)
9. Helping students build a professional network in a STEM field
10. Helping my student(s) with their resume, application, personal statement, and/or interview preparations

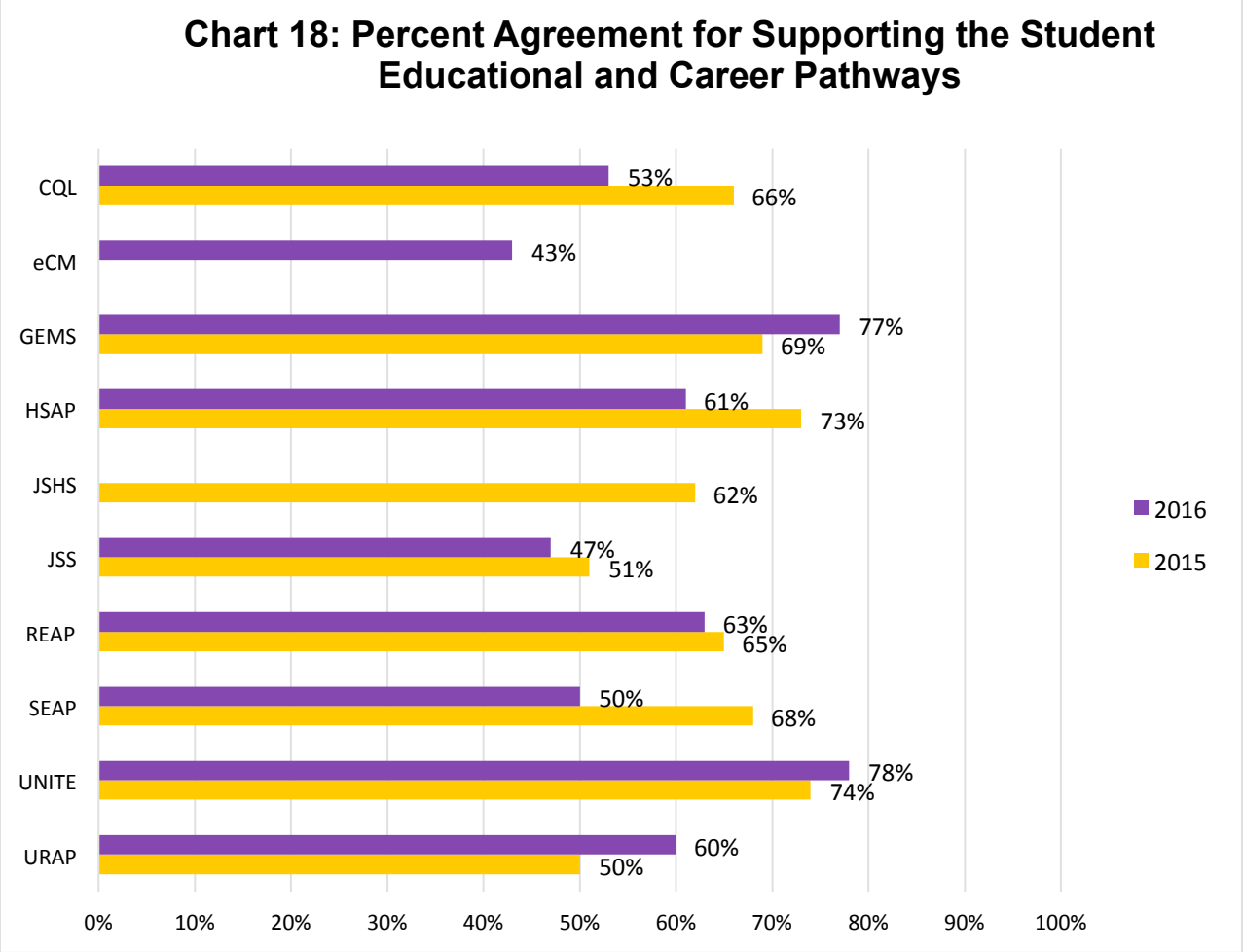
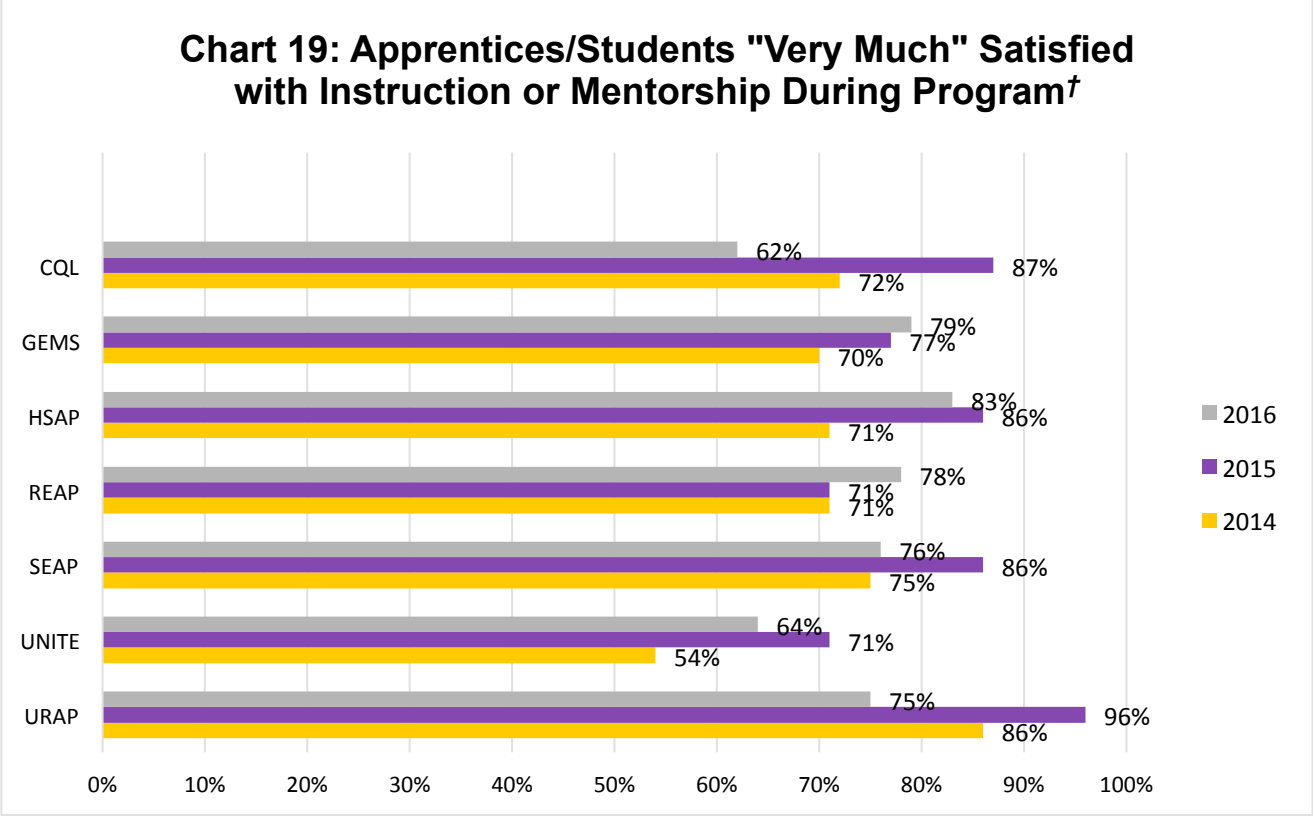


Table 36. Mentor Overall Percent Agreement for Supporting Student Engagement in Authentic STEM Activities in 2015 - 2016		
	2015 Composite % Agreement	**2016 Composite % Agreement**
CQL	66%	53%
eCM	---	43%
GEMS	69%	77%
HSAP	73%	61%
JSHS	62%	68%
JSS	51%	47%
REAP	65%	63%
SEAP	68%	50%
Unite	74%	78%
URAP	50%	60%

Overall, mentors were least likely to report using strategies to support their students' educational and career pathways, a finding that raises particular concern when considered in conjunction with findings that mentors face challenges in exposing students to and engaging them in DoD research (Priority 1, Finding #5) and mentors' mixed perceptions of the usefulness of resources for exposing students to DoD STEM careers (Priority 1, Finding #6). This is an area that should be addressed across the portfolio of AEOPs, possibly with additional training and orientation and a close examination of the availability of and usefulness of resources provided to mentors.

Across the AEOPs, most apprentices and students reported high levels of satisfaction with their mentors and the quality of instruction they received, although these levels of satisfaction were somewhat lower than those reported in FY15. The FY16 evaluation included an examination of participant satisfaction with mentorship during the AEOP program experience. Satisfaction with mentorship serves as a gauge of student perceptions of the quality of their mentoring experience, with quality mentoring conceptualized as a positive relationship that will result in a more meaningful and impactful experience and that may be sustained after program participation ends. Chart 19 displays data for apprentices and students who indicated that they were "very much" satisfied with their mentoring experience or instruction during their AEOP experience, and Table 37 contains a comparison of these data for 2014, 2015, and 2016. Although substantial numbers of participants were very satisfied with the mentoring or instruction they received in the program, the proportion of participants who reported being very satisfied with their mentoring experience declined for several programs (CQL, HSAP, SEAP, Unite, and URAP0 and increased in only two (GEMS and REAP) as compared to FY15. Overall, participants appeared to be more satisfied with their mentoring experience in FY15 (range of 71%-96%) as compared to in FY16 (range of 62%-83%).



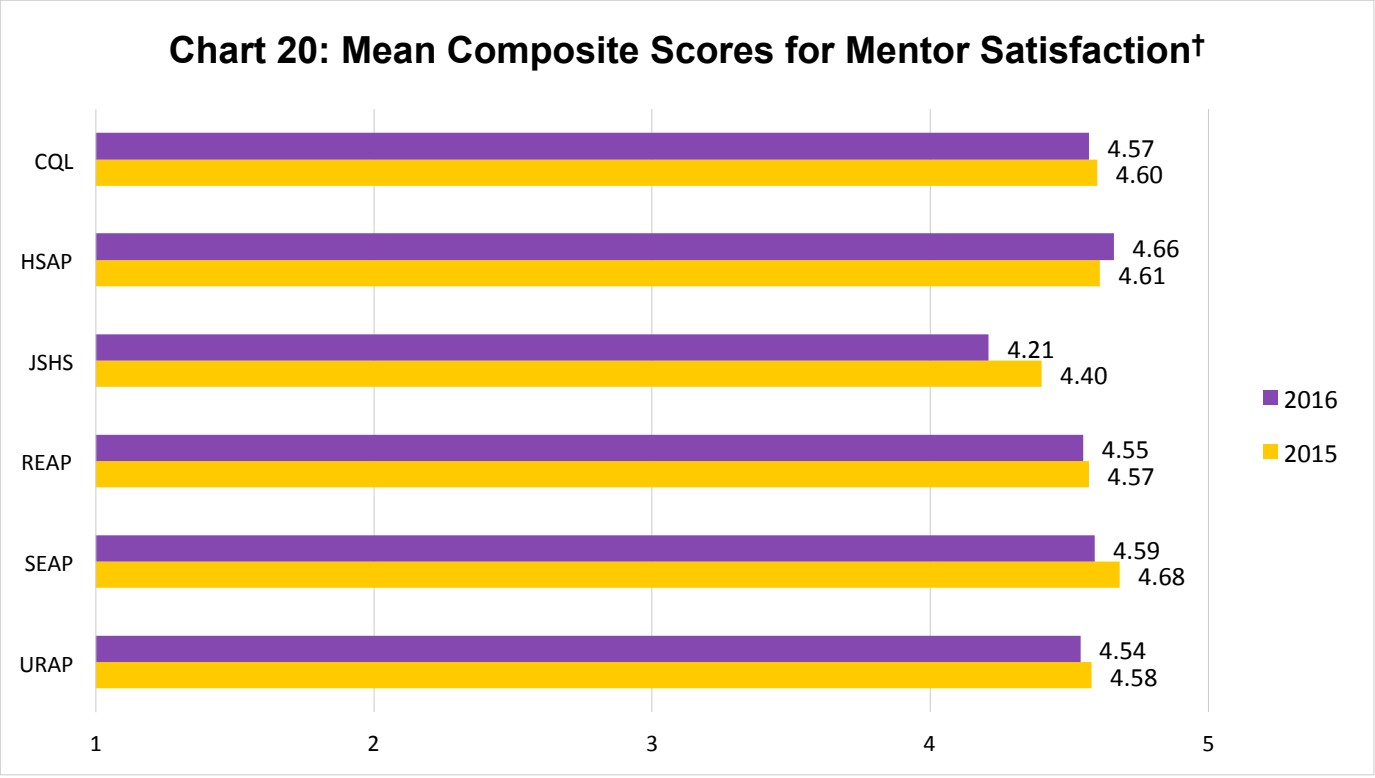
† *Only programs who work directly with a mentor (non-teacher) were asked this question.*

Table 37. Participants "Very Much" Satisfied with Instruction or Mentorship During Program 2014 vs. 2015			
	2014	**2015**	**2016**
CQL	72%	87%	62%
GEMS	70%	77%	79%
HSAP	71%	86%	83%
REAP	71%	71%	78%
SEAP	75%	86%	76%
Unite	54%	71%	64%
URAP	86%	96%	75%

The FY16 evaluation also asked participants in apprentice programs (CQL, REAP, SEAP, and URAP) and JSHS to weigh in on a number of aspects of their experiences with their mentors. These items are shown in Table 38 and were used to create a Mentor Satisfaction Composite Variable. As can be seen in Chart 20, scores on this composite were uniformly high across programs, indicating that participants were very satisfied with the quality of the mentoring they received.

Table 38. Items that form the Mentor Satisfaction Composite for CQL, HSAP, JSHS, REAP, SEAP, and URAP
1. My working relationship with my mentor
2. My working relationship with the group or team†
3. The amount of time I spent doing meaningful research
4. The amount of time I spent with my research mentor
5. The research experience overall

† *This question was not included on the JSHS survey.*



† *Response options for the items forming this composite were: 0 – Did not experience, 1 – Not at all, 2 – A little, 3 – Somewhat, 4 – Very much.*

Research Question #7 - To what extent do teacher participants report increased use of new approaches to teaching research concepts within STEM practices, and infusion of careers?

FY16 was the first year of operation for Research Experiences for STEM Educators and Teachers (RESET), an AEOP specifically designed to support STEM educators' content knowledge and to provide them with research experiences that they can translate into enhanced STEM curricula and learning experiences in their classrooms. While the data collected from participants was solely qualitative in this inaugural program year, preliminary findings indicate that RESET supported the AEOP's objective of supporting and empowering educators with Army research and technology resources. Participants were enthusiastic about the opportunities they had to network with other educators, their exposure to

Army/DoD research, and their plans to implement their RESET learning in their classrooms. For example, interview participants commented:

> *[RESET] made me re-examine some of the things that I've always done in my classroom or that I recently started doing, and think about why I'm doing that, and if it's really getting the results that I want.* [RESET Participant]

> *[A benefit of participating in RESET is] to actually help our students to see that this stuff is not just something we're teaching and they have to test on; that it's things that they have to know how to apply when they get to the real world.* [RESET Participant]

> *I definitely think [the best part of RESET] is being able to network and connect with people who are in your field, but that you wouldn't have access to normally…You can hear the different perspectives and ideas.* [RESET Participant]

Priority Three: Sustainable Infrastructure

Findings from the FY16 AEOP evaluation reveal some progress toward achieving a sustainable infrastructure. Major trends that support the achievement of this AEOP priority along with evidence from assessment data that inform the findings are presented below by associated research question(s).

Research Question #8 - To what extent do participants report growth in awareness of and/or interest in AEOP opportunities?

Despite increased investment and attention to external communications regarding AEOP opportunities in FY16, personal connections, including friends, teachers and or professors, or someone who works at the university or school the participant attends continue to be the most frequently cited means of participant information about programs (Table 39). GEMS students and SEAP and CQL apprentices were most likely to report having heard about the program through personal connections, including friends, family members, or past participants of the program. Students in eCM, and Unite and SEAP and URAP apprentices frequently heard about the AEOP through a school or university newsletter or website. Nearly half of eCM and URAP participants reported hearing about AEOP through a teacher or professor, while nearly a quarter of CQL students learned about AEOP from someone who works with the program. While over a quarter of SEAP apprentices reported learning about the AEOP through the AEOP website, few participants in other programs reported this as a source of information.

Table 39. How Students Learned About their AEOP Program (Compared to 2015)

	CQL	eCM	GEMS	HSAP	JSHS-R	JSS	REAP	SEAP	Unite	URAP
Friend	**7%** (32%)	**0%** (NA)	**21%** (27%)	**0%** (18%)	**10%** (0%)	**9%** (7%)	**6%** (17%)	**9%** (22%)	**8%** (11%)	**0%** (6%)
Family member	**11%** (NA)	**0%** (NA)	**19%** (27%)	**12%** (10%)	**5%** (5%)	**8%** (2%)	**7%** (16%)	**21%** (39%)	**19%** (8%)	**0%** (3%)
Past participant of program	**13%** (19%)	**0%** (NA)	**20%** (28%)	**0%** (0%)	**21%** (14%)	**16%** (3%)	**12%** (16%)	**12%** (36%)	**4%** (18%)	**0%** (17%)
School or university newsletter,	**4%** (14%)	**0%** (0%)	**10%** (13%)	**12%** (10%)	**18%** (20%)	**13%** (11%)	**17%** (24%)	**13%** (17%)	**25%** (13%)	**29%** (7%)

email, or website										
Someone who works with the Department of Defense	**23%** (32%)	**0%** (0%)	**6%** (15%)	**6%** (0%)	**1%** (1%)	**0%** (1%)	**2%** (1%)	**13%** (35%)	**1%** (0%)	**0%** (2%)
Website: AEOP	**5%** (8%)	**25%** (NA)	**11%** (13%)	**15%** (NA)	**7%** (0%)	**0%** (1%)	**13%** (11%)	**11%** (25%)	**3%** (3%)	**0%** (0%)
Someone who works with the program	**14%** (18%)	**0%** (NA)	**4%** (6%)	**15%** (26%)	**4%** (9%)	**2%** (1%)	**16%** (15%)	**8%** (31%)	**13%** (16%)	**13%** (17%)
AEOP social media	**NA** (NA)	**0%** (0%)	**NA** (NA)	**NA** (NA)	**1%** (NA)	**0%** (NA)	**2%** (NA)	**1%** (NA)	**2%** (NA)	**4%** (NA)
Teacher or someone who works at school/university I attend	**14%** (26%)	**25%** (NA)	**5%** (10%)	**36%** (48%)	**25%** (30%)	**30%** (11%)	**19%** (32%)	**11%** (23%)	**21%** (11%)	**46%** (33%)
Community group or program	**0%** (NA)	**50%** (NA)	**3%** **(NA)**	**3%** (NA)	**4%** (NA)	**9%** (NA)	**5%** (NA)	**3%** (NA)	**3%** (NA)	**4%** (NA)
Other	NA (4%)	**0%** (NA)	**NA** (7%)	**NA** (0%)	**NA** (4%)	**NA** (2%)	**NA** (8%)	**NA** (2%)	**NA** (4%)	**0%** (0%)
Choose not to report	**9%** (NA)	**14%** (NA)	**.5%** (NA)	**0%** (0%)	**5%** (3%)	**14%** (9%)	**3%** (0%)	**0%** (0%)	**4%** (2%)	**4%** (0%)

The FY16 evaluation also included an item in which mentors were asked identify the sources through which they learned about the AEOP. Findings for FY15 and FY16 are presented in Table 40. Most agreed that past participants as well as the school, university, or professional organization newsletter, email or website were the primary means of learning about AEOP. The exceptions included SEAP and CQL, in which mentors noted someone who works with the Department of Defense was their main source of information, and eCM mentors who shared the AEOP website was their primary means of learning about the program.

Table 40. How Mentors Learned about their AEOP Program (Compared to 2015)

	CQL	eCM	GEMS	JSHS	JSS	REAP	SEAP	Unite	URAP
Past participant	**15%** (3%)	**17%** (NA)	**16%** (28%)	**62%** (29%)	**39%** (7%)	**36%** (24%)	**17%** (30%)	**6%** (64%)	**24%** (0%)
School, university, or professional organization newsletter, email, or website	**0%** (8%)	**33%** (NA)	**18%** (20%)	**12%** (3%)	**8%** (4%)	**10%** (10%)	**17%** (0%)	**18%** (0%)	**18%** (21%)
Site host, director, or someone who works with program	**8%** (3%)	**0%** (NA)	**18%** (28%)	**4%** (17%)	**6%** (NA)	**11%** (22%)	**0%** (13%)	**24%** (0%)	**24%** (11%)
Social media	**0%** (0%)	**0%** (NA)	**0%** (1%)	**0%** (NA)	**0%** (NA)	**1%** (0%)	**0%** (0%)	**6%** (0%)	**0%** (0%)
Someone who works with the Department of Defense	**46%** (16%)	**0%** (NA)	**14%** (18%)	**0%** (20%)	**3%** (7%)	**6%** (2%)	**50%** (0%)	**0%** (0%)	**12%** (6%)
Friends	**0%** (NA)	**0%** (NA)	**7%** (23%)	**4%** (0%)	**3%** (NA)	**4%** (NA)	**0%** (NA)	**0%** (21%)	**0%** (NA)
Family member	**0%** (NA)	**0%** (NA)	**11%** (19%)	**0%** (1%)	**3%** (NA)	**0%** (NA)	**0%** (NA)	**0%** (14%)	**0%** (NA)

Community group or program	**0%** (NA)	**0%** (NA)	**NA** (1%)	**4%** (NA)	**6%** (NA)	**0%** (NA)	**0%** (NA)	**0%** (NA)	**0%** (NA)
Website: AEOP	**15%** (19%)	**50%** (NA)	**7%** (11%)	**0%** (3%)	**22%** (4%)	**10%** (20%)	**0%** (22%)	**12%** (14%)	**24%** (32%)
Choose Not to Report	**15%** (NA)	**0%** (NA)	**2%** (NA)	**8%** (NA)	**8%** (NA)	**1%** (NA)	**17%** (NA)	**0%** (NA)	**0%** (NA)

When students and apprentices were asked about factors motivating their participation in the AEOP, many students mentioned interest in STEM across all programs. There were some differences, however, in motivating factors across program types. Students in the AEOP competition programs (JSS, JSHS, eCM) reported that "having fun" and "teacher encouragement" greatly motivated their decision to participate in these programs. Students in the enrichment programs (GEMS, Unite) and apprenticeships (SEAP, HSAP, REAP, URAP, CQL) were largely motivated by the learning opportunities and experiences available through the programs and cited several factors as "very much" motivating in their decision to participate in these programs, including:

- Interest in STEM
- Desire to learn something new or interesting;
- Learning in ways that are not possible in school;
- Desire to expand laboratory or research skills; and
- Opportunity to use advanced laboratory techniques/technology.

The intent of the AEOP initiatives is to build a pipeline of opportunities for students in STEM beginning in the elementary grades and continuing across their high school and post-secondary studies. Ongoing efforts over the past several years have been made to strengthen communication about AEOP programs to potential and current participants. In order to understand the effectiveness of these efforts, the FY16 evaluation examined two aspects of the AEOP pipeline: 1) past participation in AEOPs, and 2) interest in future participation in AEOPs. Table 41 displays data for past participation in AEOPs and indicates that some programs have been more successful at recruiting participants with previous AEOP experience than others.

Table 41. AEOP Participants Reporting Having Participated in Other AEOPs											
Current Program	**Year**	**eCM**	**JSS**	**JSHS**	**GEMS**	**Unite**	**HSAP**	**REAP**	**SEAP**	**URAP**	**CQL**
CQL	2015	5%	2%	2%	13%	2%	3%	4%	32%	2%	84%
	2016	**0%**	**0%**	**1%**	**19%**	**0%**	**0%**	**1%**	**14%**	**0%**	**32%**
eCM	2015	---	2%	2%	3%	NA	1%	2%	4%	NA	NA
	2016	**---**	**---**	**---**	**---**	**---**	**---**	**---**	**---**	**---**	**---**
GEMS	2015	1%	---	---	34%	---	---	---	---	---	---
	2016	**3%**	**<1%**	**<1%**	**38%**	**<1%**	**0%**	**0%**	**0%**	**0%**	**0%**
HSAP	2015	0%	0%	0%	25%	0%	75%	0%	0%	0%	0%
	2016	**0%**	**0%**	**0%**	**3%**	**3%**	**0%**	**0%**	**0%**	**NA**	**NA**
JSHS	2015	---	---	---	---	---	---	---	---	---	---
	2016	**4%**	**<1%**	**35%**	**2%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**
JSS	2015	0%	0%	0%	0%	1%	NA†	NA†	NA†	NA†	NA†
	2016	**3%**	**62%**	**0%**	**3%**	**0%**	**NA†**	**NA†**	**NA†**	**NA†**	**NA†**
REAP	2015	2%	1%	8%	33%	27%	3%	77%	2%	---	---
	2016	**1%**	**0%**	**0%**	**2%**	**10%**	**0%**	**4%**	**1%**	**0%**	**0%**
SEAP	2015	1%	0%	0%	31%	0%	1%	0%	36%	0%	0%
	2016	**2%**	**2%**	**0%**	**35%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**
Unite	2015	13%	13%	15%	20%	81%	13%	20%	20%	---	---
	2016	**0%**	**0%**	**0%**	**1%**	**7%**	**1%**	**1%**	**2%**	**0%**	**0%**
URAP	2015	0%	0%	0%	0%	0%	0%	0%	0%	6%	0%
	2016	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**

Participants were also asked to indicate their level of interest in participating in each of the applicable programs in the portfolio in the future. Table 42 presents the percentage of current AEOP participants that indicated they were "interested" or "very interested" in other programs in the AEOP portfolio. Most program participants were somewhat interested in other AEOPs. All programs had at least 28% of participants who indicated being interested in participating in other AEOPs.

Table 42. AEOP Participants Reporting Substantial† Interest in Participating in Other AEOPs														
	Year	**eCM**	**JSS**	**JSHS**	**GEMS**	**Unite**	**HSAP**	**REAP**	**SEAP**	**URAP**	**CQL**	**SMART**	**NDSEG**	**GEMS -NPM**
CQL	2015	---	---	---	---	---	---	---	---	13%	55%	33%	29%	8%
	2016	**NA‡**	**NA‡**	**NA‡**	**20%**	**NA‡**	**NA‡**	**NA‡**	**NA‡**	**16%**	**54%**	**43%**	**35%**	**---**
eCM	2015	---	11%	14%	25%	13%	16%	15%	16%	14%	12%	20%	---	---
	2016	**38%**	**11%**	**11%**	**13%**	**10%**	**13%**	**12%**	**13%**	**11%**	**13%**	17%	14%	---
eCM NJ&EE	2015	---	---	---	---	---	---	---	---	---	---	---	---	---
	2016	**90%**	**41%**	**55%**	**70%**	**44%**	**56%**	**53%**	**61%**	**43%**	**54%**	**50%**	**47%**	**---**
GEMS	2015	10%	11%	11%	61%	10%	19%	20%	24%	17%	17%	25%	16%	35%
	2016	**16%**	**16%**	**16%**	**73%**	**12%**	**24%**	**24%**	**28%**	**19%**	**18%**	**28%**	**18%**	**43%**
HSAP	2015	---	---	---	---	---	---	---	---	50%	15%	35%	24%	3%
	2016	**NA**	**NA**	**19%**	**NA**	**7%**	**NA**	**46%**	**36%**	**43%**	**11%**	**32%**	**21%**	**---**
JSHS	2015	---	---	83%	10%	7%	10%	22%	9%	23%	15%	39%	22%	12%

	2016	**NA**	**NA**	**89%**	**30%**	**24%**	**29%**	**30%**	**31%**	**29%**	**27%**	**33%**	**29%**	**25%**
JSS	2015	6%	62%	8%	10%	8%	7%	10%	9%	4%	6%	9%	9%	8%
	2016	**15%**	**86%**	**11%**	**19%**	**8%**	**16%**	**16%**	**18%**	**14%**	**15%**	**22%**	**16%**	**14%**
REAP	2015	NA	NA	27%	22%	20%	29%	74%	46%	43%	22%	42%	24%	19%
	2016	**NA**	**NA**	**37%**	**40%**	**41%**	**59%**	**81%**	**63%**	**63%**	**53%**	**62%**	**46%**	**36%**
SEAP	2015	NA	NA	9%	NA	9%	17%	17%	67%	24%	51%	41%	15%	23%
	2016	**NA**	**NA**	**15%**	**NA**	**8%**	**15%**	**39%**	**71%**	**42%**	**42%**	**55%**	**35%**	**33%**
Unite	2015	NA	NA	22%	27%	56%	30%	34%	30%	27%	27%	38%	27%	25%
	2016	**NA**	**NA**	**42%**	**50%**	**85%**	**56%**	**56%**	**54%**	**52%**	**51%**	**61%**	**49%**	**50%**
URAP	2015	---	---	---	---	---	---	---	---	82%	7%	19%	15%	7%
	2016	---	---	---	---	---	---	---	---	---	---	---	---	---

As in FY14 and FY15, the FY16 evaluation suggests that across the AEOP, all groups (e.g., youth participants and mentors) have limited awareness of AEOP programs other than those in which they are currently participating. In spite of this, students and apprentices continue to express interest in participating in other AEOPs in the future. The Army, program administrators, site and event coordinators, mentors, and other volunteers share responsibility for exposing participants to other AEOP initiatives and for encouraging continued participation in programs for which they qualify. Program administrators should continue to bolster efforts to educate site and event coordinators, mentors, and other volunteers about AEOP opportunities so that all participants leave with a clear understanding of the AEOPs available to them.

Mid to Long-Term Evaluation

The FY16 AEOP evaluation included an alumni survey and telephone interviews with a sample of alumni. This portion of the evaluation is intended to capture near-term and mid-to long-term outcomes of AEOP participation.

An open-ended interview format was used for the 22 telephone interviews held with alumni of various programs in the AEOP portfolio. These interviews were used to elicit participant responses related to the alumni evaluation questions. The interview protocol is provided in Appendix. In particular, students were asked questions regarding:

- The impact of S&E mentors
- The influence of their AEOP participation on their attitudes toward and interest in STEM and Army/DoD STEM research and careers
- Their engagement in STEM outside of school
- Their pursuit of and achievement in STEM courses and degree programs

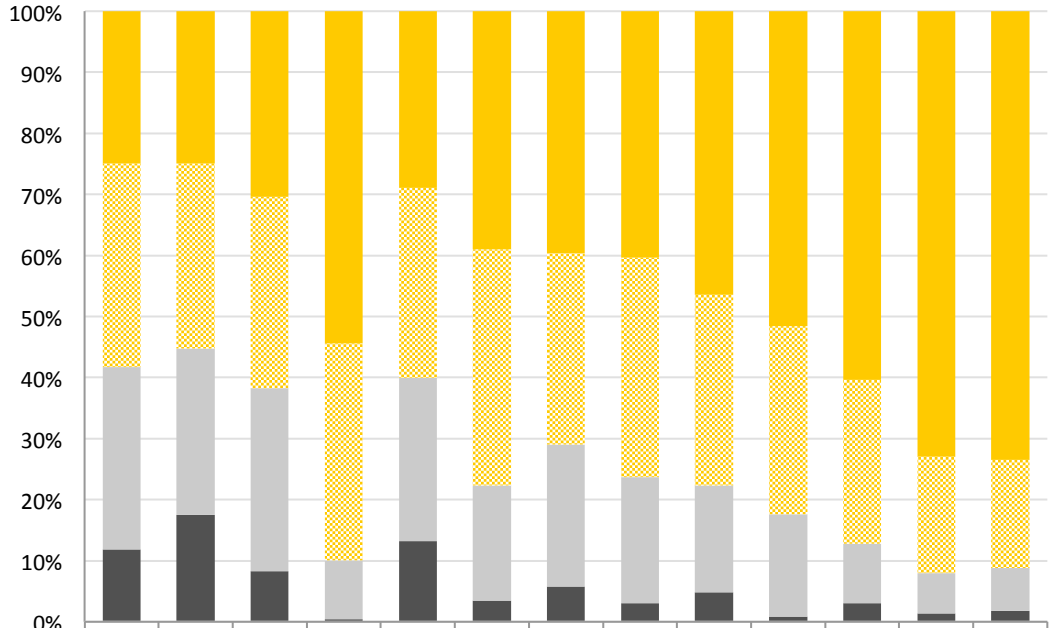
PRIORITY ONE: STEM Literate Citizenry

Research Question #1 - To what extent do alumni report positive, sustained interest and engagement in STEM?

Participating alumni were asked to report their current interest in STEM activities. The vast majority (92%) of responding alumni indicated they were both interested in earning a STEM degree and pursuing a STEM career. Most (82%) indicated interest in taking elective STEM courses, and 87% were interested in potential STEM projects/experiments in a university

or professional setting. Further, 90% reported being interested in learning about new things in STEM. These findings clearly indicate that past participants of AEOPs have current interest in STEM (Chart 21).

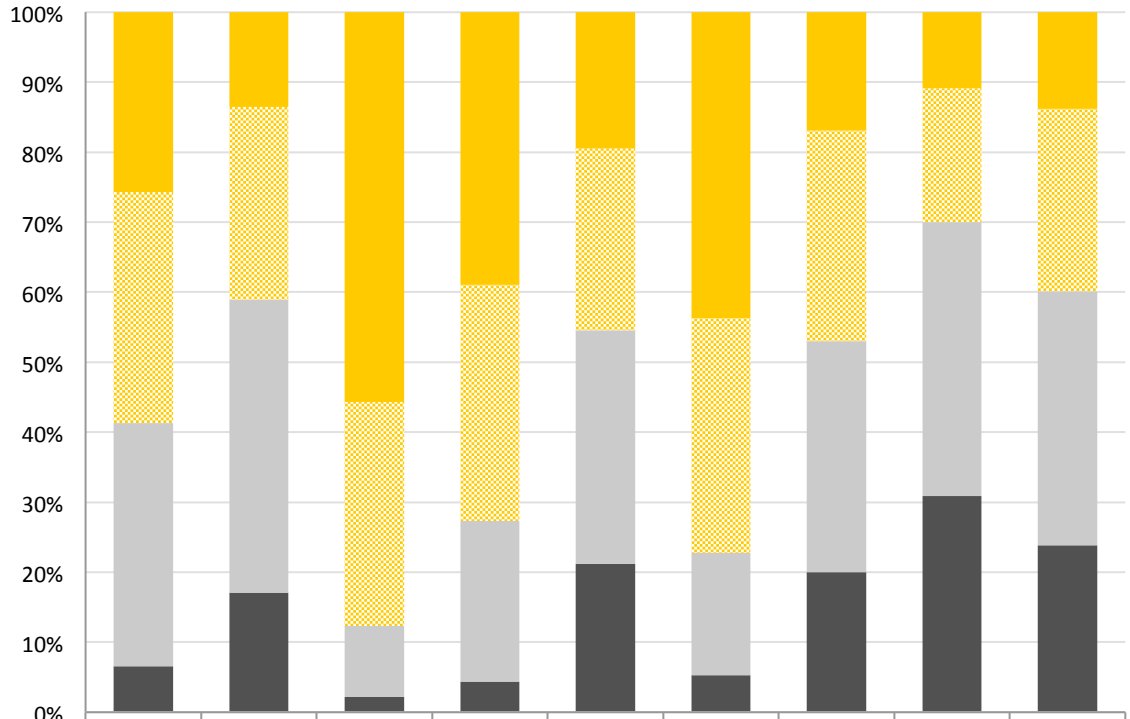
Chart 21: Alumni Interest in STEM Activities (*n* = 228)



	Reading/ Watching STEM Non-Fiction	Tinkering with Mechanical/ Electrical Device	Solving Math/ Science Puzzles	Learning about New STEM Things	Computer Design/ Programming	Talking with Friends/ Family about STEM	Mentoring/ Teaching Others about STEM	Participation in STEM Community Service Project	Participate/ Volunteer STEM Camp, Club, or Competition	Taking STEM Electives	STEM Project/ Experiment in University/ Professional Setting	Earning a STEM degree	Pursuing STEM career
Very Interested	25%	25%	30%	54%	29%	39%	40%	40%	46%	52%	60%	73%	73%
Interested	33%	30%	31%	36%	31%	39%	31%	36%	31%	31%	27%	19%	18%
Somewhat Interested	30%	27%	30%	10%	27%	19%	23%	21%	18%	17%	10%	7%	7%
Not Interested	12%	18%	8%	0%	13%	4%	6%	3%	5%	1%	3%	1%	2%

Alumni were also asked to report on their current engagement in STEM activities (Chart 22). More than 80% reported occasional to frequent engagement in learning about new things in STEM. Additionally, 44% of alumni reported talking with family and friends about STEM frequently, 26% read or watch STEM non-fiction frequently, and 39% reported solving math/science puzzles frequently. Likewise, 40% of alumni reported participating or volunteering in STEM camps, clubs, or competitions and 47% indicted they had mentored or taught others about STEM. Findings indicate nearly half or more AEOP alumni are engaged in STEM activities on an occasional to frequent basis.

Chart 22: Alumni Engagement in STEM Activities (*n* = 231)



	Reading/ Watching STEM Non-Fiction	Tinkering with Mechanical/ Electrical Device	Learning about New STEM Things	Solving Math/ Science Puzzles	Computer Design/ Programming	Talking with Friends/ Family about STEM	Mentoring/ Teaching Others about STEM	Participation in STEM Community Service Project	Participate/ Volunteer STEM Camp, Club, or Competition
Frequently	26%	14%	56%	39%	19%	44%	17%	11%	14%
Sometimes	33%	28%	32%	34%	26%	34%	30%	19%	26%
Not Often	35%	42%	10%	23%	33%	17%	33%	39%	36%
Never	7%	17%	2%	4%	21%	5%	20%	31%	24%

More than half (58%) of AEOP alumni reported that they are taking a STEM elective (not required) class or course (Table 43). Nearly half of AEOP alumni surveyed indicated they were pursuing a STEM degree (49%) and 14% are currently working in a STEM career.

