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ARMY EDUCATIONAL OUTREACH PROGRAM

Apprenticeship Programs

2018 Annual Program Evaluation Report
Executive Summary

August 2019

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ARMY EDUCATIONAL OUTREACH PROGRAM

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This report documents the evaluation study of the AEOP apprenticeship programs, which include: College Qualified Leaders (CQL); Science and Engineering Apprenticeship Program (SEAP); Research and Engineering Apprenticeship Program (REAP); High School Apprenticeship Program (HSAP); and Undergraduate Research Apprenticeship Program (URAP). In FY18 the apprenticeship programs were managed by the Academy of Applied Science (AAS). A total of 585 students were enrolled in apprenticeship programs based in Army laboratories (CQL and SEAP) and in university-based programs (REAP, HSAP, and URAP) in FY18. The following section provides an overview of each program along with program-specific Fast Facts.

Program Overview

Army Laboratory-Based Programs

College Qualified Leaders (CQL)

The CQL program, managed by the Academy of Applied Science (AAS), is a program that matches talented college students (herein referred to as apprentices) with practicing Army Scientists and Engineers (Army S&Es). The use of the term "mentor" throughout this report will refer to the Army S&E working directly with student apprentices. This direct apprentice-mentor relationship provides apprentice training that is unparalleled at most colleges. CQL allows alumni of Gains in the Education of Mathematics and Science (GEMS) and/or Science and Engineering Apprentice Program (SEAP) to continue their relationships with mentors and/or laboratories, and also allows new college students to enter the program. CQL offers apprentices the opportunity for summer, partial year, or year-round research at Army laboratories, 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 2018, CQL was guided by the following objectives:

1. To nurture interest and provide STEM research experience for college students and recent graduates contemplating further studies;
2. To provide opportunities for continued association with the DoD laboratories and STEM enrichment for previous SEAP, GEMS, and other AEOP participants as well as allow new college students the opportunity to engage with DoD laboratories;

3. To outreach to participants inclusive of youth from groups historically underrepresented and underserved in STEM;
4. To increase participant knowledge in targeted STEM areas and develop their research and laboratory skills as evidenced by mentor evaluation and the completion of a presentation of research;
5. To educate participants about careers in STEM fields with a particular focus on STEM careers in DoD laboratories;
6. To acquaint participants with the activities of DoD laboratories in a way that encourages a positive image and supportive attitude towards our defense community; and
7. 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.

Table 1. CQL 2018 Fast Facts	
Description	STEM Apprenticeship Program – Summer or school year, at Army laboratories with Army S&E mentors
Participant Population	College undergraduate students
Number of Applicants	574
Number of Participants	217
Number/Percentage U2 Participants	43 / 20%
Placement Rate	37%
Number of Mentors	216
Number of Army S&Es	216
Number of Army Research Laboratories	13
Number of Colleges/Universities	113
Number of HBCU/MIs	17
Total Cost	$1,747,201
AAS Administrative costs	$104,317
Participant Stipends	$1,596,992
Other Operational Costs (Overhead)	$58,136
Cost Per Student Participant	$8,164

Science and Engineering Apprenticeship Program (SEAP)

SEAP is an AEOP pre-collegiate program for talented high school students that matches these students (herein referred to as apprentices) with practicing Army Scientists and Engineers (Army S&Es) for an eight-week summer apprenticeship at an Army research facility. The use of the term "mentor" throughout this report will therefore refer to the Army S&E. This direct apprentice-mentor relationship

provides apprentices with training that is unparalleled at most high schools. SEAP apprentices receive firsthand research experience and exposure to Army research laboratories. The intent of the program is that apprentices will return in future summers and continue their association with their original laboratories and mentors and, upon graduation from high school, participate in the College Qualified Leaders (CQL) program or other AEOP or Army programs to continue that relationship. Through their SEAP experiences, apprentices are exposed to the real world of research, experience valuable mentorship, and learn about education and career opportunities in STEM. SEAP apprentices also learn how their research can benefit the Army as well as the civilian community.

In 2018, SEAP was guided by the following objectives:

1. Acquaint qualified high school students with the activities of DoD laboratories through summer research and engineering experiences;
2. Provide students with opportunities in and exposure to scientific and engineering practices and personnel not available in their school environment;
3. Expose students to DoD research and engineering activities and goals in a way that encourages a positive image and supportive attitude toward our defense community;
4. Establish a pool of students preparing for careers in science and engineering with a view toward potential government service;
5. 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; and
6. 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.

Table 2. SEAP 2018 Fast Facts

Description	STEM Apprenticeship Program – Summer, at Army laboratories with Army S&E mentors
Participant Population	9th-12th grade students
Number of Applicants	872
Number of Participants	114
Number/Percentage U2 Participants	31/27%
Placement Rate	13%
Number of Adults (Mentors)	150
Number of Army S&Es	150
Number of Army Research Laboratories	11
Number of K-12 Schools	76
Number of K-12 Schools – Title I	38
Total Cost	$437,550
AAS Administrative Costs	$57,954

Participant Stipends	$354,100
Other Operational Costs (Overhead)	$32,298
Cost per student participant	$3,838

University-Based Programs

Research and Engineering Apprenticeship Program (REAP)

REAP is a paid summer internship program that focuses on developing STEM competencies among high school students from groups underserved in STEM. For more than 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) works a minimum of 200 hours (over a 5 to 8-week period) 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, experience valuable mentorship, and learn about education and career opportunities in STEM through a challenging STEM experience that is not readily available in high schools.

REAP is guided by the following objectives:

1. Provide high school students from groups historically underrepresented and underserved in STEM, including alumni of AEOP's Unite program, with an authentic science and engineering research experience;
2. Introduce students to the Army's interest in science and engineering research and the associated opportunities offered through the AEOP;
3. Provide participants with mentorship from a scientist or engineer for professional and academic development purposes; and,
4. Develop participants' skills to prepare them for competitive entry into science and engineering undergraduate programs.
5.

Table 3. REAP 2018 Fast Facts	
Description	STEM Apprenticeship Program – Summer, at colleges/university laboratories, targeting students from groups historically underserved and under-represented 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 under-represented in STEM
Number of Applicants	949

Number of Participants	139
Number/Percentage U2 Participants	133/96%
Placement Rate	15%
Number of Adults (Mentors)	117
Number of College/University S&Es	117
Number of College/Universities	53
Number of HBCU/MSIs	31
Number of K–12 Schools	167
Number of K–12 Schools — Title I	119
Total Cost	$398,640
AAS Administrative Costs	$69,545
Participant Stipends	$298,500
Other Operational Costs (Overhead)	$38,757
Cost Per Student Participant	$2,889

High School Apprenticeship Program (HSAP)

HSAP, managed by the Academy of Applied Science (AAS) and 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 STEM. Students work as apprentices in Army-funded university or college research laboratories. 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) during the summer.

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 laboratory's research while learning research skills and techniques. This hands-on experience gives apprentices a broader view of their fields of interest and shows them what kind of work awaits them in their future careers. At the end of the program, the apprentices prepare abstracts for submission to the ARO's Youth Science Programs office.

In 2018, HSAP was guided by the following priorities:

1. Provide hands-on science and engineering research experience to high school students;
2. Educate students about the Army's interest and investment in science and engineering research and the associated educational opportunities available to students through the AEOP;
3. Provide students with experience in developing and presenting scientific research;
4. Provide students with the benefit of exposure to the expertise of a scientist or engineer as a mentor; and

5. Develop students' skills and background to prepare them for competitive entry to science and engineering undergraduate programs.

Table 4. HSAP 2018 Fast Facts	
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	559
Number of Participants	48
Number/Percentage U2 Participants	26/54%
Placement Rate	9%
Number of Adults (Mentors)	53
Number of College/University S&Es	53
Number of K-12 Schools	45
Number of K-12 Schools – Title I	15
Number of Army-Funded College/University Laboratories	33
Number of College/Universities	33
Number of HBCU/MSIs	13
Total Cost	$202,436
AAS Administrative costs	$23,182
Participant Stipends	$143,800
Other Operational Costs (Overhead)	$12,919
Cost Per Student Participant	$4,217

University Research Apprenticeship Program (URAP)

The Undergraduate Research Apprentice Program (URAP), managed by the U.S. Army Research Office (ARO) and the Academy of Applied Science (AAS), is an 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 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 $15 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 apprentices a broader view of their fields of interest and shows apprentices what kinds of work awaits them in their future careers. At the end of the program, the apprentices prepare final reports for submission to the U.S. Army Research Office's Youth Science Programs office.

In 2018, URAP was guided by the following priorities:

1. Provide hands-on science and engineering research experience to undergraduates in science or engineering majors;
2. Educate apprentices about the Army's interest and investment in science and engineering research and the associated educational and career opportunities available to apprentices through the Army and the Department of Defense;
3. Provide students with experience in developing and presenting scientific research;
4. Provide apprentices with experience to develop an independent research program in preparation for research fellowships;
5. Develop apprentices' research skills with the intent of preparing them for graduate school and careers in science and engineering research; and,
6. Provide opportunities for apprentices to benefit from the expertise of a scientist or engineer as a mentor.

Table 5. URAP 2018 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
Number of Applicants	321
Number of Participants	67
Number/Percentage U2 Participants	12/18%
Placement Rate	20%
Number of Adults (Mentors)	68
Number of College/University S&Es	68
Number of Army-Funded College/University Laboratories	41
Number of College/Universities	48
Number of HBCU/MSIs	22
Total Cost	$409,561
AAS Administrative Costs	$34,772
Participant Stipends	$296,100
Other Operational Costs (Overhead)	$19,379
Cost Per Student Participant	$6,113

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	321

Summary of Findings

The FY18 evaluation of AEOP apprenticeship programs 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 for each program are provided in the Tables 6-10.