Table 43. Alumni Current STEM Activities (*n* = 184)

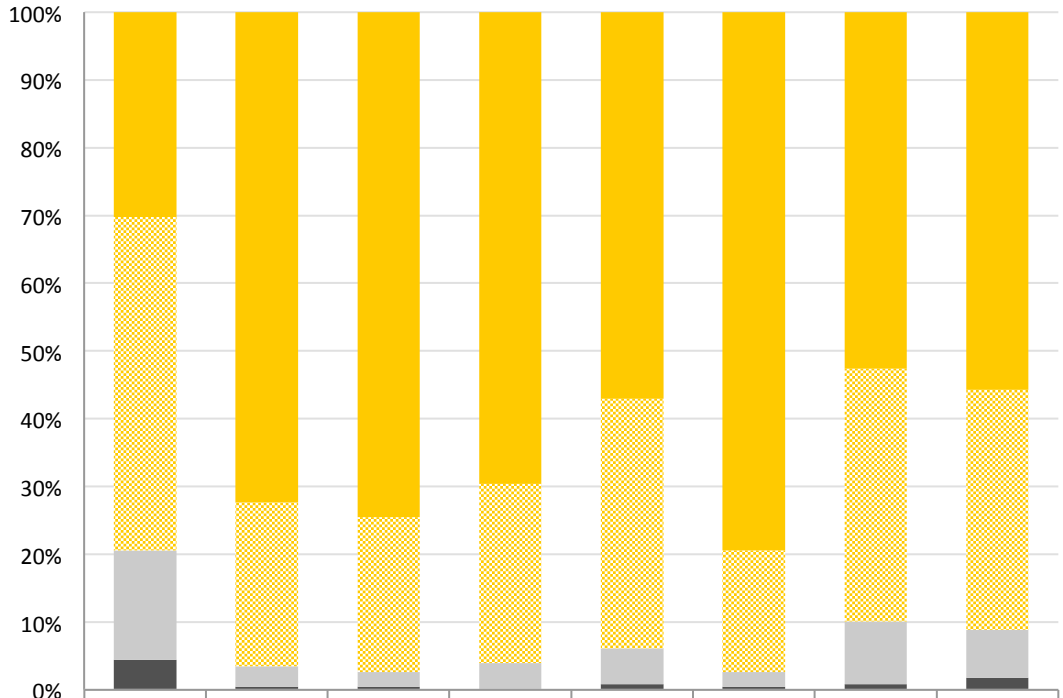
Item	Percentage
Taking a STEM elective	58%
Working on STEM project/experiment in university/professional setting	41%
Pursuing a STEM degree	49%
Working in a STEM career	14%

In order to gauge how likely AEOP alumni are to have a positive, sustained interest in STEM, interview participants were also asked about their engagement in STEM activities outside of school. Responses again varied across programs. The 6 GEMS participants who reported engaging with STEM outside of school cited school-related activities or informal, self-directed activities. The 3 JSHS alumni who reported engaging in STEM outside of school cited working in STEM-related campus jobs and participating in clubs and service organizations, such as a chemistry club and acting as a mentor in the Boy Scout Ventures program. Likewise, 1 Unite participant reported participating in a robotics club, while the REAP alumnus cited a campus job working with control systems. CQL alumni also reported engaging in STEM through a variety of club-based and work-based experiences, ranging from a materials science club to STEM-related field work in Ecuador and plans to participate in internships.

Research Question #2 - To what extent do alumni report positive attitudes toward STEM, and particularly Army/DoD STEM?

One of the priorities of the AEOP is to support the creation of a STEM literate society. An important first step in this work is to focus on developing positive attitudes for youth toward STEM. Alumni were asked to share their thoughts regarding their attitudes toward STEM, particularly Army/DoD STEM, in the questionnaire. Results indicate that AEOP alumni have very positive views toward STEM (Chart 23). Over 90% of alumni feel successful in their STEM classes and 80% believe that all people can be successful in STEM. Nearly all (98%) alumni reported enjoying solving real-world problems and 96% believe that they can use STEM to help improve their community. More than 90% reported understanding how scientists and engineers work on real problems in STEM and 98% reported there are STEM careers that are a good fit with their interests. In sum, AEOP alumni hold very positive attitudes toward STEM.

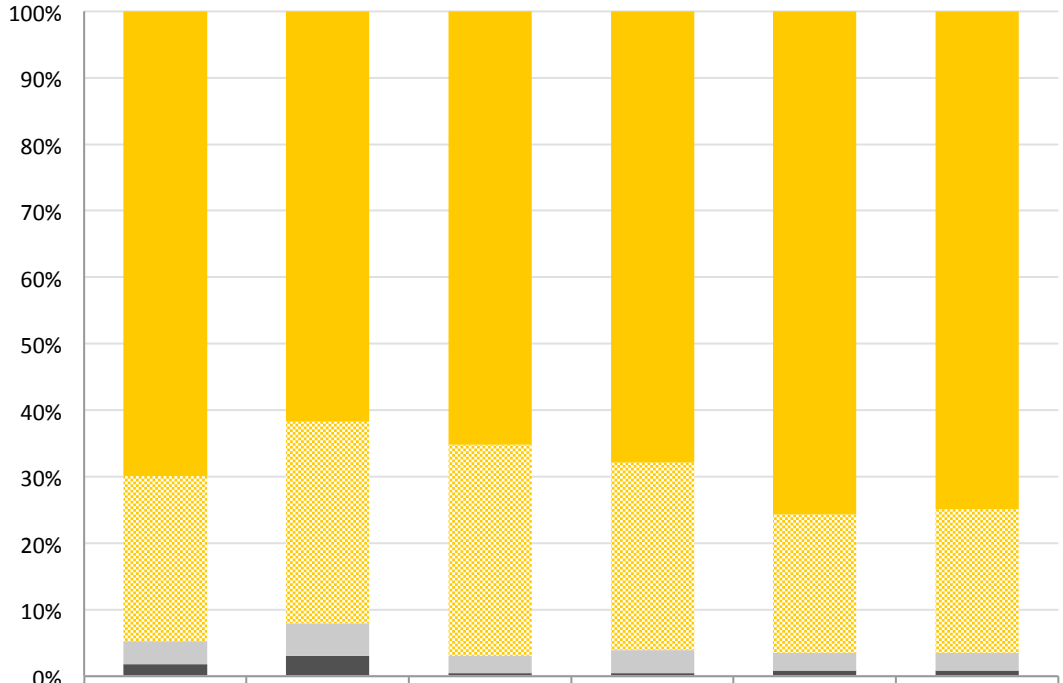
Chart 23: Alumni Attitudes Regarding STEM (*n* = 228)



	All people can be successful in STEM	I feel successful in STEM classes	I enjoy solving real-world problems	I can use STEM to help improve my community	I enjoy working on team projects and activities	There are STEM careers that are a good fit with my interests	I understand how STEM research is conducted	I understand how scientists and engineers work on real problems in STEM
Agree	30%	72%	75%	70%	57%	79%	53%	56%
Somewhat Agree	49%	24%	23%	26%	37%	18%	37%	35%
Somewhat Disagree	16%	3%	2%	4%	5%	2%	9%	7%
Disagree	4%	0%	0%	0%	1%	0%	1%	2%

In regards to attitudes toward the AEOP and Army/DoD STEM, alumni also shared very positive views (Chart 24). The vast majority (95%) reported growth in their STEM knowledge as a result of AEOP participation. More than 90% of alumni had positive attitudes regarding the work of the Army/DoD in STEM, including feeling the work is valuable to society and that the Army/DoD solves real-world problems as well as develops new, cutting edge technologies. AEOP alumni hold very positive views of Army/DoD STEM.

Chart 24: Alumni Attitudes Regarding AEOP and Army/DoD STEM (*n* = 227)



	My knowledge of STEM increased through participating in AEOP	I learned new skills that I can use to solve STEM problems in my AEOP program	Army/DoD researchers advance science and engineering fields	Army/DoD researchers develop new, cutting edge technologies	Army/DoD researches solve real-world problems	Army/DoD research is valuable to society
Agree	70%	62%	65%	68%	76%	75%
Somewhat Agree	25%	30%	32%	28%	21%	22%
Somewhat Disagree	4%	5%	3%	4%	3%	3%
Disagree	2%	3%	0%	0%	1%	1%

Research Question #3 - To what extent do alumni report pursuit of and achievement in STEM courses in secondary school, post-secondary STEM degrees, STEM careers, and Army/DoD STEM careers?

AEOP alumni reported pursuit and attainment of STEM coursework in high school. Nearly half (46%) completed calculus, 52% completed an AP science course, and 72% completed chemistry (Table 44). Further, 24% reported taking an engineering course in high school and 64% completed physics.

Table 44. Alumni Reported STEM High School Coursework Completed (*n* = 237)	
HS STEM Course	**Percentage**
Algebra I	87%
Algebra II	79%
AP Math	47%
AP Science	52%
Biology	85%
Calculus	46%
Chemistry	72%
Computer Science	26%
Earth Science	18%
Engineering	24%
Environmental Science	23%
Geometry	83%
Human Anatomy	16%
Intro Chemistry and Physics	29%
Physics	64%
Pre-Calculus	58%

AEOP alumni who had graduated high school reported enrollment in STEM degree programs in post-secondary study. Of the 46% of respondents who had graduated from high school, 42% were enrolled in post-secondary study (Table 45). This included 4% who were enrolled in associate degree programs, 32% were enrolled in bachelor's degree programs, 7% in master's degree programs, and 3% in doctoral degree programs. Additionally, 3% were enrolled in technical training programs.

Table 45. STEM Degree at College or University	
Degree Level	**Percentage**
Associate (*n*=233)	
Yes	4%
No	42%
Still in High School	54%
Bachelor's (*n*=235)	
Yes	32%
No	14%
Still in High School	54%
Graduate (*n*=231)	
Yes	7%
No	39%
Still in High School	54%
STEM Certificate/Training (*n*=233)	
Yes	3%
No	44%
Still in High School	53%

Table 46 reveals that the largest proportion of AEOP alumni who were enrolled in STEM programs of study in post-secondary education (42% of respondents to this question) reported engineering as their area of focus (13%), followed by medicine (8%), physical science (7%), life science (7%), mathematics or statistics (2%), technology or computer science (2%), Earth science (1%), and business (1%). None of the alumni reported pursuing teaching or environmental science as STEM degree focus areas. Most of the responding alumni were completing credits toward their degree as reported in Table 47.

Table 46. STEM Degree Program Enrolled In (*n*=223)	
STEM Degree Program	**Percentage**
Not Enrolled	58%
Physical Science	7%
Earth Science	1%
Life Science	7%
Medicine	8%
Engineering	13%
Technology/Computer Science	2%
Mathematics or Statistics	2%
Environmental Science	0%

Teaching	0%
Business	1%

Table 47. AEOP Alumni College Credit Hours Completed in STEM Degree Program (*n*=106)	
STEM Credits	**Percentage**
Not enrolled in classes	24%
Not enrolled in STEM	9%
0-30 Credits	17%
31-60 Credits	9%
61-90 Credits	16%
91-120 Credits	13%
121+ Credits	12%

AEOP alumni who were currently enrolled college students were asked to report their current GPA. Of the 106 alumni who responded to this question, 23% of the group reported having a 4.0 or better grade point average while 82% reported holding a 3.0 GPA or better (Table 48).

Table 48. AEOP Alumni College Student Current GPA (*n*=106)	
GPA	**Percentage**
4.0 or better	23%
3.75 - 3.9	20%
3.50 - 3.74	20%
3.0 - 3.49	25%
2.5 - 2.9	3%
2.0 - 2.49	1%
Lower than 2.0	0%
Not enrolled	8%

Some of the responding AEOP alumni reported completion of a post-secondary STEM degree program (Table 49). Nearly two thirds (66%) had completed bachelor's degrees, 6% master's degrees, and 13% associate degrees, while another 16% had completed STEM technical certificate programs.

Table 49. STEM Degree Program Completed (*n*=32)	
STEM Degree Program	**Percentage**
Associates	13%
Bachelors	66%

Masters	6%
Doctoral	0%
Certificate	16%
More	0%

All alumni interviewed were still enrolled in school and were therefore considered pre-career, with the exception of one CQL alumnus who had held a job as an electrical engineer before returning to school to earn a graduate degree. Because the GEMS alumni interviewed were primarily in middle school and therefore have little discretion over their coursework, the data presented here are limited to high school and college student participants who are alumni of JSHS, Unite, REAP, and CQL, although it should be noted that nearly all GEMS alumni expressed interest in pursuing STEM coursework and/or careers in the future.

Ten of the AEOP alumni interviewed were high school graduates, and all of these were enrolled in STEM-related degree programs. Two alumni of CQL were graduate students, enrolled in a public health master's program (with aspirations to medical school) and in a Ph.D. program in communications systems/cryptography/authentication. These students cited their classes, literature relevant to their fields, and professional organizations as key supports in their programs of study. The eight students who are currently enrolled in undergraduate STEM programs reported the following majors: biology (enrolled in a 7-year medical school program), chemistry, mechanical engineering, bio systems and agricultural engineering, computer science, electrical engineering, mathematics, and materials science and engineering. Key supports for these undergraduate students were study groups, professors, networking in their fields, programming clubs, databases available through their universities, textbooks, literature in their respective fields, and their parents.

The 4 high school AEOP alumni interviewed were asked to reflect on their educational aspirations and intended majors after they complete high school. All high school students indicated that they plan to enroll in a STEM degree program upon graduation, either by applying directly to a four-year institution or by applying to a two-year or community college with intentions to transfer to a baccalaureate-granting institution. These students intend to major in math/physics, electrical engineering, mechanical engineering, and computer engineering.

Research Question #4 - To what extent do alumni report awareness of and interest in STEM research and careers overall and for the Army/DoD specifically?

AEOP alumni were asked questions regarding their familiarity with STEM research overall, as well as Army/DoD research specifically. In regards to the STEM research alumni learned about in their programs, some examples that were shared on the open-ended question included:

- Biotechnology
- Ethics in science and engineering
- Bioinformatics
- Aerospace engineering
- Behavioral science
- Brain functioning

- Physics
- Crime scene investigations
- Atmospheric modeling
- Computer programming
- Cancer research
- Additive manufacturing
- Time vortex mechnaics
- Genetics
- Animal physiology
- Optics
- Nanoparticle vaccine
- Drones
- Materials science
- Nanotechnology
- Biomedical engineering
- Polymer science
- Mechanical engineering
- Electronics
- Infectious disease
- Solar energy
- Mathematics theory of multiple infinities

A second question asked alumni to share one area of Army/DoD STEM research they learned about in their AEOP program. Interestingly, on the survey 76% of AEOP alumni reported being aware of Army and other DoD STEM research.

Some examples of responses that were provided to the open-ended item include:

- Infectious disease research
- Robotics
- Biomedical engineering
- Aircraft safety
- Material engineering
- Human-interfaced prosthetics
- Terahertz radiation
- Antifouling coatings
- Military technologies
- Altitude chambers
- Lasers
- Mechanical engineering
- Optic fibers
- Drone design
- Chemical weapons
- Cybersecurity

Alumni were asked on the questionnaire to share up to three Army/DoD STEM careers that they learned about during the program. Most #31 open ended – name up to 3 Army/DoD STEM careers learned about in AEOP. There were 61% of respondents (n = 145) that did not respond or could not remember any careers. Alumni who did respond to this open ended item shared various careers they recalled learning about. Some examples of responses include:

- Biochemist
- Neurologist
- Epidemiologist
- Biomedical research
- Engineering
- Materials scientist
- BATMAN program
- Mechanical engineer
- Lab technician
- Physiologist
- Chemical engineer
- Research scientist
- Civil engineering
- Geochemist
- Physicist
- Physician
- Nuclear engineer
- Electrical engineer
- Systems engineer
- Computer scientist
- Analyst
- Computer programmer
- Forensic scientist
- Software developer

Alumni interview participants were also asked to reflect on their interest in STEM and their attitudes about, and awareness of STEM research overall and in the Army/DoD more specifically. Interview participants expressed interest in a wide array of STEM topics, ranging from biomedicine to computer science. All participants who shared their views on the topic indicated that their AEOP experience supported and increased their interest in STEM and helped them to grow their STEM knowledge and skills. Perspectives on the knowledge participants gained about the Army/DoD varied across programs as did their interest in pursuing STEM research careers with the Army or DoD.

GEMS students tended to make general statements about the influence of the program on their interest in STEM, citing increases in knowledge about topics such as chemical reactions and materials science. Students also noted that GEMS helped them feel more prepared for school coursework and gave them career information. As one GEMS participant said, “it really broadened my archive of what I know about…they just taught me so much.” Another GEMS participant credits GEMS with a leap in her interest in science, saying that before GEMS, “I really wasn’t interested in science at all.

[GEMS] really helped me become more interested because I was active and participating." GEMS alumni tended to have little awareness of Army/DoD STEM research after their GEMS experience. Six GEMS alumni cited that they had no knowledge of Army/DoD STEM research, although two other alumni cited specific areas of Army/DoD research to which they had been exposed including fireproof materials, parachutes, and efforts to develop easily storable food.

JSHS alumni interviewed were enthusiastic about the influence the program had on their interest in STEM. Participants particularly noted the exposure to other students and their research, the rigor of the research requirements for the program, and the opportunity to showcase their work. As one alumni said "[JSHS] changed my life because I had always wanted to do something like that but never had the resources at my school…For me to see that people actually care about science was a really big deal to me." JSHS students also gained an understanding of Army/DoD STEM research while in the program although, as one student noted, more Army/DoD information was provided at the national level as compared to the regional levels. Participants' current research interests included molecular mechanisms of disease, astrophysics research, chemistry, environmental issues and/or energy, and water filtration. These alumni were likely to see Army/DoD research as overlapping with civilian research, and several noted that they would consider a career in the Army or DoD. Students were particularly interested in careers as civilian researchers. As two students said of DoD:

When I realized I could be a DoD researcher without having to get involved in any other way than the research, It's an incredible opportunity…They get their hands on everything first and are definitely on the edge of where we're headed. I think that would be an incredible thing to be a part of DoD research. [JSHS Alumna]

I would definitely see myself as more of a civilian scientist for [the Army/DoD], but yeah, I would be interested in it. Anything to help people, and that's what the Army [does]. [JSHS Alumnus]

Unite and REAP alumni also indicated that their AEOP experiences increased their interest in STEM, and were particularly articulate about the support for their academic skills and the career information they received during their experiences. One Unite alumna and 1 REAP alumna shared that their AEOP experiences significantly influenced their career aspirations. As they said,

> *Before I went into Unite, I wanted to be nothing but a photographer. It was not until I got into Unite that I found an interest in computer engineering.* [Unite Alumna]
>
> *It's just a great opportunity for students like me… This can be the start of something new for someone who was interested in STEM. For me, I never thought I would actually be having interest in engineering, but ever since this program, it's been all about engineering.* [Unite Alumna]

One participant indicated that she would "consider" a career in Army or DoD STEM research while another replied that she was "probably not" interested and the third was undecided.

CQL alumni tended to report that their apprenticeship experiences helped them to focus or refine their STEM research interests, exposed them to different perspectives on research topics, helped them build laboratory skills necessary to pursue careers in research, and exposed them to career information. One CQL alumnus, currently a Ph.D. student, reported that his CQL experience caused him to reconsider the way he viewed his field of research in communications

security while another alumnus, a college senior, noted that he valued his experience with GPS, "something that the government uses but they don't use in school." While all of the CQL alumni plan to pursue STEM research, 3 indicated that they would likely consider careers with the Army or DoD, while 2 were less certain about this career path.

Research Question #5 – To what extent do alumni report an increase in STEM career participation and success overall, as well as within the Army/DoD specifically?

AEOP alumni were asked to report on their interest and participation in STEM careers and how successful they had been in their pursuit of STEM and Army/DoD STEM careers (Table 50). Most alumni reported being aware of Army/DoD STEM careers (78%) and 96% reported interest in pursuing STEM careers, with 67% being interested in Army/DoD STEM careers specifically. Over three-quarters (78%) of alumni reported interest in learning more about Army/DoD careers focused on STEM research.

Table 50. Alumni Awareness and Interests (*n* = 228)

Item	Somewhat Agree/Agree
I am aware of Army or DoD STEM careers	78%
I am interested in pursuing a career in STEM	96%
I am interested in pursuing a DoD/Army STEM career	67%
I am interested in learning more about Army/DoD careers focused on STEM research	78%

Some responding AEOP alumni (34%)reported that they had already applied for STEM-focused jobs (Table 51). Another 21% reported currently holding a job in a STEM field. The overwhelming majority (89%) indicated plans to seek a STEM-focused career position in the future. In regards to Army/DoD STEM, 5% of AEOP alumni indicate they hold current positions now in Army/DoD STEM while nearly half (46%) reported plans to seek an Army/DoD STEM career in the future.

Table 51. Alumni STEM Career Focus (*n*=220-224)

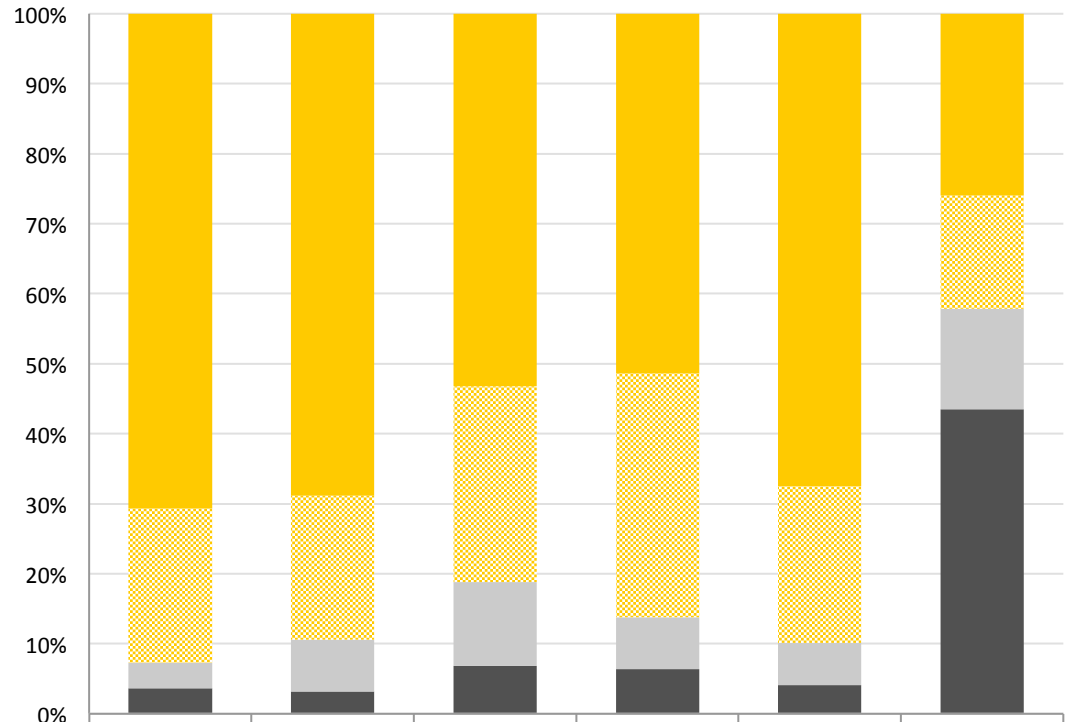
Item	Yes
I have applied for STEM-focused job positions	34%
My current job is in a STEM-focused career	21%
I plan to seek a STEM-focused career position in the future	89%
My current position is an Army/DoD STEM focused position	5%
I plan to seek an Army/DoD STEM-focused career position in the future	46%

PRIORITY TWO: STEM "Savvy" Educators

Research Question #6 - What is the impact of Scientists and Engineers (S&E) Mentors on AEOP alumni?

AEOP Alumni were asked to report on their perceptions of the impact of the mentoring they received as part of their AEOP program (Chart 25). A large majority (92%) of responding alumni reported that their experience with their mentor was very positive. A similar majority (90%) reported that their learning was enhanced by the AEOP mentor. Nearly half of alumni (42%) reported that they had stayed in touch with their mentor following program participation and 86% of AEOP alumni indicated that AEOP mentors helped to influence/inform their future academic and career decisions.

Chart 25: Alumni Perceptions of AEOP Mentoring Received (*n* = 218)



	Had very positive experience working with AEOP mentors	Learning enhanced with AEOP mentor	Learned more about Army/DoD careers & research from AEOP mentor	AEOP mentors helped influence/ inform my future academic & career decisions	Mentoring aspect of AEOP programs is valuable	I stayed in touch with my mentor after the AEOP program
Agree	71%	69%	53%	51%	67%	26%
Somewhat Agree	22%	21%	28%	35%	22%	16%
Somewhat Disagree	4%	7%	12%	7%	6%	14%
Disagree	4%	3%	7%	6%	4%	44%

Alumni interview participants were also overwhelmingly positive about their experiences with mentoring during their AEOP experiences. In particular, participants cited the guidance they received in research and laboratory work, assistance in focusing research interests, encouragement and support in publishing their research, and the knowledge they gained about career and educational pathways.

GEMS alumni's reports of their mentoring experience tended to focus on their NPMs. While these students rarely cited working directly with Army S&E's, they had a high level of satisfaction with the assistance and learning support they

received, and it is evident that these NPMs served as role models for younger students who cited the "accessibility" of the mentors and noted that NPMs were "fun to hang around with."

Of the JSHS alumni who commented on their mentors, 2 noted that their mentors their high school teachers, 1 cited e-mail correspondence with university professors, and 1 worked with a family friend who worked at a DoD lab. Benefits of mentoring mentioned included having an experienced professional to share ideas with, exposure to new ideas and laboratory procedures, assistance in focusing research, and support in learning scientific writing.

The Unite and REAP alumni had varied experiences with mentors. One Unite alumna cited learning new skills from her mentor while another was enthusiastic about the career information she received citing that her mentor exposed her to "just about every engineering, math, and science career that is out there." The REAP alumna indicated that her mentor was another student and that they had a co-worker relationship, but that she found benefits in this individual's guidance and teaching.

Their mentors particularly impacted CQL apprentices. The benefits they cited included learning about content, laboratory procedures, and presentation skills; preparation for future coursework; encouragement and support in publishing research; refining their research topics; and learning about careers and the graduate school process. One CQL alumni shared that although his primary mentor had to leave the site two weeks into his apprenticeship, two other mentors stepped in, and "taught me a lot more about the equipment that was being used, the different methods and procedures that went into the research…and how they presented it to higher members of the staff." Another CQL alumni indicated that his CQL apprenticeship was key in helping him refine his dissertation research and noted, "it made one of the most productive summers I ever had and it opened up my eyes to the field of research."

Research Question #7 – Are there measurable changes in teacher approaches to teaching research concepts within STEM practices, and careers after participation in AEOP (RESET)?

There are no findings to report on this research question in FY16 as the RESET program was in year one. This question will be explored in future AEOP Summative Evaluation Reports.

PRIORITY THREE: Sustainable Infrastructure

Research Question #8 - To what extent do alumni report increased awareness of and/or interest in AEOP opportunities?

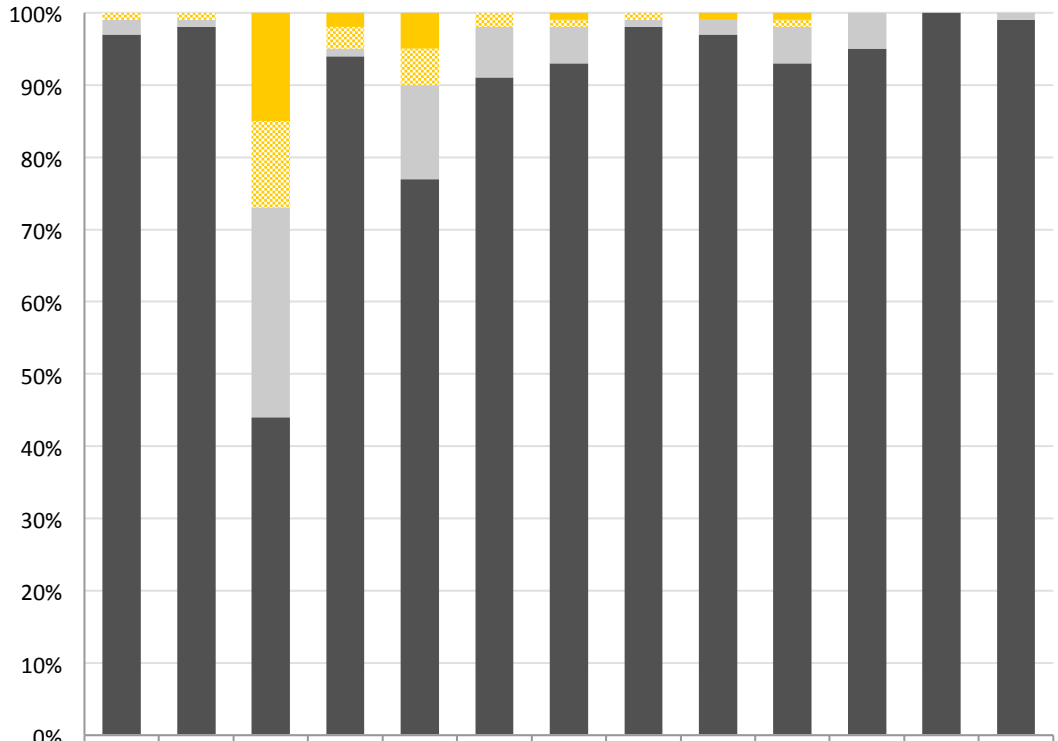
AEOP alumni (n=229) were asked to report on their awareness of other AEOPs. Over half (58%) shared that they were familiar with other AEOP programs and 78% of alumni reported being interested in participating in other AEOPs.

Research Question #9 - To what extent do alumni report participation in an AEOP program multiple times, in other AEOP elements, or in other DoD workforce development programs?

AEOP Alumni were asked to report past participation in AEOPs as part of the evaluation (Chart 26). The program with the most participation by alumni was GEMS with 29% of respondents participating once, 12% twice, and 15% three or

more times. Alumni respondents included past participants of all programs (eCM, JSS, GEMS, Unite, JSHS, SEAP, REAP, HSAP, CQL, and URAP). In addition, 1% of AEOP alumni reported receiving the NDSEG scholarship.

Chart 26: Alumni Participation in AEOP Programs (n = 237)



	eCybermission	JSS	GEMS	UNITE	JSHS	SEAP	REAP	HSAP	GEMS Near Peer Mentors	CQL	URAP	SMART College Scholarship	NDSEG
Three or more times	0%	0%	15%	2%	5%	0%	1%	0%	1%	1%	0%	0%	0%
Twice	1%	1%	12%	3%	5%	2%	1%	1%	0%	1%	0%	0%	0%
Once	2%	1%	29%	1%	13%	7%	5%	1%	2%	5%	5%	0%	1%
Never	97%	98%	44%	94%	77%	91%	93%	98%	97%	93%	95%	100%	99%

Summary of Findings

The FY16 AEOP near-term evaluation study collected data about participants, their perceptions of program processes, resources, and activities. Data were also collected regarding indicators of student impacts that relate to outcomes aligned with AEOP objectives, program objectives, and Federal guidance for evaluation of Federal STEM investments. In FY16 the AEOP began a mid to long-term study of alumni. A sample of alumni were asked to complete a questionnaire and interview focused on their interest, participation, and persistence in STEM as well as their knowledge of and interest in DoD and other STEM programs of study and careers. A summary of findings is provided in the Summary of Findings in Table 52 and 53.

Table 52. Summary of Near Term Findings (Current FY16 Programs)	
Priority 1: STEM Literate Citizenry *Broaden, deepen, and diversify the pool of STEM talent in support of our Defense Industry Base.*	Finding #1: In FY16 the AEOP provided outreach to 30,972 youth participants through its comprehensive portfolio of program. This number represents a 19% overall decrease in number of participants compared to FY15 (38,039) and a 26% decrease from FY14 (41,802). This downward trend in participation mirrors a downward trend in applications as evidenced by the fact that in FY16 16% fewer applications were received than in FY15 and 25% fewer applications were received than in FY14. The decline in enrollment numbers for FY16 can be largely attributed to decline in participation for eCM, the largest AEOP in terms of enrollment. Participation in eCM declined by over 7,000 students from FY15 to FY16, a decrease of 25%. It is important to note that eCM had used different metrics (registration) to track participation and in FY16 moved to counting only those students who complete the competition as participants. Similarly, participation in JSS and JSHS declined in FY16. JSS participation declined from 891 participants in FY14 to 585 participants in FY16, representing a 34% drop in enrollment over this two-year period. JSHS enrollment declined from 5,829 in FY15 to 5,620 in FY16 (4% decrease). While the AEOP apprenticeship portfolio experienced overall growth in applicants, there has been a slight downward trend in placement rates since FY14, with 27% of applicants placed in FY16, 33% in FY15, and 31% in FY14. High school apprenticeships (HSAP, REAP, and SEAP) served a larger proportion of students in FY16 (25% placement rate) as compared to the past two years (17% placement rate in each year). This is partially attributable, however, to a 40% increase in URAP applications from FY15 (107) to FY16 (177). At the same time, placement in undergraduate apprenticeships (CQL and URAP) decreased markedly from 72% in FY15 to 45% in FY16. This was mostly due to AEOP phasing out the awarding of apprenticeships to graduate students in FY16 to make the focus of the program more aligned with the goals of broadening the STEM talent pool. Student STEM enrichment activities (GEMS and Unite) showed increases in enrollment over FY15 levels while acceptance rates remained relatively steady. In particular, Unite enrollment increased by 29%, bringing enrollment back to FY14 levels (282 participants in FY16 as compared to 200 in FY15 and 280 in FY14). GEMS experienced a 7% growth in enrollment since FY15 and 14% since FY14 (2,428 participants in FY16 as compared to 2,270 in FY15 and 2,095 in FY14). In sum, while there were some positive enrollment trends for FY16, there continues to be considerable unmet demand for AEOPs, with over 7,000 applicants who applied but were not accepted into programs. Finding #2: The AEOP continued to emphasize participation of underserved and underrepresented groups in associated apprenticeship, competition, and enrichment programs and progress was made toward increasing the participation of these groups in most programs in FY16. Female participation increased over FY15 levels in 6 programs (CQL, HSAP, JSS, SEAP, Unite, and URAP) and stayed constant in GEMS while somewhat fewer females participated in eCM and JSHS. Participation of students identifying with racial/ethnic minority groups grew as compared to FY15 levels for every program except for Unite. CQL increased participation of females (25% to 40%) and JSS included more racial and/or ethnic minorities (13% to 28%) in FY16 as compared to FY15. Notably, CQL racial/ethnic minority participation increased from 13% in FY15 to 26% in FY16, the HSAP program saw an increase from 29% racial/ethnic minority participation in FY15 to 67% in FY16, and SEAP racial/ethnic minority participation increased from 35% in FY15 to 54% in

	FY16. REAP, a program designed to target underserved and underrepresented groups, also served increasing numbers of students from racial/ethnic minority groups, with an increase from 65% in FY14 (overall demographic data not available for FY15) to 81% in FY16. Finding #3: In FY16, the majority of program participants overwhelmingly reported learning about STEM more frequently in AEOP than in school with the exception of students in JSS. The majority of program participants overwhelmingly reported engaging in STEM (doing) more frequently in AEOP than in school with the exception of JSHS regional participants. Finding #4: As in FY15, students participating in the AEOP programs in FY16 reported that the experience improved their STEM-specific and 21st Century STEM skills competencies. They also reported gains in their abilities to use the science and engineering practices described in the Next Generation Science Standards (NGSS), as well as increases in their STEM confidence and identity. Finding #5: The AEOP's efforts to expose students to DoD research resulted in most participants reporting knowledge of such. Nearly all AEOP programs' participants reported positive attitudes (more than 60% agreement) toward DoD STEM research and researchers. Mentors/Advisors in 8 of the programs (out of 10) reported more than 50% agreement that they discussed DoD STEM research and opportunities with participants. Finding #6: The AEOP exposed students to STEM careers, as well as Army and DoD STEM careers. Apprentice program participants reported the highest agreement with more than 60% agreeing that they learned about 3 or more STEM careers. Army lab-based apprentice programs had the highest agreement with learning about 3 or more Army/DoD STEM careers (61-85%), while other apprentice programs had between 25% to 41% agreement. STEM programs had the second best ratings of learning about STEM and Army/DoD STEM careers with 50% or more participants agreeing that they learned about 3 or more STEM careers. Competitions had the lowest agreement rate in this area, with 33-44% agreement regarding STEM careers overall and 18% agreement for JSHS and JSS regarding Army/DoD STEM careers. The exception to this was eCM NJ&EE participants who reported 91% agreement in regards to learning about 3 or more Army/DoD STEM careers. Finding #7: The AEOP programs served to sustain existing STEM educational and career aspirations of participants and to inspire new achievement, including intentions to pursue higher education and STEM careers. In addition, participants reported gains in interest in pursuing DoD STEM careers as a result of participation in AEOP.
Priority 2: STEM Savvy Educators *Support and empower educators with unique Army research and technology resources.*	Finding #1: AEOP mentors' reported use of effective mentoring strategies increased for most programs in FY16. These strategies include establishing the relevance of learning activities, supporting the diverse needs of students as learners, supporting student development of interpersonal and collaboration skills, supporting student engagement in authentic STEM activities, and supporting student STEM educational and career pathways. Finding #2: Across the AEOPs, most apprentices and students report being satisfied with

	their mentors and the quality of instruction they received. The level of agreement for participant satisfaction with mentors for some programs decreased from FY15 (CQL, SEAP, Unite, URAP).
Priority 3: Sustainable Infrastructure *Develop and implement a cohesive, coordinated, and sustainable STEM education outreach infrastructure across the Army.*	Finding #1: Despite increased investment and attention to external communications regarding AEOP opportunities in FY16, personal connections, including friends, teachers and/or professors, or someone who works at the university or school the participant attends continue to be the most frequently cited means of participant information about programs. Most agreed that past participants as well as the school, university, or professional organization newsletter, email or website were the primary means of learning about AEOP. The exceptions included SEAP and CQL, where participants noted that someone who works with the Department of Defense was their main source of program information, and eCM, where mentors indicated the AEOP website was their primary means of learning about the program. Finding #2: Most AEOP program participants were somewhat interested in participating in other AEOPs. In all programs, at least 28% of participants indicated being interested in participating in other AEOPs. Finding #3: AEOPs need to continue to work to improve participation in the AEOP evaluation in FY17. Despite improved participation by youth participants in the AEOP evaluation, response rates remained less than desirable in FY16. Mentor questionnaire participation was substantially lower than desired.

Table 53. Summary of Mid to Long-Term Findings (Alumni of AEOP programs)	
Priority 1: STEM Literate Citizenry *Broaden, deepen, and diversify the pool of STEM talent in support of our Defense Industry Base.*	Finding #1: AEOP alumni (92%) indicated they were both interested in earning a STEM degree and pursuing a STEM career. Finding #2: AEOP alumni (82%) indicated interest in taking elective STEM courses, and 87% were interested in potential STEM projects/experiments in a university or professional setting. Further, 90% reported being interested in learning about new things in STEM. More than half (58%) of AEOP alumni reported that they are taking a STEM elective (not required) class or course (Table 43). Nearly half of AEOP alumni surveyed indicated they were pursuing a STEM degree (49%) and 14% are currently working in a STEM career. Finding #3: More than 80% reported occasional to frequent engagement in learning about new things in STEM. Additionally, 44% of alumni reported talking with family and friends about STEM frequently, 26% read or watch STEM non-fiction frequently, and 39% reported solving math/science puzzles frequently. Likewise, 40% of alumni reported participating or volunteering in STEM camps, clubs, or competitions and 47% indicted they had mentored or taught others about STEM. Findings indicate nearly half or more AEOP alumni are engaged in STEM activities on an occasional to frequent basis. Finding #4: AEOP alumni hold very positive views toward STEM (Chart 23). Over 90% of alumni feel successful in their STEM classes and 80% believe that all people can be successful in STEM. Nearly all (98%) alumni reported enjoying solving real-world problems and 96% believe that they can use STEM to help improve their community. More than 90% reported understanding how scientists and engineers work on real problems in STEM and 98% reported there are STEM careers that are a good fit with their interests. In sum, AEOP alumni hold very positive attitudes toward STEM. Finding #5: The vast majority of responding AEOP alumni (95%) reported growth in their STEM knowledge as a result of AEOP participation. More than 90% of alumni had positive attitudes regarding the work of the Army/DoD in STEM, including feeling the work is valuable to society and that the Army/DoD solves real-world problems as well as develops new, cutting edge technologies. AEOP alumni hold very positive views of Army/DoD STEM. Finding #6: Most alumni reported being aware of Army/DoD STEM careers (78%) and 96% reported interest in pursuing STEM careers, with 67% being interested in Army/DoD STEM careers specifically. Over three-quarters (78%) of alumni reported interest in learning more about Army/DoD careers focused on STEM research. AEOP alumni reported pursuit and attainment of STEM coursework in high school. Nearly half (46%) completed calculus, 52% completed an AP science course, and 72% completed chemistry (Table 44). Further, 24% reported taking an engineering course in high school and 64% completed physics. Finding #7: AEOP alumni who had graduated high school reported enrollment in STEM degree programs in post-secondary study. Of the 46% of respondents who had graduated from high school, 42% were enrolled in post-secondary study (Table 45). This included 4% who were enrolled in associate degree programs, 32% were enrolled in bachelor's degree

	programs, 7% in master's degree programs, and 3% in doctoral degree programs. Additionally, 3% were enrolled in technical training programs.
Priority 2: STEM Savvy Educators *Support and empower educators with unique Army research and technology resources.*	Finding #1: A large majority (92%) of responding alumni reported that their experience with their mentor was very positive. A similar majority (90%) reported that their learning was enhanced by the AEOP mentor. Nearly half of alumni (42%) reported that they had stayed in touch with their mentor following program participation and 86% of AEOP alumni indicated that AEOP mentors helped to influence/inform their future academic and career decisions.
Priority 3: Sustainable Infrastructure *Develop and implement a cohesive, coordinated, and sustainable STEM education outreach infrastructure across the Army.*	Finding #1: AEOP alumni (n=229) were asked to report on their awareness of other AEOPs. Over half (58%) shared that they were familiar with other AEOP programs and 78% of alumni reported being interested in participating in other AEOPs. Finding #2: AEOP Alumni were asked to report past participation in AEOPs as part of the evaluation. The program with the most participation by alumni was GEMS with 29% of respondents participating once, 12% twice, and 15% three or more times. Alumni respondents included past participants of all programs (eCM, JSS, GEMS, Unite, JSHS, SEAP, REAP, HSAP, CQL, and URAP). In addition, 1% of AEOP alumni reported receiving the NDSEG scholarship.

What current AEOP participants are saying…

*"**SEAP** this summer has been absolutely amazing! Not only did I gain useful research experience that colleges will be glad I have, but I also formed friendships with many people here. I got to ask scientists about their backgrounds and how they got interested in their STEM careers…SEAP definitely solidified my desire to become an engineer…Thanks so much AEOP!"* --SEAP Apprentice

*[Our **SEAP** student] was awesome. She texted me before the program to ask for information that could prepare her for the experience. She did not complain when doing the mundane and quickly got the work done…Definitely would repeat this summer."* --SEAP Mentor

*"**CQL** is an invaluable experience for college interns."* –CQL Mentor

"I have been with a fantastic team who treats me as a valuable peer, allowing me to design my own experiments and publish my own work." --**CQL** Apprentice

"The [**REAP**] *student I had was hard working and never hesitated to ask questions whenever she had any. I think she gained a good amount of knowledge working in the lab. Also she started reading and understanding the chemistry much more than I expected...It's a good experience."* --REAP Mentor

"I was very satisfied with my experience in [**HSAP**]. *I learned a lot about a very specific field, while at the same time learning skills that I will be able to use for a broad spectrum of fields later in life. I also learned a lot about my colleague's cultures, as some of them are foreign-born and there is always time to talk when waiting for measurements and tests to finish. I plan on recommending this program to everyone I know!"* --HSAP apprentice

"The [**URAP**] *program is valuable because it gives students the opportunity to gain research experience and receive financial compensation. The project I worked on was interesting, and I was able to learn about STEM and research from other members of the lab."* --URAP apprentice

"The **Unite** *program was an excellent opportunity not only to teach and introduce young students into the world of STEM and it's many opportunities. But also as a learning experience as a classroom assistant and educator to better approach students. Truly, an excellent experience both for students and teachers/instructors."* --Unite Mentor

"I feel much more confident and sure of pursuing a possible career using what I learned in [**Unite**]. *I would like to thank you for giving me the chance to be able to experience one of the best learning adventures of my life."* --Unite Student

"I greatly enjoyed having the opportunity to present my research in a formal setting and learning about the research that other students and professionals are doing." -- **JSHS** Student

*"***JSHS** *is the highlight of our year and the event our students look forward to more than any other. It is a high quality experience that has helped me build a strong research program in both middle and high school. We are very satisfied and look forward to continuing to engage in the future."* --JSHS Mentor

"Incredibly unique opportunity- [**eCM**] *was an amazing project which I plan to take in with me in my high school years as a baseline for my continued years of education in the STEM fields. I also gained/used creativity and leadership which are lifelong skills to have always."* -- eCM Student

"My kids had a blast doing **JSS***. This was the first time we competed in this event. My students failed miserably in our district event and that was the best part. They were very eager to get back to school and start working on solutions to problems they experienced…We will definitely continue competing in* **JSS***."* --JSS Mentor

"**GEMS** *was an excellent program which helped me discover more occupations I might be interested in. I experienced genuine hands-on experiments using professional equipment and procedures.* GEMS *helped me appreciate science more by exposing me to areas of open research and study."* --GEMS Student

"**GEMS** *has ignited my love and passion for science."* --GEMS Student

"[*In* **GEMS**,] *I get to interact with the young minds of the future. They're going to be our future scientists, our future engineers, doctors, lawyers…I get to interact with them and give them a military perspective of how we've gotten better as a whole because of technology."* --GEMS Mentor

Recommendations

1. **Increase and broaden participation in selected AEOP programs.** Overall enrollment in AEOP programs decreased by 7,066 in FY16 representing a total decrease of over 10,000 participants in the past two years (FY16, FY15). Most of the decline can be attributed to eCM, the largest AEOP program, in which enrollment declined by over 7,000 students. More effort should be invested into programs such as eCM, JSHS, and JSS that have the ability to grow within current funding structure. As suggested in FY15, a more concerted marketing campaign should be implemented for these programs. JSHS and JSS have the capacity to accept more

participants but are geographically constrained and distance to events may prohibit students in some communities from participating. JSHS and JSS should explore means of innovating the delivery of their programming at the regional level through the use of synchronous or asynchronous technologies.

An examination of the AEOP portfolio overall reveals that there was some growth in the participation of underserved and underrepresented groups in FY16. Female participation increased in six programs (CQL, HSAP, JSS, SEAP, Unite, URAP). Additionally, students from racial/ethnic minorities (including Asian students) in all programs increased with the exception of Unite. It is recommended that the AEOPs continue to focus on recruiting students from underserved and underrepresented groups in FY17, as there remains much room for growth across the portfolio.

As was the case in FY15, our recommendation in FY16 is for site leads to continue to utilize the Cvent system for selecting participants for Army laboratory based programs (i.e. SEAP, CQL) to protect the competitiveness of securing coveted spots in highly popular apprentice programs with low placement rates.

2. **Examine more closely the mentoring relationships within CQL, SEAP, URAP, and Unite in FY17 to determine why there was a decrease in reported satisfaction in FY16.** There was a decrease in the apprentice satisfaction with mentors in FY16. This, coupled with the FY15 findings of lack of use of effective mentoring strategies, may reveal that more attention should be directed toward mentor effectiveness and quality/quantity of mentor/apprentice interactions.

3. **Improve marketing and grow awareness of AEOP.** Overall interest in participating in other AEOPs remained strong in FY16. However, participant knowledge of other AEOPs and marketing of the AEOP portfolio across AEOPs could be improved. It is clear from the FY15 and FY16 evaluations that efforts to expose participants to the various programs within the portfolio, including distributing the AEOP brochure and using AEOP program websites and the AEOP website, are not adequate. It is recommended that in FY17 (as recommended in FY15 as well) Battelle Memorial Institute (the LO) work in concert with Widmeyer and individual programs in the consortium to develop program materials (i.e., AEOP slide deck, activities to be used within programs as part of program content) that will purposefully and collectively provide participants with a clear understanding of the AEOP program opportunities. The focus of the AEOP consortium should be on providing participants with an awareness of the pipeline of AEOP programs and should explicitly focus on providing details of each program, application procedures, timelines, and benefits of participation so that participants can make informed decisions about future participation. Furthermore, as in FY15, in FY16 mentors reported little knowledge of the AEOP portfolio. Similar efforts should be made to prepare mentors and program staff with a variety of easily accessible materials and information that can be readily shared with students and other adults.

4. **Raise awareness of Army/DoD STEM careers and research.** AEOP made progress in FY16 within the Army lab-based programs in exposing participants to Army/DoD STEM careers and research. It is recommended that IPAs work across the portfolio to share strategies that work for accomplishing this task. Specifically the competition

programs and STEM programs should work to grow exposure and experiences for participants in this area in FY17 through guest speakers and Army S&E participation as well as through the use of consortium level developed resources.

5. **Improve participation in AEOP evaluation activities.** Overall participation in the AEOP evaluation for FY16 was less than desirable. The FY16 AEOP evaluation included an analysis of participation in questionnaires, the primary data collection method. While youth participation in the evaluation questionnaire reached over 50% in most programs (eCM NJ&EE, GEMS, HSAP, REAP, SEAP, Unite) mentor completion of the questionnaire was significantly lower, ranging from 30% for URAP to 6% for SEAP. However, the overall participation rate improved, with 6,329 youth and adult participants out of 39,552 completing the questionnaire. IPAs should make a concerted effort to continue to encourage participation in the AEOP evaluation, with particular focus on improving adult response rates. As in FY15, it is recommended that all AEOP programs provide on-site (as applicable) time during the program for both participants and mentors to complete the program questionnaires. Furthermore, since the questionnaire is the primary means of information regarding the progress of AEOP each year, we recommend making participation mandatory for all participants in AEOP programs.

   In FY16 site visit data collection was also challenging. Some program schedules did not accommodate conducting focus groups after participation in the programs/competitions. Additionally, despite program efforts to recruit students and mentors for interviews and focus groups, participation has been less than desired. For FY17, programs should work with the evaluation team to determine what supports and incentives will make site visit data collection processes more successful.

Appendices

Appendix A: 2015 AEOP Evaluation

Methods and Design

The AEOP Evaluation used mixed methods approaches[15,16,17] that allow for broad generalization from "quantitative" trends generated in larger surveys of AEOP participants and in-depth focusing of the evaluation through the "qualitative" insights generated through observation and interview of smaller samples of participants. Evaluation activities included critical review of program documentation, participant questionnaires, focus groups or interviews, and on-site observations. Triangulation is used to improve the validity of findings by drawing information from different data sources (e.g., IPAs, students, and "mentors"), different methods of inquiry (e.g., program documentation, survey, focus group and interview data), and different investigators.[18] For example, in evaluation reports 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 survey data. Evaluators pose plausible explanations when divergence between data sources or data types was evident; any such explanations are subject to further exploration in iterative evaluation efforts. Periodically, more unique perspectives are reported and identified when they provide an illustration that distinctly captures the spirit of the AEOP, or a sentiment that is so antithetical to the AEOP mission that it warrants further investigation.

AEOP Evaluation endeavors to consistently employ the most rigorous designs possible accounting for the informal nature of AEOP CA educational program, the expansive variety of activities offered by different AEOP programs and sites, as well as the limited resources available for AEOP evaluation activities. AEOP evaluation has primarily employed designs described by the Academic Competitiveness Council as "Other Designs:"[19] those that do not employ the most rigorous "scientific" randomized control trials and quasi-experiments. AEOP Evaluation uses pre-post program designs, retrospective pre-post designs, and post-program only designs. In both pre-post and retrospective pre-post designs, changes in self-perceptions of outcome measures (e.g., confidence in applying a STEM research skill, from pre- to post-program) can be measured and the significance of that change can be investigated with appropriate statistical analyses. These and more rigorous designs are most methodologically appropriate for programs in which a treatment is more clearly defined and consistently delivered to a group of participants, such as in the curriculum-based summer programs. Post-program only designs are less useful for indicating whether participants have changed during the program, so efforts were also made to corroborate student perceptions of activities and program effects with those of mentors. These designs are currently used for programs in which the treatment is less clearly defined and where greater variations occur in the delivery to a group of participants, such as in the apprenticeship programs.

Measures and Sampling

[15] John Creswell, Research Design: Qualitative, Quantitative, and Mixed Methods Approaches (Thousand Oaks, CA: Sage Publications, 2003)
[16] Michael Patton, Qualitative Research & Evaluation Methods (Thousand Oaks, CA: Sage Publications, 2001)
[17] Jennifer Greene and Valerie Caracelli, Eds. "Advances in mixed method evaluation," New Directions for Evaluation, 1997, 74.
[18] Michael Bamberger, Jim Rugh, and Linda Mabry. Real World Evaluation (Thousand Oaks, CA: Sage Publications, 2006)
[19] Op. cit., U.S. Department of Education

Reviews of programs implemented were conducted and reported by some IPAs and provided to the LO in an effort to triangulate reviews of program implementation with other data.

Questionnaires, focus groups, interviews, and on-site observations were used to assess program implementation, primarily through participants' perceptions of program activities, and also to provide participants' self-assessments of program effects.

- Surveys were administered to participants online and in paper formats depending on each program site's ability to provide access to computers. All participants of the primary audiences for the program are invited to participate in these surveys, often through emails sent by the evaluation team, IPAs, or site coordinators. Questionnaires consisted of self-report items with likert-type scales as well as opened or constructed-response "qualitative" items.
- On-site focus groups are conducted with a strategic sample of sites and participants. Different sampling strategies were used, depending on the context of the program. Purposive sampling was used for assembling focus groups when large numbers of participants were available to join the focus group at a site. In this case, participants were selected to ensure equal representation of males and females and a range of age/grade levels, race/ethnicity, and STEM interests. Convenience sampling—all participants are invited to join the focus group without regard to diversity represented by the group—was employed when small numbers of participants were available at a site.
- Phone interviews were conducted to maximize participation for programs in which on-site visits are less cost-effective such as programs having many sites and with small numbers of participants at each site. Purposive sampling was used for identifying phone interview candidates to ensure diversity in geography (program sites), participant demographics, and STEM interests. When used, phone interviews were employed in addition to focus groups.
- Onsite observations were conducted whenever in-person focus groups were conducted. While observations were unstructured (i.e., not formal observation protocol), they included assessment of critical aspects of participant engagement in AEOP programming.

Data Collection and Analysis

Data collection occurred proximal to program activities. Questionnaires were released toward or after the conclusion of program activities and remained open for a period of 10–30 days. Focus groups (onsite and online) and phone interviews were conducted during program activities, but, when possible, toward the conclusion of program activities to maximize referent experiences.

Quantitative and qualitative data were compiled and analyzed after all data collection had concluded. Evaluators summarized quantitative data with descriptive statistics such as frequencies, means, and standard deviations. Where appropriate evaluators conducted inferential statistics to study any differences in participants' pre-post program outcomes, differences between participants' perceptions of program and school, and differences between different participant groups' perceptions or outcomes that could demonstrate the potential effect of their participation in an AEOP. Inferential statistics were used to identify statistically and practically significant differences. Statistical

significance indicates whether a result is likely due to programming rather than due to chance alone. Statistical significance is determined with t, Z, McNemar, ANOVA, or Tukey's tests, with significance defined at $p < 0.05$. Because statistical significance is sensitive to the number of respondents, practical significance, also known as effect size, is used to indicate the relative strength of each observed effect. Practical significance is determined with Cohen's *d* or Pearson's *r* greater than .250, which is considered weak but "substantively important".[20] Statistically and/or practically significant findings were noted in the reports and reported in appendices or footnotes. For brevity of this report, significant effects are often noted as such, with no additional details.

Evaluators analyzed qualitative data from constructed-response questionnaire items and focus group data for emergent themes. These data were summarized by theme and by frequency of participants addressing a theme. When possible, two raters analyzed each complete qualitative data set. When not possible, a portion of the data set was 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 (students and mentors), data types (quantitative and qualitative), and evaluation personnel. Triangulation enhances the credibility of findings synthesized from single data 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 data types is evident; any such explanations are worthy of further exploration in the full study and, potentially, in future evaluation efforts.

Reporting and Dissemination

Data, findings, and recommendations were presented to each program and the Army in a formal summary report. Full study reports were delivered to programs and the AEOP from November 2016 to January 2017. Individual Program Administrators (IPAs) were provided 7 days to provide critical review and a response (if desired) of their program evaluation. Any responses provided were attached as an appendix to the final report submitted to the Army. Revised reports were provided to IPAs for a second round review. The Army CAMs also participated in two rounds of report revisions.

Mid to Long Term Study – Alumni Interview Protocol

General questions

1. What grade are you in this year? Or what year in college or technical program?

AEOP Participation and Other AEOP elements, DoD Workforce Programs (ALL)

[20] 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

2. What AEOP programs have you participated in so far before this year? (read the list to them if needed and ask how many times in each program – some can be more than one)
3. Are you enrolled in an AEOP program this year? (which one)
4. Do you plant to participate in an AEOP program in the future? (which ones)
5. Have you participated in any other AEOP element (might need a list) or any DoD workforce programs?

Impact of S&E Mentors on AEOP Participants

6. What did you think the benefit was of having an AEOP mentor or coach during your AEOP program(s)?

Attitudes toward STEM and Army DoD STEM

7. What do you like about STEM (which stands for science, technology, engineering, and mathematics)?
8. Do you think participating in AEOP helped you to grow your STEM knowledge and skills? How?
9. Can you give me an example of something you learned about Army/DoD STEM work while in AEOP?

Interest in STEM (ALL)

10. Do you think participating in AEOP made you more interested in STEM (which stands for science, technology, engineering, and mathematics)? How?
11. What areas of STEM are you most interested in and why?

Engagement in STEM (ALL)

12. Can you give me an example of things you do outside of school that are related to STEM? If needed - For example, do you read about STEM or talk with others, or volunteer?

Awareness of STEM Research Overall and Army/DoD Specifically

13. What kinds of challenges/problems do STEM researchers work on?

Appendix B: 2016 College Qualified Leaders (CQL) Evaluation Executive Summary

The College Qualified Leaders (CQL) program, managed by the Academy of Applied Science (AAS), is an Army Educational Outreach Program (AEOP) that matches talented college students (herein referred to as apprentices) with practicing Army Scientists and Engineers (Army S&Es, herein referred to as mentors), creating a direct apprentice-mentor relationship that provides apprentice training that is unparalleled at most colleges. CQL allows alumni from Gains in the Education of Mathematics and Science (GEMS) and Science and Research Apprentice Program (SEAP) to continue their relationship with the mentor and/or laboratory, and also allows new college students to enter the program. CQL offers apprentices the provision of summer, partial year, or year-round research at the Army laboratory, depending on class schedules and school location. CQL apprentices receive firsthand research experience and exposure to Army research laboratories. CQL fosters desire in its participants to pursue further training and careers in STEM while specifically highlighting and encouraging careers in Army research.

In 2016, CQL supported 236 apprentices who were hosted by 162 mentors at 11 Army laboratory/CQL sites. This represents a 60% decline in enrollment from FY15 (394).

This report documents the evaluation of the FY16 CQL program. The evaluation addressed questions related to program strengths and challenges, benefits to participants, and CQL's overall effectiveness in meeting AEOP and program objectives. The assessment strategy for CQL included post-program questionnaires distributed to all apprentices and mentors, site visits to three CQL sites, three focus groups with apprentices, three focus groups with mentors, and an annual program report compiled by AAS.

2016 CQL Fast Facts	
Description	STEM Apprenticeship Program – Summer or school year, at Army laboratories with Army S&E mentors
Participant Population	College undergraduate and graduate students
No. of Applicants	467
No. of Students (Apprentices)	236
Placement Rate	51%
No. of Mentors (Army S&Es and other adult mentors)	162
No. of Army Research Laboratories	11
No. of Colleges/Universities	112
No. of HBCU/MSIs	4
Total Cost	$2,360,394
Stipend Cost	$2,235,418
Cost Per Student Participant	$10,002

Summary of Findings

The FY16 evaluation of CQL 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.

2016 CQL Evaluation Findings	
Participant Profiles	
CQL experienced decline in enrollment overall while seeing participation of females increase slightly while other groups remained steady with no increase.	Overall enrollment for CQL significantly decreased in FY16 by 40% (236 participants), as well as number of overall applications by 8%. However, CQL did make some progress in growing the number of female participants to 46% (compared to 40% in FY15). Although females continued to participate at a lower rate than males (in FY16 54% of participants were males, 46% were females), this increase in the participation of female students—a population that is historically underrepresented in STEM fields (particularly physical science and engineering fields) – is a significant gain. It is important to note that in FY16 CQL began phasing out graduate student participation and did not award any new graduate student CQL apprenticeships.
	CQL continued to serve students from historically underrepresented and underserved race/ethnicity groups, however the majority of enrolled apprentices (85%) identified themselves as "White" or "Asian." The percentage of Black or African American and Hispanic or Latino apprentices remained steady at 11% and 3% respectively. In sum, only 13% of enrolled participants identified themselves as being from an underrepresented or underserved minority groups (same as in FY15), indicating that continued focus needs to be invested in growing the diversity of CQL participants.
CQL participants reported limited past participation in other AEOPs, suggesting that recruiting apprentices from other AEOPs is an area with potential for growth.	Questionnaire data indicate that responding apprentices had participated in few AEOPs aside from CQL previously, although 32% report having participated in CQL in the past. While 19% reported having participated in GEMS, only 14% of respondents reported having participated in SEAP previously as compared with 32% of CQL apprentices who reported participating in SEAP in FY15. Program registration data indicated that 41% of enrolled CQL participants had participated in SEAP in FY15 and 17% had previously participated in GEMS.
CQL did not meet its targeted number of program applicants or mentors.	CQL received 467 of their targeted 650 applications in FY16. This was an increase in applicants from FY15 (550) but fewer than targeted. In CQL, student participation is dependent upon the number of available mentors. The CQL program had only 162 mentors in FY16, which limited the number of apprentices that could be accepted significantly. However, the 162 mentors served more than one apprentice on the rolling schedule of apprenticeships – meeting the 1:1 mentor requirement. The number of CQL mentors decreased in FY16 (176) from FY15 (369).
Actionable Program Evaluation	

CQL's primary mode of recruitment continues to be personal connections.	Apprentice questionnaire respondents indicated that they most commonly learned about CQL from a personal or university contact.
	Apprentice interview data support the notion that pre-existing relationships are key factors in apprentice awareness of CQL.
CQL apprentices were motivated to participate in CQL by a variety of factors.	Apprentices were motivated to participate in CQL by a wide variety of factors, however large majorities of apprentices indicated that the desire to learn something new or interesting, interest in STEM, and the desire to expand their laboratory or research skills were key motivators for participation.
CQL engaged apprentices in meaningful STEM learning.	Apprentices reported consistent learning in a variety of areas as a result of CQL, including learning about STEM topics, applying STEM to real-life situations, and learning about STEM careers.
	Apprentices reported consistently engaging in a variety of STEM practices during their CQL experience. For example, most apprentices reported engaging in activities such as using laboratory procedures and tools, working as part of a team, and carrying out investigations on most days or every day of their CQL experience.
	CQL provided more intensive opportunities for apprentices to learn about STEM and engage in STEM practices than they had within their typical school settings.
	Mentors reported using a wide variety of strategies to help make learning activities relevant to apprentices, support the needs of diverse learners, develop apprentices' collaboration and interpersonal skills, engage apprentices in authentic STEM activities, and support apprentices' STEM career and education pathways.
CQL promoted apprentice awareness of DoD STEM research and careers.	A large majority of CQL participants reported learning about at least one STEM career and most reported learning about 4 or more. Similarly, a large majority of apprentices reported learning about at least one DoD STEM job, with over half reporting they learned about 4 or more. Apprentices reported that their mentors and the CQL experience contributed the most to this impact.
Apprentices' awareness of other AEOPs increased as a result of their CQL participation, however mentors and apprentices overall have only limited awareness of other AEOP opportunities and AEOP resources.	Over half of responding apprentices reported that CQL influenced their awareness of AEOPs and, similarly, over half of apprentices reported being interested in future participation in AEOP initiatives. Apprentices reported that participation in CQL and their mentors were the most useful resources learning about other AEOPs, however, mentors overall reported limited familiarity with AEOP initiatives aside from CQL. Large proportions of apprentices and mentors reported having no experience with AEOP resources such as the AEOP website, the It Starts Here! Magazine, AEOP on social media, and the AEOP brochure.
Apprentices and mentors value the CQL experience, although aspects of program administration continue to be areas identified	A large majority of responding apprentices reported being satisfied with their mentors and experiences during the CQL program. For example, 99% of responding apprentices reported being at least somewhat satisfied with their working relationship with their mentors and 89% with the amount of time they spent doing meaningful research.
	Both apprentices and mentors were asked about their overall satisfaction with the CQL program in an open-ended item on the questionnaire. Almost all respondents had positive

for improvement.	perceptions of the program. However some apprentices described dissatisfaction with administrative aspects of the program. In particular, apprentices noted difficulties in getting computer access and difficulties in receiving stipend payments on time. When asked how the program could be improved, apprentice respondents indicated that improvements could be made in administrative tasks such as timely stipend payments, and faster computer access.
Outcomes Evaluation	
CQL apprentices reported gains in their STEM knowledge and competencies.	Large proportions of apprentices reported large or extreme gains in their STEM knowledge. For example, a majority of respondents reported large or extreme gains in their knowledge of what everyday research work is like in STEM, knowledge of how scientists and engineers work on real problems in STEM, in-depth knowledge of a STEM topic(s), and knowledge of research conducted in a STEM topic or field.
	Most apprentices reported large or extreme gains in their STEM competencies. For example, most apprentices reported large or extreme gains in their abilities to ask questions that can be answered with one or more scientific experiments; support an explanation with relevant scientific, mathematical, and/or engineering knowledge; Integrate information from technical or scientific texts and other media to support their explanation of an observation; and communicate about their experiments and explanations in different ways (through talking, writing, graphics, or mathematics).
CQL participants reported gains in apprentices' 21st Century Skills.	Apprentices reported large or extreme gains in several critical workplace skills, with most apprentices reporting large or extreme gains in areas such as the ability to make changes when things do not go as planned, sticking with a task until it is complete, and learning to work independently.
CQL participants reported increased confidence and identity in STEM.	Apprentices reported gains in their confidence and STEM identity. For example, most apprentices reported large or extreme gains in feeling prepared for more challenging STEM activities, the desire to build relationships with mentors in STEM fields, and having a sense of accomplishing something in STEM.
CQL participants reported increased interest in future STEM engagement.	Apprentices reported that that they were more likely to engage in STEM activities outside of school after participating in CQL. For example, a majority of apprentices indicated that they were more likely to mentor or teach other students about STEM, to talk with friends or family about STEM, and to work on a STEM project or experiment in a university or professional setting after participating in CQL.
CQL influenced apprentices' education aspirations, but did not change their career aspirations.	Apprentices expressed more interest in pursuing advanced degrees after their participation in CQL. In particular, apprentices were more likely to aspire to earn Ph.D. degrees after CQL as compared to their pre-CQL educational aspirations.
	Nearly all apprentices aspired to a career in a STEM field both before and after participating in CQL.

CQL participants reported interest in participating in AEOPs in the future.	A majority of apprentices reported being at least somewhat interested in participating in CQL, the SMART scholarship, and the NDSEG fellowship in the future. Although substantial numbers of apprentices indicated that they had never heard of the GEMS Near Peer Mentor program (36%) and URAP (41%), over a quarter of apprentices expressed some interest in participating in these programs in the future. Apprentices reported that participation in CQL and their mentors were most likely to impact their awareness of other AEOPs.
CQL apprentices have positive opinions about DoD researchers and research.	Apprentice perceptions of DoD researchers and research were overwhelmingly positive. All responding apprentices agreed or strongly agreed that DoD researchers advance science and engineering fields, and nearly all agreed or strongly agreed that DoD researchers solve real-world problems, that DoD research is valuable to society, and that DoD researchers develop new, cutting-edge technologies.

Responsiveness to FY15 Evaluation Recommendations

The primary purpose of the AEOP program evaluation is to serve as a vehicle to inform future programming and continuous improvement efforts with the goal of making progress toward the AEOP priorities. In previous years the timing of the delivery of the annual program evaluation reports has precluded the ability of programs to use the data as a formative assessment tool. However, beginning with the FY16 evaluation, the goal is for programs to be able to leverage the evaluation reports as a means to target specific areas for improvement and growth.

In this report, we will highlight recommendations made in FY15 to programs and summarize efforts and outcomes reflected in the FY16 APR toward these areas.

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

Finding: Work remains to be done in achieving the CQL program goal of broadening the talent pool in STEM fields.

CQL FY16 Efforts and Outcomes: In FY16, more students from the AEOP pipeline transitioned to the CQL program; specifically more SEAP alumni. There were more female participants in CQL as well, than in previous years. In FY17, AAS will specifically contact HBCUs/MSIs that are located near the labs to ask for representation on their internship websites. We will also connect with the AEOP's strategic partners for additional contacts.

Finding: The program may want to consider how students are recruited and subsequently selected to serve as apprentices since personal relationships continue to play a key role in how students are recruited into CQL.

CQL FY16 Efforts and Outcomes: In FY16, personal relationships did continue to be a factor in choosing a student for participation. 467 applications were received this year, and 20% were from self-reported underserved populations. AAS will continue to work with lab coordinators to explore how apprentices are chosen and to recommend a cap on students that have personal relationships to mentors in the labs.

Finding: The CQL program should continue its work in phasing out the practice of granting apprenticeships to graduate students.

CQL FY16 Efforts and Outcomes: In FY16 all graduate students were transferred out of the CQL program. The program is now exclusively for undergraduate students.

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

Finding: Grow mentor participation and ensure one-to-one mentorship. Provide incentives such as highlighting the potential 12 benefits of apprentice involvement in mentors' projects, publicizing the work of apprentice-mentor teams, publicizing the professional accomplishments of former CQL apprentices, and recognizing mentors who exemplify outstanding mentorship practices. Consider what supports can be put in place to help mentors efficiently and effectively utilize their apprentices and to assist them in fostering their mentoring skills. For example, mentors may benefit from ideas for ways in which apprentices can productively contribute to ongoing research. In addition, potential mentors should be made aware of these supports as an added incentive to participate in CQL.

CQL FY16 Efforts and Outcomes: In FY16, CQL met the 1:1 mentorship requirement. Mentors for CQL appear to be on a rotating schedule since CQL is a year-round program, i.e. once a student completes CQL, the mentor moves on to mentor another student.

In FY16, AAS issued certificates of recognition to mentors and lab coordinators. AAS has received positive feedback and will continue with this recognition. In FY17, all apprenticeships will develop best practices to assist all mentors and communicate routinely. AAS will work with Widmeyer to highlight mentors and student impact.

Finding: Consider innovative ways to work with other AEOP programs to create a more seamless continuum of programs and make efforts to ensure that mentors are informed about the range of AEOPs. Information about AEOPs could be incorporated into orientation materials, provided during the student symposium, and incorporated into alumni communications.

CQL FY16 Efforts and Outcomes: In FY16, AAS cross-marketed all AEOP programs and materials to all program administrators. Mentors received, through their lab coordinators, bi-monthly communication that included AEOP opportunities, Alumni newsletters and the 2016 Guide to STEM Careers. In FY17, AAS will continue to cross promote all AEOP programs. AAS will also reach out to our consortium and strategic partners to see how individual program material can be cross-marketed.

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

Finding: Address administrative difficulties such as problems with receiving stipends in a timely fashion, lack of computer access, and security clearance issues.

CQL FY16 Efforts and Outcomes: In FY16, AAS worked with Battelle to improve the stipend payment process. A clear process was developed to pay stipends on time at the first of each month. We anticipate continuing the use of this process because it tracks stipend payments clearly for both the labs and the CAM. Lab coordinators report no difficulty with the system and students receive payments on time. Lab coordinators and student alike both pointed out that the timeframe for security clearance and computer access takes a great deal of time.

While AAS has no direct control over these issues, we will suggest opening and closing the application earlier to allow for more time to process paperwork before a student begins an apprenticeship.

Finding: The continued low response rates for both the student and mentor questionnaires continued in FY16.

CQL FY16 Efforts and Outcomes: In FY16, an email outreach to students was done about the evaluation, but achieved low success. In FY17, AAS plans to target current students earlier in their participation. A better response rate might be achieved if the survey was shorter and some sort of incentive was offered, such as a gift card. Mentor participation in program evaluation was limited because lab coordinators indicated mentors did not want to be bothered with "unnecessary" emails. In FY17, AAS will communicate to lab coordinators that evaluation links must be sent to the mentors for completion and the importance of the evaluations. Again, a shorter survey and an incentive could prove to be helpful.

FY16 Recommendations

Evaluation findings indicate that FY16 was a year of mixed success overall for the CQL program. Despite a significant drop in CQL apprentice participation, those that did participate reported positive impacts of the program on their STEM competencies and knowledge, as well as high levels of satisfaction with the program. Additionally, CQL increased the participation of female apprentices as well. While these successes are commendable, there are some areas that remain with potential for growth and/or improvement. The evaluation team therefore offers the following recommendations for FY16 and beyond:

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

1. CQL should focus on growing the pool of applicants overall as well as for underrepresented groups. The significant decline in participation this year (40%) indicates that much more effort should go into recruiting potential apprentices – outside of the personal connections that are most frequently reported as the primary means of learning about and participating in CQL. Further, though percentages of underrepresented groups held steady at 13% in FY16, there should be continued focus on growing the representation of these groups in the CQL program. A suggestion for doing this may be to connect with more HBCUs/MSIs, as well as implementing other new methods to actively recruit students nationwide.

2. Personal relationships continue to play a key role in how students are recruited into CQL, as 23% learned about the program through someone who works with CQL, 22% learned about CQL through a past participant, and 19% learned about CQL from a DoD employee. In order to broaden and diversify the pool of applicants, the program may wish to revise recruitment and selection practices. In particular, the AAS may want to consider how the CQL program is publicized to students. In addition, selection processes that ensure applicants are selected based on their qualifications and aptitudes rather than on their personal connections should be considered. These activities should be undertaken with mindfulness of the program goal of recruiting former AEOP participants into CQL, however. Since it is a goal of the program to recruit SEAP students into CQL, the program may wish to work with the SEAP program to ensure that the pool of applicants is broadened and diversified at that level as well.

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

1. Since the number of available mentors places a limit on the number of apprentices the CQL program can accommodate, the program may want to consider what incentives it can provide for mentor participation. Mentors in focus groups suggested increased program outreach to potential mentors, program recognition of mentor efforts, and support in the form of overhead funding for mentors as means to increase the pool of CQL mentors. Other mentor recruitment strategies the program may wish to consider include highlighting the potential benefits of apprentice involvement in mentors' projects, publicizing the work of apprentice-mentor teams, publicizing the professional accomplishments of former CQL apprentices, and recognizing mentors who exemplify outstanding mentorship practices. Possibly AAS can provide support to the LPCs to enact a strategy for providing recognition.

2. In light of the program goal to have SEAP apprentices' progress into CQL apprentice positions, the low percentage of CQL apprentices who had participated in SEAP is an area with room for growth. The program may wish to work with the SEAP program to ensure that the pipeline between the two programs is clear to both apprentices and mentors. Apprentice responses indicated that mentors are key resources in learning about other AEOPs and therefore efforts should be made to ensure that mentors are informed about the range of AEOPs and that GEMS and SEAP mentors are equipped with information about CQL. Because of the time constraints mentors face in working with students, however, the program should also consider ways to educate participants about AEOP opportunities that do not rely on mentors. Given the limited use of the AEOP website, print materials, and social media, the program should consider how these materials could be more effectively utilized to provide students with targeted program information.

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

1. The administrative difficulties noted in both FY14 and FY15 continued in FY16. While students indicated that their CQL experiences were mostly positive, problems with receiving stipends in a timely fashion and lack of computer access continued to color apprentice experiences. Likewise, some mentors reported considerable frustration with apprentice pay issues and computer access. The AAS should be mindful of these issues and leverage its past experience with administering apprenticeship programs to streamline processes and improve communication with apprentices.
2. The continued decline in response rates for both the student and mentor questionnaires raises questions about the representativeness of the results. The program may want to consider emphasizing the importance of these evaluations with individual program sites and communicating expectations for evaluation activities. In addition, CQL may want to consider incentivizing participation in the AEOP evaluation.

Appendix C: 2016 eCYBERMISSION (eCM) Evaluation Executive Summary

eCYBERMISSION (eCM) is sponsored by the U.S Army and managed by the National Science Teachers Association (NSTA). Since the program's inception in 2002, more than 176,000 students form across the U.S., U.S. territories, and Department of Defense Educational Activities (DoDEA)'s schools worldwide have participated in the program. eCYBERMISSION is a web-based science, technology, engineering, and mathematics (STEM) competition free to students in grades six through nine that promotes self-discovery and enables all students to recognize the real-life applications of STEM. Teams of three or four students are instructed to ask questions (for science) or define problems (for engineering), and then construct explanations (for science) or design solutions (for engineering) based on identified problems in their community. Students compete for State, Regional, and National Awards.