CQL Findings

Table 6. 2018 CQL Evaluation Findings	
Priority #1: *Broaden, deepen, and diversify the pool of STEM talent in support of our Defense Industry Base*	
Slightly fewer students were placed in apprenticeships in 2018 than in 2017 although the number of applicants remained constant at 2017 levels.	A total of 574 students applied for CQL apprenticeships, compared to 575 in 2017.
	A total of 214 (37%) applicants were placed in CQL apprenticeships, a slight decrease from 2017 when 229 students (39%) were placed.
	Fifteen Army labs accepted applications for CQL apprentices in 2018. Apprentices were hosted at 13 of these sites (an increase over the 12 participating host sites in 2017).
One fifth of CQL apprentices met the AEOP definition of U2. Enrollment of apprentices from groups historically underserved and underrepresented in STEM showed variations from 2017 levels with the most substantial shifts being in lower participation by females and higher participation by	20% of CQL apprentices met the AEOP's definition of U2 in 2018.
	Participation by females decreased in 2018. Slightly less than half (45%) of participants were female, a decrease as compared to 2017 when 54% of CQL apprentices were female.
	Participation by White students (64%) and Asian students (14%) was similar to 2017 participation (67% and 14% respectively).

apprentices identifying as Black or African American.	The proportion of CQL participants identifying themselves as Black or African American increased somewhat as compared to 2017 (13% in 2018; 7% in 2017) while by students identifying as Hispanic or Latino remained relatively constant (6% in 2018; 5% in 2017).
	Few students spoke English as a second language (3%) and relatively few were first generation college attenders (16%).
CQL mentors reported gains in 21st Century Skills for the few apprentices assessed; gains were statistically significant in only one area.	While only 3 apprentices were assessed for their growth in 21st Century Skills, mentors reported increases in these apprentices' 21st Century Skills from the beginning (pre-) to the end (post-) of their CQL experiences in all areas except Information, Media, & Technological Literacy. Apprentices demonstrated statistically significant growth in Communication, Collaboration, Social, & Cross-Cultural skills; growth in other skills was not significant.
Apprentices reported engaging in STEM practices more frequently in CQL than in their typical school experiences; non-minority apprentices reported more frequent engagement than minority apprentices.	Most apprentices (60% - 98%) reported engaging in each STEM practice about which they were asked at least once during their CQL experience. Apprentices were engaged particularly frequently (weekly or every day) in interacting with STEM researchers (98%), identifying questions or problems to investigate (93%), and working with a STEM researcher or company on a real-world STEM research project (91%).
	No significant differences were found in reported frequency of engaging in STEM Practices in CQL by U2 classification, although non-minority students reported significantly greater engagement on average compared to Minority students (medium effect size).
	Apprentices reported significantly higher frequency of engagement in STEM practices scores in CQL as compared to in school (extremely large effect size), suggesting that CQL offers apprentices substantially more intensive STEM learning experiences than they would generally experience in school.
Apprentices reported gains in their STEM knowledge as a result of participating in CQL; non-minority apprentices reported larger gains than minority apprentices.	A large majority of apprentices (86%-98%) reported experiencing some level of gains in their STEM knowledge as a result of participating in CQL. Apprentices were most likely to have experienced large gains in their knowledge of what everyday research work is like in STEM (69%) and knowledge of research conducted in a STEM topic or field (67%).
	There were no differences in gains in STEM knowledge by U2 classification although there were significant differences in STEM knowledge gains by race/ethnicity, with non-minority apprentices reporting higher gains than minority apprentices (medium effect size).

Apprentices reported gains in their STEM competencies as a result of participating in CQL; first generation college attenders reported larger gains than apprentices who had a parent who attended college.	A large majority of apprentices (93%-98%) reported experiencing some level of gains in their STEM competencies as a result of participating in CQL. Apprentices were most likely to have experienced large gains in communicating about their experiments and explanations in different ways (53%) and identifying the strengths and limitations of explanations in terms of how well they describe or predict observations (50%).
	There were no differences in gains in STEM competencies by U2 classification although there were significant differences in STEM knowledge gains by first generation college status with students who reported being a first generation college student indicated greater gains in STEM competencies compared to students who had a parent who attended college (medium effect size).
Apprentices reported that CQL participation had positive impacts on their 21st Century Skills; first generation college attenders reported larger gains than apprentices who had a parent who attended college.	A large majority of apprentices (93%-98%) reported experiencing some level of gains in their 21st Century Skills as a result of participating in CQL. Apprentices were most likely to have experienced large gains in making changes when things do not go as planned (69%), sticking with a task until it is finished (60%), and communicating effectively with others (60%).
	There were no differences in gains in 21st Century Skills by U2 classification although there were significant differences in these skill gains by first generation college status with students who reported being a first generation college student reporting greater gains in STEM competencies compared to students who had a parent who attended college (medium effect size).
Apprentices reported gains in their STEM identities as a result of participating in CQL; first generation college attenders reported larger gains than apprentices who had a parent who had attended college.	A large majority of apprentices (91%-98%) reported experiencing some level of gains in their STEM identities as a result of participating in CQL. Apprentices were most likely to have experienced large gains in feeling prepared for more challenging STEM activities (69%) and their desire to build relationships with mentors who work in STEM (69%).
	There were no differences in gains in STEM identity by U2 classification although there were significant differences in gains by first generation college status with students who reported being a first generation college student reporting greater gains in STEM competencies compared to students who had a parent who attended college (medium effect size).
Priority #2: *Support and empower educators with unique Army research and technology resources.*	

Mentors used a range of mentoring strategies with apprentices.	A majority of CQL mentors reported using most strategies associated with each of the five areas of effective mentoring about which they were asked: 1. Using strategies to establish relevance of learning activities (65%-100%) 2. Supporting the diverse needs of learners (47%-88%) ● 53% did not highlight under-representation of women and racial and ethnic minority populations in STEM and/or their contributions in STEM fields 3. Supporting student development of collaboration and interpersonal skills (82%-100%) 4. Supporting student engagement in "authentic" STEM activities (47%-88%) ● 53% did not have their students search for and review technical research to support their work 5. Supporting student STEM educational and career pathways (41%-100%) ● 59% did not help students with resumes, applications, personal statements, and/or interview preparations.
CQL apprentices were satisfied with program features that they had experienced and identified a number of benefits of CQL. Apprentices also offered various suggestions for program improvement.	Approximately half or more (46%-93%) of responding apprentices were somewhat or very much satisfied with all of the CQL program features about which they were asked. Features apprentices reported being most satisfied with included: the physical location of program activities (95%); amount of the stipend (95%); and timeliness of receiving stipend (95%).
	Few apprentices expressed dissatisfaction with CQL program features, although 22% of students were not satisfied with administrative tasks such as security clearances and issuing CAC cards.
	A large majority of apprentices (88%-95%) reported being at least "somewhat" satisfied with each element of their CQL experience. Apprentices were most likely to be "very much" satisfied with their working relationship with their mentors (85%) and their working relationship with the group or team (83%).
	Nearly all (98%) of apprentices made positive comments about their satisfaction with CQL in response to open-ended questions. The most frequently mentioned benefits were the research skills and lab experiences they gained followed by the networking opportunities and mentoring.

	In open-ended responses, the improvements most frequently suggested by apprentices were to provide more opportunities for apprentices to connect with one another and to provide earlier computer access
CQL mentors satisfied with program features that they had experienced and identified a number of strengths of the CQL program. Mentors also offered various suggestions for program improvements.	More than half (59%-88%) of mentors reported being somewhat or very much satisfied with all program features with the exception of two features that large proportions indicated having not experienced: communicating with AAS (71% did not experience) and timeliness of stipend payment to apprentices (35% did not experience). Mentors were most likely to be "very much" satisfied with support for instruction or mentorship during program activities (47%) and research abstract preparation requirements (47%).
	Nearly all mentors made positive comments about CQL in their responses to open-ended questions. The most frequently mentioned strength of CQL was the research and hands-on experience apprentices receive.
	In open-ended responses, the improvement most frequently suggested by mentors was to provide a larger budget in order to fund more apprentices and lab supplies.
Priority #3: *Develop and implement a cohesive, coordinated and sustainable STEM education outreach infrastructure across the Army*	
Both CQL apprentices and mentors learned about AEOP primarily through DoD and personal contacts.	Apprentices most frequently learned about AEOP through past participants of the program (30%); family members (30%); someone who works with the program (32%); and someone who works with the DoD (43%).
	More than a third (35%) of mentors reported learning about AEOP through someone who works with the DoD. Other sources of information (cited by 29% of participants) included workplace communications and past participants of the program.
Apprentices were motivated to participate in CQL primarily by the learning opportunities and their interest in STEM.	The most frequently cited motivators for participating in CQL were apprentices' interest in STEM (94%); desire to learn something new or interesting (89%); desire to expand laboratory or research skills (87%); and learning in ways that are not possible in school (87%).
CQL apprentices reported having participated in a variety of AEOPs in the past and are interested in	While 38% indicated they had never participated in any AEOP programs, apprentices reported having participated in the following AEOPs in the past: CQL (26%), SEAP (19%), GEMS (15%), Camp Invention (8%), UNITE (2%), and JSHS (2%). A quarter of responding

participating in AEOPs in the future.	CQL participants reported participating in other STEM programs (25%) that were not part of AEOP.
	Almost all apprentices were at least somewhat interested in participating in CQL again (91%), and more than half of apprentices (54%-72%) reported being at least somewhat interested in all programs except GEMS-NPM (33%). Nearly a third or more of apprentices had never heard of the NDSEG fellowship (35%), GEMS-NPM (33%), and URAP (31%).
	The resources apprentices most frequently cited as being somewhat or very much useful for their awareness of AEOPs were participation in CQL (76%) and their program mentors (74%). More than half of responding apprentices had not experienced AEOP resources such as AEOP on social media (72%) and the AEOP brochure (57%).
Mentors discussed AEOPs with apprentices, but with only limited reference to specific programs.	The program mentors most frequently discussed with apprentices was GEMS-NPM (71%). More than 40% of mentors reported discussing CQL (47%) and SMART (41%) with their apprentices. Almost 65% of mentors reported discussing AEOPs in general but without reference to any specific program.
	The resource mentors most frequently cited as being somewhat or very much useful for making apprentices aware of AEOPs was participation in CQL (81%). Most mentors reported that they did not experience materials provided by AEOP such as social media (82%) and the AEOP brochure (65%) as resources for exposing students to AEOPs.
Apprentices learned about STEM careers during CQL, although they learned about more STEM careers generally than STEM careers specifically within the DoD.	A large majority of CQL apprentices (93%) reported learning about at least one STEM job/career, and most (74%) reported learning about 3 or more general STEM careers. Similarly, a large majority of apprentices (93%) reported learning about at least one DoD STEM job/career, although somewhat fewer (67%) reported learning about 3 or more Army or DoD STEM jobs during CQL.
	The resources apprentices most frequently cited as being somewhat or very much useful for their awareness of DoD STEM careers were participation in CQL (85%) and their mentors (81%). A majority of apprentices reported that they either had not experienced AEOP resources such as the AEOP brochure, the ARO website, and AEOP on social media or found them not impactful on their awareness of DoD STEM careers.
	The resources mentors most frequently cited as being somewhat or very much useful for making apprentices aware of DoD STEM careers were participation in CQL (82%) and invited speakers (65%). Most mentors had not experienced AEOP materials such as the It Starts Here! Magazine (88%), AEOP on social media (82%), and the AEOP

	brochure (71%) as resources for exposing students to DoD STEM careers.
Apprentices expressed positive opinions about DoD research and researchers.	CQL apprentices' opinions about DoD researchers and research were overwhelmingly positively with more than 90% agreeing to all statements about DoD researchers and research.
Apprentices reported that they were more likely to engage in various STEM activities in the future after participating in CQL; first generation college attenders were more likely to engage in future STEM activities compared to apprentices who had a parent that attended college	Approximately 50% or more of CQL apprentices reported an increased likelihood of engaging in each STEM activity about which they were asked. The activities in which most apprentices reported being more likely or much more likely to engage were in working on STEM projects in a university setting (81%) and mentor or teach other students about STEM (72%).
	There were no differences in likelihood of future engagement by U2 classification although there were significant differences by first generation college status with first generation college attenders significantly more likely to engage in STEM activities in the future than apprentices who had a parent who attended college (medium effect size).
All CQL apprentices planned to at least complete a bachelor's degree and many reported an interest in a graduate or terminal degree.	All responding apprentices reported wanting to at least earn a bachelor's degree and many reported a desire to earn a master's degree (21%) or terminal degree (48%) in their field.
CQL apprentices reported that participating in the program impacted their confidence and interest in STEM and STEM careers with no differences in impact across any constituent categories of U2 status.	About two-thirds or more apprentices reported that CQL contributed to each area relating to their confidence and interest in STEM. The areas in which most apprentices reported impacts were having more awareness of Army or DoD research and careers (95%), increased confidence in their STEM knowledge, skills, and abilities (91%), and increased interest in pursuing a STEM career with the Army or DoD (85%).
	No significant differences were found in impact in CQL by U2 classification or by any constituent group of U2 classification.

SEAP Findings

Table 7. 2018 SEAP Evaluation Findings	
Priority #1: *Broaden, deepen, and diversify the pool of STEM talent in support of our Defense Industry Base*	
SEAP enrollment remained steady at 2017 levels although the program received slightly more applications in 2018.	A total of 872 applications were received in 2018, a slight increase (2%) over the 852 applications in 2017.
	A total of 114 (13%) applicants were placed in SEAP apprenticeships as compared to 113 (13%) in 2017.
	Thirteen Army labs accepted applications for SEAP apprentices in 2018; apprentices were hosted at 11 of these sites.
Over a quarter of SEAP students met the AEOP definition of U2. SEAP continues to serve students from a variety of races and ethnicities with slight variations in enrollment of apprentices from groups historically underserved and underrepresented in STEM as compared to 2017.	Slightly over a quarter of SEAP apprentices (27%) met the AEOP definition of students underserved or underrepresented (U2) in STEM.
	Participation of females in SEAP remained relatively constant at 2017 levels (48% in 2018; 54% in 2017).
	Although the most frequently represented races/ethnicities continued to be White (47%) and Asian (27%), more students identified as White than in 2017 (42%) and slightly fewer as Asian (32% in 2017).
	Fewer students identified themselves as Black or African American (12%) than in 2017 (17%) while a similar proportion of students identified themselves as Hispanic or Latino (4%) as in 2017 (3%).
	Few students received free or reduced-price school lunches (9%), did not speak English as their first language (5%), and would be first generation college attenders (2%).
SEAP mentors reported significant gains in apprentices' 21st Century Skills.	While only 5-6 apprentices were assessed for their growth in 21st Century Skills, mentors reported significant increases in these apprentices' 21st Century Skills from the beginning (pre-) to the end (post-) of their SEAP experiences in all but one skill set. Apprentices demonstrated the most growth in the skill set of Flexibility, Adaptability, Initiative, & Self-Direction. While mentors reported apprentice growth in critical thinking and problem solving, this growth was not statistically significant.
Apprentices reported engaging in STEM practices	Most apprentices (57% - 100%) reported engaging in each STEM practice about which they were asked at least once during their SEAP

more frequently in SEAP than in their typical school experiences with no differences in engagement across any constituent categories of U2 status.	experience. Apprentices were engaged particularly frequently (weekly or every day) in interacting with STEM researchers (92%) and working with a STEM researcher or company on a real-world STEM research project (92%).
	No significant differences were found in reported frequency of engaging in STEM Practices in SEAP by U2 classification or by any constituent group of U2 classification.
	Apprentices reported significantly higher frequency of engagement in STEM practices scores in SEAP as compared to in school (extremely large effect size), suggesting that SEAP offers apprentices substantially more intensive STEM learning experiences than they would generally experience in school.
Apprentices reported gains in their STEM knowledge as a result of participating in SEAP with no differences in gains across any constituent categories of U2 status.	Nearly all apprentices (98%-100%) reported experiencing some level of gains in their STEM knowledge as a result of participating in SEAP. Apprentices were most likely to have experienced large gains in their knowledge of what everyday research work is like in STEM (77%) and knowledge of how scientists and engineers work on real problems in STEM (66%).
	No significant differences were found in reported gains in STEM knowledge in SEAP by U2 classification or by any constituent group of U2 classification.
Apprentices reported gains in their STEM competencies as a result of participating in SEAP with no differences in gains across any constituent categories of U2 status.	Most SEAP apprentices (80% - 94%) reported experiencing some level of gains in their STEM competencies as a result of participating in SEAP. Apprentices were most likely to have experienced large gains in considering different interpretations of data when deciding how data answer a question (43%) and supporting an explanation for an observation with data from experiments (43%).
	No significant differences were found in reported gains in STEM competencies in SEAP by U2 classification or by any constituent group of U2 classification.
Apprentices reported that SEAP participation had positive impacts on their 21st Century Skills with no differences in gains across any constituent categories of U2 status.	A large majority of apprentices (91%-100%) reported experiencing some level of gains in their 21st Century Skills as a result of participating in SEAP. Apprentices were most likely to have experienced large gains in learning to work independently (69%) and making changes when things do not go as planned (69%).
	No significant differences were found in reported gains in 21st Century Skills in SEAP by U2 classification or by any constituent group of U2 classification.

<table>
<tr><td rowspan="2">Apprentices reported gains in their STEM identities as a result of participating in SEAP with no differences in gains across any constituent categories of U2 status.</td><td>Most apprentices (83%-100%) reported experiencing some level of gains in their STEM identities as a result of participating in SEAP. Apprentices were most likely to have experienced large gains in feeling prepared for more challenging STEM activities (69%) and their desire to build relationships with mentors who work in STEM (60%).</td></tr>
<tr><td>No significant differences were found in reported gains in STEM identity in SEAP by U2 classification or by any constituent group of U2 classification.</td></tr>
<tr><td colspan="2">Priority #2:
Support and empower educators with unique Army research and technology resources.</td></tr>
<tr><td>Mentors used a range of mentoring strategies with apprentices.</td><td>A majority of SEAP mentors reported using most strategies associated with each of the five areas of effective mentoring about which they were asked:
1. Using strategies to establish relevance of learning activities (65%-100%)
2. Supporting the diverse needs of learners (35%-100%)
● 65% did not integrate ideas from education literature to teach/mentor students from groups underrepresented in STEM
● 60% did not highlight under-representation of women and racial and ethnic minority populations in STEM and/or their contributions in STEM fields
3. Supporting student development of collaboration and interpersonal skills (65%-95%)
4. Supporting student engagement in “authentic” STEM activities (70%-100%)
5. Supporting student STEM educational and career pathways (35%-100%)
● 65% did not discuss the economic, political, ethical, and/or social context of a STEM career
● 65% did not recommend student and professional organizations in STEM to students
● 60% did not recommend AEOPs that align with students’ goals
● 60% did not help students with resumes, applications, personal statements, and/or interview preparations
.</td></tr>
</table>