This report documents the evaluation of the FY16 eCM program. The evaluation addressed questions related to program strengths and challenges, benefits to participants, and overall effectiveness in meeting AEOP and program objectives. The assessment strategy for eCM included questionnaires for students and Team Advisors; two focus groups with eCM NJ&EE student participants and two with their Team Advisors; observations of the NJ&EE event, and an annual program report compiled by eCM.

There were 20,607 students that entered state competitions in FY16 (Table 1 displays the number of participants per State/DoDEA/Territories). The top 12 teams from each of the 5 regions advanced to regional competitions for a total of 60 teams that compete in the virtual regional judging. Judging is done via Blackboard. This year a total of 216 students participated in the regional judging. The highest score in each region for each grade determines the national finalists. The STEM in Action Grant recipient teams are selected from the regional finalist teams that submit a proposal to implement their solution in their community. Up to 5 STEM in Action Grants are given each year. This year 2 of the 5 teams were also national finalists. A total of 86 students participated in NJ&EE, 20 from the national finalist teams and 3 additional STEM in Action Grant recipient teams.

2016 eCM Fast Facts	
Description	STEM Competition - Nationwide (incl. DoDEA schools), state-level competition, regional competition and winners advancing to NJ&EE.
Participant Population	6th-9th grade students
No. of Applicants	23,323 students registered
No. of Participants	20,607 State, 216 Regional Participants (of whom 86 were selected to attend the NJ&EE) with a total of 15,710 that submitted completed folders (76.2%)
Placement Rate	N/A all that apply are permitted to participate
No. of Adults (Team Advisors and Volunteers – including S&Es and Teachers)	3,389

Team Advisors (with complete teams)	802
Number of Volunteers (Ambassadors, CyberGuides, Virtual Judges)	2,047
Number of Army S&Es	540
Number of Army/DoD Research Laboratories	37
Number of K-12 Teachers (including preservice)	727
Number of K-12 Schools (home, private, public, DoDEA)	547
Number of K-12 Schools Title 1	294
Number of Colleges/Universities	153
Number of DoDEA Students	417
Number of DoDEA Teachers	21
Number of DoDEA Schools	15
Number of Other Collaborating Organizations	19
Total Awards	Second-Place State Winners: $500 U.S. Savings Bonds/student First-Place State Winners: $1,000 U.S. Savings Bonds/student All Regional Finalists: $1,000 U.S. Savings Bonds/student First-Place Regional Winners: $2,000 U.S. Savings Bonds/student, all expense paid trip to NJ&EE First-Place National Winners: $5,000 U.S. Savings Bonds/student
Total Cost	$3,038,180
NJ&EE Cost	$335,599
Scholarship/Award Cost	$747,194
Cost Per Student Participant	$147

Summary of Findings

The FY16 evaluation of eCYBERMISSION included collection of data about participants, their perceptions of program processes, resources, and activities, and indicators of achievement related to AEOP's and eCM's objectives and intended outcomes. A summary of findings is provided in the following table.

2016 eCM Evaluation Findings	
Participant Profiles	
Participation in eCM decreased in FY16 by 18%.	In 2016, there were 20,607 State Participants, and 216 Regional Participants (of whom 86 were selected to attend the NJ&EE). This represents an 18% decrease in student participants from 2015.
	Eighty-four percent of national eCM students and 55% of regional eCM students reported being "somewhat" or "very much" satisfied with the submission process. Over 90% of Team Advisors reported being "very much" or "somewhat" satisfied the submission process.

	Participation in eCM for FY16 included nearly equally distributed representation of males (49%) and females (51%). In regards to other underrepresented groups, the group included predominantly White participants (49%). However, there were 18% Hispanic or Latino participants, and 8% Black or African American eCM participants.
	There were more White and Asian Participants that progressed to regionals. Of the regional finalists (n=216), there were slightly more females (51%) than males. Proportionally, a slightly higher percentage of White students proceeded to the regional finals (56%), followed by 24% of students identifying as Asian, and 8% identifying as Hispanic or Latino/a. Only 8% of Black or African American students progressed to the regional finals, and .4% of Native Americans or Alaskans and .4% of Native Hawaiians or other Pacific Islanders were regional finalists
	Demographic data collected from Team Advisors on the evaluation survey indicated more responding Team Advisors were female than male (64% vs. 35%). As with the responding students, most of the responding Team Advisors identified themselves as White (73%).
Actionable Program Evaluation	
The most effective means of recruitment in FY16 were personal contacts and the eCM website. However, some Team Advisors learned about eCM at professional conferences.	Forty-eight percent of students learned about eCM from someone who works at the school or university they attend, followed by 36% of students learning about eCM from a school or university newspaper or website. Less than 10% of students learned from other sources and 18% chose not to respond to this question.
	The most frequent responses were personal contacts, including a past eCM participant (33%), a colleague (20%), or a supervisor (14%). In addition, 17% learned from a STEM or STEM education conference and 12% learned from an email or newsletter from a school, university, or a professional organization.
Students are motivated to participate in eCM via teacher encouragement and/or requiring students to participate, desire to have fun, learn something new, and overall interest in STEM.	For the eCM-R responders, the top two motivating factors were interest in teacher or professor encouragement (51%), and equal factors include an academic requirement (36%) and having fun (36%). Other factors include a desire to learn something new or interesting (27%) and an interested in STEM (22%).

National eCM students learned more about DoD/STEM careers than regional participants.	Sixty-nine percent of National participants reported learning about five or more DoD/STEM careers and 66% of Regional students reported learning about at least one DoD STEM job/career during their eCM experience. However only 13% of regional participants reported learning about 5 or more different STEM jobs/careers in the DoD. This finding reveals the NJ&EE does a much more effective job of introducing participants to DoD opportunities than the regional events.
	Participants in the NJ&EE focus groups reported that that they had not learned much about STEM jobs/careers with the DoD in eCM before they came to the national event. Participants shared that the field day (visiting congressional leaders and national monuments) and the AEOP STEM Challenge Day at the national event did a great deal to expose them to STEM careers in the DoD.
The eCM experience and competition overall is valued by both students and Team Advisors. However, many participants did not experience the Cyber Guide live chat, feedback, and forum.	Roughly half of responding NJ&EE participants were very much satisfied with the eCM registration (54%), submission (51%), and eCM website (49%). Many National eCM students reported that they did not experience the eCM Cyber Guide live chat (23%), Cyber Guide feedback (24%), and Cyber Guide forum (29%). Regional eCM students reported similar satisfaction rates. Highest satisfaction rates were reported for the eCM registration (26%), submission (26%), and eCM website (36%) for eCM Regional students. Also similar to the NJ&EE students, the Regional competition participants also reported little experience with eCM Cyber Guide live chat (50%), Cyber Guide feedback (39%), and Cyber Guide forum (39%).
	Over 90% of Team Advisors reported being "very much" or "somewhat" satisfied the submission process (91%) and the eCM website (91%). Also, 83% of Team Advisors reported being "very much" or "somewhat" satisfied with variety of STEM mission folders available, and 61% reported being "very much" or "somewhat" satisfied with communication with NSTA. However, many Team Advisors reported that they did not experience several of the components such as Cyber Guide live chats, feedback or forums.
Outcomes Evaluation	
eCM participants are engaged in solving STEM problems, and recognize that they can impact their communities through STEM	More than 50% of NJ&EE participants experienced *all* STEM practices in eCM, which were reported on the survey except for building or making a computer model. Regional students reported having engaged in fewer of the STEM practices reported on the survey and spent less time than the National students in doing STEM practices. Although this is a difference, it is expected as the National participants spent more time preparing their projects for the NJ&EE.

activities.	Significant group differences were found in terms of Engaging with STEM Practices in eCM for both competition level and race/ethnicity. National eCM participants reported significantly higher levels of engagement with STEM practices in eCM compared to regional participants and minority students reported significantly higher levels compared to White students.
	Eighty-nine percent of Team Advisors helped students understand the role of STEM in their community, and one of the major open-ended responses to the benefits of eCM by both Regional and National participants included an understanding of how solving problems in the STEM field can help their community and the global community.
	Students reported greater "Learning about STEM" in eCM than in school for both Regional and National students. Similar results were found for the "Engaging in STEM Practices" composite for Regional and National students.
eCM had positive impacts on students' perceptions of their 21st Century Skills.	More than 80% of NJ&EE participants reported "medium" or "large" gains on all 21st Century skills listed on the survey. Between 60% and 75% of Regional participants reported "medium" or "large" gains on all 21st Century skills listed on the survey.
NJ&EE participants reported positive gains in student confidence and identity in STEM, as well as their interest in future STEM engagement. Regional findings were mixed.	The survey data strongly suggest that the program has had a positive impact on student confidence and identify in STEM for the National group. A large majority of NJ&EE participants reported "medium" or "large" gains in every category.
	Regional participants were mixed in their reporting of gains in the eCM program, with roughly an equal spread across the responses "no gain," "little gain," "medium gain," and "large gain" for all categories.
According to Team Advisors, eCM succeeded in raising students' education and future STEM career aspirations.	Mentors reported that participation in eCM (63%) and the eCM website (56%) were most often rated as "very much" useful in influencing students' educational aspirations.
eCM participants and Team Advisors were aware of only a few of the other AEOP programs, and many only knew about eCM. However, many participants indicated interest in other AEOP	Although about a quarter of the Team Advisors discussed other AEOP programs in general, less than 10% of Team Advisors discussed any other AEOP program with the eCM students.
	Half to over three-quarters of Team Advisors did not utilize the Army Educational Outreach Program (AEOP) website, AEOP on Facebook, Twitter, Pinterest or other social media, AEOP brochure, It Starts Here! Magazine, or Invited speakers or "career" events.

programs.	Regional participants reported being unaware of the various AEOP programs at a much higher rate (between 7% and 64% for all programs listed in the survey) than the NJ&EE participants (between 2% and 46% for all programs listed in the survey). This was likely attributed to the AEOP alumni panel that was part of the programming at the NJ&EE in FY16. However, many students (both regional and NJ&EE) expressed that they would be "very much" or "somewhat" interested in future programs. For example, eCM (N-89%; R-38%) and GEMS (N-70%; R-13%).

Responsiveness to FY15 Evaluation Recommendations

The primary purpose of the AEOP program evaluation is to serve as a vehicle to inform future programming and continuous improvement efforts with the goal of making progress toward the AEOP priorities. In previous years the timing of the delivery of the annual program evaluation reports has precluded the ability of programs to use the data as a formative assessment tool. However, beginning with the FY16 evaluation, the goal is for programs to be able to leverage the evaluation reports as a means to target specific areas for improvement and growth.

In this report, we will highlight recommendations made in FY15 to programs and summarize efforts and outcomes reflected in the FY16 APR toward these areas.

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

Finding: Team Advisor Assessment data regarding quality of eCYBERMISSION program supports also identified socio-economic challenges of program participation that continue to place lower income student competitors at a disadvantage.

eCM FY16 Efforts and Outcomes: This issue has been addressed by offering Mini-Grants to help implement the competition into a classroom. Teachers or district administrators apply for the Mini-Grant, and awardees are selected based on economic need, using as one of the first criteria funding going to Title I applications. Last year 70.7% of Mini-Grant students were from Title I schools.

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

Finding: Introduce mechanisms to enhance Team Advisors' interactions and peer-to-peer support.

eCM FY16 Efforts and Outcomes: A pilot program was established beginning in January 2016 to pair a new Team Advisor (first year) with a veteran Team Advisor to serve in the role of a Team Advisor. Additional mechanisms included encouraging Team Advisors to participate in the Team Advisor Forum on the website. This information was shared via the newsletters sent to all Team Advisors by their eCM POC.

Finding: Introduce an appropriate buddy system to the FY16 NJ&EE competition to enable students more freedom of movement and reduce Team Advisor strain.

eCM FY16 Efforts and Outcomes: Our teams are made up of students in grades 6 through 9. We are responsible for their safety 24/7. It is the Team Advisor's responsibility to chaperone their students from the time the

students meet their Team Advisor to leave for NJ&EE until the students are returned to their parents at the end of NJ&EE. Students from the same team were to select a fellow teammate of the same gender to be a buddy during the week. If the students needed to leave for the bathroom, they were able to do so with their buddy (and not the Team Advisor as in previous years) as long as they let their Team Advisor, NCO, or Team Advisor know they were doing so. At all other times during the week, the Team Advisors were expected to be with their students except at night in their rooms. All Team Advisors did have their sleeping room in very close proximity to the student rooms at the NCC.

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

Finding: Increase eCYBERMISSION participants' awareness of program resources by embedding a brief introductory video into the online registration.

eCM FY16 Efforts and Outcomes: A video was produced in 2015, edited to 4 minutes 19 seconds (originally it was 10 minutes) and was added to the home page of the eCYBERMISSION website (originally found in teacher resources). The video is titled "eCYBERMISSION Website Tutorial" and is a brief overview of the features and pages available at www.ecybermission.com. Information for the video is part of the "welcome letter" each Team Advisor receives once registered. A link to all eCM resources is included in the welcome letter.

Finding: Improve the eCYBERMISSION experience by addressing current issues with the Mission Folder auto-save and multi-user functionality.

eCM FY16 Efforts and Outcomes: The following message was sent to every Team Advisor via an email newsletter sent from the Team Advisor's Point of Contact (POC):

"*MISSION FOLDER TIMEOUT!*

Students can only be logged in to their Mission Folder for 30 minutes before it will timeout. There may be no change on the screen, but students will not be able to save information. Let them know to save and log out every 25 minutes or so to ensure they avoid this problem and don't lose any work!"

The problem with the auto-save and the multi-user functionality was discussed in detail with our team, so if any phone calls came into Mission Control, everyone would be giving the same information to help support the Team Advisors. There was discussion with our IT web developer and it was decided to not allow "cookies" to be enabled. The reason behind this decision, which would solve the problem, is that most students may be doing work either on a school computer or at a public library. If the student does not log out, and someone else begins to use the computer, the second person could totally overwrite the original work and the first student would lose all of their work.

Finding: Either extend the length of NJ&EE or reduce the number of its activities to ensure participants have longer activity transitions and time designated specifically to their presentation preparation and practice.

eCM FY16 Efforts and Outcomes: A concerted effort was made in the scheduling of NJ&EE to ensure teams had more time to prepare for their presentations. The following changes were incorporated into the schedule for 2016:

- All teams were required to be on-site by 2 p.m. on Monday. This allowed time for students to prepare for the opening activity at 4 p.m. In putting this requirement in place (previously it had been 3 p.m.), six of the 23 teams flew in on Sunday, to allow their teams extra time to get ready for the event due to the length of time for travel from their origin.
- The 2016 venue, the National Conference Center (NCC) in Leesburg, Virginia, was selected for its proximity to Washington, D.C., to help facilitate less travel time on Tuesday when teams travel to Washington, D.C., for their visits to their congressional leaders and tour of the city.
- Due to the change of venue, the schedule for each day was put together to facilitate ease of movement between sessions (a dedicated area was allotted for our group with all rooms within very close proximity of each other allowing for much easier and less time consuming transitions).
- A change to Tuesday's schedule included adjusting the order of events to take full advantage of time. The tour of Washington, D.C., was changed to the morning to avoid some of the crowds that occur later in the day. A limit of two congressional visits was requested. The buses left Washington, D.C., by 3:45 p.m. and returned to NCC by 5:00 p.m. (in 2015 this time was closer to 6 p.m. with one bus arriving back at 6:30 p.m.). There were no scheduled activities for the remainder of the day besides a 15-minute synch-up with the teams after dinner for announcements.

Finding: Assessment of meals at Hunt Valley in 2015 for NJ&EE was the only logistical item that demonstrated a statistically significant decrease in satisfaction when compared to FY14.

eCM FY16 Efforts and Outcomes: National Conference Center has a buffet with many choices for meals, which provided many more options for participants along with break service as part of the "complete meeting package" that we negotiated as part of the contract.

Finding: Qualitative descriptions of why students participated in eCYBERMISSION revealed that many students felt "forced" to participate because of a mandatory classroom requirement or grade.

eCM FY16 Efforts and Outcomes: This is an issue that is classroom-driven and not one that eCYBERMISSION can control. Our program is targeted to teachers, and our Mini-Grant program is set up for at least 50 students participating in order for a teacher to get a grant to support the implementation of eCYBERMISSION into the classroom.

Finding: Student assessment data regarding eCYBERMISSION program resources gave participants 10 program resources and asked them to rate them as: Very useful, Useful, Somewhat Useful, Slightly Useful, Not at All Useful, or Did not Use. CyberGuide Chats prompted the weakest assessment, followed by Mission Control Help Desk.

eCM FY16 Efforts and Outcomes: During the competition year, every Team Advisor receives communication via a newsletter delivered via email from the Team Advisor's Point of Contact. Cyber Guide Chats were promoted in these newsletters.

During FY16, the use of a Point of Contact to communicate more frequently with Team Advisors resulted in overall fewer phone calls from students and Team Advisors into Mission Control with questions about the program. Students can call/email Mission Control, but the frequency of such communication was not high since most often Team Advisors call/email on behalf of their team.

Finding: Team Advisor Assessment data regarding quality of eCYBERMISSION program supports also identified CyberGuides as a resource in need of improvement. Specifically in the evaluation the following is mentioned: "CyberGuides should be more visible" and that their responses to students "could be more timely and detailed."

eCM FY16 Efforts and Outcomes: In an effort to make the CyberGuides more visible to students, eCYBERMISSION staff collected short bios and photos of the CyberGuides and posted them on the student website by Mission Challenge area (see Appendix A for an example). Students use the bios to learn more about the CyberGuides' areas of expertise and to pick out which CyberGuide to connect with for a specific question. The bios also help students get to know the CyberGuides as people, too.

After registering, all CyberGuides are asked to review the CyberGuide User Guide, which outlines eCYBERMISSION's expectations around timeliness of communications with students. Using Team Talk, students can directly connect with a specific CyberGuide to ask a Mission Folder question. If a team does not receive a response within 24 hours after a reminder, eCYBERMISSION contacts the CyberGuide to correct the situation.

CyberGuides are asked to visit the Discussion Forums regularly and to respond to questions, starting with the oldest post and working up to the most recent. eCM staff monitors the Discussion Forums as well and will encourage CyberGuides to get on the boards if there are posts waiting for a reply.

Finding: Open-ended survey remarks from students who participated in NJ&EE for the item regarding initial notification of their finalist status indicated the item's rating could be improved by earlier notification.

eCM FY16 Efforts and Outcomes: This year, an effort was made to notify winning teams earlier than in the past. In FY15 teams were notified May 4–6 with NJ&EE beginning on Monday, June 15. This year, phone calls were made on May 3–4 and NJ&EE began on June 20.

Finding: Open-ended survey remarks from Team Advisors who participated in NJ&EE for the item regarding initial notification of their finalist status indicated the item's rating could be improved by allocation of more time for the completion of pre-NJ&EE paperwork.

eCM FY16 Efforts and Outcomes: This year in an effort to honor this request, the initial email with information went out to Team Advisors on May 6, 2016. The Team Advisors had until May 19 to submit the necessary documents. In FY15, Team Advisors were notified on May 7 with a request to have all paperwork turned in within one week on May 14

FY16 Recommendations

Evaluation findings indicate that FY16 was a success overall for the eCM program. Notable successes for the year include high levels of Team Advisor and student satisfaction with the program, and equal number of male and female participants, the majority of National students learning about five or more DoD/STEM careers, student reports that eCM helped them recognize how STEM activities can help them solve problems in their community, minority students had a significantly higher reported engagement with STEM than White students, all students reported learning more STEM at eCM than in their schools, a majority of students reporting gains on 21st Century skills, and the majority of Team Advisors reporting the participation and eCM website were very useful. While these successes are commendable, there are some areas that remain with potential for growth and/or improvement. Additionally, there were proportionally more White and Asian students who advanced to the national level as compared to Hispanic and Latino/a students and Black and African American students. Another marked difference was between the numbers of DoD/STEM careers of which students became aware during the eCM experience. Regional students reported much lower numbers than National students, and National students reported during the focus group interviews that is was during the field trip when they encountered engagement with a variety of DoD/STEM careers. Similarly, the Regional students reported that eCM had significantly less of an impact on confidence and identify in STEM than the National students. Although NSTA has improved outreach to the Team Advisors and subsequently students through emails and the eCM website, the results of the survey indicate that few participants use the CyberGuide live chat, feedback, or forum. Finally, most Team Advisors were unfamiliar with other AEOP materials such as It Starts Here! Magazine and only a quarter of Team Advisors discussed other AEOP programs with their students. Subsequently, students were mostly unaware of other AEOP programs, although they indicated on the surveys that they would be interested in participating.

The evaluation team therefore offers the following recommendations for FY17 and beyond:

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

1. The AEOP objective of broadening, deepening, and diversifying the pool of STEM talent continues to be a challenge for eCM. The majority of students participating in the regional competition were White, and proportionally more White and Asian students proceeded to the NJ&EE than Hispanic and Latino/a and Black and African American students. It is recommended for the program to consider doing more to recruit students from schools serving historically underrepresented and underserved groups and to find ways to support these students so that they can potentially progress to the National competition.
2. Participation in eCM overall declined largely in FY16. Nearly 13% of potential participants were not retained through the registration process. Additionally, there was an 18% decrease in the participants from 2015. Retention/attrition through the registration process is something that should be focused on in FY17. It is recommended that there is a concerted effort in FY17 to increase participation in the program overall.

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

1. Mentors and participants expressed overall satisfaction with the resources available to them through participation in eCM and the eCM website. At the same time, however, both Team Advisors and students reported little familiarity with Army resources such as the AEOP website, the It Starts Here! magazine, and the AEOP brochure. This suggests that participants may not make connections between eCM and some AEOP resources. Interestingly, it was clear in the national student surveys and focus group interviews that the NJ&EE participants recognized the connection between eCM and Army sponsorship – so the lack of familiarity of AEOP resources did not hinder their awareness of eCM being an Army/DoD focused effort. However, better marketing and use of the website, brochure, and other AEOP resources may assist with recruitment for other AEOPs and retention of participants in the AEOP pipeline. Although recent efforts of NSTA to improve the eCM website to make clear the association of eCM with the AEOP, it may be useful to provide AEOP brochures electronically to teams at all state and regional eCM events, and to consider ways in addition to the "Volunteer Spotlight" to communicate a variety of STEM careers available in the DoD, particularly to the state and regional students.

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

1. Students continue to report having little knowledge of other programs in the AEOP. This is an area of concern due to the overarching goal of creating an AEOP pipeline and retention of participants in additional AEOPs. Although students at the national level and to a lesser extent at the regional level reported gains in their STEM knowledge, confidence and identity, students were largely unaware of programs for which they are or will soon be eligible. Only a quarter of the Team Advisors discussed other AEOP programs with their students. Although NSTA responded appropriately to earlier recommendations by connecting the AEOP logo with the AEOP website and explaining this connection in the video tutorial, the evaluation results suggest that more should be done to make the connection and to inform students of future opportunities in AEOP. In addition, since Team Advisors are an important source of student information, additional efforts should be made to educate Team Advisors about the AEOP and programs for which their students are eligible. One suggestion would be to include a dedicated webinar for Team Advisors and students using the eCM website.

Appendix D: 2016 Gains in the Education of Mathematics & Science (GEMS) Evaluation Executive Summary

GEMS, administered by the National Science Teachers Association (NSTA) under the AEOP cooperative agreement, is a non-residential summer STEM enrichment program for elementary, middle, and high school students hosted at Army laboratories on site or in close coordination off site with the area Army laboratories. The overarching mission that drives the GEMS program is to interest youth in STEM through a hands-on Army laboratory experience that utilizes inquiry-based learning and Near Peer mentoring. 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 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, experiment-based model) and procedures that make sense considering the specialties of the facility and available resources. GEMS programs are one week sessions that may be executed over several weeks during the summer, depending on individual laboratory schedules.

In 2016, GEMS provided outreach to 2,427 students and 100 Near-Peer Mentors. Fourteen Army research laboratories and centers were involved across 11 different GEMS sites. The number of GEMS students in 2016 represents a 6% increase in enrollment over the 2,270 student participants in 2015. Consistent with historical data, many of the GEMS sites received applications from more qualified students than they could serve.

This report documents the evaluation of the FY16 GEMS program. The evaluation addressed questions related to program strengths and challenges, benefits to participants, and overall effectiveness in meeting AEOP and program objectives. The assessment strategy for GEMS included questionnaires for students and mentors, 3 focus groups with students, 3 focus groups with mentors, and an annual program report compiled by NSTA.

2016 GEMS Fast Facts	
Description	GEMS is an AEOP STEM-enrichment program hosted by U.S. Army research laboratories research laboratories and engineering centers where local students are invited to participate in a one-week curriculum led by Army scientists and egnineers, resource teachers and near peer mentors.
Participant Population	5th through 12th Grade
No. of Applicants/Students	4,414
No. of Students	2,427
Placement Rate	55%
Submission Completion Rate	N/A
Number of Adults (Team Advisors and Volunteers – including S&Es, Near Peer Mentors, and Teachers)	345
Number of Army S&Es	215
Number of Army/DoD Research Laboratories	14
Total number of K–12 Teachers (including preservice and DoDEA)	30
Total number of K–12 Schools (Home, Private, Public, DoDEA)	907
Number of K–12 Schools — Title I	230
Number of Colleges/Universities	50
Number of DoDEA Students	26
Number of DoDEA Teachers	6
Number of DoDEA Schools	5
Number of Other Collaborating Organizations	1
Total Cost	$1,010,121
Cost Per Student Participant – total cost/# of student participants	$416

Summary of Findings

The FY16 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.

2016 GEMS Evaluation Findings	
Participant Profiles	
GEMS served students from populations historically underrepresented in STEM at rates similar to previous years.	In FY16, 46% of enrolled participants were female, indicating that GEMS successfully attracted participation from female students, a population historically underrepresented in engineering fields; this participation rate is comparable to the FY15 female participation rate of 45% and the FY14 rate of 44%.
	Students from historically underrepresented and underserved minority race/ethnicity and low-income groups participated in GEMS comparably to previous years. In FY16, 23% of participating students identified themselves as Black or African American, a rate comparable to this group's participation in FY15 (22%). Participation for students identifying themselves as Hispanic or Latino was 8%, comparable to the 9%, of students identifying with this group in FY15. A small proportion (10% in FY16 versus 11% in FY15 and 12% in FY14) of students continued to report qualifying for free or reduced-price lunch (FRL) – a common indicator of low-income status.
	GEMS served students across a range of school contexts, although more than half (60%) of participants identified their school setting as suburban.
GEMS attracted more applicants and served more students in FY16 as compared to previous years.	GEMS met and exceeded its FY16 target of receiving 3,750 applications (4,414 applications were received in FY16, an increase of 6% over the 4,161 applications in FY15). Although the program failed to meet its FY16 goal for student participation of 2,600, there was a 6% increase in student enrollment from FY15 to FY16, continuing an upward trend in enrollment over the past three program years.
Actionable Program Evaluation	
GEMS marketed the program in a number of ways, however reaching schools and organizations serving groups historically underrepresented in STEM is an area for growth.	While NSTA and GEMS sites employed multiple strategies to disseminate information about the GEMS program, few of these efforts were targeted specifically to reaching underserved and underrepresented populations.
	Students most frequently learned about the GEMS through personal connections including past participants, friends, and DoD employees.

GEMS students reported being motivated to participate in the program by an interest in STEM and the learning opportunities GEMS presents.	Students were most frequently motivated to participate in GEMS by their interest in STEM and a desire to learn something new and interesting. Other motivators cited by most students included learning in ways not possible in school and the opportunity to used advanced laboratory technology.
GEMS students reported engaging in meaningful STEM learning through team-based and hands-on activities.	Students reported engaging in a number of STEM activities on most days or every day of their GEMS experience. Over three-quarters of students reported learning about STEM topics new to them, communicating with other students about STEM, and learning about careers on most days or every day of their GEMS experience.
	Students reported engaging in a variety of STEM practices during their GEMS experience, with nearly all students reporting working as part of a team most days or every day. Large majorities of students (76%) also reported engaging in practices such as participating in hands-on STEM activities and using laboratory procedures or tools on most days or every day of their GEMS experience.
	Students reported that they had more opportunities to learn about STEM and engage in STEM practices in their GEMS experience than they typically have in school.
	Mentors reported using strategies to help make learning activities relevant to students, support the needs of diverse learners, develop students' collaboration and interpersonal skills, engage students in "authentic" STEM activities, and support students' STEM educational and career pathways.
GEMS informed students about STEM careers in general and, to a lesser extent, about DoD STEM careers specifically.	Nearly all students (97%) reported learning about 1 or more STEM careers during GEMS and over three-quarters learned about 3 or more STEM careers. Slightly fewer students (84%) reported learning about 1 or more DoD STEM career and slightly more than half reported learning about 3 or more.
	All responding mentors reported asking students about their educational and career interests and nearly all reported providing guidance about educational pathways that will prepare students for STEM careers. Most mentors also discussed STEM career opportunities within the DoD or other government agencies.
	Other than simply participating in GEMS, students reported that participating in GEMS, their GEMS mentors and invited speakers or career events during GEMS were resources that impacted their awareness of DoD STEM careers. Most students had not experienced AEOP resources such as the website, brochure, social media, and It Starts Here! magazine.

GEMS has an opportunity to improve student and mentor awareness of other AEOPs.	The programs mentors most frequently reported discussing with students were GEMS and GEMS Near Peer Mentors. Less than half (15-40%) reported discussing any other AEOPs specifically, although over half reported discussing AEOPs generally but without referencing any specific program.
	Mentors reported that the most useful resources for exposing students to AEOP were participation in GEMS, program administrators or site coordinators, and invited speakers or career events. Over half of mentors had no experience with AEOP on social media or It Starts Here! Magazine as resources to expose students to AEOPs.
Students and mentors value the GEMS experience.	Nearly all students (90-94%) indicated being somewhat or very much satisfied with GEMS program features such as teaching or mentoring, the stipend, and availability of program topics. Students also offered positive comments about their overall satisfaction with the program, focusing on their learning experiences in GEMS and the personal connections they made with mentors and peers.
	Mentors also reported being satisfied with most program features, including the support they received for instruction or mentoring, communication with program organizers, and invited speakers and career events.
Outcomes Evaluation	
GEMS students reported positive impacts on their STEM knowledge and competencies.	Students reported gains in their STEM knowledge as a result of participating in GEMS. These gains were reported in areas such as in depth knowledge of a STEM topic, knowledge of how scientists and engineers work on real problems in STEM, and knowledge of what everyday research work is like in STEM. Females reported significantly higher impacts in these areas than males, however there were no differences across races/ethnicities.
	Students also reported impacts on their abilities in various STEM competencies, including science and engineering practices. Participants reported some to large gain in their science practices (65%) and engineering practices (50%) after participating in GEMS. These gains were reported in abilities such as supporting an explanation for an observation with data from experiments, communicating about experiments and explanations in different ways, and using knowledge and creativity to propose a testable solution for a problem. Female students and students identifying with racial/ethnic minority groups reported significantly higher gains than males and non-minority students.

GEMS participants reported gains in students' 21st Century Skills.	A large majority of students (81%) reported gains in their 21st Century Skills as a result of participating in GEMS. These gains were reported in areas such as their ability to work well with students of all backgrounds, communicating effectively with others, making changes when things do not go as planned, and sticking with a task until it is finished. Female students reported significantly more gains than male students although there were no significant differences across races/ethnicities.
GEMS participants reported gains in their confidence and identity in STEM, and in their interest in engaging in STEM in the future.	A large majority of students (79%) reported gains in areas related to their STEM identity, defined as confidence in one's ability to succeed in STEM. These gains were reported in areas such as students' sense of accomplishing something in STEM, feeling prepared for more challenging STEM activities, and thinking creatively about a STEM project or activity. Females reported significantly higher gains in STEM identity and confidence than males although there were no significant differences across races/ethnicities.
	Students also reported gains in the likelihood that they would engage in STEM activities in the future after participating in GEMS. For example, most students indicated that, as a result of GEMS, they were more likely to participate in a STEM camp, club, or competition; work on a STEM project or experiment in a university or professional setting; and take an elective STEM class. Females reported significantly higher perceptions of their likeliness to engage in STEM Activities compared to males, and White students reported being more likely to engage in STEM activities in comparison to minority students.
Students reported higher education aspirations after participating in GEMS, although their career aspirations showed little change.	After participating in GEMS, students reported an upward shift in their educational aspirations evidenced by an increase in the number of students who aspired to continue their education after college (from 55% before GEMS to 67% after).
	Most responding students expressed interest in STEM-related careers both before and after participating in GEMS. There was, however, a shift in student interest in careers in engineering and architectures (17% of students aspiring to these careers before GEMS and 22% after participating in GEMS) and in careers as scientists or researchers (8% of students aspiring to these careers before GEMS and how 12% after participating in GEMS).

Although GEMS students have limited awareness of other AEOP initiatives, students showed interest in future AEOP opportunities.	Around half or more of responding students had not heard of AEOP initiatives other than GEMS and GEMS Near Peer Mentors. In spite of this, between a third and a half of students indicated interest in participating in future AEOPs other than GEMS. For example, approximately half (49%) of students indicated interest in participating in SEAP in the future and over a third (36%) expressed interest in participating in JSHS. Students credited participating in GEMS, their mentors, and invited speakers or career events with increasing their interest in participating in other AEOPs. Over half of students had not experienced AEOP on social media as a resource for learning about AEOPs and 21% and 18% respectively reported not having experienced the AEOP website and AEOP brochure as a resource for learning about AEOPs.
GEMS participants reported positive opinions of DoD research and DoD researchers and reported increases in their awareness of their interest in pursuing a STEM career with the DoD.	Students had overwhelmingly positive opinions of DoD research and researchers and the value of DoD research. For example, large majorities of students agreed that DoD research is valuable to society and that DoD researchers advance science and engineering fields.
	Large majorities of students reported that GEMS contributed to their awareness of DoD STEM research and careers and to a greater appreciation of Army and DoD STEM research. Over half of students also indicated that they are more interested in pursuing a STEM career with the Army or DoD after participating in GEMS.

Responsiveness to FY14 and FY15 Evaluation Recommendations

The primary purpose of the AEOP program evaluation is to serve as a vehicle to inform future programming and continuous improvement efforts with the goal of making progress toward the AEOP priorities. In previous years the timing of the delivery of the annual program evaluation reports has precluded the ability of programs to use the data as a formative assessment tool. However, beginning with the FY16 evaluation, the goal is for programs to be able to leverage the evaluation reports as a means to target specific areas for improvement and growth. In this report, we will highlight recommendations made in FY15 to programs and summarize efforts and outcomes reflected in the FY16 APR toward these areas.

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

Finding: The large number of applications the program receives provides some evidence that the GEMS program could successfully be expanded to accommodate the considerable amount of unmet need and interest that persist with qualified students. It is recommended that more GEMS sites be identified, recruited, and started in a variety of geographic locations to meet the needs and interests in more communities.

GEMS FY16 Efforts and Outcomes: The student placement rate for FY16 remained at FY15 levels (55%), however, 8 out of 11 GEMS sites grew in enrollment. For example the program at Adelphi added 71 student participants, Fort Rucker added 31, and San Antonio added 27. Program staff reported that 9 of the 11 sites were at or near capacity in FY16, indicating that space and staffing will need to be expanded for significant program growth. There was no RFP process to expand sites in FY16, however the program did maintain the 11 sites that transitioned into the consortium in FY16. The next RFP to add a location is scheduled for FY17.

Finding: It is likely that GEMS will need to expand targeted marketing while implementing more aggressive marketing and recruitment practices. The program may wish to particularly consider targeting outreach to low-income and minority-serving schools, educational networks, community organizations, and professional associations that serve these populations.

GEMS FY16 Efforts and Outcomes: Participation by females and participants identifying as Black or African American and Hispanic or Latino and those remained essentially constant (changes of < 2%) since FY15. Due to a change in the definition of underserved/underprivileged students in FY16, the rate of participation of these students was reported in the annual program report at 10% although it should be noted that 23% of enrolled students were Black or African American, 8% were Hispanic or Latino, and 10% reported receiving free or reduced price lunch. Facebook advertising was used more aggressively in FY16 and low-income schools were targeted by local program coordinators (LPCs) in areas around their sites. Furthermore, the addition of strategic partners such as the Society for Women Engineers and the Tiger Woods Foundation will provide further opportunities to reach underserved and/or underrepresented populations of students.

Finding: The program and individual GEMS sites may need to consider practical solutions to help more GEMS students travel to sites that are not close in proximity to their homes.

GEMS FY16 Efforts and Outcomes: Transportation to and from sites was an issue again in FY16. While White Sands Missile Range was provided transportation with GEMS funding, other locations did not receive this support. The major limiting factor was the increased liability to damages during student transport. White Sands Missile Range avoided this issue by hiring a vendor, but that option seemed cost prohibitive at other locations. Student stipends are designed to compensate for increased cost of transportation, however stipends are often seen as a reward for participation. This unintentional mixed message diverted focus away from stipends as a potential solution for participants.

Finding: Given the large proportion of students who reported learning about GEMS through personal connections, it is recommended that the program consider strategies to ensure that students without a personal connection to sites have access to the GEMS program.

GEMS FY16 Efforts and Outcomes: In FY16, personal relationships continued to be a factor in choosing a student for participation. Program administrators reported that LPCs choose participants with a variety of methods. “Connected” selections are still a potential issue, but it is unclear which selection methods increase risk. The program focused on including U/U participants in FY 16 as a way to offset the number of connected

participants. The program used target marketing, such as Facebook advertising, to expand the possible pool of applicants beyond personal connections.

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

Finding: The programs' ability to serve increasing numbers of students is limited by the number of mentors available, and therefore strategies to recruit additional RTs and NPMs should be considered.

GEMS FY16 Efforts and Outcomes: There was no FY16 goal for Near-Peer Mentor (NPM) and Resource Teacher (RT) involvement; however, NSTA observed a best practice for staff ratios during site visits. Sites that were closer to this ratio had observably higher student engagement. This ratio was one RT for every four NPMs, and one NPM for every six to eight students.

Finding: Mentors should be provided with more comprehensive information about AEOP initiatives. The program may therefore wish to incorporate information about other AEOPs into the mentor orientation materials.

GEMS FY16 Efforts and Outcomes: GEMS participant awareness of other AEOP opportunities was above the target of 60% for FY16. GEMS locations were given AEOP collateral to support staff training. Also, Widmeyer created a presentation of program overviews that were provided to LPC for staff orientations. ERDC-CERL and WRAIR reported using SEAP and/or CQL students as Near Peer Mentors in program to increase awareness.

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

Finding: The program may want to consider innovative ways to work with other AEOPs to create a more seamless continuum of programs.

GEMS FY16 Efforts and Outcomes: GEMS awareness of other AEOP opportunities was above the target of 60% in FY16. LPC and regional Camp Invention (CI) leaders met and conducted cross-program site visits in FY16 to increase recruitment of CI into GEMS. Some locations also used SEAP and CQL students in curriculum to increase awareness.

Finding: Familiarize mentors with resources available to expose students to DoD STEM careers.

GEMS FY16 Efforts and Outcomes: The program relied heavily on scientists and engineers (S&E) for the majority of the Department of Defense (DoD) and STEM career influence. A large majority of participants reported learning about at least one DoD STEM career.

Finding: It may also be useful to familiarize mentors with strategies to increase the likelihood that the program will have a long-term impact on students' decisions to pursue STEM.

GEMS FY16 Efforts and Outcomes: The IPA did not provide specific mentor skill training to LPCs. Some sites may have training that wasn't reported to the IPA.

Finding: The program may want to consider emphasizing the importance of these evaluations with individual program sites and communicating expectations for evaluation activities.

> **GEMS FY16 Efforts and Outcomes:** Time was set-aside during the program for students to complete evaluations. A lack of reliable Internet access challenged the viability of internet-based evaluation instruments. Paper was provided at many locations to offset this challenge, but logistics problems created some delays in paper implementation.

Recommendations

Evaluation findings indicate that FY16 was a successful year overall for the GEMS program. Notable successes for the year include continued increases in participant applications and enrollment, continued participation by groups traditionally underrepresented in STEM fields, and high levels of mentor and student satisfaction with the programs. Both students and mentors reported gains in students' STEM knowledge and competencies and gains in students' 21st Century Skills as a result of the GEMS experience, and students emerged from the program more aware of other AEOPs and of Army and DoD STEM careers.

While these successes are commendable, there are some areas that remain with potential for growth and/or improvement. The evaluation team therefore offers the following recommendations for FY16 and beyond:

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

1. GEMS served 2,427 students in FY16, a 6% increase over FY15. The continued upward trends in applications and enrollment provides some indication that the program attended to previous evaluator recommendations that existing sites expand their capacity to accommodate more students in order to meet existing needs and interest in communities that are already served by GEMS programs. The placement rate of 55% remained constant from FY15 to FY16 however, indicating significant continued unmet need in the program. Therefore, the FY14 and FY15 recommendation that more GEMS sites be identified, recruited, and started in a variety of geographic locations to meet the needs and interest in more communities is repeated. Program administrators noted that there was no RFP for a new site in FY16, precluding an expansion in the number of sites, although the program did maintain the 11 sites that transitioned into the consortium in FY16. The next RFP to add a location is scheduled for FY17, and it is recommended that the program evaluate existing sites' ability to expand their capacity as well as consider adding new locations in the coming years. In order to expand the capacity of existing sites, the program should consider ways of increasing administrative support, teaching staff, physical infrastructure, and mentor participation to meet the needs and interest of potential GEMS participants.

2. There was little change in participation of groups underserved and underrepresented in STEM from FY14 to FY16. In FY15 and FY16 there was little evidence of targeted outreach to organizations that serve groups historically underserved and underrepresented in STEM. It is likely that in order to engage increasing numbers of students underserved and underrepresented in STEM, GEMS will need to expand targeted marketing while implementing more aggressive marketing and recruitment practices. The inclusion of organizations such as the Society for Women

Engineers (SWE) and the Tiger Woods Foundation as strategic partners of the AEOP presents opportunities for marketing targeted toward theses underserved and underrepresented groups. In addition, the more aggressive use of Facebook marketing implemented in FY16 should be continued, although program administrators should be mindful that only a very small percentage (3%) of students reported learning about AEOP via social media. Due to the perception of mentors that travel barriers preclude participation of some groups of students, the program and individual GEMS sites may wish to consider practical solutions to help more GEMS students travel to sites that are not close in proximity to their homes.

3. Students continue 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 FY16 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.

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

1. Since the program's ability to serve increasing numbers of students is limited by the number of mentors available, strategies to recruit additional RTs and NPMs and should be considered. Mentors noted in focus groups that they felt that additional support for mentors in terms of overhead funding, support for mentoring from superiors, and assistance in recruiting students for the program would be beneficial in retaining existing mentors and would increase the likelihood that Army S&Es would volunteer to act as GEMS mentors.

2. Since a majority of students identified their mentors as a key resource for information about AEOP opportunities, mentors should be provided with more comprehensive information about AEOP initiatives. Many mentors reported having no experience with AEOP resources. The program noted that in FY16 a presentation highlighting the AEOP portfolio was created for LPCs for use during staff orientation. Program administrators should take measures to ensure that this, and other AEOP resources, is utilized at sites during mentor orientation or informational sessions.

3. Late stipend payments were a concern for NPMs and RTs at some sites. In order to retain highly skilled NPMs and recruit new NPMs, it is recommended that the program take measures to ensure that stipend payments are made on a regular, timely basis.

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

1. Due to continued low rates of student awareness of AEOPs other than GEMS, the FY15 recommendation is repeated for the program to consider innovative ways to work with other AEOPs to create a more seamless continuum of

programs. Since students reported that their mentors were key resources for learning about AEOPs, the program should ensure that AEOP informational materials, including the presentation created in FY16 highlighting the AEOP portfolio, reach mentors.

2. The FY16 GEMS participation in the evaluation questionnaire is an area for concern. While the response rates for students were at an acceptable level, it was lower than in FY15. The ongoing low response rates for mentors raise questions about the representativeness of the results. Continued efforts should be undertaken to increase completion of the questionnaire, particularly for mentors. The program should emphasize the importance of evaluations with individual program sites and communicate expectations for evaluation activities. Because of issues with Internet access at GEMS sites, alternative means of questionnaire access for students should be considered. In addition, the evaluation instruments may need to be streamlined as perceived response burden could affect participation.

Appendix E: 2016 High School Apprenticeship Program (HSAP) Evaluation Executive Summary

The High School Apprenticeship Program (HSAP), managed by the U.S. Army Research Office (ARO), is an Army Educational Outreach Program (AEOP) commuter program for high school students who demonstrate an interest in science, technology, engineering, or mathematics (STEM) to work as an apprentice in an Army-funded university or college research laboratory. HSAP is designed so that students (herein called apprentices) can apprentice in fields of their choice with experienced scientists and engineers (S&Es, herein called mentors) full-time during the summer or part-time during the school year.

Students receive an educational stipend of up to $3,000, and are allowed to work up to 300 hours total. The students contribute to the research of the laboratory while learning research techniques in the process. This "hands-on" experience gives students a broader view of their fields of interest and shows students what kind of work awaits them in their future career. At the end of the program, the students prepare abstracts for submission to the US Army Research Office Youth Science programs office.

In 2016, HSAP provided outreach to 65 apprentices and their 42 mentors at 35 Army-sponsored university/college laboratory sites (herein called HSAP sites). Sixteen of the university/college sites were HBCU/MIs, which is a 129% increase from 2015 (at 7 HBCU/MIs).

This report documents the evaluation of the 2016 HSAP program. The evaluation addressed questions related to program strengths and challenges, benefits to participants, and overall effectiveness in meeting AEOP and program objectives. The assessment strategy for HSAP included post-program questionnaires distributed to all apprentices and mentors, individual interviews with eight apprentices, and interviews with three mentors.

2016 HSAP Fast Facts	
Description	STEM Apprenticeship Program – Summer, in Army-funded laboratories at colleges/universities nationwide, with college/university mentors
Participant Group	11th-12th grade students
No. of Applicants	363
No. of Students (Apprentices)	65
Placement Rate	18%
No. of Adults (Mentors)	42
No. of K-12 Schools	53
No. of Army-Funded College/University Laboratories	35
No. of HBCU/MIs	16
Total Cost	$235,746*
Total Stipends	$180,876.00
Cost Per Student Participant	$3,627

*Includes matching funds from ARO.

Summary of Findings

The FY16 evaluation of HSAP 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 table below.

2016 HSAP Evaluation Findings	
Participant Profiles	
HSAP continues to be a popular and selective program which serves students of historically underrepresented and underserved populations.	HSAP has been extremely successful in reaching out to more high school students – experiencing a 26% increase in applications received in FY16 (267 vs. 363 applications). The ARO office utilized direct email to targeted schools, which produced a significant increase in applications.
	HSAP experienced continued success in providing outreach to students from historically underrepresented and underserved race/ethnic and low-income groups. The number of HCBU/MIs increased from 2 HBCU/MI sites in 2014, 7 HBCU/MIs in 2015, and 16 HBCU/MIs in 2016.
	More than half of the respondents in the HSAP program were from race/ethnicity categories other than White.
Actionable Program Evaluation	
HSAP recruitment continue to be mainly from personal contacts and from websites.	Many apprentices learned about HSAP from someone who works at the university (29%), school or university newsletter, email, or website (15%), and the AEOP website (15%). Other responses include hearing about HSAP from a family member (11%) and from someone who works in the program (11%).
	Marketing via social media such as Facebook, Twitter or Pinterest were the least frequently used sources for learning about HSAP specifically and AEOP generally.
HSAP apprentices learn STEM skills and knowledge that they do not learn in school settings.	There is a statistically significant difference in student perceptions of STEM Learning and STEM Engagement when comparing these activities in School and HSAP. Apprentices report significantly higher STEM Learning and STEM Engagement in HSAP over school.
Although HSAP apprentices come to the program with an interest in STEM, HSAP offers opportunities for high school students in authentic STEM learning that provides insight into college and beyond.	More than 90% of apprentices agree or strongly agree that DoD researchers develop new, cutting edge technologies, solve real-world problems, advance science and engineering fields, and that their research is valuable to society.
	Mentor access is a key component of HSAP, and apprentices were asked about the availability of their mentor. Apprentices responded that mentors were always available to apprentices in HSAP and 100% of mentors were available for more than half of the time of the project.
	97% of the apprentices interacted with scientists or engineers on most days or every day, 92% applied STEM learning to real-life situations most days or every day, and 97% learned about new STEM topics. Similarly, 76% of apprentices learned about new discoveries in STEM, 85% communicated with other students about STEM, and 75% learned about different careers that use STEM most days or every day.

HSAP mentors used effective research-based strategies to help mentors understand STEM knowledge and skills. They were less aware of other AEOP programs, although a majority of apprentices reported that mentors were helpful in increasing awareness of other AEOP programs.	Mentors were very strong in using all of the research-based strategies, and at least 84% of the mentors reported using all of the strategies listed on the questionnaire. 100% of the mentors reported having their students search for and review technical research, demonstrate lab and/or field techniques, encouraged students to learn collaboratively, and provided their students with constructive feedback.
	Most of the apprentices had not heard of the range of AEOP programs (78% had not hear of UNITE, 86% had not heard of CQL, and 79% had not heard of GEMS Near Peer). Apprentices rated the HSAP program (78%) and their mentors (61%) at somewhat or very much impactful on their awareness of AEOPs. Conversely, the majority of HSAP apprentices reported not experiencing the AEOP brochure and AEOP social media.
HSAP was highly valued by apprentices and mentors alike.	Similar to 2015, apprentices and mentors reported being very satisfied with their HSAP experience, including communications from Army Research Office, and the application/ registration process. Mentors reported in the interview that they felt having high school students in their laboratories was a valuable professional development experience.
Outcomes Evaluation	
HSAP apprentices reported large or extreme gains in their STEM knowledge and skills, and expect to use their STEM knowledge and skills extensively in the future.	Between 67-89% of apprentices reported a large or extreme gain on all aspects of STEM knowledge asked in the questionnaire. Eighty-nine percent of apprentices reported a large or extreme gain in their knowledge of what everyday research is like in STEM and 69% of apprentices reported that their knowledge of research conducted in a STEM topic or field had a large or extreme gain.
	Additionally, 89% of apprentices expect to use their STEM knowledge, skills and abilities at least half of the time, with the remaining 11% using their STEM skills, knowledge, and abilities at least a quarter of the time, indicating a large amount of apprentices who want to pursue a STEM career.
HSAP positively impacted apprentices' 21st Century skills related to STEM	Most responding apprentices reported large or extreme gains on each of these skills, including making changes when things do not go as planned, viewing failure as an opportunity to learn, and communicating effectively with others.
	The majority of apprentices indicated they were more likely or much more likely to engage in many of these activities as a result of HSAP, such as working on solving mathematical or scientific puzzles, talking with a friend or family member about STEM, helping with a community service project that relates to STEM, and mentoring or teaching other students about STEM.
HSAP apprentices come to the program with an interest in STEM, but the program positively influences their aspirations to pursue higher education degrees.	In terms of education, the questionnaire asked apprentices how far they wanted to go in school before and after participating in HSAP. More of the responding apprentices indicated wanting to obtain advanced degrees after participating in HSAP than before HSAP, most notably a 17% increase in the desire to obtain a Ph.D.
HSAP raised some apprentice awareness and appreciation of DoD STEM research but	97% of HSAP apprentices learned about at least one general STEM job/career, and 50% learned about 5 or more STEM jobs/careers. The number of reported careers that were 5 or more has increased from the 2015 reports.

websites and social media outlets did not inform the apprentices about DoD STEM careers.	There was little overall impact of resources on apprentice awareness of DoD STEM careers, and that only 68% of HSAP apprentices felt that their participation in the program impacted their awareness and 64% felt that their mentors impacted their awareness. Apprentices reported not experiencing the AAS website (83%), It Starts Here! Magazine (83%), social media outlets (72%), Invited speakers (61%), and the ARO website (53%).

Responsiveness to FY15 Evaluation Recommendations

The primary purpose of the AEOP program evaluation is to serve as a vehicle to inform future programming and continuous improvement efforts with the goal of making progress toward the AEOP priorities. In previous years the timing of the delivery of the annual program evaluation reports has precluded the ability of programs to use the data as a formative assessment tool. However, beginning with the FY16 evaluation, the goal is for programs to be able to leverage the evaluation reports as a means to target specific areas for improvement and growth.

In this report, we will highlight recommendations made in FY15 to programs and summarize efforts and outcomes reflected in the FY16 APR toward these areas.

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

Finding: AEOP objectives include expanding participation of historically underrepresented and underserved populations. Between 2014 and 2015, HSAP has engaged more apprentices who identify with a typically underrepresented group in STEM, which is a positive trend. Additionally, it is positive that the HBCU/MI sites increased from 2 in 2014 to 7 in 2015. Future marketing efforts could focus on the need for a more diverse pool of STEM professionals, and take the opportunity to showcase the diversity of mentors in electronic and printed materials.

HSAP FY16 Efforts and Outcomes: As HSAP is a commuter program conducted at university/college locations that vary annually, recruitment of apprentices is focused upon the surrounding area of the community in which the host sites are situated. ARO and AAS identified and targeted nearby high schools and organizations that have traditionally underserved and underrepresented populations in STEM, then directly sent emails advertising the HSAP program to those locations. The number of HBCU/MI sites participating in HSAP increased from 7 to 16 in FY16; 46% of HSAP host sites are HBCU/MIs. More focus was also given to diversity of STEM professionals via electronic mailings and social media.

Finding: Similar to past years, in HSAP, recruitment of apprentices is largely accomplished with personal interactions, either by knowing a teacher who is familiar with AEOP or a personal friend who has received an email about HSAP. As a result, the ability of HSAP to recruit underserved or underrepresented populations of students depends upon the diversity of the high schools in which recruitment takes place. Thus, HSAP may want to emphasize recruiting a more diverse pool of mentors and apprentices, perhaps specifically targeting more urban schools or schools who receive Title 1 funding. A focused and strategic plan to engage a more diverse pool of apprentices could ultimately improve the diversity of the STEM pipeline, based on the large impact that HSAP has on STEM knowledge, skills, and identity.

HSAP FY16 Efforts and Outcomes: ARO and AAS identified and specifically marketed HSAP and other AEOP opportunities to schools who receive Title 1 funding in the surrounding area of the FY16 HSAP host site locations, which resulted in 35% of HSAP students represented underserved population, 15% over the FY16 target.

Finding: HSAP is very effective in giving apprentices authentic opportunities to engage in STEM professional activities, and for mentors to build the next generation of STEM professionals. Mentors are particularly skilled in being able to engage high school students into their laboratory by giving them meaningful learning experiences and asking them to report on their work to graduate students and STEM professionals. Although mentors are particularly skilled in their area of expertise, mentors can be more effective in helping students understand the big picture of how STEM can improve community. Only 54% of mentors reported communicating how STEM can improve community. Only 52% of the mentors highlighted the under-representation of women and racial and ethnic minority populations in STEM as well. Mentors can be provided ways to incorporate how STEM topics affect the larger community in a systematic way by the program, so that the bigger picture of how STEM fits into society can be explicitly emphasized.

HSAP FY16 Efforts and Outcomes: Mentors were required to express how STEM topics affect the larger community in the educational merit description of their proposals to ARO. They were also encouraged to discuss this with their participants. FY17 program plans include a focused attempt for improvement in this area by providing more-detailed training for mentors to empower them in this effort.

Finding: Similar to recommendation #3, given the goal of exposing apprentices to Army/DoD STEM research and careers, the program may want to build in systematic opportunities to provide this information to their apprentices. More than half of apprentices who completed the survey reported that they did not learn about any DoD STEM jobs/careers during HSAP. Perhaps more importantly, only a few mentors were aware of specific Army/DoD STEM research and careers and even fewer mentors explicitly discussed this with their apprentices. This lack of awareness is a barrier in communicating about Army/DoD STEM research and careers. In an effort to increase and standardize the information provided to apprentices, it would be beneficial to create a resource that profiles Army STEM interests and the education, on-the-job training, and related research activities of Army careers. Such a resource could not only start the conversation about Army STEM careers and motivate further exploration beyond the resource itself, but could be used to train the mentors to learn more about specific Army/DoD STEM research and careers. The application to be a HSAP site or a mentor could ask for their plan to

explicitly discuss these resources (e.g., Army and directorate STEM career webpages, online magazines, federal application guidelines), thus developing a network of ongoing opportunities for the apprentices.

HSAP FY16 Efforts and Outcomes: In FY16, HSAP student awareness of DoD STEM careers was 68%, an increase over FY15. The increased awareness of DoD STEM careers was due to weekly communication with apprentices and mentors that included the 2016 Guide to STEM Careers and the AEOP newsletters. Sites, mentors, and students received AEOP print materials and information for access to online resources via Welcome Packets and weekly emails. The weekly communications with apprentices and mentors, which included the 2016 Guide to STEM Careers and the AEOP newsletters were provided online. HSAP students were also invited to participate in an Army DoD STEM Career Scavenger Hunt. Unfortunately, many students did not complete the scavenger hunt. However, enough did to distribute a gold, silver, and bronze winning medal. Also, ARO inquired about the scavenger hunt during local (NC) site visits and we were told by several students that they were very interested but didn't have time to participate. I'm not sure how to compare the increase in awareness as this was the first year we've implemented the scavenger hunt. We also utilized Constant Contacts for the first time this year (for promoting of the scavenger hunt and in general), but it is our intent to use a more personal approach in FY17. [Please see below the intent to use a more personal approach for survey completion as well. HSAP students were also given the ARO program manager contact information to create professional connections.

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

Finding: There were no recommendations in this area for HSAP in FY15.

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

Finding: Apprentices and mentors who participate in HSAP are only aware in a general way that other programs in AEOP exist. When asked, the mentors and apprentices could not name many of the other AEOP programs. Apprentices rated the HSAP program (88%) and their mentors (89%) at somewhat or very much impactful on their awareness of AEOPs. However, the majority of HSAP apprentices reported not experiencing the AEOP brochure and AEOP social media. Social media efforts, in particular, require constant updates and focused attention on messaging to gain attention. Since most HSAP applicants hear about the program through another individual, having a social media presence may increase the likelihood that an apprentice or mentor may hear about the program from another person who learned about it on Facebook, Twitter, or Pinterest. A recommendation for the FY16 years and beyond would be for the HSAP program mentors to provide time for apprentices to complete the survey during their apprenticeship meeting time. This will provide a more accurate measure to gauge how effective HSAP activities and communications are in growing awareness of AEOPs.

HSAP FY16 Efforts and Outcomes: Program evaluation completion is always challenging. In FY16, ARO plans to send mentor recognition letters to the dean of the university to encourage mentor participation. AAS will explore the use of incentives to complete the program evaluations in FY17. A new social media campaign was introduced over the summer and ongoing communication with students and mentors to promote awareness of AEOP opportunities and encourage visibility to the AEOP website. Specific programs were highlighted in “exit letters and emails” for consideration as pipeline opportunities.

Recommendations

Evaluation findings indicate that 2016 was a successful year for the HSAP program. HSAP had a 26% increase in the number of apprentice applicants and had a very competitive 18% placement rate of the apprentice applicants, which indicates there is great interest in this program, but potentially some unmet need. From the high quality applicants (mentors and apprentices), there were 42 mentors and 65 apprentices selected. HSAP has experienced some success in recruiting diverse apprentices, as there was an increase from 7 HBCU/MI sites to 16 HBCU/MI sites. Apprentices and mentors overwhelmingly reported satisfaction with HSAP experience. Mentors indicated they use innovative and research-based strategies to engage apprentices in STEM activities, and by engaging the apprentices, graduate students become better educators. Apprentices reported that the mentors were widely available and helpful in improving their STEM knowledge and skills. The apprentices similarly report increased ability to engage in STEM activities due to the HSAP experience. Additionally, engaging in more hands-on STEM experiences motivated the apprentices, which was delivered by their HSAP experience.

While the successes for HSAP 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 FY17 and beyond.

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

1. AEOP objectives include expanding participation of historically underrepresented and underserved populations. Between 2014 and 2016, HSAP has engaged more apprentices who identify with a typically underrepresented group in STEM, which is a positive trend. Additionally, it is positive that the HBCU/MI sites increased from 2 in 2014 to 7 in 2015 to 16 in 2016. HSAP should explore how to accommodate more participants in coming years – as the 18% placement rate indicates a much larger interest and need than is currently being accommodated.

2. Similar to past years in HSAP, recruitment of apprentices is largely accomplished with personal interactions, either by knowing someone at the university or someone who works at HSAP. As a result, the ability of HSAP to recruit underserved or underrepresented populations of students depends upon the diversity of the high schools in which recruitment takes place. Thus, HSAP may want to emphasize recruiting a more diverse pool of mentors and apprentices, perhaps specifically targeting more urban schools or schools who receive Title 1 funding. AAS and ARO should work with AEOP SOI awardees and identify possible overlaps where we can leverage our strategic outreach partners' reach and network A focused and strategic plan to engage a more diverse pool of apprentices could ultimately improve the diversity of the STEM pipeline, based on the large impact that HSAP has on STEM knowledge, skills, and identity.

3. HSAP is very effective in offering apprentices authentic opportunities to engage in STEM professional activities, and for mentors to build the next generation of STEM professionals. Mentors are particularly skilled in being able to engage high school students in their laboratory by giving them meaningful learning experiences and asking them to report on their work to graduate students and STEM professionals. Most of the apprentices had not heard of the range of AEOP programs (78% had not hear of UNITE, 86% had not heard of CQL, and 79% had not heard of GEMS Near Peer). Although mentors are particularly skilled in their area of expertise, mentors

should be better prepared by the program to provide information and resources on the array of AEOP opportunities. AAS/ARO should work with the Battelle and the CAM to develop materials and training/onboarding that could be used with mentors each year to target this area of need.

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

1. HSAP mentors were effective in FY16 at informing apprentices about DoD STEM jobs/careers, as 97% of respondents reported hearing about one STEM career and 50% reported hearing about 5 or more, which is increased greatly from 2015. However, there was little overall impact of the program and mentors on apprentice awareness of DoD STEM careers, as only 68% of HSAP apprentices felt that their participation in the program impacted their awareness and 64% felt that their mentors impacted their awareness.

   Apprentices reported not utilizing the AAS website (83%), It Starts Here! Magazine (83%), social media outlets (72%), Invited speakers (61%), and the ARO website (53%). This lack of awareness/utilization is a potential barrier for communicating about Army/DoD STEM research and careers and the AEOP portfolio overall. In an effort to increase and standardize the information provided to apprentices, it would be beneficial to create a resource that profiles Army STEM interests and the education, on-the-job training, and related research activities of Army careers. Such a resource could not only start the conversation about Army STEM careers and motivate further exploration beyond the resource itself, but could be used to train the mentors to learn more about specific Army/DoD STEM research and careers. The application to be a HSAP site or a mentor could ask for their plan to explicitly discuss these resources (e.g., Army and directorate STEM career webpages, online magazines, federal application guidelines), thus developing a network of ongoing opportunities for the apprentices. Again, some type of onboarding/training for mentors – even virtual – would help to support progress in this area for HSAP.

2. Participation in the HSAP evaluation improved for apprentices but less than desirable for mentors. Very few mentors (12%) and apprentices (55%) completed the evaluation survey. The program leadership reported the decrease in participants was greatly due to the use of Constant Contacts for the majority of marketing/promotion, instead of more personal approaches to participation in the evaluation survey. It is recommended that the program use a more personal approach to recruiting participation in the evaluation survey. This strategy worked well for recruiting participants in the evaluation interviews in FY16. A recommendation for the FY17 years and beyond would be for the HSAP program mentors to provide time for apprentices to complete the survey during their apprenticeship meeting time. This will provide a more accurate measure to gauge how effective HSAP activities and communications are in growing awareness of AEOPs.

Appendix F: 2016 Junior Science & Humanities Symposium (JSHS) Evaluation Executive Summary

The Junior Science & Humanities Symposia Program (JSHS), administered by the Academy of Applied Science (AAS) on behalf of the Services, is an AEOP pre-collegiate science, technology, engineering, and mathematics (STEM) research competition for high school students. JSHS is co-sponsored by the Army, Navy and Air Force. JSHS encourages high school students to engage in original research in preparation for future STEM career pathways. In regional (R-JSHS) and national (N-JSHS) symposia, students present their research in a forum of peer researchers and practicing researchers from government (in particular the DoD), industry, and academia.

This report documents the evaluation of the FY16 JSHS program. The evaluation addressed questions related to program strengths and challenges, benefits to participants, and overall effectiveness in meeting AEOP and program objectives. The assessment strategy for JSHS included questionnaires for R-JSHS and N-JSHS participants and mentors; three focus groups with R-JSHS students; four focus groups with N-JSHS students; three R-JSHS focus groups with mentors; and one focus group with N-JSHS mentors; and an annual program report compiled by AAS.

Regional symposia were held in 47 university campus sites nationwide. The top five students in each region received an invitation to participate and compete at NJSHS, an all-expense-paid trip hosted by the Services. Of these five, the top two students were invited to present their research as part of the national competition; the third place student was invited to display a poster of his/her research in a competitive poster session; and the fourth and fifth place students were invited to attend as student delegates with the option to showcase their research in a non-competitive poster session.

2016 JSHS Fast Facts	
Description	STEM Competition - Nationwide (incl. DoDEA schools), research symposium that includes 47 regional events and one national event
Participant Population	9th-12th grade students
No. of Applicants	8,947 students and 970 teachers self-reported by each of the the 47 sites
No. of Students	5,300 Regional Participants (of whom 230 were selected to attend the National JSHS Symposium)
Placement Rate	60%
No. of Adults (Mentors, Regional Directors, Volunteers – incl. Teachers and S&Es)	3,214 + Mentors for students would increase total to > 8,000
No. of Army and DoD S&Es	234
No. of Army/DoD Research Laboratories	56
No. of K-12 Teachers	970
No. of K-12 Schools	1,060
No. of K-12 Schools – Title I	196

No. of College/University Personnel	1,979
No. of College/Universities	120
No. of Other Collaborating Organizations	189
DoDEA Students	45
DoDEA Teachers	30
Total Cost	$1,879,713
National Symposium Cost	$386,240
Regional Symposia Support Cost	$730,790
Scholarship/Award Cost	$403,000
Administrative Cost to AAS	$359,683
Cost Per Student Participant	$355

Summary of Findings

The FY16 evaluation of JSHS collected data about participants, their perceptions of program processes, resources, and activities, and indicators of achievement related to AEOP's and JSHS's objectives and intended outcomes. A summary of findings is provided in the following table.

2016 JSHS Evaluation Findings	
Participant Profiles	
Participation in JSHS remained similar to FY15, with a 4% decrease in applications and participants. JSHS continued to engage a majority of female participants. However, growing the ethnic/racial diversity of JSHS continues to be an area in need of focus.	In FY16, JSHS received slightly fewer applications than in FY15 (4%). The 47 R-JSHS sites received 8,947 applications and were able to accommodate 63% of these (5,620). This represents a 4% decrease in participants from FY15 when 9,347 students applied and 5,829 were selected.
	JSHS continued to be successful in FY16 in attracting a majority of female participants based upon data that were available. In the regions that reported gender data, 57% of participants were female and 43% were male. However, demographic data was available from only 29 of 46 regional symposiums (2,065 participants – less than 50% of total population).
	JSHS continued to struggle with growing diversity of participants in FY16. JSHS participants remained predominantly White or Asian in FY16, as nearly half (45%) of students identified themselves as White with another 22% identifying themselves as Asian. 21% of students chose not to report their race/ethnicity, 4% identified themselves as Black or African American and 6% as Hispanic or Latino. Native American students comprised .3% of the students reporting their race/ethnicity, while .3% identified as Native Hawaiian or Pacific Islander.

	R-JSHS participants were mostly from public schools (77%) though some students represented DoD schools (3%). The percentage of rural students participating in JSHS declined by 50% down to 14% (compared to over 40% in FY15). The majority of students reported being from suburban schools (59%) and urban locations (27%).
	More than half of participants were oral research presenters (57%). There were 24% poster presenters, and 19% of attendees did not present at JSHS.
JSHS mentor demographics reflected the diversity of participants in FY16.	There were 970 teachers who participated in JSHS in FY16. Demographics reported on the mentor questionnaire (109 participants) indicated that 63% were female, 34% male, and 3% chose not to report gender. Ethnic/racial diversity was similar to the participant group including 75% White, 12% Asian, 3% Native American, 1% Hispanic/Latino, 2% other, and 7% chose not to report. There were 0% Black or African American mentors that completed the questionnaire.
Actionable Program Evaluation	
Marketing of JSHS continues to predominantly be schools and past participants. Students continue to be motivated to participate in JSHS to receive experiences they normally do not receive in school.	JSHS continued to utilize marketing and recruitment strategies focused primarily at the regional level through JSHS directors in FY16, along with AAS driven communications and marketing on websites/social media. Similar to FY15, participants learned about JSHS through three primary means: 20% of participants indicated they learned about JSHS through their school or university, 18% learned about JSHS through a school newsletter or website, and 18% learned about JSHS through a past participant. Other ways that were reported included: friend (9%); AEOP website (8%); family (5%); someone who works with program (4%); community group (4%); Department of Defense (1%); social media (1%) and 5% chose not to report.
	The top motivations for participating in JSHS in FY16 were the same as in FY15 though the percentage agreement decreased considerably and a broader array of reasons received similar agreement. The top two included interest in STEM (10%) and desire to learn something new (8%), though were closely followed by having fun (8%); desire to expand laboratory or research skills (8%); and learning through ways not possible in school (7%).
Participation in STEM activities occurred more frequently on a most to every day basis in JSHS than in school. However, participants reported less frequent use of most STEM practices in JSHS than in	Participants indicated JSHS STEM Activities occurred more frequently than in school STEM activities in nearly all areas. Participants (41%) indicated that they learn about STEM topics that are new to them every day both in school and in JSHS. However, more participants agreed JSHS provides them opportunities every day to apply STEM learning to real-life 32% (18% in school); learn about new discoveries in STEM 34% (14% in school); learn about different careers that use STEM 25% (10% in school); interact with scientists or engineers 30% (10% in school); and communicate with other students about STEM 40% (27% in school).

school. Mentors increased their use of strategies for diverse learners.	As in FY15, participants reported using STEM Practices less frequently during R-JSHS than during school – with the exception of building or making a computer model –, which had 17%, agreement during R-JSHS compared to 10% agreement at school. Findings indicate that R-JSHS students are not as frequently engaged in (less than most days) STEM practices including: using laboratory procedures and tools, hands on STEM activities, working as part of a team, identifying questions or problems to investigate, designing and carrying out investigations, analyzing data and drawing conclusions, and coming up with creative explanations or solutions.
	Mentors reported increased use of strategies for diverse learners in FY16 compared to FY15. 91% of mentors reported using a variety of teaching and/or mentoring activities to meet the needs of students while 85% interacted with students and other personnel the same way regardless of their backgrounds. Nearly all mentors (90%) reported directing students to other individuals or programs for additional support. treating all students the same way, regardless of gender or race/ethnicity. Most of responding mentors also reported using strategies such as identifying different learning styles students may have at the beginning of their JSHS experience (70%) and providing extra readings, activities, or learning support for students who lacked essential background skills (78%).
JSHS succeeded in exposing participants to STEM careers/jobs through program activities and mentor efforts. However, 60% of R-JSHS participants reported not learning about any DoD STEM jobs/careers. N-JSHS participants reported that invited speakers and career events were the key way they learned about DoD STEM careers. The difference	R-JSHS participant reported exposure to STEM careers and DoD STEM jobs/careers specifically were areas of decline for FY16. Only 10% of R-JSHS students reported learning about at least one STEM job/career, and 21% reported learning about five or more. Additionally, 22% of R-JSHS participants reported that they did not learn about any STEM jobs/careers during the program. Comparatively, many fewer R-JSHS participants learned about DoD STEM jobs/careers overall. 60% of participants reported that they did not learn about even one DoD STEM job/career. Only 12% learned about one job, 11% two jobs, 8% three jobs, 2% four jobs, and 8% five or more jobs. However, a large majority of N-JSHS (80%) students indicated that invited speakers or career events were a key resource for learning about DoD STEM careers.

in experiences may be attributed to low percentage (35%) of mentors who reported discussing DoD STEM careers with students. **Additionally, only 31% of mentors recommended other AEOPs to participants.**	Mentors for both R-JSHS and N-JSHS were asked to report their use of strategies specifically focused on introducing participants to STEM careers and DoD specific STEM jobs/careers in FY16. 73% of mentors reported discussing STEM career opportunities with participants, indicating JSHS participants are learning about STEM careers – as participants have also reported. However, only 35% reported discussing DoD STEM career opportunities with participants. Additionally, only 31% of mentors recommended other AEOPs to participants. These are areas that should be considered for improvement in FY17.
Participant satisfaction with JSHS program components ranged from around 50% to 82% for various aspects in FY16. N-JSHS participants were dissatisfied with feedback received from judges. Mentors continued to report satisfaction with JSHS in FY16.	Participant satisfaction with JSHS program components ranged from around 50% to 82% for various aspects in FY16. Despite this decline, R-JSHS students were somewhat or very much satisfied with the student oral presentations (82%) while over half (56%) were very satisfied with student poster presentations, and invited speaker presentations (64%). Nearly half (47%) were very satisfied with social events while 51% reported being very satisfied with features such as feedback from VIPs and peers, and tours of field trips (47%). Another 53% of students indicated being satisfied with feedback from judges. It should be noted that large proportions of students did not experience features such as panel or round table discussions (48%), team-building activities (55%), and career exhibits (53%). Participant dissatisfaction with the judging process continued to be an area of concern in FY16 (which has declined since FY14). Though 64% of R-JSHS participants were satisfied, the majority of N-JSHS participants (60%) reported dissatisfaction with feedback received from judges at R-JSHS. Respondents reported wanting more diversity in expertise and ethnic/racial/gender backgrounds of judges, more focus actual project content than presentation skills, and written feedback on presentation/poster.
	The research experience overall ranked as the top JSHS resource for participants (89%). The amount of time spent with their mentor was also rated highly (79%). Many participants did not utilize some JSHS resources including the oral presentation tips (42%), sample papers (42%), and JSHS Groundrules (31%). Surprisingly, 47% of R-JSHS respondents to the survey indicated they did not have a JSHS mentor.
	Mentors reported being very satisfied with JSHS program features. Communication with the JSHS site organizers was rated highest (75%) followed by the physical location (67%), application or registration process (62%), support for instruction or mentorship (58%), and research abstract preparation requirements (56%).
Outcomes Evaluation	

Nearly half of R-JSHS participants reported large gains on their STEM knowledge and STEM competencies.	Over 40% of R-JSHS students reported large gains on their in-depth knowledge of a STEM topic or field; knowledge of research, processes, ethics, and rules for conduct in STEM; knowledge of what everyday research work is like in STEM; knowledge of how scientists and engineers work on real problems in STEM; and knowledge of research conducted in a STEM topic or field.
	Slightly over 40% of R-JSHS participants reported large impacts on some of the STEM competencies, or abilities to "do STEM." These areas included: using knowledge and creativity to suggest a solution to a problem; identifying limitations of methods and tools used for data collection; carrying out procedures for an experiment and recording data accurately; organizing data in charts or graphs to find patterns and relationships; supporting an explanation for an observation with data from experiments and STEM knowledge; supporting a solution for a problem with data; identifying the strengths and limitations of explanations in terms of how well they describe or predict observations; communicating about your experiments and explanations in different ways.
R-JSHS participants reported large gains in 21st Century Skills.	Slightly over 40% of responding R-JSHS participants reported large gains in 21st Century Skills. These skills included communicating effectively with others (50% R-JSHS), viewing failure as an opportunity to learn (55% R-JSHS), and setting goals and reflecting on performance (49% R-JSHS).
Participants reported gains in STEM identity and interest in engaging in STEM in the future.	50% of R-JSHS participants reported large gain in the STEM identity areas including: feeling prepared for more challenging STEM activities (51%); confidence to try out new ideas or procedures on my own in a STEM project (51%); and desire to build relationships with mentors who work in STEM (50%).
	Over 60% of R-JSHS participants reported being more likely to engage in out-of-school STEM activities including: work on a STEM project or experiment in a university of professional setting (70%); participate in a STEM camp, club, or competition (64%); talk with friends or family about STEM (63%); help with a community service project related to STEM (63%); mentor or teach other students about STEM (61%); and take an elective STEM class (61%). As in FY15, the impact of JSHS extends and is lasting beyond the actual competition.
JSHS participants aspired to further their education beyond finishing college after JSHS. The type of work they expected to do before and after participation were	After participating in JSHS, students indicated being more likely to go further in their schooling than they would have before JSHS. For R-JSHS students, the proportion of students wanting to graduate high school increased from .50% to 2% and get a Ph.D. grew from 21% to 29% from before JSHS to after JSHS participation. R-JSHS participants wanting to finish college remained similar at about 14% prior to participation and 9% after.

similar.	Participants were asked to indicate what kind of work they expected to be doing at age 30, both before and after JSHS participation. The majority of students aspired to STEM careers both before and after JSHS participation and no significant change was found.
Some R-JSHS participants were more aware of and interested in other AEOPs. N-JSHS students reported learning about the SMART Scholarship but no other AEOPs were mentioned.	Almost half of R-JSHS participants agreed JSHS made them more aware of other AEOPs (49%) and 46% of R-JSHS participants indicated interest in participating in other AEOPs. The program of most interest was JSHS (59%), followed by SMART College Scholarship (33%), SEAP (31%), REAP (31%), HSAP (29%), URAP (29%), NDSEG Fellowship (29%), CQL (27%), GEMS Near Peer Mentor (25%) and Unite (24%). The N-JSHS questionnaire asked participants to list the AEOP programs they had learned about through JSHS this year. Most participants reported learning about the SMART Scholarship. N-JSHS participants mentioned no other AEOPs.
	R-JSHS participants reported that participation in JSHS was the best resource available to learn about other AEOPs (43%). Most students reported not experiencing the AAS website (89%) or AEOP website (85%) or AEOP social media (91%) at all. Further, the AEOP brochure was not provided to 87% of responding participants in FY16.
	Mentors reported similar experiences with resources that may be utilized to expose participants to other AEOPs. 84% of mentors did not use the AAS website and 87% did not use the AEOP website. 95% did not use any form of AEOP social media and 81% did not experience the AEOP brochure. Interestingly, 62% of mentors indicated the JSHS program administrator or site coordinator were their best sources of information (62%) along with actual participation in JSHS (82%) for learning about other AEOPs. Mentors reported their discussion of individual programs within the AEOP portfolio with student participants. Unite was the most discussed at 23%, followed by SMART College Scholarship (14%), eCYBERMISSION (12%), SEAP (11%), URAP (10%), REAP (10%), HSAP (9%), CQL (5%), and NDSEG Fellowship (6%).
Most R-JSHS participants had positive views of Army/DoD research and a subset of the group were interested in pursuing Army/DoD STEM careers.	R-JSHS participants reported being more aware of Army/DoD STEM research and careers (53%) and having greater appreciation of Army/DoD STEM research (56%). More than 60% of R-JSHS students expressed agreement that DoD research is valuable to society, that DoD researchers solve real-world problems, that DoD researchers develop new, cutting edge technologies, and the DoD researchers advance science and engineering fields. Finally, 42% of R-JSHS participants reported being more interested in pursuing a STEM career with the Army or DoD.