SEAP apprentices were satisfied with program features that they had experienced and identified a number of benefits of SEAP. Apprentices also offered various suggestions for program improvement.	More than half (66%-94%) of responding apprentices were somewhat or very much satisfied with all of the program features about which they were asked. Features apprentices reported being most satisfied with included: the physical location of program activities (97%); teaching/mentoring provided during SEAP (95%); and applying/registering for the program (94%).
	Few apprentices expressed dissatisfaction with SEAP program features, although 20% of students were not satisfied with administrative tasks such as security clearances and issuing CAC cards.
	About half or more of apprentices (49%-86%) reported being at least "somewhat" satisfied with each element of their SEAP experience. Apprentices were most likely to be "very much" satisfied with their working relationship with their mentors (86%) and their working relationship with the group or team (71%).
	All SEAP apprentices who responded to open-ended questions made positive comments about their satisfaction with SEAP. The most frequently mentioned benefits were gaining STEM skills and/or research experience, career information and exposure, networking opportunities, and the opportunity to develop general workplace skills.
	In open-ended responses, the improvements most frequently suggested by apprentices were to provide more opportunities for apprentices to improve computer access and the security clearance process and to provide opportunities for apprentices to interact with one another.
SEAP mentors satisfied with program features that they had experienced and identified a number of strengths of the SEAP program. Mentors also offered various suggestions for program improvements.	Approximately half or more (55%-65%) of mentors reported being somewhat or very much satisfied with all program features. SEAP mentors were most likely to be "very much" satisfied with the research presentation process (50%). More than a third indicated not experiencing two features: amount of stipends (40% did not experience) and timeliness of stipend payment to apprentices (45% did not experience).
	Most mentors (77%) made positive comments about SEAP in their responses to open-ended questions. The most frequently mentioned strength of SEAP was the hands-on, real world research experiences apprentices gain.
	Mentors offered a wide variety of suggestions for program improvement; however, none were mentioned by more than 4 respondents (25%). The most frequently mentioned suggestions (19%-25%) included improvements in student selection, including more flexibility, more time, or more information about students; better

	communication between mentors and program administrators; and more interaction between apprentices.
Priority #3: *Develop and implement a cohesive, coordinated and sustainable STEM education outreach infrastructure across the Army*	
Both SEAP apprentices and mentors learned about AEOP primarily through DoD and personal contacts.	Apprentices most frequently learned about AEOP through family members (54%) and someone who works for the DoD (51%).
	Responding mentors most frequently learned about AEOP through someone who works with the DoD (29%), friends (14%), someone who works with the program (14%), and past participants of the program (14%).
Apprentices were motivated to participate in SEAP primarily by the learning opportunities and their interest in STEM.	The most frequently cited motivators for participating in SEAP were apprentices' interest in STEM (91%), their desire to learn something new or interesting (89%), and learning in ways that are not possible in school (86%).
Few apprentices had participated in AEOPs other than GEMS and SEAP in the past but are interested in participating in AEOPs in the future.	While 37% of SEAP apprentices indicated they had never participated in any AEOPs, 37% had participated in GEMS. Smaller proportions reported having participated in the following AEOPs: SEAP (20%), eCM (9%), Camp Invention (3%), and JSHS (3%). Almost half of responding SEAP participants reported participating in other STEM programs (46%) that were not part of AEOP.
	More than half of apprentices were at least somewhat interested in participating in CQL (54%), and SMART (63%), however nearly a quarter or more of apprentices had never heard of other AEOPs (23%-51%).
	The resources apprentices most frequently cited as being somewhat or very much useful for their awareness of AEOPs were participation in SEAP (86%) and their program mentors (77%). Approximately half or more of responding apprentices had not experienced AEOP resources such as AEOP on social media (80%) and the AEOP brochure (49%).
Few mentors discussed AEOPs other than SEAP with apprentices.	While 75% of mentors reported that they discussed SEAP with their apprentices, most SEAP mentors did not discuss other AEOPs (55%-100%) or AEOP in general (85%) with their apprentices.
	The resources mentors most frequently cited as being somewhat or very much useful for making apprentices aware of AEOPs were participation in SEAP (90%) and SEAP program administrators or site coordinators (60%). Most mentors reported that they did not

	experience materials provided by AEOP such as social media (70%) and the AEOP brochure (55%) as resources for exposing students to AEOPs.
Apprentices learned about STEM careers generally and STEM careers within the DoD during SEAP.	A large majority of SEAP apprentices (91%) reported learning about at least one STEM job/career, and most (83%) reported learning about 3 or more general STEM careers. Similarly, a large majority of apprentices (97%) reported learning about at least one DoD STEM job/career, and again most (86%) reported learning about 3 or more Army or DoD STEM jobs during SEAP.
	The resources apprentices most frequently cited as being somewhat or very much useful for their awareness of DoD STEM careers were participation in the SEAP (89%) and their mentors (74%). A majority of apprentices reported that they had not experienced AEOP resources such as the ARO website (54%) and AEOP on social media (66%).
	The resources mentors most frequently cited as being somewhat or very much useful for making apprentices aware of DoD STEM careers were participation in SEAP (80%) and invited speakers (50%). Most mentors had not experienced AEOP materials such as AEOP on social media (70%) and the AEOP brochure (71%) as resources for exposing students to DoD STEM careers.
Apprentices expressed positive opinions about DoD research and researchers.	SEAP apprentices' opinions about DoD researchers and research were overwhelmingly positively with more than nearly 90% agreeing to all statements about DoD researchers and research.
Apprentices reported that they were more likely to engage in various STEM activities in the future after participating in SEAP with no difference in likelihood across any constituent category of U2 status.	Approximately 50% or more of SEAP apprentices reported an increased likelihood of engaging in each STEM activity about which they were asked. The activities in which most apprentices reported increased likelihood were working on STEM projects in a university setting (71%); talking with family or friends about STEM (74%); and mentoring or teaching other students about STEM (83%).
	No significant differences were found in reported likelihood of engaging in future STEM activities by U2 classification or by any constituent group of U2 classification.
All SEAP apprentices planned to at least complete a bachelor's degree and many reported an interest in a graduate or terminal degree.	All responding apprentices reported wanting to at least earn a bachelor's degree and many reported a desire to earn a master's degree (31%) or terminal degree (46%) in their field.

SEAP apprentices reported that participating in the program impacted their confidence and interest in STEM and STEM careers with no differences in impact across any constituent categories of U2 status.	More than 70% of apprentices reported that SEAP contributed to each area relating to their confidence and interest in STEM. The areas in which most apprentices reported impacts were having a greater appreciation of Army or DoD STEM research (100%); increased confidence in their STEM knowledge, skills, and abilities (97%); and increased interest in pursuing a STEM career with the Army or DoD (86%).
	No significant differences were found in impact of SEAP by U2 classification or by any constituent group of U2 classification.

REAP Findings

Table 8. 2018 REAP Evaluation Findings	
Priority #1: *Broaden, deepen, and diversify the pool of STEM talent in support of our Defense Industry Base*	
More students applied for and were placed in REAP apprenticeships in 2018 as compared to 2017.	In 2018, 949 students applied for the REAP program, a 25% increase over the 709 applicants in 2017.
	A total of 138 students were placed in REAP apprenticeships in 2018, a 14% increase over the 118 apprentices placed in 2017.
More colleges and universities hosted REAP apprentices in 2018 than in 2017; a slightly smaller percentages of those institutions were HBCUs/MSIs than in 2017.	A total of 53 colleges and universities participated in REAP in 2018, a 23% increase over the 41 participating institutions in 2017. Of these institutions, 31 (57%) were HBCUs or MSIs, compared to 25 (60%) in 2017.
REAP continues to serve students from groups underserved and underrepresented in STEM, with substantial increases in the participation of some racial/ethnic groups and with a large majority of students meeting the AEOP definition of U2.	A large majority of apprentices (96%) qualified for U2 status under the AEOP definition.
	As in 2017, over half (62% as compared to 61% in 2017) of participants were female.

	The proportion of students identifying themselves as Asian (20%) or White (8%) decreased compared to 2017 when 27% identified as Asian and 19% as White.
	The proportions of apprentices identifying themselves as Black or African American (40%) and Hispanic or Latino (22%) increased substantially compared to 2017 enrollment when 29% of students identified as Black or African American and 15% as Hispanic or Latino.
	Over half of REAP apprentices (55%) qualified for free or reduced-price lunch, while English was a second language for over a quarter (27%) and over a third (36%) would be first generation college attenders.
REAP mentors reported significant gains in apprentices' 21st Century Skills.	Mentors assessed 10-11 apprentices' 21st Century Skills and reported significant growth from the beginning (pre-) to the end (post-) of their REAP experiences in all skills assessed. Apprentices demonstrated the most growth in the Communication, Collaboration, Social, & Cross-Cultural and the Information, Media, & Technological Literacy skill sets.
Apprentices reported engaging in STEM practices more frequently in REAP than in their typical school experiences with no significant differences in engagement across any constituent categories of U2 status.	Most apprentices (67% - 98%) reported engaging in each STEM practice about which they were asked at least once during their REAP experience with the exception of presenting STEM research to a panel of judges from industry or the military and building or making a computer model (57% and 54% respectively did not engage in these practices in REAP). Apprentices were engaged particularly frequently (weekly or every day) in using laboratory procedures and tools (87%) and working with a STEM researcher or company on a real-world STEM research project (87%).
	No significant differences were found in reported frequency of engaging in STEM Practices in REAP by U2 classification or by any constituent group of U2 classification.
	Apprentices reported significantly higher frequency of engagement in STEM practices scores in REAP as compared to in school (extremely large effect size), suggesting that REAP offers apprentices substantially more intensive STEM learning experiences than they would generally experience in school.
Apprentices reported gains in their STEM knowledge as a result of participating in	Nearly all apprentices (98%-100%) reported experiencing some level of gains in their STEM knowledge as a result of participating in REAP. Apprentices were most likely to have experienced large gains in knowledge of what everyday research work is like in STEM (77%) and their knowledge of research conducted in a STEM topic or field (72%).