Responsiveness to FY14 and FY15 Evaluation Recommendations

The primary purpose of the AEOP program evaluation is to serve as a vehicle to inform future programming and continuous improvement efforts with the goal of making progress toward the AEOP priorities. In previous years the timing of the delivery of the annual program evaluation reports has precluded the ability of programs to use the data as a formative assessment tool. However, beginning with the FY16 evaluation, the goal is for programs to be able to leverage the evaluation reports as a means to target specific areas for improvement and growth. In this report, we will highlight recommendations made in FY15 to programs and summarize efforts and outcomes reflected in the FY16 APR toward these areas.

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

FY15 Finding: Although the applicant placement rate increased from 55% to 62% from FY14 to FY15, it is concerning that there was a 30% decrease in the number of applicants in FY15 as compared to FY14, and overall participation was 21% lower. It is recommended that JSHS track the number of applicants and placement rates at each regional site to insure more consistent placement rates across the portfolio (i.e. Illinois – Chicago had only 20% placement rate compared to 100% at other sites such as South Carolina). One strategy would be for AAS to work with regional sites to support increasing their capacity to accept more participants in the low placement rate regions.

The program failed to meet its goal of a 10% increase in the number of participating high schools and, in fact, there was an 8% decline in the number of schools participating in FY15. Of the 47 regional events held, 18 regions showed a 27% increase over the previous year in the total number of participating high schools. Another 14 regions showed a 37% decrease since FY14. While there are a variety of intervening factors associated with these phenomena, including weather impacts, competing activities, and impacts of school budget cuts on students' ability to travel, program administrators should be mindful of these decreases in participation and particularly the effect they may have on engaging students from underserved and underrepresented populations.

AAS may want to support states to reach out and cast broader nets for recruiting participants – beyond the local area of the competition or host. The program may wish to investigate student recruitment practices from the regions that demonstrated growth in FY15 and identify scalable recruitment and marketing strategies that could be applied across regions. Likewise, the program may wish to investigate strategies from regions with decreasing participation with the aim of identifying longitudinal changes in regional practices that may have affected student participation rates. Some recommended strategies to grow the diversity of student participants to increase the number of underrepresented students include conducting outreach to schools with high populations of underrepresented students to make them aware of JSHS and reaching out to academically prepare and competitively eligible underrepresented students to encourage actual participation in JSHS.

JSHS FY16 Efforts:

- Invite younger students and those from underrepresented populations to observe and/or participate in specific sessions to encourage future participation, including non-competitive poster sessions, science related visual art presentations, and oral presentations with reflection and feedback discussions. (Alabama, Connecticut, Florida, Intermountain, Missouri, North Carolina, Ohio, South Carolina, Wisconsin-UP of Michigan)
- Provide training and support to students in specific topics concerning how to conduct research, write papers, and present projects through workshops, webinars, and print materials. (Connecticut, Iowa)
- Engage volunteers from underrepresented populations to serve as role models and those to whom underrepresented students can better relate. (Connecticut, Florida, Hawaii, Philadelphia, Southeastern Michigan, Southwest, and Washington)
- Connect undergraduate and graduate students in STEM fields from host institution to teachers in rural schools to serve as mentors in new mentorship initiative that plans to expand in FY17. (Alabama, Ohio)
- Provide direct mentor support to underrepresented students through the US2020 program. (Philadelphia)
- Provide additional funding to reduce or eliminate costs for travel, meals, and accommodations associated with the JSHS regional symposia; use private donations to provide STEM opportunities and research supplies to schools with large underrepresented populations. (Alaska, Intermountain, Missouri, New York-Upstate)
- Adjust maximum number of students allowed from a school to participate in JSHS regional symposia, especially if school is from a more financially challenged district. (Missouri)
- Create and use Advisory Board which includes key school district personnel to outreach to Detroit schools and students. (Southeastern Michigan).

JSHS FY16 Outcomes:

- The AEOP has the goal of broadening the talent pool in STEM fields, specifically targeting underrepresented and underserved populations, and therefore increasing the number of participants in programs, including JSHS. In FY15, JSHS experienced a decrease in student and high school participation overall due to several factors which affected regional competitions such as inclement weather, school budget cuts and competing activities. With respect to including underrepresented and underserved populations, the evaluation data indicate that JSHS was able to attract a significant number of female participants (a recognized underrepresented group in STEM) the program had limited success in attracting underserved minority race/ethnicity and low-income groups on a regional and national scale.
- To expand participation in FY16, the AAS identified sustainable recruitment strategies used in Regional Symposia, which saw increases in participation and explored avenues to pursue similar practices in regions struggling to meet participation goals, with specific emphasis placed on practices targeting underrepresented groups. Each of the Regional Symposia reported outreach efforts to heighten awareness of JSHS among high schools, particularly those serving underrepresented populations, or efforts to develop partnerships with STEM enrichment programs serving underrepresented population. However, overall participation in JSHS continued to decline in FY16.
- As a result in FY16, JSHS participation by Title I high school increased as measured by the number of participating Title I schools. The FY16 target of 10% or 110 Title I schools was exceeded with 18% or 196 Title I

high schools participating in JSHS Regional Symposia. The number of participating high schools remained steady in FY '16, with 1,060 high schools participating in FY '16 as compared to 1,100 high schools in the previous year.

FY15 Finding: AEOP objectives include expanding participation of populations historically underrepresented in STEM careers. Since no program-wide demographic data was available from FY14, however, it is not possible to determine whether there was any change in participation of these groups from FY14 to FY15. Collecting demographic information on students participating in the R-JSHS through Cvent will enable a more accurate representation of the JSHS participation pool and concerted efforts should be made by program administrators to ensure that demographic data for all JSHS participants is compiled annually. JSHS failed to meet its FY15 goal for attracting Title I schools (associated with low-income status students) to the program. Of the 1,020 schools participating 15% were Title I schools, falling short of its FY15 goal of 20%. The program should continue to collect information and strategies from specific regional symposia as well as other AEOPs that successfully attract underrepresented and underserved students. This information should be disseminated to the larger JSHS community of regional directors. Additionally, the program may with to consider ways to build on previous efforts to strengthen its outreach to schools that serve large proportions of underrepresented groups of students (e.g., urban schools, Title I schools). JSHS might also consider the possibility of engaging with target districts through the AEOP's strategic outreach initiative opportunities, which provide limited financial support to assist in the ability of a target community to engage with the AEOPs.

JSHS FY16 Efforts and Outcomes:

- JSHS encouraged more sites to use Cvent in FY16 – however only a few did. As a result, demographic data outside of the evaluation data was incomplete at best.

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

FY 15 Finding: The frequency with which students expressed dissatisfaction with judging practices and judging feedback during their JSHS experience (including the increased dissatisfaction from FY14 to FY15) suggests that there may be a need to direct additional resources to judge recruitment and training. While participation of DoD STEM personnel was constant from FY14 to FY15, there was a 33% decrease in the participation of college/university personnel from FY14 to FY15. The program may wish to further investigate practices of regions that were successful in attracting larger numbers of and greater diversity of judges with the aim of identifying practices that may be scaled across regions. Additionally, the program may wish to consider whether current judging practices established by the program are adequate to ensure standardization of judging practices nationwide and consider additional methods to standardize judging and reduce students' perception of judging bias. The program may wish to consider, for instance, creating judging rubrics, providing enhanced judging training or orientation, and providing methods for judges to easily provide both oral and written feedback to students. Currently, the feedback at regional level JSHS competitions is varied and is mostly verbal in format.

JSHS FY16 Efforts and Outcomes:

- The AEOP program wide goal to empower educators with unique Army research and technology resources to mentor students and develop the pool of future STEM talent is assessed through multiple experience related questions in the evaluation. JSHS data collected reveals that while participation of DoD STEM personnel was constant from FY14 to FY15. Participation by mentors, regional directors, and volunteers representing academia continued to grow from FY14 (2,500) to FY16 (3,214).
- In FY '16 a total 3,214 mentors, regional directors, and volunteers representing academia contributed to JSHS Regional and National symposia. Among the total 275 adults attending the National JSHS, 275 reported the data on Gender and/or Race/Ethnicity. Reported NRM data on National adult leaders was:
    - Gender: 103 Female; 170 Male ; 2 Choose not to report
    - Race/Ethnicity: 10-Asian; 11-Black or African American; 9-Hispanic or Latino; 1-Native American or Alaskan Native; 1-Native Hawaiian; 6-Other; 13-Choose not to report.
- Recommendation was made to the Academy to investigate practices employed by regions that attract larger numbers and greater diversity of judges for Regional Symposium in order to establish best practices, which can be distributed across all regions. The Academy was also advised to examine judging procedures to ensure standardization across the Regional and National Symposia and to reduce students' perception of judging bias. In response to the evaluation report, the Academy devoted time and facilitated an intentional discussion about the topic of judging at the Annual Meeting of Regional Directors in FY16. The Academy also reinstituted the Regional Directors Advisory Council (RDAC). RDAC, a representative body of JSHS regional symposium directors and others, will advise the Academy of Applied Science in the continuing development and direction of the JSHS program. This group met in August FY16 and has revised the rules of competition and judging policies for FY17. These revisions have been published in the National guidelines and will be distributed to all regional directors through email and website publications.
- In addition to the Academy's immediate responses to the issue of judges and AEOP's goal to empower educators with research and technology resources, particularly those from the DoD, to serve as mentors and volunteers, the Academy will also identify current practices employed by regions to recruit and train judges and further develop and distribute these methods to all Regional Symposia. Practices, which can be shared, include collaboration with DoD STEM personnel at regional and national symposia and participation practices, engagement by JSHS alumni, engagement by graduate students, volunteer diversity, and use of technology for training judges and volunteers.

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

FY15 Finding: In order to create a robust pipeline of AEOP programs in which students' progress from other AEOPs into JSHS and beyond, the program may want to consider innovative ways to work with other AEOPs to create a more seamless continuum of programs. One finding that is cause for concern is that although many participants expressed interest in other AEOP programs, most students had never heard of AEOP programs outside of JSHS. Large numbers of students at R-JSHS events reported not having seen the AEOP brochure. This is especially concerning since the FY15 APR indicates that AEOP resources were distributed to all regional symposia. Coupled with this is student reliance on

teachers or mentors for information about AEOPs and mentor reports of having little familiarity with AEOPs other than JSHS. The program may wish to consider devising methods to disseminate AEOP information directly to teachers and mentors before the regional events as well as communicating expectations to regional symposia concerning the distribution of AEOP materials at events to ensure that all mentors, teachers, and students have access to structured opportunities that both describe the other AEOPs and provide information to students on how they can apply to them.

Evaluation data indicate that nearly half (47%) of R-JSHS students did not hear about any Army or DoD STEM career opportunities during their JSHS experience. Since R-JSHS mentors were reported to be a useful source of information about DoD STEM careers it would be useful for the program to devise ways to familiarize mentors with resources available to expose students to DoD STEM careers. A large majority of N-JSHS (80%) students indicated that invited speakers or career events were a key resource for learning about DoD STEM careers, however over a third (35%) of R-JSHS students reported not having experienced these resources. Because of the potential marked impact of this resource on student awareness of DoD STEM careers, the program may wish to consider innovative ways to connect regional students with DoD STEM professionals, including creating web-based video profiles of DoD STEM professionals, creating virtual lab tours hosted by DoD STEM professionals, and devising strategies to facilitate regional symposia's efforts to engage DoD STEM professionals as speakers at events.

The R-JSHS experience comprises the entirety of the JSHS experience for most students, however consistent differences between R-JSHS and N-JSHS student responses suggest that N-JSHS may have a greater impact on students than R-JSHS. While some of these differences are likely due to initial differences in interest and/or ability between students who are selected to go on to N-JSHS and those who are not, other differences may be related to differences in the availability/quality of mentor support or the availability/quality of activities at each symposium. The program should consider what guidance and support can be provided to regional directors, mentors, and other supporters of R-JSHS to facilitate the identification of mentors (particularly in rural areas and other areas with logistical barriers to accessing university and other professional STEM resources), active engagement in STEM activities, useful feedback from judges, and feelings of success that support a positive STEM identity among students who are not selected for N-JSHS.

JSHS FY16 Efforts and Outcomes:

- The AEOP established a goal to create a robust pipeline of AEOP programs in which students' progress from other AEOPs into JSHS and beyond. The primary objective has been to expand cross-marketing and outreach for JSHS to include other AEOP programs, however, data from the FY15 evaluation confirms that despite marketing efforts, JSHS participants do not know about AEOP or its opportunities outside of JSHS. Survey responses indicate strong participant interest in other AEOP programs but that a majority have little or no awareness of these programs. It is evident that JSHS and the AEOP programs as a whole need to develop a brand identity to connect them to each other and to the larger organization of AEOP. In addition to the lack of awareness of AEOP specifically, the evaluation revealed a significant disconnect between the amount of Army and DoD STEM experiences highlighted at the Regional and National Symposium and that students who participate in the National competition receive much more exposure to DoD STEM opportunities than those who only participate at the Regional level. In FY15, the Academy mailed AEOP resources to all regional

directors for distribution at the Regional Symposia. The Academy continued this practice in FY16, however the supply of materials was more limited and regional requests were not always met in full.

- Recommendation was made to the Academy to consider innovative ways to collaborate with other AEOPs to create a more seamless continuum of programs. The Academy disseminates AEOP materials directly to teachers and mentors to highlight the organization and the multiple opportunities offered. Survey results illustrate that students identify teachers and mentors as a useful source of information about STEM careers in general.
- The Academy continues to support all AEOP programs through cross marketing. In FY16, AAS made pointed efforts to collaborate with the LO and Widmeyer to promote AEOP programs among JSHS participants and alumni. A more robust social media and marketing campaign that included AEOP branding was implemented in FY16 and will continue to grow into FY17 and beyond. In FY16, targeted communication was sent to alumni to recruit volunteers for eCYBERMISSION, and newsletters and emails were sent to JSHS and participants in the Apprenticeship Programs to encourage continued engagement in AEOP opportunities. To address the disconnect between the presence of AEOP and awareness of DoD STEM careers between the regional and national symposia, the Academy is considering ways to create and distribute promotional materials such as banners and posters to be displayed at all Regional Symposia to include and highlight AEOP branding. The Academy will also continue to encourage all regions to include language about AEOP and to engage DoD volunteers to establish a stronger Army and DoD presence at events to raise awareness.

FY15 Finding: Participation in the AEOP evaluation continues to be an area of concern. While student and mentor participation rates rose slightly from FY14 to FY15, the continued relatively low rates of participation threaten the generalizability of results. Improved communication with regional JSHS sites about expectations for the evaluation may help. A recommendation was made in the FY14 evaluation report as follows: "Given the large number of participants in the Regional competitions, it may be worth randomly sampling students to respond to the questionnaire, and rechanneling efforts into getting a high response rate from the sample." Although there is no indication that this recommendation was acted upon in FY15, it may be a strategy to consider going forward. It is recommended that JSHS consider requiring regional sites to provide time for participants to complete the AEOP evaluation questionnaire during regional symposia.

JSHS FY16 Efforts and Outcomes:

- JSHS encouraged more sites to complete the evaluation in FY16, including hosting webinars for regional directors. Participation in the FY16 evaluation was still very low despite the efforts.

Recommendations for FY17 Program Improvement/Growth

Evaluation findings indicate that FY16 was a successful year overall for the JSHS program. Notable successes for the year include the continued high participation rate for females, continued participation by other groups traditionally underrepresented in STEM fields, and good levels of mentor and student satisfaction with the programs. In FY16 JSHS mentors increased their use of effective mentoring strategies and most R-JSHS participants indicated strong interest in engaging in out-of-school STEM experiences in the future.

While these successes are commendable, there are some areas that remain with potential for growth and/or improvement. The evaluation team therefore offers the following recommendations for FY16 and beyond:

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

1. In FY16 JSHS continued to experience a decrease in applications and participation in the program overall – which represents a three-year downward trend. For FY16 there were 8,900 applications and 5,300 participants – compared to 9,347 and 5,829 respectively in FY15. This is an area that is in need of focus for FY17. We suggest as an example a couple of strategies for addressing enrollment concerns: 1) work with regions to expand their recruitment efforts beyond the local area utilizing websites, social media, and other marketing efforts of the consortium, 2) grow capacity for stronger regions to accept more participants. For example, most participants at the Kentucky regional site visit were from the greater Louisville region – with very little to no representation from other central and southeastern parts of the state. We suspect this may be the case for other regional sites. JSHS may also consider utilizing electronic formats to grow participation in JSHS from remote locations – similar to an eCYBERMISSION model – for the future. Additionally, it is recommended that JSHS provide the Regional Directors a forum to share best practices in both program administration as well as infusing information about AEOP programs and DoD research and careers into programming.

2. In addition to increasing participation overall – JSHS should also continue and expand efforts to provide outreach to prospective participants from historically underrepresented groups. JSHS participants remained predominantly White or Asian in FY16, as nearly half (45%) of students identified themselves as White with another 22% identifying themselves as Asian. 21% of students chose not to report their race/ethnicity, 4% identified themselves as Black or African American and 6% as Hispanic or Latino. Native American students comprised .3% of the students reporting their race/ethnicity, while .3% identified as Native Hawaiian or Pacific Islander. JSHS should examine housing regional sites within areas that provide great representation of potential diverse JSHS participants and work with regional directors to specifically target schools that have not been well represented in JSHS.

3. R-JSHS participants reported having experience with STEM activities within JSHS. However, most reported that they were able to use STEM practices more frequently in school than in JSHS. This should be an area of focus for JSHS and AAS should consider providing specific suggestions/guidelines/handbook to regional sites on how to include STEM practices within the programming for R-JSHS. Further, almost half (40%) reported large gains in their STEM knowledge, STEM competencies, and 21st Century Skills after participating in JSHS. In FY16 most participants did not feel that JSHS impacted their abilities to do STEM and associated knowledge. This is another data point that illuminates a need to provide more guidance and structure to the JSHS programming – particularly at the regional level – to ensure that participants are gaining these valuable experiences and abilities during the program.

4. Program provided/collected demographic data on participants was incomplete, as in FY15. It is strongly suggested that JSHS require regional sites to collect full demographic data on all participants – ideally through Cvent in FY17.

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

1. In FY16 JSHS participants continued to report dissatisfaction with judging practices and judging feedback at regional competitions – a finding that has been reported in FY14 and FY15 as well. There were several data points that reinforced this finding, from the R-JSHS survey to N-JSHS focus group sessions and the N-JSHS survey. Participants reported not being satisfied with the quality of and amount of feedback provided from judges – including receiving no written feedback from judges. Further, participants felt that the judges were not content experts and that they were judged primarily for their presentation skills rather than the actual content and focus of their research project. As has been recommended in previous years, JSHS should develop and implement guidelines for judging that include templates for providing feedback (written and oral) to participants. Further, regional sites should make every effort to have judges that reflect the breadth and depth of STEM content that participants may focus on as much as possible. STEM experts as well as Army/DoD STEM experts should be sought to engage in R-JSHS events. Virtual judging processes that may enable more qualified STEM judges to participate may be a potential strategy – along with virtual competitions for those that are regionally unable to participate.

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

1. As in FY15, less than 50% of JSHS participants agreed that JSHS made them more aware of other AEOPs and only 46% were interested in participating in other AEOPs. Additionally, only 15% of JSHS participants had used the AEOP website and fewer had used social media related to AEOP (9%). Further, only 13% of participants had been provided with the AEOP brochure. Most mentors did not discuss AEOPs with participants – as only 23% discussed Unite, 14% SMART, 12% eCYBERMISSION, 11% SEAP, 10% URAP, 10% REAP, 9% HSAP, 5% CQL, and 6% NDSEG Fellowship. These findings are concerning, primarily because these are areas that AAS could address through collective and organized marketing efforts for JSHS. In FY17 AAS should develop with or without consortium support materials to be provided to participants (i.e. brochures, handouts) as well as instructional resources for regional sites (mandatory) to go through with all regional site participants during the overview/orientation session prior to competition or at the conclusion (e.g. slides, speakers). Promotion of the AEOPs should be collective responsibility of each and every program within the consortium.

2. The majority of participants in R-JSHS (78%) in FY16 reported learning about STEM careers during the program and most (68%) learned about more than one career. However, JSHS did a much less effective job of exposing participants to Army/DoD STEM careers – as only 40% learned about at least one Army/DoD STEM career. Conversely, a large majority of N-JSHS (80%) students indicated that invited speakers or career events were a

key resource for learning about DoD STEM careers. The difference in growth of learning about STEM careers overall and DoD STEM careers specifically may be attributed to mentor level of discussion of each during the program. Mentors (78%) reported discussing STEM careers with participants. However, only 35% discussed Army/DoD STEM careers. Mentors (78%) reported discussing STEM careers with participants. However, only 35% discussed Army/DoD STEM careers. In FY17 JSHS should address this area through development of a toolkit for regional sites to use (i.e. slideshow, handouts, social media posts) and also an inventory of potential regional Army/DoD STEM career people who could be engaged to participate in person or by video in the programming.

Appendix G: 2016 Junior Solar Sprint (JSS) Evaluation Executive Summary

Junior Solar Sprint (JSS), managed by the Technology Student Association (TSA), is an Army Educational Outreach Program (AEOP) science, technology, engineering, and mathematics (STEM) education program where 5th-8th grade students apply scientific understanding, creativity, experimentation, and teamwork to design, build, and race solar electric vehicles. JSS activities occur nationwide, in classrooms and schools, through extracurricular clubs and student associations, and as community-based events that are independently hosted and sponsored. The AEOP's JSS programming is designed to support the instruction of STEM in categories such as alternative fuels, engineering design, and aerodynamics. Through JSS, students develop teamwork and problem-solving abilities, investigate environmental issues, gain hands-on engineering skills, and use principles of science and math to create the fastest, most interesting, and best crafted vehicle possible. Students have the opportunity to participate in JSS through TSA chapters and Army-hosted locations across the country.

This report documents the evaluation of the FY16 JSS program. The evaluation addressed questions related to program strengths and challenges, benefits to participants, and overall effectiveness in meeting AEOP and program objectives. The assessment strategy for JSS included questionnaires for students and mentors, two focus groups with students at regional events, one focus group with students at the national event, one interview with a mentor at a regional event, and one focus group with mentors at the national event. In 2016, students participated in JSS through 26 TSA-affiliated state competitions, two regional Army laboratory-hosted locations, and one national competition in Nashville, TN.

2016 JSS Fast Facts	
Description	STEM competition-Solar car competition regional events at 2 Army laboratories, 25 TSA state events, and one national event hosted in conjunction with the national TSA conference.
Participant Population	5th-8th grade students
No. of Student Applicants	609 (based on Cvent)
No. of Students	585
Placement Rate	N/A (all students who register compete as participants)
No. of Adults (Mentors and Volunteers – incl. Teachers and Army S&Es)	222(total regional/state level Adult Participants+ TSA adults at national level + army)
No. of Army Research Centers and Laboratories	2
No. of K-12 Schools	*609 (21 did not include school name)
No. of K-12 Schools – Title I	61 (17 did not report)
No. of Other Collaborating Organizations	2 (Army Research Labs – APG and ARDEC)
Total Cost	$174,752.48
Scholarships/Awards Cost	$12,401.48
Administrative Cost to TSA	$162,351.00
Cost Per Student Participant	$223.00

*Number based on reports from Cvent.

Summary of Findings

The FY16 evaluation of JSS 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.

2016 JSS Evaluation Findings	
Participant Profiles	
JSS served relatively small percentages of students from historically underrepresented and underserved populations; there is room for growth in this.	Female participation in JSS remained close to FY15 levels. In FY16 only 26% of JSS student participants were female (a population historically underrepresented and underserved in STEM fields) as compared to 27% in FY15.
	Slightly fewer participants identified themselves as Black or African American or as Hispanic or Latino in FY16 as compared to FY15 (7% versus 6% and 9% versus 6% respectively). This indicates that JSS has had limited success in engaging students from these groups.
	Participant demographic data was readily available in FY16. This is an improvement as compared to previous years, however there are significant discrepancies between Cvent registration data and data reported by state advisors.
JSS participants have little experience with other AEOPs and only limited interest in participating in other AEOPs in the future.	As in previous years, only very small number of students reported having participated in other AEOPs. This may be due to the grade levels that are eligible for JSS – as one of the first AEOP programs that are open to elementary students. The majority of students have not heard of AEOPs that they currently qualify for or that they may qualify for in high school, suggesting that AEOP information may not be reaching students through JSS.
Actionable Program Evaluation	
TSA markets JSS widely to its members, although there is little evidence that students learn about AEOPs more generally through JSS or the TSA.	In FY16, TSA continued to market JSS by mailing postcards to TSA chapter advisors, and through print and electronic mailings to TSA state advisors and middle school advisors.
	Students and mentors reported high levels of satisfaction with TSA online resources. Although the TSA website was identified by students as a source of information about other AEOPs, most students had not heard of the other programs in the AEOP portfolio.
JSS students reported a variety of motivators for participating in the program.	Students identified having fun, interest in STEM, teacher encouragement, and the desire to learn something new as the primary motivators for participating in JSS.
JSS students reported engaging in meaningful STEM learning through team-based and hands-on activities.	Large proportions of students reported gains in skills related to teamwork such as including others' perspectives when making decisions and communicating effectively with others. Student responses to open-ended questionnaire items also indicated that they place a high value on the teamwork components of JSS.

2016 JSS Evaluation Findings	
	The majority of students reported gains in skills related to problem solving such as using knowledge and creativity to suggest testable explanations (hypotheses) for observations and making models of an object or system showing its parts and how they work. Student responses to open-ended questionnaire items also indicated that participants place a high value these aspects of JSS.
	Students reported engaging in a variety of other STEM practices on a frequent basis, including analyzing data or information (59%) and drawing conclusions from an investigation (55%).
	Mentors reported using a variety of strategies to help make learning activities to students relevant, support the needs of diverse learners, develop students' collaboration and interpersonal skills, and engage students in authentic STEM activities.
JSS has an opportunity to improve student and mentor awareness of other AEOPs and DoD STEM careers.	Although 78% of students reported that participating in JSS had some impact on their awareness of other AEOPs, most students reported that they had never heard of the other AEOPs. Although 28% of mentors reported discussing AEOPs in general with their students, the vast majority of mentors (97%-100%) reported that they did not discuss specific programs, and 80% of mentors reported that they did not recommend AEOPs that align with students' goals to participants.
	Mentors (89%) reported that found the TSA website was a useful resource to expose students to DoD STEM careers and, to a lesser extent, that the JSS website was useful for this purpose (68%). This suggests that there is an opportunity for these websites to be used for targeted marketing of programs for which JSS students are or will soon be eligible such as GEMS, JSHS, and SEAP.
	Although student attitudes toward DoD researchers and research were positive, over half of responding students (55%) of students reported that they did not learn about any DoD STEM careers during JSS. Over a third of students (34%) reported that JSS participation did not impact their awareness of Army and DoD STEM careers.
Students and mentors reported overall satisfaction with the JSS experience.	The majority of students reported satisfaction with program features including mentoring during JSS and the location of JSS activities. The only area in which more than four responding students reported dissatisfaction was the process of applying or registering for the program (12% or respondents were "not at all satisfied" with this aspect of JSS).
	Mentors also reported satisfaction with program features that they had experienced. Mentor satisfaction with the application or registration process was higher than for students (71% of mentors were at least "somewhat satisfied" with this process).
Outcomes Evaluation	
JSS students reported gains in STEM knowledge and competencies.	A majority of students (62-76%) reported medium or large gains in their STEM knowledge, including knowledge of research processes, ethics, and rules for conduct in STEM, Knowledge of how scientists and engineers work on real problems in STEM, and in-depth knowledge of a STEM topic(s).

2016 JSS Evaluation Findings	
	Additionally, students (45-76%) reported medium or large gains in most STEM competencies, including using knowledge and creativity to suggest a solution to a problem, identifying the limitations of the methods and tools used for data collection, and carrying out procedures for an experiment and recording data accurately.
JSS participants reported gains in 21st Century Skills.	Most participants (62-87%) also reported medium or large gains in all 21st Century Skills, including sticking with a task until it is finished, making changes when things do not go as planned, and communicating effectively with others.
JSS participants reported gains in their identity in STEM and in their interest in engaging in STEM in the future.	JSS participants (61-79%) reported medium or large gains in all aspects of their STEM identities, including their decisions to pursue a STEM career, thinking creatively about a STEM project or activity, and feeling prepared for more challenging STEM activities.
	Participants reported being more likely to engage in STEM activities outside of school, with a majority indicating that they are more likely to engage in activities such as using a computer to design or program something (59%), take an elective (not required) STEM class (65%), and work on a STEM project or experiment in a university or professional setting (50%).
Students' education aspirations were higher after participating in JSS, and there were shifts in their career aspirations toward STEM careers.	Participants were more likely to aspire to continue their education after college after JSS as compared to before participation (66% after versus 50% before).
	More students aspired to careers as scientists and researchers and as engineers or architects after participating in JSS as compared to before participation. The vast majority of students (97%) reported that they expect to use STEM knowledge, skill, and abilities in their jobs when they are 30.
Although JSS students are largely unaware of AEOP initiatives, students showed some interest in future AEOP opportunities.	Over half of students indicated that JSS contributed to their interest in participating in other AEOPs. Most students were at least somewhat interested in participating in JSS again in the future. While strong interest in participating in other AEOPs was limited (10% or fewer of students were "very much" interested in any particular program), most students reported being at least "a little" interested in participating in future programs.

Responsiveness to FY14 and FY15 Evaluation Recommendations

The TSA has been generally responsive to the recommendations made in FY14 and FY15 evaluation reports, although progress has been limited in all areas. In particular:

- The TSA has responded to recommendations for attracting students from groups historically underrepresented in STEM by sending postcards and emails to Title 1 schools with TSA chapters promoting JSS and the free solar car kit. There is no evidence that specific efforts were made to engage female participants.
- FY14 and FY15 evaluation reports recommended that the TSA work with JSS sites and with other AEOPs to enhance awareness of AEOP initiatives across programs. While the TSA website contains links to the AEOP website and other AEOP information and the program reported providing AEOP brochures for each state TSA conference, questionnaire results indicate that these brochures may not have reached students. Awareness of AEOP materials including the website, print materials, and social media remain at low levels.

- The TSA responded to recommendations to communicate expectations for and the importance of evaluation activities to individual program sites by providing opportunities to complete evaluations at check-in at the national event, sending evaluation links to state and chapter advisors and sending follow-up emails, and sending evaluation links to national competitors. In spite of these efforts, participation in evaluation activities remains low. It should be noted that, because of the transition in evaluation activities from Virginia Tech to Purdue University, the response to the recommendation to streamline the questionnaire has been delayed.

Recommendations for FY17 Program Improvement/Growth

Evaluation findings indicate that FY16 was a success overall for the JSS program. Notable successes for the year include high levels of mentor and student satisfaction with the program, expansion in the number of regional JSS sites, and satisfaction with TSA resources. There is continued evidence of gains in students' STEM knowledge and competencies and gains in students' 21st Century Skills as a result of the JSS experience.

While these successes are commendable, there are some areas that remain with potential for growth and/or improvement. Specifically, in spite of the increase in the number of regional competitions, the JSS program again experienced a decline in number of participants and overall lack of diversity in participant demographics. The membership model associated with TSA chapters being the main source of recruitment (along with Army lab-based efforts) may be limiting the ability of JSS to grow and reach the desired target populations. In addition, JSS participants continue to report little familiarity Army and DoD STEM careers and with other programs in the AEOP portfolio, suggesting that AEOP resources are not reaching students and mentors. The evaluation team therefore offers the following recommendations for FY17 and beyond:

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

Although not an explicit goal of JSS, the AEOP objective of broadening, deepening, and diversifying the pool of STEM talent continues to be a challenge for JSS. The available demographic enrollment data for the past three years suggests that little change in the rates of participation of underserved and underrepresented groups of students has occurred. Previous recommendations (made in the 2013, 2014, and 2015 JSS evaluation reports) for the program to consider doing more to recruit students from schools serving historically underrepresented and underserved groups are therefore repeated. In particular, since many students participate in JSS via the TSA, it is important to consider ways of reaching a broader range of schools through both the TSA and through Army-hosted events. One strategy may be to market the program to fifth graders, a group that has been largely unrepresented in JSS to date.

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

Mentors and students expressed overall satisfaction with the resources available to them through TSA. At the same time, however, both mentors and students reported little familiarity with Army resources such as the AEOP website, the It Starts Here! magazine, and the AEOP brochure. This suggests that participants may not make connections between JSS and Army sponsorship, particularly since participants' primary organizational connection is with the TSA. The fact that Army representatives at one regional TSA event were unaware that JSS is an AEOP initiative and, more importantly, were unfamiliar with the AEOP, suggests that stronger connections between JSS and the AEOP could be made. Although

the TSA website makes clear the association of JSS with the AEOP, it may be useful to ensure that AEOP brochures are on hand at all state and regional TSA events, and to educate Army personnel who staff student events about the AEOP and its various initiatives.

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

1. Students continue to report having little knowledge of other programs in the AEOP. Because of the goal of creating a pipeline of programs in which participants progress from JSS into other AEOPs, this is an area of concern. While over half of students indicated that JSS had an impact on their interest in participating in AEOPs in the future, students were largely unaware of programs for which they are or will soon be eligible such as JSHS and GEMS. In spite of this, over half of responding students reported that the TSA website was helpful in learning about JSS and other AEOPs. Likewise, over half of responding students reported that their JSS mentors were helpful in learning about AEOPs. A large majority of mentors reported that found the TSA website was a useful resource to expose students to DoD STEM careers and, to a lesser extent, that the JSS website was useful for this purpose. This suggests that there is an opportunity for these websites to be used for targeted marketing of programs for which JSS students are or will soon be eligible such as GEMS, JSHS, and SEAP. In addition, since mentors are an important source of student information, additional efforts should be made to educate mentors about the AEOP and programs for which their students are eligible. Further, JSS should consider marketing participation in eCM – as it is available to students regardless of location and is a similar competition-based AEOP.

2. The TSA provided support to the JSS objective of creating a national infrastructure to support events and increase participation in JSS. The expansion of the number of regional events is evidence of this work, however it should be noted that JSS participation declined in 2016. As noted above, since many students participate in JSS via the TSA, it is important to consider ways of reaching a broad range of schools through both the TSA and through Army-hosted events. In addition, although demographic data for participants is more widely available than in past years, use of Cvent remains limited and, for some regional competitions, no participation data was available. The TSA should therefore continue to emphasize the importance of collecting enrollment and participation data with state and regional TSA chapters and other groups holding state and regional competitions.

3. The low response rates for student and mentor questionnaires continue to be an area with potential for growth. There were 10 regional sites and one Army Lab that did not participate in the evaluation survey. Although response rates for mentors have displayed an upward trend over the past three years, the student response rate remained constant from FY15 to FY16. The program may want to consider ways to communicate the importance of these evaluations with individual program sites. Streamlining evaluation instruments may also increase response rates by reducing the time commitment of respondents.

Appendix H: 2016 Research & Engineering Apprenticeship Program (REAP) Evaluation Executive Summary

REAP is a summer research apprenticeship program focused on the development of high school students' STEM competencies, with particular emphasis on groups historically underrepresented and underserved in STEM. For over 30 years, REAP has placed talented high school students in research apprenticeships at colleges and universities throughout the nation. Each REAP student (herein referred to as apprentice) are provided a minimum of 200 hours (over a 5 to 8 week period) of research experience under the direct supervision of a university scientist or engineer on a hands-on research project. REAP apprentices are exposed to the real world of research, gain valuable mentorship, and learn about education and career opportunities in STEM through a challenging STEM experience that is not readily available in high schools.

This report documents the evaluation of the FY16 REAP program. Purdue University, the evaluation lead, prepared the FY16 evaluation reports, which addressed questions related to program strengths and challenges, benefits to participants, and REAP's overall effectiveness in meeting AEOP and program objectives.

For FY16, there were 120 REAP apprentices at 42 different colleges and universities. This was a slight increase in participation of 3% from FY15 enrollment (117). The FY16 evaluation addressed questions related to program strengths and challenges, benefits to participants, and overall effectiveness in meeting AEOP and program objectives. The evaluation plan for REAP was comprised of questionnaires for apprentices and mentors, interviews with apprentices and mentors, and review of the FY16 annual program data compiled by the Academy of Applied Science (AAS).