REAP; males reported higher levels of gains than females.	No significant differences were found in STEM knowledge gains in REAP by U2 classification, however males reported significantly greater gains in their STEM knowledge than females (extremely large effect size).
Apprentices reported gains in their STEM competencies as a result of participating in REAP with no differences in gains across any constituent categories of U2 status.	A large majority of REAP apprentices (90% -100%) reported experiencing some level of gains in their STEM competencies as a result of participating in REAP. Apprentices were most likely to have experienced large gains in **communicating** about experiments and explanations in different ways (59%) and supporting an explanation for an observation with data from experiments (59%).
	No significant differences were found in reported gains in STEM competencies in REAP by U2 classification or by any constituent group of U2 classification.
Apprentices reported that REAP participation had positive impacts on their 21st Century Skills with no differences in gains across any constituent categories of U2 status.	Nearly all apprentices (98%-100%) reported experiencing some level of gains in their 21st Century Skills as a result of participating in REAP. Apprentices were most likely to have experienced large gains in communicating effectively with others (76%) and viewing failure as an opportunity to learn (75%).
	No significant differences were found in reported gains in 21st Century Skills in REAP by U2 classification or by any constituent group of U2 classification.
Apprentices reported gains in their STEM identities as a result of participating in REAP; minority apprentices reported larger gains than non-minority apprentices.	A large majority of apprentices (94%-100%) reported experiencing some level of gains in their STEM identities as a result of participating in REAP. Apprentices were most likely to have experienced large gains in their desire to build relationships with mentors who work in STEM (76%) and sense of accomplishing something in STEM (69%).
	No significant differences were found in reported gains in STEM identity in REAP by U2 classification, however minority apprentices reported significantly larger gains than non-minority apprentices (medium effect size).
Priority #2: *Support and empower educators with unique Army research and technology resources.*	
Mentors used a range of mentoring strategies with apprentices.	A majority of REAP mentors reported using most strategies associated with each of the five areas of effective mentoring about which they were asked:

	1. Using strategies to establish relevance of learning activities (73%-93%) 2. Supporting the diverse needs of learners (55%-91%) 3. Supporting student development of collaboration and interpersonal skills (72%-87%) 4. Supporting student engagement in "authentic" STEM activities (82%-97%) 5. Supporting student STEM educational and career pathways (48%-99%) ● 52% did not help students with resumes, applications, personal statements, and/or interview preparations .
REAP apprentices were satisfied with program features that they had experienced and identified a number of benefits of REAP. Apprentices also offered various suggestions for program improvement.	About three-quarters or more (75%-95%) of responding apprentices were somewhat or very much satisfied with all program features about which they were asked. Features apprentices reported being most satisfied with included: applying/registering for the program (95%); amount of the stipend (89%); and communicating with the host site organizers (89%).
	Few apprentices expressed dissatisfaction with REAP program features, although 12% of students were not satisfied with timeliness of stipend payments.
	A large majority (87%-96%) of apprentices indicated being "very much" satisfied with all elements of their REAP experience. Apprentices were most likely to be "very much" satisfied with their working relationship with their mentors (74%) and the research experience overall (71%).
	Most apprentices (84%) who responded to open-ended questions made positive comments about their satisfaction with REAP. The most frequently cited benefits of REAP were the STEM skills and research skills they gained, their STEM learning, the career information they gained, and the opportunity for real world, hands-on experience.
	In open-ended responses, the improvements most frequently suggested by apprentices were for apprentices to have more input into the choice of topic or project, that there be more specific guidelines or clearer instructions for projects, and that the program expand to include more participants and/or more locations.
REAP mentors satisfied with program features that they had experienced and identified a number of strengths of the REAP	More than three-quarters of mentors (81%-87%) reported being somewhat or very much satisfied with all program features. Mentors were most likely to be very much satisfied with communicating with REAP organizers (81%), the application or registration process (72%),

program. Mentors also offered various suggestions for program improvements.	and support for instruction or mentorship during program activities (72%).
	All mentors made positive comments about REAP in their responses to open-ended questions. The most frequently mentioned strengths of REAP were apprentices' exposure to STEM research and technology, the opportunity for hands-on laboratory experiences, and the stipend.
	In open-ended responses, the improvements most frequently suggested by mentors were increasing program funding to provide larger stipends, financial support for mentors, and/or a longer program, and creating more apprentice positions.
Priority #3: *Develop and implement a cohesive, coordinated and sustainable STEM education outreach infrastructure across the Army*	
REAP apprentices and mentors learned about AEOP primarily through communications through their school or workplace and professional contacts.	Apprentices most frequently learned about AEOP through a school/university newsletter, email or website (38%) or someone who works at the school/university they attend (24%).
	Mentors most frequently learned about AEOP through a STEM conference or STEM education course (39%); AAS (36%); or a colleague (32%).
Apprentices were motivated to participate in REAP primarily by the learning opportunities and their interest in STEM.	The most frequently cited motivators for participating in REAP were apprentices' interest in STEM (98%), a desire to learn something new or interesting (91%), the opportunity to use advanced laboratory technology (82%) and learning in ways that are not possible in school (80%).
Most apprentices had not participated in AEOPs other than REAP, and most did not report interest in participating in other AEOPs in the future.	While 62% of REAP apprentices indicated they had never participated in any AEOP programs, smaller proportions reported having participated in the following AEOPs: UNITE (21%), GEMS (5%), and REAP (5%). Twenty percent of responding REAP participants reported participating in other STEM programs that were not part of AEOP.
	Less than half of apprentices reported being at least somewhat interested in participating in AEOPs listed (22%-49%). This is likely because at least a third of apprentices had never heard of the programs (35%-59%).
	The resources apprentices most frequently cited as being somewhat or very much useful for their awareness of AEOPs were participation in REAP (87%); their program mentors (75%); and the AEOP website (74%). More than half of responding apprentices had not experienced AEOP on social media (53%).

Few mentors discussed AEOPs other than REAP with apprentices.	While 79% of mentors discussed REAP with their apprentices, a large majority of mentors did not discuss any other specific AEOPs with their REAP apprentices (61%-87%), and less than half of mentors (45%) reported discussing AEOPs in general but without reference to any specific program.
	The resources mentors most frequently cited as being somewhat or very much useful for making apprentices aware of AEOPs were participation in REAP (88%), REAP program administrators (78%), STEM career information (67%), and the AEOP website (67%). Approximately half of mentors reported not experiencing AEOP on social media (52%).
Apprentices learned about STEM careers during REAP, although they learned about more STEM careers generally than STEM careers specifically within the DoD.	All REAP apprentices (100%) reported learning about at least one STEM job/career, and most (76%) reported learning about 3 or more general STEM careers. A large majority of apprentices (77%) reported learning about at least one DoD STEM job/career, although somewhat fewer (43%) reported learning about 3 or more Army or DoD STEM jobs during REAP.
	The resources apprentices most frequently cited as being somewhat or very much useful for their awareness of DoD STEM careers were participating in REAP (76%), presentations or information shared in REAP (64%), their REAP mentors (63%), and the AEOP website (59%). A majority of apprentices reported that they had not experienced AEOP on social media (54%).
	The resources mentors most frequently cited as being somewhat or very much useful for making apprentices aware of DoD STEM careers were participation in REAP (87%), REAP program administrators or site coordinators (72%), STEM career information (61%), the AEOP website (60%), and AEOP brochure (51%).
Apprentices expressed positive opinions about DoD research and researchers.	REAP apprentices' opinions about DoD researchers and research were overwhelmingly positively with more than 80% agreeing to all statements about DoD researchers and research.
Apprentices reported that they were more likely to engage in various STEM activities in the future after participating in REAP; low-SES students reported higher likelihood of future engagement than apprentices who did not qualify for free or reduced-price school lunches.	Approximately 50% or more of REAP apprentices reported an increased likelihood of engaging in each STEM activity about which they were asked. The activities in which most apprentices reported increased likelihood were working on STEM projects in a university setting (88%) and taking an elective STEM class (81%).
	No differences were found in future STEM engagement by overall U2 classification, however low-SES apprentices reported significantly more

	likelihood of engaging in future STEM activities compared to students who did not receive free or reduced lunch (medium effect size).
All REAP apprentices planned to at least complete a bachelor's degree and many reported an interest in a graduate or terminal degree.	All responding apprentices reported wanting to at least earn a bachelor's degree and many reported a desire to earn a master's degree (28%) or terminal degree (55%) in their field.
REAP apprentices reported that participating in the program impacted their confidence and interest in STEM and STEM careers with no differences in impact across any constituent categories of U2 status.	About two-thirds or more apprentices reported that REAP contributed to each area relating to their confidence and interest in STEM. The areas in which most apprentices reported impacts were increased confidence in their STEM knowledge, skills, and abilities (95%), increased interest in participating in STEM activities outside of school requirements (87%), and greater appreciation of Army and DoD STEM research (86%).
	No significant differences were found in impact in REAP by U2 classification or by any constituent group of U2 classification.

HSAP Findings

Table 9. 2018 HSAP Evaluation Findings
Priority #1: *Broaden, deepen, and diversify the pool of STEM talent in support of our Defense Industry Base*

Fewer students applied for and were placed in HSAP apprentices in 2018 than in 2017.	In 2018, 559 students applied for the HSAP program, a decrease of 13% as compared to the 629 applicants in 2017.
	Forty-eight applicants were placed in HSAP apprenticeships, a 13% decrease in enrollment compared to 2017 when 54 apprentices were served.
Slightly fewer colleges and universities hosted HSAP apprentices in 2018 than in 2017, and fewer of those institutions were HBCUs/MSIs.	Thirty-three colleges and universities placed HSAP apprentices in 2018, a 9% decrease as compared to 2017 when 36 colleges and universities hosted HSAP apprentices. Thirteen of the 33 host institutions (39%) were HBCU/MSIs, a slight decrease from 2017 when 19 (53%) of the sites were HBCUs/MSIs.
More than half of HSAP apprentices met the AEOP definition of U2. Enrollment demographics show slight variations from 2017 levels.	More than half of apprentices (54%) qualified for U2 status under the AEOP definition.
	As in 2017, over half of apprentices were female (60% in both 2017 and 2018).
	As in 2017, the most commonly reported races/ethnicities were White and Asian, although fewer apprentices identified as White (31% in 2018; 42% in 2017) and more apprentices identified themselves as Asian (33% in 2018; 25% in 2017).
	The percentage of apprentices identifying as Hispanic or Latino was also similar to 2017 enrollment data (15% in 2018; 14% in 2017).
	Relatively few students received free or reduced-price school lunch (17%), spoke English as a second language (10%), and would be first generation college attenders (8%).
HSAP mentors reported significant gains in apprentices' 21st Century Skills.	While only 4-6 apprentices were assessed for their growth in 21st Century Skills, mentors reported significant increases in these apprentices' 21st Century Skills from the beginning (pre-) to the end (post-) of their HSAP experiences in all but two skill sets. Apprentices demonstrated the most growth in the Critical Thinking & Problem-Solving skill set. While mentors observed growth in apprentices' Information, Media, & Technological Literacy skills, it was not significant, and apprentices' skills in Productivity, Accountability, Leadership, & Responsibility had a slight non-significant negative change from pre to post.