2016 REAP Fast Facts	
Major Participant Group	Rising 10th, 11th, and 12th grade high school students, rising first-year college students
Number of applications (Cvent)	487
Apprentices	120 (100 REAP, 20 UNITE/REAP)
Placement rate	25%
Mentors	121 (including one new mentor who trained with a veteran mentor)
Sites	42
Total Cost	$388,217
Total Stipends (apprentices & mentors)	$250,350
Cost Per Student Participant	$3,235

Summary of Findings

The FY16 evaluation of REAP collected data about participants, their perceptions of program processes, resources, and activities, and indicators of achievement related to AEOP's and REAP's objectives and intended outcomes. A summary of findings is provided in the following table.

2016 REAP Evaluation Findings	
Participant Profiles	
REAP continues to have success in serving historically underrepresented and underserved populations.	REAP experienced continued success in recruiting female students at a high rate. In fact, 73% of participants in FY16 were female, a population that is historically underrepresented in STEM fields. There was an increase in female apprentices (from 61% in 2015) for REAP.
	REAP was very successful in meeting the program requirement of providing outreach to students from historically underrepresented and underserved groups as defined in admission requirements using the AEOP definition (students must self-identify as meeting at least two of the following requirements: qualifies for free or reduced-price lunch; is a minority historically underrepresented in STEM (Alaskan Native, Native American, Black or African American, Hispanic, Native Hawaiian, or other Pacific Islander); is a female pursuing research in physical science, computer science, mathematics, or engineering; receives special education services; has a disability; speaks English as a second language; or is a potential first-generation college student). There were a total of 120 apprentices involved in REAP and 73% of the apprentices were female. 46% of apprentices reported their race/ethnicity as African American, 16% Asian/Pacific Islander, 14% Hispanic, 3% Native American, 18% Caucasian, and 3% did not report race/ethnicity.
	REAP continued to implement the bridge with UNITE, another AEOP program that serves students from underrepresented and underserved groups. The percentage of REAP apprentices who have participated in UNITE continues to increase from 2013 to 2016.
REAP mentors are gradually becoming more diverse from year to year.	FY16 mentors were remained predominantly male (68%) and White (41%). However, this did represent a decrease in the percentage of White mentors overall from 2015 and from 2014.
	A comparison of apprentice and mentor demographics suggested that many apprentices of underserved or underrepresented populations are not likely to have mentors sharing the same gender or race/ethnicity. Having a mentor who shares an apprentice's gender or race/ethnicity is a potential motivator for reducing stereotypes and increasing students' performance and persistence in STEM.
REAP apprentices tend to want to pursue higher education degrees after attending REAP.	Before their experience with REAP, most students were interested in obtaining a Bachelor's degree or higher. Overall the percentages shifted to the apprentices (see Table 25b) wanting to pursue terminal degrees, such as getting a Ph.D. (from 18% before REAP to 32% after REAP) and a combined M.D./Ph.D. (from 8% to 16%).
Actionable Program Evaluation	
REAP apprentices were recruited from a more diverse variety of sources,	Mentors used a variety of methods to recruit apprentices. Many mentors indicated recruiting their apprentice(s) through applications from AAS or AEOP (38%), K-12 teachers at the local schools (34%), and informational materials sent to a K-12 setting

rather than only at the local level. REAP mentors continue to learn about the program through personal contacts.	(31%). About a quarter indicated colleagues from the workplace (22%). Communications from both a K-12 school (16%) and a university (16%) helped with recruitment. About the same amount of students were recruited from organizations that serve underserved or underrepresented populations (16%), and STEM or STEM education conferences (16%).
	The most frequently mentioned source of information about the local REAP program was someone who works at the school or university (19%) followed by school or university newsletter, email, or website (17%) and someone who works with the program (17%). Other sources mentioned relatively frequently were the AEOP website (13%), and past participant (12%).
	The sources that the responding mentors most frequently identified were a supervisor or superior (41%), a colleague (38%), the AEOP website (22%) and a past REAP participant (16%). In 2015 33% of responding mentors stated AAS as a source for learning about REAP as compared to 9% in 2016.
REAP is strongly marketed to students from historically underrepresented and underserved groups.	The RFP specified to university directors/mentors that the targeted participants were underrepresented and underserved high school students. In addition, the REAP administrator worked with all of the directors and mentors to ensure that the students being considered for the apprenticeships identified as coming from an underrepresented and underserved groups.
Participation in REAP helps students identify knowledge and skills for STEM careers.	Some apprentices expressed interest in STEM-related careers both before and after participating in REAP. For example, 24% indicated aspiring to a career in engineering before REAP, with another 23% interested in medicine. After REAP, 31% of apprentices expressed interest in engineering, and 22% in medicine.
	All apprentices expect to use STEM somewhat in their career. A large majority (91%) expects to use STEM 75-100% of the time in their work, 4% expect to use STEM 51-75% of the time, and 5% expect to use STEM 26-50% of the time. None of the apprentices expected never to use STEM in their work at age 30
REAP apprentices engage in meaningful STEM learning through analyzing or interpreting data and carrying out investigations.	86% of responding apprentices indicated analyzing or interpreting data on most days or every day; 76% reported carrying out investigations; and 79% reported posing questions to investigate. In addition, apprentices indicated being integrally involved the work of STEM on most days or every day, including drawing conclusions from an investigation (75%), using laboratory procedures and tools (85%), and carrying out an investigation (76%). However, 61% of apprentices did not build or create a computer model.
REAP mentors are improving efforts to promote AEOP opportunities and DoD STEM careers and some resources to promote other AEOP opportunities are useful.	Participating in REAP was most likely to be rated as impacting their awareness of AEOP "somewhat" or "very much" (82%). Their mentor (66%) was also rated by a majority of apprentices as having at least somewhat of an impact on their awareness of AEOP programs, as well as the AEOP website (70%). This is a change from 2015, when the majority of apprentices did not report that the AEOP website impacted their awareness of AEOPs.
	Participation in REAP (72%), REAP Program administrator or site coordinator (59%), and the AEOP website (41%) were most often rated as "very much" useful. Invited speakers, It Starts Here! Magazine, or "career" events and AEOP social media tended not to be seen as very useful, with large proportions of mentors indicating they did not

	experience these resources.
Connections between REAP and UNITE continue to grow stronger.	The percentage (20%) of REAP apprentices who have participated in UNITE continues to increase from 2013 to 2016. This represents a continued increased attendance in UNITE by REAP apprentices since 2013.
The REAP program is highly valued by apprentices and mentors.	98% of apprentices were satisfied with the physical location of REAP, 95% were satisfied with the stipends, 97% were satisfied with the registration process, 94% were satisfied with communication with REAP organizers and 85% were satisfied by the variety of STEM topics offered in REAP.
	66% of mentors reported being very much satisfied with support for instruction during program activities, 60% were very much satisfied with communication with REAP organizers and the application process, and 56% were very much satisfied with research abstract preparation requirements.
Outcomes Evaluation	
REAP apprentices reported large or extreme gains in STEM knowledge and competencies.	Nearly all responding apprentices reported gains in their STEM knowledge as a result of the REAP program, with large majorities indicating large or extreme gains in each area. Large or extreme gains were reported by 84% of apprentices on their knowledge of research conducted in a STEM topic/field, and 73% on their knowledge of a STEM topic/field in depth. Similar impacts were reported on knowledge of how professionals work on real problems in STEM (86%), knowledge of what everyday research work is like in STEM (89%), and knowledge of research processes, ethics, and rules for conduct in STEM (76%).
	Apprentices reported large or extreme gains on their ability to support an explanation for an observation with data from experiments (74%), supporting an explanation with STEM knowledge (74%), integrating information from technical or scientific texts (66%), and using knowledge and creativity to suggest a testable explanation for an observation (66%).
	Additionally, 97% of mentors reported supervising students while they were doing STEM research, and 97% provided students with constructive feedback on STEM competencies. The strategies of having students search for and review technical research, demonstrating laboratory techniques, and learning collaboratively was reported by at least 84% of the mentors.
REAP apprentices' reported gains in 21st Century Skills.	81% of responding apprentices reported a large or extreme gain in sense of accomplishing something in STEM. Similarly, substantial proportions of apprentices reported large or greater gain in their desire to build relationships with their mentors (83%), connecting a STEM topic to a personal interest (76%), and feeling prepared for more challenging STEM activities (79%). In addition, 82% reported an increase in their confidence to try out new ideas or procedures, and 65% reported that REAP was influential in deciding on a path to pursue a STEM career.
REAP mentors engaged in best practices and supported students engaged in STEM learning.	Mentors reported finding out about students' backgrounds and interests at the beginning of the program (84%), and most gave students real-life problems to investigate or solve (97%). Over 70% of the mentors reported asking students to relate outside events or activities to topics covered in the program and selecting

	readings or activities that relate to students' backgrounds. The majority of mentors also reported helping students understand how STEM can help them improve their communities (72%), and encouraging students to suggest new readings, activities, or projects (94%). Mentors also suggested other ways that they establish relevance, such as demonstrating how skills learned in the laboratory are pertinent to other fields.
	Mentors indicated having students listen to the ideas of other with an open mind (91%) and had them work on collaborative activities (91%). The vast majority had students explain difficult ideas to other (88%), and tell others about their backgrounds and interests (66%).
	Apprentices were asked to indicate what kind of work they expected to be doing at age 30, and the data were coded as STEM-related or non-STEM-related. The majority of the apprentices were interested in STEM-related careers before participating in REAP, and almost all were interested in STEM-related careers after participating in REAP.
REAP outcomes include apprentice learning about STEM topics that were new to them and applying STEM learning to real-life situations	Apprentices reported that they learned about STEM topics that were new to them (91%), and applied STEM learning to real-life situations (81%). Mentors were asked similar questions about the nature of the apprentices' experiences. Overall, their responses paint a similar picture of the REAP experience.
	Apprentices indicated they were more likely to engage in many of these activities as a result of REAP. For example, 90% reported being more likely to work on a STEM project or experiment in a university or professional setting; 84% to take an elective STEM class; 85% to participate in a STEM camp, club, or competition; and 76% to mentor or teach other students about STEM.
REAP gives apprentices opportunities to participate in STEM that they cannot get in school.	There is a statistically significant difference in student perceptions of STEM Learning and STEM Engagement when comparing these activities in School and REAP. Apprentices report significantly higher STEM Learning and STEM Engagement in REAP over school (Learning effect size is large with d = 2.14; Engagement effect size is large with d = 1.68).

Responsiveness to FY15 Evaluation Recommendations

The primary purpose of the AEOP program evaluation is to serve as a vehicle to inform future programming and continuous improvement efforts with the goal of making progress toward the AEOP priorities. In previous years the timing of the delivery of the annual program evaluation reports has precluded the ability of programs to use the data as a formative assessment tool. However, beginning with the FY16 evaluation, the goal is for programs to be able to leverage the evaluation reports as a means to target specific areas for improvement and growth. In this report, we will highlight recommendations made in FY15 to programs and summarize efforts and outcomes reflected in the FY16 APR toward these areas.

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

Finding: Although the REAP mentor group was more diverse ethnically, there were fewer female mentors than in 2014. Efforts should be made to focus on increasing the number of female mentors, perhaps by encouraging

junior faculty (typically more female professors are in the lower ranks in STEM fields) to partner with senior faculty to submit proposal to be a REAP site.

REAP FY16 Efforts and Outcomes: REAP mentor group continues to hold steady with similar numbers reported in 2015. Only 32% of the REAP mentors were female, a slight increase in Hispanic/Latino mentors, from 2% to 4% and a decrease in Black or African American mentors, from 21% to 17%. Conversely, 73% of REAP participants were female. All AEOP programs should be working to attain a mentor population that mirrors their respective participant groups. More targeted efforts should be executed to achieve this in FY17.

Finding: A number of apprentices suggested that the REAP program could be improved by extending the length of the experience. Similar to responses from FY14, many apprentices in FY 15 noted that 5-8 weeks was not enough time to learn about and get involved with a research project.

REAP FY16 Efforts and Outcomes: REAP program administration has been concerned about the continuum of STEM research education once students leave the lab at the end of the summer. REAP program administrators will determine if there are any mentors who are assisting students once the official apprenticeship ends and develop a plan to introduce to other universities.

Finding: Mentors and apprentices are overall not aware of DoD STEM research and careers. Forty-five percent of apprentices reported not learning about any DoD STEM careers during their REAP experience.

REAP FY16 Efforts and Outcomes: In FY16, student awareness of DoD STEM careers was 73%, an increase of 28% over FY15. The increased awareness of DoD STEM careers was due to weekly communication with apprentices and mentors that included the 2016 Guide to STEM Careers and the AEOP newsletters.

Finding: Mentors and apprentices mentioned that the amount of the stipend was too small. One mentor mentioned that they never paid themselves out of the funding, and rather they made sure the students had an appropriate stipend.

REAP FY16 Efforts and Outcomes: Stipend amounts across all apprenticeships seem to be inconsistent. Perhaps, AAS, Battelle and the CAM will discuss at a future date. In the meantime, AAS will continue to provide certificates of recognition/appreciation to students and mentors. AAS will also work with partners to determine if there are other incentives that are being used within the consortium.

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

Finding: REAP should continue to focus on growing the number of mentors participating in the program to work toward a 1:1 mentor/apprentice ratio. One potential strategy for consideration is to increase the amount of the mentor stipend (currently $1,000).

REAP FY16 Efforts and Outcomes: In FY16, REAP achieved a 1:1 mentor/apprentice ratio due to increased communication with directors. AAS also issued certificates of appreciation to all mentors in FY16. AAS will explore ways to provide more incentives for mentors, especially to more diverse population.

Finding: As was found in 2014, REAP apprentices report having little previous experience with AEOP and limited knowledge of other AEOP programs, even after participating in REAP. Given the goal of having apprentices

progress from REAP into other AEOP programs, the program may want to have a systematic method to inform mentors in tangible ways to increase apprentices' exposure to AEOP.

REAP FY16 Efforts and Outcomes: In FY16, REAP student awareness of AEOP opportunities was 81%, well above the FY16 target of 60% and a definite increase from FY15. This increase in awareness was largely due to weekly communication to students and mentors that included all AEOP program information, AEOP newsletter, 2016 Guide to STEM Careers and a new social media campaign.

Finding: Exposure to DoD STEM careers and research are also areas targeted for improvement for REAP.

REAP FY16 Efforts and Outcomes: In FY16, REAP student awareness of DoD STEM careers was 73%. The increase in awareness was largely due to weekly communication to students and mentors that included all AEOP program information, AEOP newsletter, 2016 Guide to STEM Careers and a new social media campaign. In FY17, AAS will have more direct contact with mentors. AAS will also work with directors and mentors to develop best practices. AAS will also develop a web-based orientation for students and mentors. Due to the satisfactory results, AAS will continue weekly communication with students and mentors.

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

Finding: No findings tied to recommendations for REAP in this area in FY15.

FY16 Recommendations

Evaluation findings indicate that FY16 was a successful year overall for the REAP program. The REAP program has the goal of broadening the talent pool in STEM fields, and, overall, the program has been successful at attracting students from groups historically underrepresented and underserved in these fields. A primary area of growth for REAP has been in broadening diversity of participants. In particular, there has been a steady increase in the number of female apprentices. Strategies that have been shown to be effective for encouraging historically underserved and underrepresented students in STEM careers include providing role models for students, exposing them to different education and career possibilities, providing guidance on how to pursue specific education and career paths (e.g., what courses they need to take in school, how to navigate the college application process), and providing coaching on the "soft skills" (e.g., time management, communication skills) needed to be successful in STEM careers. This is an encouraging trend and it is expected that having more role models will continue to encourage students from groups historically underrepresented and underserved in STEM to participate in REAP.

Another area of strength for REAP is reported meaningful STEM learning in the REAP program. Both mentors and apprentices reported increased confidence in pursuing STEM activities. Most of the REAP apprentices intend to continue to pursue STEM activities outside of school, and outreach to these apprentices about other opportunities is essential. One example of a positive trend is the UNITE/REAP partnership, which continues to increase apprentices participating in both programs consistently since 2013.

While these successes for REAP are commendable, there are some areas that remain with potential for growth and/or improvement. The evaluation team therefore offers the following recommendations for FY16 and beyond:

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

1. Although the REAP mentor group was more diverse ethnically, there still are not enough mentors that represent the diverse group of participants in REAP. Effort should be focused on recruiting more diverse mentors overall. Additionally, since 2014 the number of female mentors continues to decrease. Efforts should be made to focus on increasing the number of female mentors, perhaps by encouraging junior faculty (typically more female professors are in the lower ranks in STEM fields) to partner with senior faculty to submit proposal to be a REAP site. This could be marketed as professional development for both the junior and senior faculty members. Additionally, if each mentor/apprentice pair occasionally met in groups with other mentor/apprentice pairs, not only could they share resources, apprentices would be exposed to a more diverse range of mentor backgrounds.

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

1. Although REAP has seen some success with informing both mentors and apprentices about DoD STEM careers, efforts should be made to help mentors and apprentices become more aware of opportunities to pursue DoD STEM careers. The program should continue to provide mentors and apprentices with new materials and resources (website links, articles, etc.) that describe current DoD STEM research and careers which can be easily passed on to all REAP apprentices. Creating a network for mentors to form a community of practice where mentors can share their research activities with other mentors could be a first step to informing apprentices about other Army/DoD STEM careers. Some apprentices and mentors made suggestions that DoD STEM researchers visit REAP sites or hold a webinar to inform and inspire REAP apprentices to pursue work in this avenue.

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

1. REAP mentors and apprentices are more often using newsletters and websites to become aware of other AEOP programs. However, as was found in 2014 and 2015, there are still many REAP apprentices and mentors who report having little previous experience with AEOP and limited knowledge of other AEOP programs. Given the goal of having apprentices progress from REAP into other AEOP programs, the program may want to have a systematic method to inform mentors in tangible ways to increase apprentices' exposure to AEOP. Only 50% of mentors recommended other AEOPs to apprentices. For example, mentors mentioned that they were only generally aware of other. However, they could not name the programs or provide information that might lead an interested student to a website. The program should work with each site to ensure that all apprentices have access to structured opportunities—such as invited speakers, presentations, and career events—that both describe the other AEOPs and provide information to apprentices on how they can apply to them.

Appendix I: 2016 Research Experiences for STEM Educators and Teachers (RESET) Evaluation Executive Summary

Research Experiences for STEM Educators and Teachers (RESET) is a program sponsored by the U.S Army and managed by Tennessee Technological University (Tennessee Tech). As part of AEOP's renewed effort in empowering educators by providing meaningful research experience, AEOP launched RESET in 2016. RESET provides educators with online learning experiences and summer research experience at participating Army laboratories and research centers The goal of RESET is to reinforce teachers' content knowledge through research experience and interactions with Army and Department of Defense scientists and engineers. Selected teachers participate in on-line learning as cohorts, with a subset of the cohort selected to conduct research on-site with a mentor Army scientist or engineer. At the completion of the program, teachers translate this knowledge and experience into enhanced science, technology, engineering and math research curricula and enriched learning for their students.

This report documents the evaluation of the FY16 RESET program. The evaluation addressed questions related to program strengths and challenges, and benefits to participants. The assessment strategy for RESET included interviews with 7 participating teachers.

Fast Facts

2016 Fast Facts	
Description	RESET provides a summer research experience at participating Army Army laboratories and on-line for teachers and educators from "high need" areas across the nation. The goal is to reinforce teachers' content knowledge through research experiences and interactions with Army and DoD scientists and engineers and to support teacher participants as they translate this knowledge and experience into enhanced STEM research curricula for use in their classroom.
Participant Population	Middle school and high school STEM educators
Number of Applicants/Teachers	24 full, 1 partial
Number of RESET participants	20
Placement Rate (percentage)	20/24 = 83%
Submission Completion Rate	20 of 20 for Level I and Level II, Module 1; 6 of 6 for Level II; 18 of 20 for Level I and Level II, Module 2
Number of Army S&Es	6
Number of Army/DoD Research Laboratories	3
Number of K–12 Teachers	20
Number of K–12 Schools	20
Number of K–12 Schools — Title I	16
Number of Colleges/Universities	1
Number of Other Collaborating Organizations	5

Total Cost	$133,048
Cost Per Participant – total cost/# of student participants	$6,652

Summary of Findings

The FY16 evaluation of RESET included collection of interview data reflecting participants' perceptions of program processes and activities and program information provided in the Annual Program Report. A summary of findings is provided here, with findings aligned to the 3 AEOP key priorities:

1. Broaden, deepen, and diversify the pool of STEM talent in support of our Defense Industry Base
2. Support and empower educators with unique Army research and technology resources
3. Develop and implement a cohesive, coordinated and sustainable STEM education outreach infrastructure across the Army.

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

RESET participants were primarily female and White, although 20% of participants were Black or African American. No data was available on the Title I status of schools in which teachers were employed (this item will be added to FY17 registration materials), however half of participants taught in urban schools. The RESET participants for 2016 were from six states: Florida (5), Michigan (1), Montana (1), Pennsylvania (2), Tennessee (10), Virginia (1). While six states were represented, the majority come from two states, Florida and Tennessee, suggesting that the overall participant population may have had limited geographic diversity in this first program year.

The primary method employed to recruit participants was to reach out to teachers through the National Science Teachers Association (NSTA). Recruitment was complicated in FY16 by the short timeframe for recruitment. In future years, the program plans to collaborate with the AEOP consortium partner base to reach teachers involved in AEOPs such as eCYBERMISSION and Junior Solar Sprint. The program has developed a rubric for teacher selection although no details of the criteria for selection were provided in the APR.

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

Participants interviewed were overwhelmingly positive about the online delivery of the program and the use of the Legacy Cycle as a framework for student learning in their classrooms. Participants particularly expressed satisfaction with the ability to collaborate with other teachers and expressed satisfaction with the book provided for the class. Open source platforms such as Google Hangouts were used for participant collaboration in FY16 although a new, dedicated platform will be available for FY17.

Participants indicated that they would apply their learning in RESET to their classroom practice. In particular, teachers interviewed noted that they would use the Legacy Cycle with students and that RESET activities caused them to think about new approaches to teaching content in their classrooms and to consider new approaches to student research.

Improvements suggested by participants focused on details of the online course design and the logistics of the on-site research experiences. Participants suggested that a course syllabus provided in advance of the course would be useful and expressed a desire for more consistent communication throughout the online component of the experience. Improvements for the on-site component of RESET included expediting the security clearance process and increasing the number of collaborating Army labs.

Program administrators acknowledged in the APR that there were slips in scheduling during the FY16 program year. These slips were due to factors such as delays in activation of funds at Tennessee Tech, the need to recruit mentors at Army/DoD sites, a lack of marketing materials for the program, and the short timeframe for applicant registration.

RESET administrators plan to address the issues in security clearance and computer access by creating a flowchart to determine what sort of security clearance and IT access are necessary for teachers. In addition, earlier selection of participants in FY17 will permit a longer timeframe in which security clearance activities can be completed.

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

Most participants interviewed had gained some knowledge of Army/DoD careers and/or research during their RESET experience. The program format calls for on-site participants to collaborate with on-line participants, creating a forum in which on-line participants can access the research and learning of participants who are engaged in research experiences.

While several of the interview participants had heard of AEOPs, three had no knowledge of other AEOPs. Participants learned about AEOPs either through on-site research experiences or through the AEOP website. Some efforts at cross-program collaboration between RESET and eCYBERMISSION, as eCYBERMISSION encouraged participating teachers to apply for RESET at a NSTA conference and plans to reach out to RESET teachers with information about eCYBERMISSION.

Appendix J: 2016 Science & Engineering Apprenticeship Program (SEAP) Evaluation Executive Summary

The Science & Engineering Apprenticeship Program (SEAP), managed by the Academy of Applied Science (AAS) in 2016, is an Army Educational Outreach Program (AEOP) that matches talented high school students (herein referred to as apprentices) with practicing Army Scientists and Engineers (Army S&Es, herein referred to as mentors), creating a direct apprentice-mentor relationship that provides apprentice training that is unparalleled at most high schools. SEAP apprentices receive firsthand research experience and exposure to Army research laboratories during their summer apprenticeships. The intent of the program is that apprentices will return in future summers and continue their association with their original laboratory and mentor and, upon graduation from high school, participate in the College Qualified Leaders (CQL) program or other AEOP or Army programs to continue their relationship with the laboratory. Through their SEAP experience, apprentices are exposed to the real world of research, gain valuable mentorship, and learn about education and career opportunities in STEM. SEAP apprentices learn how their research can benefit the Army as well as the civilian community.

In 2016, SEAP provided outreach to 113 apprentices and 113 adult mentors at 10 Army laboratory sites herein called SEAP sites. This represents at 19% increase in the number of student apprentices served over 2015, when 92 SEAP apprentices participated.

This report documents the evaluation of the 2016 SEAP program. The evaluation addressed questions related to program strengths and challenges, benefits to participants, and overall effectiveness in meeting AEOP and program objectives. The assessment strategy for SEAP included post-program questionnaires distributed to all apprentices and mentors, site visits to three SEAP sites, three focus groups with apprentices, three focus groups with mentors, and an annual program report compiled by AAS.

2016 SEAP Fast Facts	
Description	STEM Apprenticeship Program – Summer, at Army laboratories with Army S&E mentors
Participant Population	9th-12th grade students
No. of Applicants	690 individual applicants
No. of Students (Apprentices)	113
Placement Rate	16%
No. of Army S&E Mentors	113
No. of Army Research Laboratories	10
No. of K-12 Schools	71
No. of K-12 Schools – Title I	11
No. of DoDEA Students	n/a
No. of DoDEA Schools	n/a
Total Cost	$379,998

Stipend Cost (paid by participating labs)	$320,157
Administrative Cost to AAS	$59,841
Cost Per Student Participant	$3,363

The response rates for the post-program apprentice and mentor surveys were 66% and 6% respectively. This represents an increase in participation for apprentices and slight decrease for mentors as compared to FY15 when 64% of mentors and 18% of apprentices responded to the survey. The margin of error for the mentor survey is than generally acceptable (6.6% at 95% confidence[21] for the apprentice survey and 36.0% at 95% confidence for the mentor survey), indicating that the samples may not be representative of their respective populations and therefore caution is needed in interpreting the results.

Summary of Findings

The FY16 evaluation of SEAP 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.

2016 SEAP Evaluation Findings	
Participant Profiles	
SEAP experienced another year of growth in participation of apprentices from historically underrepresented and underserved populations.	The proportion of females participating in SEAP increased again in FY16 to 55% (compared to 45% in FY15). This is substantial in that females are underrepresented in STEM disciplines overall and to a greater degree in the physical sciences and engineering specifically.
	SEAP continued to serve students from historically underrepresented and underserved race/ethnic groups and experienced growth in percentage of Black or African American apprentices to 19% (comparted to 14% in FY15) and Hispanic or Latino apprentices to 5% (compared to 2% in FY15). This is a second year of growth for SEAP in diversity of participants and should continue to be an area of focus for future growth.

[21] "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, there is a 95% likelihood that between 42% and 52% would have selected that answer. A 2-5% margin of error is generally acceptable at the 95% confidence level.

SEAP experienced limited success in recruiting participants from other AEOPs to SEAP.	While over half of SEAP participants had never participated in any other AEOP, 35% had participated in GEMS and small numbers of students had participated in Camp Invention and e-Cybermission in the past. This is a slight increase from FY15 when 32% of respondents reported having participated in GEMS at least once.
SEAP apprentices expressed interest in participating in AEOPs in the future.	Most apprentices were interested in participating in SEAP again and many expressed interest in other AEOPs, such as CQL, and the GEMS Near Peer Mentor program, as well as the SMART scholarship, a workforce initiative to bring research talent into DoD labs.
SEAP increased their number of applicants, but did not reach their FY16 target.	The program fell short of its FY16 goal of 990 applicants. However there was an increase in the number of applicants from FY15 (690 compared to 633).
Actionable Program Evaluation	
Pre-existing relationships continue to be a factor in SEAP recruitment, however students reported hearing about SEAP from a variety of sources.	Mentors' most commonly identified method of student recruitment was informational materials sent to K-12 schools or universities (43%). As in FY14 and FY15, references from workplace colleagues and applications from the AAS or AEOP websites were also commonly reported methods of apprentice recruitment.
	The most often cited source of apprentice information about AEOP was family members. A school or university newsletter, email, or website and someone who works for the DoD were less commonly identified sources of information about SEAP as was the AEOP website.
SEAP apprentices continue to be motivated by a variety of factors.	A range of factors motivated apprentices to participate in SEAP. All responding apprentices identified interest in STEM as a motivator, and nearly all identified a desire to learn something new or interesting. Large proportions of apprentices also identified learning in ways that are not possible in school, the desire to expand laboratory or research skills, and figuring out education or career goals as motivators.
SEAP engaged apprentices in meaningful STEM learning.	A large majority of apprentices reported interacting with scientists or engineers, applying STEM to real life situations, and learning about STEM topics new to them on most days or every day of their apprenticeship. Likewise, over half of apprentices reported communicating with other students about STEM, learning about careers that use STEM, and learning about new discoveries in STEM on most days or every day.
	Apprentices reported engaging in a variety of STEM practices during their SEAP experience. For example, a large majority of apprentices reported participating in hands-on STEM activities, working as part of a team, and using laboratory procedures and tools every day or most days of their SEAP experience.
	Apprentices reported more intensive STEM learning opportunities in SEAP as compared to their typical school experiences.
	Responding mentors reported using a variety of teaching and/or mentoring activities to meet students' needs. Mentors used a variety of strategies to

	establish relevance of learning activities, support the diverse needs of their students as learners, to support student collaboration and interpersonal skills, support apprentices' engagement in authentic STEM activities, and to support STEM educational and career pathways. The most commonly reported mentoring strategies used (identified by 100% of responding mentors) included asking students about educational or career goals, having students search for and review technical research to support their work, providing students with constructive feedback to improve their STEM competencies, allowing students to work independently, having students work on collaborative activities or projects, and giving students real-life problems to investigate or solve.
SEAP promotes apprentice awareness of DoD STEM research and careers.	A large majority of apprentices reported positive opinions about DoD researchers and research. For example, nearly all apprentices reported that they believe that DoD research is valuable to society and that DoD researchers advance science and engineering fields.
	Nearly all apprentices reported learning about at least one DoD STEM career during their participation in SEAP. Apprentices found participation in SEAP and their mentors to be the most impactful resources in learning about DoD STEM careers while mentors reported that participation in SEAP and the SEAP program administrator or site coordinator were at least somewhat useful resources in their efforts to expose apprentices to DoD STEM careers.
SEAP has an opportunity to improve mentor and apprentice awareness of and marketing of other AEOP opportunities.	Most apprentices reported never hearing about or never participating in AEOP programs beyond SEAP. Similarly, responding mentors generally had little awareness of or past participation in other AEOP programs. In spite of this, 89% of apprentices indicated that SEAP contributed to their awareness of other AEOPs and 85% indicated that SEAP contributed to their increased interest in participating in other AEOPs in the future.
The SEAP experience is valued by apprentices and mentors, however apprentices expressed some dissatisfaction with administrative aspects of the program.	Nearly all responding apprentices expressed overall positive perceptions of the program. Most apprentices were at least somewhat satisfied with various aspects of their research experience including their working relation with their mentor, their relationship with their group or team, and the amount of time they spent doing meaningful research. A large majority of apprentices reported being at least somewhat satisfied with SEAP features such as applying or registering for the program, the variety of STEM topics available, and communicating with SEAP host site organizers. Mentors also expressed satisfaction with features of the program they had experienced.
	Administrative aspects of the program were an area of some dissatisfaction for apprentices, as 18% of apprentices reported being not at all satisfied with "other administrative tasks" associated with SEAP including in-processing and network access. This is an increase over FY15 when 15% of students expressed dissatisfaction with these administrative features of SEAP. This theme was echoed in apprentice responses to an open-ended survey item in which respondents emphasized lack of computer access and late stipend payments as areas in which the program could improve. Mentors in focus groups echoed student concerns over delays in apprentice

	computer access.
Outcomes Evaluation	
SEAP apprentices reported gains in STEM knowledge and competencies.	Nearly all apprentices reported gains in their STEM knowledge, with large or extreme gains in areas such as knowledge of what everyday research work is like in STEM, knowledge of research conducted in a STEM topic or field, and in-depth knowledge of a STEM topic(s).
	A majority of apprentices reported gains in a variety of STEM competencies, including large or extreme gains in areas such as communicating about their experiments and explanations in different ways and supporting an explanation with relevant scientific, mathematical, and/or engineering knowledge.
SEAP participants reported gains in 21st Century Skills.	Apprentices reported gains in their 21st century skills as a result of participating in SEAP. Large or extreme gains were reported in areas such learning to work independently, sticking with a task until it is finished, making changes when things do not go as planned, setting goals and reflecting on performance, and including others' perspectives when making decisions
SEAP participants reported increased confidence and identity in STEM.	Apprentices reported gains in their confidence and STEM identity, including large or extreme gains in areas such as their desire to build relationships with mentors who work in STEM, feeling prepared for more challenging STEM activities, and their sense of accomplishing something in STEM.
SEAP participants reported increased interest in future STEM engagement.	Apprentices reported that after participating in SEAP they were more likely to engage in STEM activities outside of school such as working on a STEM project or experiment in a university or professional setting, taking an elective (not required) STEM class, and mentoring or teaching other students about STEM.
SEAP participants reported aspiring to advanced degrees and STEM careers both before and after SEAP.	Most apprentices indicated wishing to pursue an advanced degree both before and after SEAP, although somewhat more students expressed interest in a Ph.D. or M.D./Ph.D. degree after participating in SEAP.
	Most apprentices expressed interest in STEM-related careers both before and after participating in SEAP, however the number of students interested in careers in biological science increased after SEAP participation.
SEAP participants show interest in future AEOP opportunities.	A majority of apprentices indicated being at least somewhat interested in participating in SEAP again and many expressed interest in participating in CQL and other AEOPs such as the SMART scholarship and URAP.

Responsiveness to FY15 Evaluation Recommendations

The primary purpose of the AEOP program evaluation is to serve as a vehicle to inform future programming and continuous improvement efforts with the goal of making progress toward the AEOP priortiies. In previous years the timing of the delivery of the annual program evaluation reports has precluded the ability of programs to use the data as

a formative assessment tool. However, beginning with the FY16 evaluation, the goal is for programs to be able to leverage the evaluation reports as a means to target specific areas for improvement and growth.

In this report, we will highlight recommendations made in FY15 to programs and summarize efforts and outcomes reflected in the FY16 APR toward these areas.

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

Finding: SEAP demonstrated slight growth in diversity. This should be a continued focus area for FY16.

SEAP FY16 Efforts and Outcomes: In FY 16, the number of Black or African American and Hispanic or Latino groups has increased to 25%, up from 20% in FY15. AAS directed outreach to underrepresented schools within proximity to the laboratories. This outreach helped to increase the number of underrepresented populations. AAS will continue this outreach effort. In FY17, the apprentice program will work with one or more strategic partners to increase the underrepresented minority population (URM).

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

Finding: SEAP should work to increase the number of mentors – and corresponding capacity to host more apprentices in FY16.

SEAP FY16 Efforts and Outcomes: SEAP mentors remained steady in FY16. AAS has had conversations with lab coordinators to talk about mentor recruitment. During the conversations, AAS was made aware of the following:

a. The Army has issued a "line of sight" directive regarding minors. No minor is allowed to move unaccompanied on a base. This means a minor must be accompanied by an adult from the time the student enters the base to the time the student exits. This is a burden on the mentor to cross the base to walk a student to the place of work and then back again at the end of the day. Many mentors are not willing to put forth this kind of effort.
b. Some lab coordinators indicated that it takes approximately 4 weeks to get a student computer access and process the necessary paperwork. Mentors do not have extra time to devote to paperwork on behalf of a student.

To address some of these concerns, in FY17, SEAP registration will be open from November 1 to February 28 (two months earlier than prior years). AAS anticipates that mentors will review applications by April 30, which will enable student notification in early May and begin the paperwork. Students could be notified in early May and the necessary paperwork set in motion. Students could then begin their apprenticeships in June and with no time lost due to lack of computer access. The lab coordinators have agreed to the new timeline.

AAS recognized the mentors with a certificate of appreciation in FY16. The feedback from this recognition was very positive. The mentors had not received any kind of recognition prior to this time. AAS would like to continue this tradition into FY17.

In addition, AAS would like the opportunity to visit DoD labs and host a recruitment effort in the form of a "lunch and learn" or a variation of that theme. This could bring more recognition to the benefits that

mentorship provides, i.e., the impact on a student's future, personal growth, and an opportunity to grow resume experience.

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

FY15 Finding: There is a need to improve the effectiveness of the administration of the SEAP program.

SEAP FY16 Efforts and Outcomes: In FY 16, AAS assumed the administration of all apprenticeship programs. First priority for AAS was to build positive working relationships with the lab coordinators; we will continue this effort in FY17. Battelle and AAS were successful in streamlining the stipend process, ensuring timely stipend payments.

AAS implemented weekly communication with consistent AEOP messaging to students, director/mentors and lab coordinators. AAS also centralized distribution of AEOP materials to students, directors/mentors and lab coordinators. New program flyers were created and distributed in FY16 and AAS will work with Widmeyer to create a consolidated flyer that describes all apprenticeships.

Finding: There is a need to market other AEOPs within the SEAP program.

SEAP FY16 Efforts and Outcomes: In FY16, AAS had ongoing communication throughout the summer to all students, mentors and lab coordinators. As part of the communication, AAS highlighted AEOP programs and the benefits offered. In addition, AAS networked with GEMS to see if additional marketing of SEAP (and all apprenticeships) would be possible by NSTA. They offered to present the apprenticeship marketing materials at NSTA events, once the promotion poster was developed. Brochures were also distributed by lab coordinators to all participants regarding AEOP opportunities as part of a lab welcome packet.

Finding: There is a need to increase SEAP participation in the AEOP evaluation.

SEAP FY16 Efforts and Outcomes: Onsite evaluations were conducted at three labs in FY16 which resulted in some good data. Students were contacted weekly regarding the survey mid-way through the apprenticeship in an effort to encourage completion. The feedback observed regarding the evaluation was that it was too long and took too much time to complete. A shorter, more concise program evaluation may result in greater completion rates. An incentive may encourage evaluation completion, as well, such as a gift card for completion. It would be beneficial to require year end reporting later in the year so that the program evaluation link could remain open until early September.