Apprentices reported engaging in STEM practices more frequently in HSAP than in their typical school experiences with no significant differences in engagement across any constituent categories of U2 status.	Most apprentices (53% - 100%) reported engaging in each STEM practice about which they were asked at least once during their HSAP experience with the exception of presenting STEM research to a panel of judges from industry or the military (74% did not engage in this practice in HSAP). Apprentices were engaged particularly frequently (weekly or every day) in working with a STEM researcher or company on a real-world STEM research project (100%); interacting with STEM researchers (95%); identifying questions or problems to investigate (90%); and analyzing data or information and drawing conclusions (90%).
	No significant differences were found in reported frequency of engaging in STEM Practices in HSAP by U2 classification or by any constituent group of U2 classification.
	Apprentices reported significantly higher frequency of engagement in STEM practices scores in HSAP as compared to in school (extremely large effect size), suggesting that HSAP offers apprentices substantially more intensive STEM learning experiences than they would generally experience in school.
Apprentices reported gains in their STEM knowledge as a result of participating in HSAP with no differences in gains across any constituent categories of U2 status.	All apprentices (100%) reported experiencing some level of gains in their STEM knowledge as a result of participating in HSAP. Apprentices were most likely to have experienced large gains in their knowledge of what everyday research work is like in STEM (84%) and knowledge of research conducted in a STEM topic or field (68%).
	No significant differences were found in reported gains in STEM knowledge in HSAP by U2 classification or by any constituent group of U2 classification.
Apprentices reported gains in their STEM competencies as a result of participating in HSAP with no differences in gains across any constituent categories of U2 status.	A large majority of HSAP apprentices (95% -100%) reported experiencing some level of gains in their STEM competencies as a result of participating in HSAP. Apprentices were most likely to have experienced large gains in communicating about their experiments and explanations in different ways (57%).
	No significant differences were found in reported gains in STEM competencies in HSAP by U2 classification or by any constituent group of U2 classification.

Apprentices reported that HSAP participation had positive impacts on their 21st Century Skills; U2 apprentices reported higher gains than non-U2 apprentices.	A large majority of apprentices (95%-100%) reported experiencing some level of gains in their 21st Century Skills as a result of participating in HSAP. Apprentices were most likely to have experienced large gains in sticking with a task until it is finished (68%) and making changes when things do not go as planned (68%).
	Significant differences in 21st Century Skills gains were found by overall U2 status with underrepresented HSAP apprentices reporting significantly greater gains than non-underrepresented apprentices. No significant differences were found between any of the constituent groups compared.
Apprentices reported gains in their STEM identities as a result of participating in HSAP with no differences in gains across any constituent categories of U2 status.	Most apprentices (89%-100%) reported experiencing some level of gains in their STEM identities as a result of participating in HSAP. Apprentices were most likely to have experienced large gains in their desire to build relationships with mentors who work in STEM (68%) and sense of accomplishing something in STEM (68%).
	No significant differences were found in reported gains in STEM identity in HSAP by U2 classification or by any constituent group of U2 classification.
Priority #2: *Support and empower educators with unique Army research and technology resources.*	
Mentors used a range of mentoring strategies with apprentices.	A majority of HSAP mentors reported using each strategy associated with each of the five areas of effective mentoring about which they were asked: 1. Using strategies to establish relevance of learning activities (75%-100%) 2. Supporting the diverse needs of learners (75%-100%) 3. Supporting student development of collaboration and interpersonal skills (75%-100%) 4. Supporting student engagement in "authentic" STEM activities (50% - 100%) 5. Supporting student STEM educational and career pathways (100%)
HSAP apprentices were satisfied with program	About two-thirds (63%-95%) or more (75%-95%) of responding apprentices were somewhat or very much satisfied with all

features that they had experienced and identified a number of benefits of HSAP. Apprentices also offered various suggestions for program improvement.	program features about which they were asked. Apprentices were most likely to report being very much satisfied with the teaching or mentoring provided during HSAP (90%) and the amount of stipends (84%).
	No apprentices expressed dissatisfaction with any feature except for timeliness of stipend payments (16% were "not at all" satisfied).
	A large majority of apprentices (79%-100%) were somewhat or very much satisfied with all elements of their HSAP experience. Apprentices were most likely to be "very much" satisfied with the research experience overall (90%) and their working relationship with the group or team (79%).
	All apprentices who responded to open-ended questions made positive comments about their satisfaction with HSAP. The most frequently cited benefits of HSAP were the research exposure and experience and the STEM skills they gained during HSAP.
	In open-ended responses, the improvements most frequently suggested by apprentices focused on communication, including improving communication about stipend payments; sending more frequent (weekly) newsletters; and improving communication about program requirements, dates, and resources required for the apprenticeship (e.g., laptops).
HSAP mentors satisfied with program features that they had experienced and identified a number of strengths of the HSAP program. Mentors also offered various suggestions for program improvements.	Three-quarters or more of mentors (75%-100%) reported being somewhat or very much satisfied with all program features. Three-quarters of respondents had not experienced communicating with AAS.
	The few mentors who responded to open-ended questions all made positive comments about HSAP. Mentors cited as program strengths apprentices' research exposure and experience, the college and career information apprentices gain, the DoD career information apprentices receive, the fact that the program allows time for apprentices to experience growth and learning, and the stipend.
	The few mentors who responded to open-ended questions suggested improvements that focused on program logistics such as providing clearer expectations to apprentices in terms of deadlines and requirements, more opportunities for apprentices to present their research, providing supports for mentors regarding working with high school students,

	and providing additional support to sites in their local outreach efforts.
Priority #3: *Develop and implement a cohesive, coordinated and sustainable STEM education outreach infrastructure across the Army*	
Apprentices learned about AEOP through their school, the AEOP website, or a past program participant.	Apprentices most frequently learned about AEOP through someone who works at their school/university (59%); the AEOP website (41%); and past program participant (35%).
	The one mentor who responded learned about AEOP through a past participant of the program.
Apprentices were motivated to participate in HSAP primarily by the learning opportunities and their interest in STEM.	The most frequently cited motivators for participating in HSAP were apprentices' interest in STEM (100%); desire to learn something new or interesting (94%); and desire to expand laboratory or research skills (94%).
Very few apprentices reported participating in any AEOPs other than HSAP, although many were interested in participating in AEOPs in the future.	While 76% of apprentices indicated they had never participated in any AEOP programs, one apprentice reported having participated in Camp Invention (6%) and one in GEMS (6%). Over a quarter of responding HSAP participants reported participating in other STEM programs (29%) that were not part of AEOP.
	Approximately two-thirds or more of apprentices reported being interested in URAP (74%) and SMART (63%), however more than half of HSAP apprentices indicated they had never heard of CQL (74%), GEMS-NPM (58%), and NDSEG (53%).
	The resources apprentices most frequently cited as being somewhat or very much useful for their awareness of AEOPs were participation in HSAP (74%) and the AEOP website (74%). More than half of responding apprentices had not experienced AEOP on social media (58%).
Few mentors reported discussing AEOPs with students.	Of the four mentors who provided a response, 75%-100% indicated they did not discuss any specific AEOP with their participants. Three of the four mentors (75%) reported

	discussing AEOP with their apprentices, but not any specific programs
	The resources the four responding mentors most frequently cited as being somewhat or very much useful for making apprentices aware of AEOPs were the AEOP website (100%), HSAP program administrators (100%), participation in HSAP (75%). Most mentors reported that they did not experience materials provided by AEOP such as social media (75%) and invited speakers or career events (75%) as resources for exposing students to AEOPs.
Apprentices learned about STEM careers during HSAP, although they learned about more STEM careers generally than STEM careers specifically within the DoD.	All HSAP apprentices (100%) reported learning about at least one STEM job/career, and most (58%) reported learning about 3 or more general STEM careers. A large majority of apprentices (84%) reported learning about at least one DoD STEM job/career, although somewhat fewer (26%) reported learning about 3 or more Army or DoD STEM jobs during HSAP.
	The resources apprentices most frequently cited as being somewhat or very much useful for their awareness of DoD STEM careers were participation in the apprenticeship program (63%), their mentors (53%), and the AEOP website (53%). A majority of apprentices reported that they had not experienced AEOP on social media (63%).
	The resources the four responding mentors most frequently cited as being somewhat or very much useful for making apprentices aware of DoD STEM careers were the AEOP website (100%), the ARO website (75%), HSAP program administrators or site coordinators (75%), and participation in HSAP (75%). No mentors had experienced AEOP materials such as AEOP on social media (100%) and most had not experienced invited speakers or career events (75%) as resources for exposing students to DoD STEM careers.
Apprentices expressed positive opinions about DoD research and researchers.	HSAP apprentices' opinions about DoD researchers and research were overwhelmingly positively with 90% or more agreeing to all statements about DoD researchers and research.

Apprentices reported that they were more likely to engage in various STEM activities in the future after participating in HSAP with no difference in likelihood across any constituent category of U2 status.	Approximately 50% or more of HSAP apprentices reported an increased likelihood of engaging in each STEM activity about which they were asked. The activities in which most apprentices reported increased likelihood were working on STEM projects in a university setting (95%) and mentoring or teaching other students about STEM (90%).
All HSAP apprentices planned to at least complete a Bachelor's degree and many reported an interest in a graduate or terminal degree.	All responding apprentices reported wanting to at least earn a bachelor's degree and many reported a desire to earn a master's degree (21%) or terminal degree (66%) in their field.
HSAP apprentices reported that participating in the program impacted their confidence and interest in STEM and STEM careers; males reported greater overall impact than females.	About two-thirds or more apprentices reported that HSAP contributed to each area relating to their confidence and interest in STEM. The areas in which most apprentices reported impacts were increased confidence in their STEM knowledge, skills, and abilities (100%), greater appreciation of Army and DoD STEM research (95%), and increased interest in participating in STEM activities outside of school requirements (90%).
	No significant differences were found in overall impact by U2 classification, however males reported significantly greater overall impact than females (large effect size).

URAP Findings

Table 10. 2018 URAP Evaluation Findings	
Priority #1: *Broaden, deepen, and diversify the pool of STEM talent in support of our Defense Industry Base*	
More students applied to and were placed in URAP apprenticeships in 2018 than in 2017.	In 2018, 321 students applied for URAP apprenticeships, a 26% increase in applicants as compared to the 239 students who applied in 2017.
	A total of 67 applicants were placed in URAP apprenticeships in 2018, a 12% increase in number of students placed compared to 2017 when 59 apprentices were placed. It is noteworthy that although the number of students placed increased, the percentage of applicants placed decreased from 25% in 2017 to 21% in 2018.
More colleges and universities hosted URAP apprentices in 2018 than in 2017, and slightly more of these institutions were HBCUs/MSIs.	A total of 48 colleges and universities hosted URAP apprentices in 2018, a 19% increase over the 39 participating institutions in 2017. Of these institutions, 22 (46%) were HBCUs/Mis, compared to 17 (44%) in 2017. Six institutions received applications from prospective apprentices but did not host any URAP apprentices.
Less than one fifth of URAP apprentices met the AEOP definition of U2, and fewer females and Hispanic Latino students participated in 2017 than in 2018.	Of the enrolled URAP apprentices in 2018, 18% met the AEOP definition of U2.
	A smaller proportion of apprentices were female in 2018 (39%) as compared to 2017 (58%).
	The proportion of students identifying as White increased as compared to 2017 (64% in 2018; 53% in 2017) while the proportion of students identifying as Asian decreased as compared to 2017 (9% in 2018; 14% in 2017).
	The proportion of apprentices identifying as Black or African American was similar to in 2017 (9% in 2018; 8% in 2017), and the proportion of students identifying as Hispanic or Latino decreased somewhat as compared to 2017 (10% in 2018; 15% in 2017).

	Few students spoke English as a second language (6%) and relatively few were first generation college attenders (15%).
URAP mentors reported significant gains in apprentices' 21st Century Skills.	Mentors assessed 5-8 apprentices' 21st Century Skills and reported significant growth from the beginning (pre-) to the end (post-) of their URAP experiences in all skills assessed. Apprentices demonstrated the most growth in the skill sets related to Critical Thinking, Communication, and Productivity.
Apprentices reported engaging in STEM practices more frequently in URAP than in their typical school experiences with no significant differences in engagement across any constituent categories of U2 status.	Most apprentices (62% - 100%) reported engaging in each STEM practice about which they were asked at least once during their URAP experience with the exception of presenting STEM research to a panel of judges from industry or the military (71% did not engage in this practice in URAP). Apprentices were engaged particularly frequently (weekly or every day) in working with a STEM researcher or company on a real-world STEM research project (100%); interacting with STEM researchers (88%); and interacting with STEM researchers (88%).
	No significant differences were found in reported frequency of engaging in STEM Practices in URAP by U2 classification or by any constituent group of U2 classification.
	Apprentices reported significantly higher frequency of engagement in STEM practices scores in URAP as compared to in school (large effect size), suggesting that URAP offers apprentices substantially more intensive STEM learning experiences than they would generally experience in school.
Apprentices reported gains in their STEM knowledge as a result of participating in URAP; apprentices who had a parent who attended college were more likely to report gains than apprentices who were first generation college attenders.	A large majority of apprentices (94% - 100%) reported experiencing some level of gains in their STEM knowledge as a result of participating in URAP. Apprentices were most likely to have experienced large gains in their knowledge of what everyday research work is like in STEM (74%) and knowledge of research conducted in a STEM topic or field (62%).
	No significant differences were found in reported gains in STEM knowledge in URAP by U2 classification, however students who had a parent who attended college reported significantly greater gains than first generation college attenders (medium effect size).
Apprentices reported gains in their STEM competencies as a result of participating in URAP with no differences in gains	Most URAP apprentices (82% -97%) reported experiencing some level of gains in their STEM competencies as a result of participating in URAP. Apprentices were most likely to have experienced large gains in **supporting** an explanation with

across any constituent categories of U2 status.	relevant scientific, mathematical, and/or engineering knowledge (44%) and using knowledge and creativity to suggest a testable explanation (hypothesis) for an observation (41%).
	No significant differences were found in reported gains in STEM competencies in URAP by U2 classification or by any constituent group of U2 classification.
Apprentices reported that URAP participation had positive impacts on their 21st Century Skills with no differences in gains across any category of U2 status.	A large majority of apprentices (91%-98%) reported experiencing some level of gains in their 21st Century Skills as a result of participating in URAP. Apprentices were most likely to have experienced large gains in making changes when things do not go as planned (62%).
	No significant differences were found in reported gains in 21st Century Skills in URAP by U2 classification or by any constituent group of U2 classification.
Apprentices reported gains in their STEM identities as a result of participating in URAP with no differences in gains across any constituent categories of U2 status.	Most apprentices (79%-97%) reported experiencing some level of gains in their STEM identities as a result of participating in URAP. Apprentices were most likely to have experienced large gains in their desire to build relationships with mentors who work in STEM (62%) and feeling prepared for more challenging STEM activities (56%).
	No significant differences were found in reported gains in STEM identity in URAP by U2 classification or by any constituent group of U2 classification.
Priority #2: *Support and empower educators with unique Army research and technology resources.*	
Mentors used a range of mentoring strategies with apprentices.	A majority of URAP mentors reported using most strategies associated with each of the five areas of effective mentoring about which they were asked: 1. Using strategies to establish relevance of learning activities (44%-96%) ● 56% had not helped students understand how STEM can help them improve their own community 2. Supporting the diverse needs of learners (41%-89%)

	● 59% did not highlight under-representation of women and racial and ethnic minority populations in STEM and/or their contributions in STEM fields 3. Supporting student development of collaboration and interpersonal skills (70%-93%) 4. Supporting student engagement in "authentic" STEM activities (89%-100%) 5. Supporting student STEM educational and career pathways (44%-100%) ● 56% did not discuss the economic, political, ethical, and/or social context of a STEM career
URAP apprentices were satisfied with program features that they had experienced and identified a number of benefits of URAP. Apprentices also offered various suggestions for program improvement.	More than three-quarters (77%-91%) of responding apprentices were somewhat or very much satisfied with all URAP program features. Apprentices were most likely to be "very much" satisfied with the physical location of URAP activities (82%) and the amount of stipend (77%).
	Few apprentices expressed dissatisfaction with any feature, although 12% reported being "not at all" satisfied with timeliness of payments.
	A large majority of apprentices (85%-88%) reported being somewhat or very much satisfied with all elements of their experience. Apprentices were most likely to be "very much" satisfied with their working relationship with their mentor (82%) and the research experience overall (77%).
	Most apprentices (94%) who responded to open-ended questions made positive comments about their satisfaction with URAP. The most frequently cited benefits of URAP were the research experience and skills and the specific STEM skills (such as 3D printing or learning new computer programs) apprentices gained.
	Apprentices suggested a wide variety of improvements in open-ended responses. The most frequently mentioned improvements were communication with the program, including better communication about stipends, abstract and poster requirements; providing more project or topic choices; providing more opportunities for connections between AEOP participants; and providing more or more varied webinars or DoD speakers.
URAP mentors satisfied with program features that they had experienced and	Two-thirds or more (70%-89%) of mentors reported being somewhat or very much satisfied with all program features they had experienced. Over half of mentors (59%) reported

identified a number of strengths of the URAP program. Mentors also offered various suggestions for program improvements.	that they had not experienced communicating with AAS. Mentors were most likely to be "very much" satisfied with communicating with the Army Research Office (74%), communicating with URAP organizers (67%), and stipends (67%).
	Most mentors (89%) made positive comments about URAP in their responses to open-ended questions. The most frequently mentioned strength of URAP was apprentices' access to hands-on, cutting edge research in URAP.
	In open-ended responses, the most frequently mentioned suggestions were to provide an earlier application and acceptance process and an earlier funding stream and to provide better communication about deadlines, abstract requirements and goals, and other programs.
Priority #3: *Develop and implement a cohesive, coordinated and sustainable STEM education outreach infrastructure across the Army*	
Apprentices learned about AEOP primarily through school contacts or communications through their school or workplace; the ARO website was a primary source of AEOP information for mentors.	Apprentices most frequently learned about AEOP through someone who works at the university they attend (59%) and a school/university newsletter, email, or website (47%).
	Mentors most frequently learned about AEOP through the ARO website (59%) and through their supervisors (30%) and the AEOP website (22%).
Apprentices were motivated to participate in URAP primarily by the learning opportunities and their interest in STEM.	The most frequently cited motivators for participating in URAP were apprentices' interest in STEM (100%); desire to learn something new or interesting (85%); and learning in ways that are not possible in school (74%).
No URAP apprentices reported having participated in other AEOPs and expressed limited interest in participating in AEOPs in the future.	No URAP apprentices reported participating in any other AEOP, and only 15% of URAP participants indicated they had previously participated in a STEM program not associated with AEOP.
	While some apprentices reported being interested in URAP again (56%) and SMART (44%), large proportions of apprentices indicated they had not heard of CQL (56%), GEMS-NPM (56%), and NDSEG (41%).