FY 16 Recommendations

Evaluation findings indicate that FY16 was a successful year overall for the SEAP program. Notable successes for the year include high levels of mentor and apprentice satisfaction with program features; evidence of strong apprentice gains in STEM knowledge, skills, and competencies; and apprentice interest in participating in AEOPs in the future. Apprentices and mentors continue to report high levels of satisfaction with mentor-apprentice relationships, and both groups likewise report strong apprentice gains in 21st Century skills. While these successes are commendable, there are some

areas that remain with potential for growth and/or improvement. The evaluation team therefore offers the following recommendations for FY16 and beyond:

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

The AEOP goal of attracting students from groups historically underrepresented and underserved in STEM continues to be met with limited success in SEAP. Many apprentices reported learning about SEAP through personal connections, suggesting that marketing efforts may have limited effectiveness. Since the lack of growth in SEAP apprentices from groups historically underrepresented and underserved groups is influenced by various factors including the recruitment and selection process and the marketing of SEAP to target groups it is recommended that AAS review these processes and identify ways to ensure that SEAP information reaches these students and that the apprentice selection process is not unduly influenced by personal connections. The AAS may also wish to consider mentors suggestions that targeting funding specifically to provide outreach and logistical support (for example bus passes) for students from underserved or underrepresented groups may support these students' participation in SEAP. In sum, the program should consider additional/alternate means of broadening the pool of applicants and consider devising strategies for recruiting and selecting apprentices to ensure that SEAP includes diverse groups of highly talented participants.

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

1. There is a continued need for SEAP to grow the number of participating mentors in the program. There is a substantial unmet need in terms of mentor capacity with only 113 students (16% of applicants) being placed out of 690 applicants. Program expansion will require active recruitment of additional Army S&Es to serve as mentors. Mentor suggestions to this end include providing more outreach to Army S&Es about the program and providing overhead hour pay to mentors. The AAS may wish to investigate the procedures and resources used to recruit SEAP mentors and identify factors that motivate and discourage Army S&Es from assuming this role.

2. Apprentices and mentors reported that students lacked computer access for long periods of time during their apprenticeships. This lack of access to technology may interfere with apprentices' work and learning experiences and is likely to limit their involvement in research activities. The AAS should work with SEAP site coordinators to identify ways to expedite computer access for students.

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

1. Some features of SEAP program administration continue to be a concern. Student dissatisfaction with timeliness of stipend payments continues to be an issue, as do the computer access issues referenced above. The AAS should be mindful of these issues and leverage its past experience with administering apprenticeship programs to streamline processes. It is recommended that AAS work with SEAP site coordinators to identify ways to expedite computer access for students and ensure timeliness of stipend payments.

2. Marketing of SEAP and dissemination of information about AEOPs is an area with continued room for growth within the SEAP program. Although apprentices identify mentors as a key source of information about AEOPs, few mentors or apprentices reported being familiar with most AEOPs for which students currently are or will soon be eligible. This suggests that the program may benefit from targeting AEOP information to mentors as well as apprentices. In order to meet the AEOP objective of creating a robust pipeline of AEOP programs in which students progress from other AEOPs into SEAP and from SEAP into CQL and other programs, the program may want to consider innovative ways to work with other AEOPs to create a more seamless continuum of programs. In particular, SEAP administrators may wish to target GEMS alumni to participate in SEAP, devising ways to disseminate SEAP information to GEMS participants and alumni. Given the limited apprentice awareness of resources such as the AEOP website, print materials, and social media, the program should consider how these materials could be more effectively utilized to provide students with targeted program information.

3. The SEAP program's participation in the overall AEOP evaluation continues to be lower than desired. The continued low response rates for both apprentice and mentor questionnaires (36% and 6% in FY16) continue to be a challenge, which may be attributed to the schedule for apprenticeships compared to the annual AEOP reporting schedule. It is notable that FY16 participation rates represent a substantial decrease from FY15 rates when response rates were 50% for apprentices and 21% for mentors. It is recommended that SEAP/AAS continue to emphasize the importance of these evaluations with individual program sites and communicating expectations for evaluation activities to take place on-site during the program. The evaluation team will work with AAS to administer the survey to more apprentices and earlier in their experience if necessary.

Appendix K: 2016 Unite Evaluation Executive Summary

Unite, managed by the Technology Student Association (TSA), is an AEOP pre-collegiate program for talented high school students from groups historically underrepresented and underserved in science, technology, engineering, and mathematics (STEM). Unite encourages and helps prepare high school students to pursue a college education and career in engineering and other STEM-related fields. In a four to six-week summer program at a partner university, Unite provides academic and social support to participants so that they have the ability and confidence to pursue careers in STEM fields.

This report documents the evaluation of the FY16 Unite program. Purdue University, in collaboration with the TSA, collected the FY16 evaluation data for the Unite program. The evaluation reports addressed questions related to program strengths and challenges, benefits to participants, and overall effectiveness in meeting AEOP and program objectives. The assessment strategy for Unite included questionnaires for students and mentors, 2 site visits, 3 student focus groups, 2 mentor focus groups, and an annual program report compiled by TSA.

Unite sites for 2016 included:

Alabama State University (AL)*

Fayetteville State University (NC)*

Florida Agricultural and Mechanical University (FL)*

Harris-Stowe State University (MO)*

Howard University (Washington, DC)*

Jackson State University (MS)*

Marshall University (WV)*

Michigan Technological University (MI)

New Jersey Institute of Technology (NJ)

Texas Southern University (TX)*

University of Colorado, Colorado Springs (CO)*

University of Nevada, Las Vegas (NV)*

University of New Mexico (UNM)*

University of Pennsylvania (UPENN)

University of Puerto Rico, Rio Piedras (PR)*

Virginia Tech (VA)

* Indicates Historically Black Colleges and Universities (HBCUs) and minority-serving institutions (MSIs)

2016 Unite Fast Facts	
Description	STEM Enrichment Activity: Pre-collegiate, engineering summer program at university host sites, targeting students from groups historically underserved and underrepresented in STEM
Participant Population	rising 9th-12th grade students from groups historically underserved and underrepresented in STEM
No. of Applicants	685 (446 on Cvent)
No. of Students	282 (250 on Cvent)
Placement Rate	41%
No. of Adults	285
No. of Army S&Es	18
Number of Army/DoD Research Laboratories	11
No. of K-12 Teachers	37
No. of K-12 Schools	220
No. of K-12 Schools – Title I	98‡
No. of College/Universities	16
No. of HBCU/MSIs	12
Total Cost	$560,682
Stipend Cost	$86,300
Cost Per Student Participant	$1988

‡ *Data from Unite reflects the number of participants from Title I schools rather than the number of Title I schools.*

Summary of Findings

The FY16 evaluation of Unite collected data about participants, their perceptions of program processes, resources, and activities, and indicators of achievement related to AEOP's and Unite's objectives and intended outcomes. A summary of findings is provided in the following table.

2016 Unite Evaluation Findings	
Participant Profiles	
Unite experienced growth in program interest and participation, and served increasing numbers of students from groups underserved and underrepresented in STEM.	Unite achieved a 28% increase in applicants to the program in FY16 as compared to FY15. Enrollment data indicate that the overall enrollment increased by 29% (in FY16 there were 282 participants; in FY15 there were 200 participants). Substantially more participants were from Title I schools in FY16 as well (98 as compared to 36 in FY15).
	In FY16, Unite enrollment included students from groups historically underrepresented and underserved in STEM. Over half of participants were female, and over half (57%) identified himself or herself as Black or African American (this is an increase over FY15 when 39% of participants identified themselves as Black or African American). There was a slight increase in participation by students identifying themselves as Hispanic or Latino in FY16 (18% as compared to 14% in FY15). All students who responded to the registration information item indicated that they received free or reduced-price school lunch.
	Most student questionnaire respondents attended urban schools (72%), a school context that tends to serve higher proportions of underserved students.
Actionable Program Evaluation	
Unite is successfully reaching out to schools and teachers serving historically underrepresented and underserved groups, however participants continue to report that personal connections are a primary source of information about AEOPs.	Efforts to market to and recruit students from schools and school networks identified as serving populations of traditionally underrepresented and underserved students were employed by Unite sites. Students most frequently learned about the AEOP from a school newsletter, email, or website; from someone who works at their school; or from a family member.
Students are motivated to participate in Unite by a variety of factors.	Students were most frequently motivated to participate in Unite by an interest in STEM and the desire to learn something new or interesting. Other motivators included figuring out education and career goals and learning in ways not possible in school.
Unite successfully engaged students in meaningful team-based, hands-on STEM learning experiences.	Students reported consistently engaging in STEM activities such as learning about new STEM topics, learning about careers that use STEM, and communicating with other students about STEM during Unite.
	A large majority of students reported that they engaged in STEM practices such as working as part of a team, participating in hands-on activities, and analyzing data or information on most days or every day of Unite.

	Students reported more intensive STEM learning and greater engagement in STEM practices in their Unite experience than they typically have in school.
	Unite mentors reported using a wide variety of mentoring practices to establish the relevance of learning activities, support the diverse needs of learners, develop student collaboration and interpersonal skills, and engage student in authentic STEM activities.
Unite participants reported increased awareness of and interest in AEOPs, but there is room for growth in the marketing of other AEOP opportunities.	Most Unite students have not participated in other AEOPs in the past, however the majority expressed increased awareness of AEOPs and reported interest in participating in AEOPs in the future after participating in Unite. Students indicated that participation in Unite, invited speakers and career events, and their mentors were the most impactful resources for learning about AEOPs.
	Most mentors did not discuss AEOPs other than Unite with students. Notably, fewer than half of mentors reported discussing programs for which students are or will soon be eligible, such as SEAP, GEMS Near Peer Mentors, and JSHS.
	Mentors had more experience with AEOP resources designed to expose student to AEOPs, such as the AEOP website and brochure, in FY16 as compared to FY15.
Students and mentor had high levels of overall satisfaction with Unite.	Students reported high levels of satisfaction with features of the Unite program including field trips or laboratory tours, teaching or mentoring, invited speakers or career events, and the variety of STEM topics available. Students perceived STEM learning, career information, college information and preparation, and experience to be key benefits of the program.
	Mentors reported high levels of satisfaction with features of the Unite program including the location of Unite activities, teaching or mentoring, and laboratory tours. Mentors perceived student STEM learning, career information, and opportunities for new experiences to be key strengths of Unite.
Outcomes Evaluation	
Unite students reported gains in their STEM knowledge and competencies with significantly higher gains reported by male students.	Unite students reported large or extreme gains in their STEM knowledge in areas such as their in-depth knowledge of a STEM topic, their knowledge of research conducted in a STEM topic or field, and their knowledge of how scientists and engineers work on real problems in STEM.
	Unite students reported large or extreme gains in their STEM skills in areas such as their ability to define a problem that can be solved by developing a new or improved object, process, or system; their ability to make a model of an object or system to show its parts and how they work; and in their ability to consider different interpretations of data when deciding if a solution works as intended.
	Although a vast majority of students reported that Unite contributed to gains in knowledge about science and engineering practices, male students reported higher gains in STEM knowledge and STEM competencies than did female students.
Unite students reported gains in their 21st Century Skills.	A majority of students reported large or extreme gains in all of the 21st Century Skills such as including others' perspectives when making decisions, communicating effectively with others, and making changes when things do not go as planned.
Unite students' reported higher education aspirations	After participating in Unite, students reported aspiring to go further in their schooling than they would have before Unite, with the greatest change being in the proportion

after Unite participation and slight shifts in their career aspirations after their Unite experience.	of students who expected to continue their education beyond a Bachelor's degree (48% before Unite, 66% after).
	There were slight shifts in students' career aspirations toward STEM related fields after participating in Unite as compared to before. For example, 27% indicated aspiring to a career in engineering or architecture before Unite, while 33% expressed interest in these fields after. Fewer students reported aspiring to non-STEM careers after participating in Unite.
Unite students reported having interest in future AEOP opportunities, but substantial numbers had not heard of AEOPs for which they are eligible.	A large majority of students indicated that Unite contributed to their increased awareness of AEOPs and their increased desire to participate in AEOPs in the future. However, over a quarter of students reported not having heard about programs for which they are or soon will be eligible such as GEMS, JSHS, SEAP, and GEMS Near Peer Mentors.
Unite continues contribute to students' increased awareness of STEM research and careers overall, and DoD STEM research and careers specifically.	Most students reported an increased awareness of, and interest in DoD STEM careers.
	All students reported learning about at least one STEM career and a large majority learned about at least one DoD STEM career during Unite.
	Students reported overwhelmingly positive attitudes toward DoD STEM research and researchers.
Unite students reported gains in their STEM identity and their future out-of-school STEM engagement after participating in Unite.	Students reported gains in their STEM identities, or perceptions of themselves as capable of succeeding in STEM. The majority of students reported large or extreme gains in areas such as their sense of accomplishing something in STEM, feeling prepared for more challenging STEM activities, and their decision on a path to pursue a STEM career.
	Most students reported that they will be more likely or much more likely to engage in STEM activities such as working on a STEM project or experiment in a university or professional setting, taking an elective STEM class, working on solving mathematical or scientific puzzles, and talking with friends or family about STEM.

Responsiveness to FY15 Evaluation Recommendations

The primary purpose of the AEOP program evaluation is to serve as a vehicle to inform future programming and continuous improvement efforts with the goal of making progress toward the AEOP priorities. In previous years the timing of the delivery of the annual program evaluation reports has precluded the ability of programs to use the data as a formative assessment tool. However, beginning with the FY16 evaluation, the goal is for programs to be able to leverage the evaluation reports as a means to target specific areas for improvement and growth. In this report, we will highlight recommendations made in FY15 to programs and summarize efforts and outcomes reflected in the FY16 APR toward these areas.

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

Finding: Future marketing efforts could focus on the need for a more diverse pool of STEM professionals and take the opportunity to showcase the diversity of mentors in electronic and printed materials.

> **Unite FY16 Efforts and Outcomes:** This will be discussed with sites individually, as needed, and as a group in the upcoming year wrap-up conference call.

Finding: The program may want to emphasize recruiting a more diverse pool of mentors and students by considering social media communication plans. Social media has the potential to reach more students and mentors than personal connections.

> **Unite FY16 Efforts and Outcomes:** TSA used social media and press release venues (as well as the TSA website) to communicate news of Unite. Sites used social media, local media sources, and their websites to share news of Unite. TSA issued one press release, one tweet, and one Facebook post regarding Unite. Individual sites implemented varying marketing plans including elements such as websites, printed matter, local TV and radio, social media, community programs, school counselors, word of mouth, and personal contact.

Finding: Given that Unite is doing a good job recruiting minority populations in STEM, the program is encouraged to systematically incorporate materials for the mentors to share successes of minority populations in STEM.

> **Unite FY16 Efforts and Outcomes:** The program administrator will discuss the availability of success stories from sites in the wrap-up conference call, and will seek assistance from Widmeyer, who may have success stories from other IPAs that can be distributed to Unite sites.

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

Finding: In an effort to increase and standardize the information [AEOP opportunities] provided to students, it would be beneficial to create a resource that profiles AEOPs and the relationship they have to ongoing education, on-the-job training, and related research activities of Army careers. The application to be a mentor could ask for their plan to explicitly discuss these resources thus expanding the network of ongoing opportunities for students.

> **Unite FY16 Efforts and Outcomes:** The program administrator responded, “Is such a resource something that AEOP currently has compiled? If not, I can begin work on this for AEOP programs that are natural transitions to and from Unite. Once completed, this resource can be made available to mentors in the Unite program, with the expectation that mentors should develop a plan for sharing this information with student participants.”

Finding: It would beneficial to create a resource that profiles Army STEM interests and the education, on-the-job training, and related research activities of Army careers. Further, efforts should be focused on growing the participation of more Army S&Es

Unite FY16 Efforts and Outcomes: The program administrator responded, "Is such a resource something that AEOP currently has compiled? If not, I can begin work on this for AEOP programs that are natural transitions to and from Unite. Once completed, this resource can be made available to mentors in the Unite program, with the expectation that mentors should develop a plan for sharing this information with student participants."

Finding: Efforts should be undertaken to improve participation in evaluation activities

Unite FY16 Efforts and Outcomes: Added emphasis about this requirement will be part of the Unite wrap-up conference call, as well as spring correspondence with Unite site directors for summer 2017 programs.

Recommendations for FY17 Program Improvement/Growth

Evaluation findings indicate that FY16 was overall a successful year for the Unite program. Unite has been successful in its focus on recruiting underrepresented and underserved participants to the program[22]. Students and mentors reported high levels of satisfaction with the Unite experience. In particular, Unite students reported gains in STEM learning and also reported being actively engaged in STEM practices. Students gained awareness of and interest in other AEOPs, STEM careers, and DoD STEM careers. Mentors used a variety of strategies to support student STEM learning, to support student engagement in STEM activities, and to support students' development of STEM education and career pathways. Students are more interested in pursuing post-graduate studies after participating in Unite, and students particularly valued the hands-on experiences, field trips, and speakers incorporated into the Unite program.

While the successes for Unite detailed above are commendable, there are some areas that have potential for growth and/or improvement. The evaluation team therefore offers the following recommendations for FY16 and beyond.

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

[22] Underserved populations are inclusive of low-income students, students belonging to race and ethnic minorities that are historically underrepresented in STEM (e.g., Alaska Natives, Native Americans, Blacks or African Americans, Hispanics, Native Hawaiians and other Pacific Islanders), students with disabilities, students with English as a second language, first generation college students, students in rural and frontier schools, and females in certain STEM fields (e.g., physical science, computer science, mathematics, or engineering).

1. AEOP objectives include expanding participation of historically underrepresented and underserved populations. In 2015 and 2016, Unite engaged a majority of female and Black or African American students, however students continue to report that personal connections are a primary source of information about AEOPs. Since emails, newsletters, and websites distributed through students' schools are also a key source of information, future marketing efforts could focus on disseminating these resources through schools more effectively.
2. Evaluation findings indicate that male Unite participants believed they gained more in terms of their STEM knowledge and STEM competencies than did female participants, although both males and females reported similar gains in terms of their STEM identities. The program may wish to review its practices and content to ensure that both address the needs of female participants and that mentors in the FY17 program are aware of these findings.

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

1. The Unite program may benefit from developing resources designed to provide information to students about DoD STEM research and careers. Evaluation findings indicate that mentors and field trips/speakers are key resources for this information. Because of the variety of locations of Unite programs, field trips and speakers highlighting DoD STEM research and careers are not consistently available to all sites. Creating resources that highlight the diversity of STEM career opportunities within the DoD may be beneficial. These resources may include, for example, virtual field trips to DoD STEM research sites or a database of Army S&E's willing to interact with students remotely via video or other technological means. These resources could also be used in mentor orientation to disseminate information about specific Army/DoD STEM research and careers. Furthermore, efforts to grow the participation of Army S&E's in the Unite program may be useful.

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

1. Few mentors explicitly discussed AEOP opportunities other than Unite with their students and substantial numbers of students had not heard of programs for which they are or soon will be eligible such as GEMS, JSHS, SEAP, and GEMS Near Peer Mentors. Since students identified mentors as a key source of AEOP information, mentors' lack of familiarity with other AEOP opportunities may be a barrier to disseminating this information to students. In an effort to increase and standardize the information provided to students, it may be beneficial to create resources that profile AEOP programs and the relationship they have to ongoing education, on-the-job training, and DoD/Army careers and ensure that these resources reach mentors and students. Additionally, mentor orientation activities could include information about other AEOPs and resources and provide strategies for mentors to share this information with students.

2. Efforts should be undertaken to improve participation in evaluation activities, as continued low response rates for the mentor questionnaire raises questions about the representativeness of the results. Improved program communication with the individual program sites about expectations for the Unite evaluation study may help. In addition, the evaluation instruments may need to be streamlined as response fatigue can affect participation.

Appendix L: 2016 Undergraduate Research Apprenticeship Program (URAP) Evaluation Executive Summary

The Undergraduate Research Apprenticeship Program (URAP), managed by the U.S. Army Research Office (ARO), is an Army Educational Outreach Program (AEOP) commuter program for undergraduate students who demonstrate an interest in science, technology, engineering, or mathematics (STEM) to gain research experience as an apprentice in an Army-funded university or college research laboratory. URAP is co-sponsored by AEOP and ARO. URAP is designed so that students (herein called apprentices) can apprentice in fields of their choice with experienced Army-funded scientists and engineers (S&Es, herein called mentors) full-time during the summer or part-time during the school year.

Apprentices receive an educational stipend equivalent to $10 per hour and are allowed to work up to 300 hours total. The apprentices contribute to the research of the laboratory while learning research techniques in the process. This "hands-on" experience gives students a broader view of their fields of interest and shows students what kind of work awaits them in their future career. At the end of the program, the apprentices prepare abstracts for submission to the US Army Research Office Youth Science programs office.

This report, prepared by the consortium evaluation team with based in part on data from the U.S. Army Research Office, documents the administration of 2016 URAP. The intent is to provide key data points from 2015 URAP as well as a contextualized understanding of administration decisions and program achievements.

In 2016, there were 52 URAP apprentices and 46 mentors who participated at 39 Army-sponsored university/college laboratory sites, an increase in all categories from 2015. This report documents the evaluation of the 2016 URAP program. The evaluation addressed questions related to program strengths and challenges, benefits to participants, and overall effectiveness in meeting AEOP and program objectives. The assessment strategy for URAP included: in-person interviews with apprentices and mentors conducted over the telephone post-program.

2016 URAP Fast Facts	
Description	STEM Apprenticeship Program – Summer, in Army-funded labs at colleges/universities nationwide, with college/university S&E mentors
Participant Population	College undergraduate students
No. of Applicants	177
No. of Students (Apprentices)	52
Placement Rate	29%
No. of Adults (Mentors)	46
No. of Army-Funded College/University Laboratories	39
No. of HBCU/MSIs	14
Total Cost	$202,703*
Admin/Overhead Costs	$49,303
Total Stipends	$153,400.
Cost Per Student Participant	$3,898

*Includes matching funds from ARO.

Summary of Findings

The 2016 evaluation of URAP collected data about participants; participants' 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 25. 2016 URAP Evaluation Findings	
Participant Profiles	
URAP's number of applications far exceeded available apprenticeship opportunities.	Of the 177 applications for URAP apprenticeships, only 52 students were selected, yielding an acceptance rate of 29%, which is very competitive and reflective of a large unmet need for potential URAP participants.
URAP outreach efforts are reaching more HBCUs and MSIs. However most apprentices do not come from groups typically underrepresented in STEM.	Fourteen of the 39 institutions have Historically Black College and University (HBCU) or Minority-serving Institution (MSI) status, twice the number of HBCU or MSI status institutions from 2015.
	There were 58% male and 42% female URAP apprentices in FY16. Of this group, only 10% reported being Black or African American, 13% Hispanic or Latino, 13% Asian, and 58% reported being White. URAP is providing access for females similar to male students. However, participation from other underrepresented groups is less than desired.
Actionable Program Evaluation	
Participation in URAP was useful in exposing apprentices to other AEOP programs. However, other resources were not as useful.	Mentors reported participation in URAP (64%) was the only resource they utilized to learn about AEOP programs, which more than half of responding mentors rated as "very much" useful. Apprentices indicated the URAP Program administrator or site coordinator was useful for learning about other AEOPs (50%). More than half of respondents reported that they did not see/use the AEOP brochure, It Starts Here! Magazine, AEOP social media, or invited speakers or career events.
	When asked how interested they were in future participation in AEOP programs, a majority of apprentices (75%) indicated being at least somewhat interested in participating in URAP again, as well as some interest in NDSEG (35%), and SMART (50%). Interest in participating in the other programs may be reported as low because the apprentices also reported that they were not aware of specific AEOP programs. URAP participants are ineligible for many of the other available AEOPs based on their level of education.

URAP engage apprentices who come to the experience with high interest in STEM through hands-on activities that are meaningful.	The majority of respondents indicated communicating with other students about STEM, and interacting with scientists or engineers. About three quarters of the respondents indicated they were learning about new STEM topics (75% most days or everyday), and applying STEM knowledge to real-life situations (90%) on most or every day of the experience during URAP. Half of the apprentices reported learning about different careers that use STEM most days or every day, which is an increase from 2015.
	Ninety percent of responding apprentices indicated practicing hands-on STEM activities on most days or every day; 85% reported using laboratory procedures and tools; 75% noted analyzing data or information; and 80% reported working as part of a team. In addition, apprentices indicated being integrally involved the work of STEM on most days or every day, including drawing conclusions from an investigation (75%), carrying out investigations (65%), designing investigations (55%), coming up with creative explanations or solutions (75%), and identifying questions or problems to investigate (75%).
URAP apprentices are more likely to engage in STEM activities because of their participation in URAP.	95% of apprentices reported being more likely to work on a STEM project or experiment in a university or professional setting, 75% being more likely to participate in a STEM camp, club, or competition, 80% to talk with friends or family about STEM and 75% being more likely to mentor or teach other students about STEM.
URAP mentors communicated about STEM careers and marketing of other AEOP opportunities to the apprentices, however they were not explicit about the actual programs.	Most apprentices reported that mentors discussed AEOP with them, but did not discuss any specific program (88%). Of the programs, which were explicitly discussed, the most commonly mentioned were NDSEG (42%; increase from 2015). Mentors reported not sharing the GEMS Near Peer Mentor Program (0%) or SMART programs with their apprentices (0%).
	Apprentices were asked which resources impacted their awareness of the various AEOPs. URAP mentors (70%) and participants in the program (80%) rated the impact of URAP on their awareness of AEOP as “somewhat” or “very much.” Beyond these two, most resources were reported to have little or no impact on the majority of responding apprentices’ awareness of AEOPs, in part because some participants did not experience these resources
URAP offers meaningful experiences to both apprentices and mentors.	The vast majority of responding apprentices were somewhat or very much satisfied with each of the listed program features. For example, more than three quarters of the responding participants reported being somewhat or very much satisfied with all of the categories of this question including the physical location of URAP activities (95%), instruction or mentorship during program activities (85%), participant stipends (80%), the application or registration process (95%), the availability of interesting program topics or fields (80%), communication with URAP host site organizers (75%), other administrative tasks (90%), and research abstract preparation requirements (80%).

	Three-quarters of responding mentors were somewhat or very much satisfied with communicating with ARO (93%), communicating with URAP organizers (93%) and other administrative tasks (85%). Satisfaction with stipends was reportedly lower than the other categories (57% at least somewhat satisfied).
Outcomes Evaluation	
URAP had a positive impact on apprentices' STEM knowledge and competencies, and 21st Century Skills.	Large or extreme gains were reported by 85% of apprentices in their knowledge of what everyday research work is like in STEM, and by 85% in their knowledge of research conducted in a STEM topic or field. Similarly, most apprentices reported impacts on knowledge of how professionals work on real problems in STEM (85%); knowledge of a STEM topic or field in depth (80%); and knowledge of research processes, ethics, and rules for conduct in STEM (70%). There were only two apprentices who indicated that they had no or little gain in any of the areas on the survey.
	At least half of apprentices indicated large or greater gains in 8 of the 10 competencies, with the exception of defending an argument that conveys how an explanation best describes an observation (45%), and Integrating information from technical or scientific texts and other media to support your explanation of an observation (40%).
	Between 60-90% of responding apprentices reported large or extreme gains for all of these skills. The highest impact of a large or extreme gain was with the skills of learning to work independently (90%), sticking with a task until it is finished (80%), and working well with people from all backgrounds (75%).
URAP helped apprentices' gain confidence in learning and doing STEM as well as developing a STEM identity.	Data strongly suggest that the program has had a positive impact in this area. For example, 75% of responding apprentices reported a large or extreme gain in feeling prepared for more challenging STEM activities and 70% reported gains in confidence to try out new ideas or procedures on my own in a STEM project.
	Substantial proportions of apprentices reported large or extreme gains in their interest in a new STEM topic (60%), sense of accomplishing something in STEM (65%), patience for the slow pace of STEM research (65%), desire to build relationships with mentors in STEM (60%), and connecting a STEM topic or field to their personal values (50%).
URAP and URAP mentors supported apprentices' plans to pursue a STEM education at a higher level, and a	Before participating in URAP, 40% of apprentices indicated that they wanted to either attend or finish college, with no indication of wanting to pursue additional higher education. After participating in URAP, only 15% the students indicated that their highest level of desired education was finishing college, with the remaining 85% wanting to pursue graduate degrees.

career in STEM.	92% of the responding mentors reported asking students about their educational and career interests. Many also indicated providing guidance to students about educational pathways that would prepare them for a STEM career (79%); and discussing STEM career opportunities in private industry or academia (71%). Over half of the mentors reported that they recommend student and professional organizations in STEM to their students (62%)
URAP apprentices and mentors felt that URAP had positive impacts on apprentices' STEM knowledge.	A large majority of responding apprentices (90%) indicated an impact of participation in URAP on confidence in their STEM knowledge, skills, and abilities, with 70% reporting that URAP contributed to this impact and another 20% reporting that URAP was the primary reason for this impact.

Responsiveness to FY15 Evaluation Recommendations

The primary purpose of the AEOP program evaluation is to serve as a vehicle to inform future programming and continuous improvement efforts with the goal of making progress toward the AEOP priorities. In previous years the timing of the delivery of the annual program evaluation reports has precluded the ability of programs to use the data as a formative assessment tool. However, beginning with the FY16 evaluation, the goal is for programs to be able to leverage the evaluation reports as a means to target specific areas for improvement and growth. In this report, we will highlight recommendations made in FY15 to programs and summarize efforts and outcomes reflected in the FY16 APR toward these areas.

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

Finding: AEOP objectives include expanding participation of historically underrepresented and underserved populations. URAP has made some progress in this area, as it was noted as an area for improvement in the FY14 evaluation report. Future marketing efforts could focus on the need for a more diverse pool of STEM professionals, and take the opportunity to showcase the diversity of mentors in electronic and printed materials.

URAP FY16 Efforts and Outcomes: As URAP is an ARO and AEOP co-sponsored program; the mentor pool is comprised of professors and undergraduate students at universities, which currently have an active grant with ARO. Ongoing communication to mentors and students, and a new social media campaign throughout the summer, showcased the diversity of STEM professionals. In FY16, 25% of URAP students were underrepresented, 5% over the FY16 target.

Finding: A second area that was noted for improvement in FY14 was the need to focus more on recruiting students from underrepresented populations. Similar to past years, in URAP, recruitment of apprentices is largely accomplished with personal interactions, either by knowing a professor or peer who attended URAP previously, using professional or academic connections, or mechanisms available to the university or college site. As a result, the ability of URAP to recruit underserved or underrepresented populations of students depends upon the diversity of the universities or colleges in which recruitment takes place. Additionally, the Army and ARO may need to consider practical solutions to the challenge posed by URAP locations, as the student population of some universities and colleges is likely to advantage some groups of students more than

others, particularly in STEM fields. Thus, the program may want to emphasize recruiting a more diverse pool of mentors and apprentices, perhaps specifically targeting Historically Black Colleges and Universities and other Minority Serving Institutions. A focused and strategic plan to engage a more diverse pool of mentors could ultimately engage a more diverse pool of apprentices.

URAP FY16 Efforts and Outcomes: 14 of the 39 FY16 URAP host sites (or 36%) were HBCU/MSIs, a notable increase over FY15. ARO will continue to aggressively advertise the URAP opportunity to HBCU/MIs that currently have an active grant with our organization. ARO also plans to more clearly express the importance of diversity to mentors when detailing the student selection process.

Finding: URAP is very effective in giving apprentices authentic opportunities to engage in STEM professional activities, and for mentors to build the next generation of STEM professionals. Given the goal of exposing apprentices to Army/DoD STEM research and careers, the program may want to build in systematic opportunities to provide this information to their apprentices. More than half of apprentices who completed the survey reported that they did not learn about any DoD STEM jobs/careers during URAP. Perhaps more importantly, only a few mentors were aware of specific Army/DoD STEM research and careers and even fewer mentors explicitly discussed this with their apprentices. This was an area noted by the FY14 evaluation report as a need for additional focus that has not improved much in FY15. In an effort to increase and standardize the information provided to apprentices, it would be beneficial to create a resource that profiles Army STEM interests and the education, on-the-job training, and related research activities of Army careers. Such a resource could not only start the conversation about Army STEM careers and motivate further exploration beyond the resource itself, but could be used to train the mentors to learn more about specific Army/DoD STEM research and careers. The application to be a URAP site or a mentor could ask for their plan to explicitly discuss these resources (e.g., Army and directorate STEM career webpages, online magazines, federal application guidelines), thus developing a network of ongoing opportunities for the apprentices.

URAP FY16 Efforts and Outcomes: In FY16, URAP student awareness of DoD STEM careers was 68%, an increase over FY15. The increased awareness of DoD STEM careers was due to weekly communication with apprentices and mentors that included the 2016 Guide to STEM Careers, and the AEOP newsletters. URAP students were also invited to participate in an Army DoD STEM Career Scavenger Hunt. URAP students were also given the ARO program manager contact information to create professional connections.

Finding: Perhaps more importantly, as in FY14 evaluation findings, only a few mentors were aware of specific AEOP programs and even fewer mentors explicitly discussed other AEOP opportunities with their apprentices. This lack of awareness is a barrier in communicating about other AEOP opportunities. In an effort to increase and standardize the information provided to apprentices, it would be beneficial to create a resource that profiles AEOP opportunities and the relationship they have to ongoing education, on-the-job training, and related research activities of Army careers. Such a resource could not only start the conversation about AEOP programs and motivate further exploration beyond the resource itself, but could be used to train the mentors to learn more about specific AEOP opportunities. The application to be a URAP site or a mentor could ask for their plan to explicitly discuss these resources thus expanding the network of ongoing opportunities for the apprentices.

URAP FY16 Efforts and Outcomes: Increased social media, electronic mailings, and postal mailings were utilized to consistently promote awareness of AEOP opportunities and encourage visibility to the AEOP website. Specific programs were highlighted in "exit letters and emails" for consideration as pipeline opportunities.

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

Findings: There were no recommendations for URAP on this AEOP Priority area in FY15.

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

Finding: Efforts should be undertaken to improve participation in evaluation activities, as the low response rates for both the apprentice and mentor questionnaires raise questions about the representativeness of the results. Low response rates were also a concern during the 2013, 2014 and 2015 questionnaire administration. Improved communication with the individual program sites about expectations for the URAP evaluation study may help. In addition, the evaluation instruments may need to be streamlined as the questionnaires are quite lengthy (estimated response time 45 minutes) and response burden can affect participation. It is recommended that program sites provide time on-site for participants to complete the AEOP evaluation survey.

URAP FY16 Efforts and Outcomes: Program evaluation completion is always challenging. In FY16, ARO planned to send mentor recognition letters to the dean of the university to encourage mentor participation. AAS will explore the use of incentives to complete the program evaluations in FY17. A new social media campaign was introduced over the summer and ongoing communication with students and mentors to promote awareness of AEOP opportunities and encourage visibility to the AEOP website. Specific programs were highlighted in "exit letters and emails" for consideration as pipeline opportunities.

Recommendations

Evaluation finding indicate that FY16 was a successful year for the URAP program. URAP had a very competitive 29% acceptance rate of the apprentice applicants, which indicates there is great interest in this program. From the high quality applicants (mentors and apprentices), there were 46 mentors and 52 apprentices selected. URAP has experienced success in recruiting diverse STEM mentors and have had increased numbers of women in FY16. Mentors overwhelmingly reported their satisfaction with the apprentices and apprentices reported their satisfaction with their mentor and with the URAP experience. Mentors indicated they consistently use innovative and research-based strategies to engage apprentices in STEM activities, and the apprentices similarly report increased ability to engage in STEM activities and have STEM habits of mind, due to the URAP experience. Apprentice educational aspirations were reportedly increased due to the URAP experience, most notably in a 45% increase of apprentices wanting to pursue graduate degrees after the URAP experience. Additionally, engaging in more hands-on STEM experiences motivated the apprentices, which was delivered by their URAP experience. The URAP program succeeded in increasing STEM knowledge and confidence in pursuing more STEM-focused activities, increasing mentor and apprentice diversity, and providing an authentic hands-on experience for apprentices that was a professional development experience for mentors.

While the successes for URAP 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 FY17 and beyond.

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

1. AEOP objectives include expanding participation of historically underrepresented and underserved populations. URAP has made some progress in this area, as it was noted as an area for improvement, particularly in recruiting female mentors, in the FY16 evaluation report. Between 2014 and 2016, URAP has engaged more female mentors, which is a positive trend. Future marketing efforts could focus on the need for a more diverse pool of STEM professionals, and take the opportunity to showcase the diversity of mentors in electronic and printed materials.

2. A second area that was noted for improvement in FY14 and FY15 was the need to focus more on recruiting students from underrepresented populations. Similar to past years in URAP, recruitment of apprentices is largely accomplished with personal interactions, either by knowing a professor, peer who attended URAP previously, using professional or academic connections, or mechanisms available to the university or college site. However, in 2016 there was a slight increase in recruitment through websites, which is promising in encouraging a more diverse apprentice pool. It should be noted that URAP was successful in recruiting more Historically Black Colleges and Universities and other Minority Serving Institutions as research sites. Continued efforts in recruiting mentors from HBCUs and MSIs in addition to maintaining communications through websites could offer more diversity in the future.

3. Perhaps more importantly, as in FY14 and FY15 evaluation findings, only a few mentors were aware of specific AEOP programs and even fewer mentors explicitly discussed other AEOP opportunities with their apprentices. This lack of awareness is a barrier in communicating about other AEOP opportunities. It would be beneficial to create a resource that profiles AEOP opportunities and the relationship they have to ongoing education, on-the-job training, and related research activities of Army careers. Such a resource could not only start the conversation about AEOP programs and motivate further exploration beyond the resource itself, but could be used to train the mentors to learn more about specific AEOP opportunities.

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

URAP is very effective in giving apprentices authentic opportunities to engage in STEM professional activities, and for mentors to build the next generation of STEM professionals. Given the goal of exposing apprentices to Army/DoD STEM research and careers, the program may want to build in systematic opportunities to provide this information to their apprentices. Most of the apprentices who completed the survey reported that they did not learn about any DoD STEM jobs/careers during URAP. In an effort to increase and standardize the information provided to apprentices, it would be

beneficial to create a resource that profiles Army STEM interests and the education, on-the-job training, and related research activities of Army careers. Such a resource could not only start the conversation about Army STEM careers and motivate further exploration beyond the resource itself, but could be used to train the mentors to learn more about specific Army/DoD STEM research and careers.

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

Efforts should be undertaken to improve participation in evaluation activities, as the low response rates for both the apprentice and mentor questionnaires raise questions about the representativeness of the results. Low response rates were also a concern during the 2013, 2014, 2015 and 2016 questionnaire administration. The evaluation instruments may need to be streamlined as the questionnaires are quite lengthy (estimated response time 45 minutes[23]) and response burden can affect participation. It is recommended that program sites provide time on-site for participants to complete the AEOP evaluation survey.

[23] Berry, S. (2013). How to estimate questionnaire administration time before pretesting: An interactive spreadsheet approach. *Survey Practice, 2*(3). Retrieved from http://www.surveypractice.org/index.php/SurveyPractice/article/view/166. Date accessed: 13 Mar. 2015.