	The resources apprentices most frequently cited as being somewhat or very much useful for their awareness of AEOPs were participation in URAP (65%) and their program mentors (68%). More than half of responding apprentices had not experienced AEOP on social media (72%).
Mentors discussed AEOPs with apprentices, but with only limited reference to specific programs.	A majority of mentors (76%) reported discussing AEOPs in general, without reference to specific programs. Large proportions of mentors reported not discussing any specific AEOPs with their apprentices (70%-96%).
	The resources mentors most frequently cited as being somewhat or very much useful for making apprentices aware of AEOPs were participation in URAP (89%), the URAP program administrator (70%), and the AEOP website (74%). Most mentors reported that they did not experience AEOP on social media (67%) as a resource for exposing students to AEOPs.
Apprentices learned about STEM careers during URAP, although they learned about more STEM careers generally than STEM careers specifically within the DoD.	A large majority of URAP apprentices (82%) reported learning about at least one STEM job/career, and half (50%) reported learning about 3 or more general STEM careers. Similarly, a majority of apprentices (53%) reported learning about at least one DoD STEM job/career, although somewhat fewer (24%) reported learning about 3 or more Army or DoD STEM jobs during URAP.
	The resource apprentices most frequently cited as being somewhat or very much useful for their awareness of DoD STEM careers was participation in URAP (53%). A majority of apprentices reported that they had not experienced AEOP on social media (71%).
	The resources mentors most frequently cited as being somewhat or very much useful for making apprentices aware of DoD STEM careers were participation in URAP (78%), HSAP program administrators or site coordinators (56%), and the AEOP website (56%). Most mentors had not experienced AEOP on social media (74%) as a resource for exposing students to DoD STEM careers.
Apprentices expressed positive opinions about DoD research and researchers.	URAP apprentices' opinions about DoD researchers and research were overwhelmingly positively with more than 85% agreeing to all statements.

Apprentices reported that they were more likely to engage in various STEM activities in the future after participating in URAP with no difference in likelihood across any constituent category of U2 status.	Approximately 50% or more of URAP apprentices reported an increased likelihood of engaging in each STEM activity about which they were asked. The activities in which most apprentices reported increased likelihood were working on STEM projects in a university setting (71%) and mentoring or teaching other students about STEM (68%).
	No significant differences were found in reported likelihood of engaging in future STEM activities by U2 classification or by any constituent group of U2 classification.
All HSAP apprentices planned to at least complete a Bachelor's degree and many reported an interest in a graduate or terminal degree.	All responding apprentices reported wanting to at least earn a Bachelor's degree and many reported a desire to earn a master's degree (32%) or terminal degree (44%) in their field.
URAP apprentices reported that participating in the program impacted their confidence and interest in STEM and STEM careers with no differences in impact across any constituent categories of U2 status.	Half or more apprentices reported that URAP contributed to each area relating to their confidence and interest in STEM. The areas in which most apprentices reported impacts were increased confidence in their STEM knowledge, skills, and abilities (94%); greater appreciation of Army and DoD STEM research (85%); and increased awareness of Army or DoD STEM research and careers (82%).
	No significant differences were found in impact of URAP by U2 classification or by any constituent group of U2 classification.

Responsiveness to FY17 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 FY17 to programs and summarize efforts and outcomes reflected in the FY18 APR toward these areas.

Army Laboratory-Based Programs

CQL

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

FY17 Finding: As recommended in FY17, CQL should continue in FY18 to focus on growing the pool of applicants overall as well as for underserved groups. There were some gains in participation of females (54% compared to 46% in FY16) and Hispanic or Latino apprentices (5% compared to 3% in FY16). However, it is warranted to invest more focus and effort on broadening the participation of ethnic/racial groups including Hispanic or Latinos (beyond 5% overall) and Black or African American (only 7% of FY17 CQL group).

CQL FY18 Efforts and Outcomes: Outreach was made to over 300 universities; 100 of those are HBCU/MSIs. University directors and PIs also assisted in posting apprenticeship flyers online to promote the program. Again, although there is no directive in FY18, lab coordinators were encouraged, through several communications, to consider U2 students when selecting CQL students. 58 or 10% of CQL applicants met the U2 criteria and 10, or 10% were selected as CQL participants. It may also benefit this effort if this subject was discussed during a regularly scheduled lab coordinator/AEOP phone call.

FY17 Finding: As in FY16, personal relationships continued to play a major role in FY17 in how students were recruited into CQL. AAS should continue investments that were started in FY17 to recruit more broadly and also follow up to provide expectations to labs that students outside of those mentors know of are included in program participation in FY18.

CQL FY18 Efforts and Outcomes: Although lab coordinators are encouraged to broaden the pool of students selected, through several communications, personal relationships still play a role in student selections in FY18. The directive to broaden the pool of students selected must come from the Army. Several lab coordinators have commented that there is an expectation to hire a co-worker's relative, although some do so reluctantly.

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

FY17 Finding: CQL should continue to recruit and grow the pool of available mentors to support apprentices. The CQL program goal of one-to-one mentoring provides deep and meaningful experiences for apprentices. However, without growing the number of adults to serve as mentors, the program will continue to have unmet need.

CQL FY18 Efforts and Outcomes: Mentor recruitment is at the discretion of the DoD lab coordinator and directly correlates with the lab's funding. If funding decreases, then mentor and student participation decreases and in many instances in FY18 that was the case. It is also important to note there is a continuous challenge for lab coordinators to recruit mentors. Based on comments made by mentors, required paperwork and lab requirements impede mentor participation. A mentor is also allowed to mentor multiple students, at different times, for example, alternating days and changing blocks of time.

FY17 Finding: 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.

CQL FY18 Efforts and Outcomes: No response or data available in the FY17 APR.

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

FY17 Finding: As in FY16, mentor FY17 participation in the CQL evaluation is still below the desirable level (20% of population). Apprentice participation improved in FY17 to 47%. It is recommended that CQL continue to strongly emphasize the importance of both mentor and apprentice participation in the CQL evaluation.

CQL FY18 Efforts and Outcomes: CQL is the only year-round apprenticeship opportunity. AAS will develop a communication plan for those CQL students who are in labs year-round so that they receive the same AEOP information and instructions. CQL evaluation should increase in years to come.

SEAP

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

FY17 Finding: The AEOP goal of attracting students from groups historically underserved in STEM continues to be met with limited success in SEAP. As in FY16, many apprentices report learning about SEAP through personal connections, suggesting that marketing efforts may have limited effectiveness and may not be widely reaching outside of laboratory connections. Participation of underserved groups decreased somewhat in FY17. There was a 2% decrease (17% compared to 19%) in Black or African-American apprentices and similarly, Hispanic or Latino participation also decreased 2% (3% compared to 5%). 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.

SEAP FY18 Efforts and Outcomes: Outreach was made by phone or email to over 5,000 counselors, science teachers at 600 high schools; 300 of those are Title I high schools, where there is a high population of U2 students. In addition, as indicated above, STEM/ Minority organizations provided outreach to their U2 students. Although there is no mandate, in FY18 lab coordinators were encouraged, through several communications, to consider U2 students when selecting SEAP students. 92 or 11% of SEAP applicants met the U2 criteria and 7, or 6% were selected as SEAP participants. It is important to note that of the SEAP students selected to participate, 51% attended Title I high schools. The directive to choose more diverse pool of applicants must come from Army leadership.

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

FY17 Finding: As in FY16, there is a continued need for SEAP to grow the number of participating mentors in the program. There was an 8% decrease in the number of mentors for SEAP in FY17 with a

20% increase in applicants, resulting in a substantial unmet need in terms of mentor capacity with only 113 students (16% of applicants) being placed out of 852 applicants. Program expansion will require active recruitment of additional Army S&Es to serve as mentors. It is recommended that AAS investigate the procedures and resources used to recruit SEAP mentors and identify factors that motivate and discourage Army S&Es from assuming this role.

SEAP FY18 Efforts and Outcomes: Mentor recruitment is at the discretion of the DoD lab coordinator and directly correlates with the lab's funding. If funding decreases, then mentor and student participation decreases and in many instances in FY18 that was the case. It is also important to note there is a continuous challenge for lab coordinators to recruit mentors. Based on comments made by mentors, required paperwork and lab requirements impede mentor participation. A mentor is also allowed to mentor multiple students, at different times, for example, alternating days and changing blocks of time.

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

FY17 Finding: Both apprentices and mentors reported lack of information regarding other AEOPs being conveyed in SEAP in FY17. Two-thirds (66%) of mentors reported they did not discuss other AEOPs to apprentices. More than 33% of apprentices had not heard of CQL, URAP, and the NDSEG Fellowship. SEAP should work to invest efforts in FY18 to address this communication and marketing issue. It is critical that participants are informed of other opportunities available to them in the AEOP pipeline.

SEAP FY18 Efforts and Outcomes: In FY17 and FY18, students and mentors received AEOP news throughout the summer, such as, other program information, spotlights that highlight other programs and webinar information. Mentors have been asked to talk to their students about other Army programs and STEM careers.

FY17 Finding: Apprentice participation in the SEAP evaluation improved in FY17 to 54%. However, mentor participation should be increased in FY18 to reach a level of at least 40% participation (compared to 29% in FY16).

SEAP FY18 Efforts and Outcomes: Due to increased direct contact with mentors, FY18 mentor survey results should be improved. It is important to note that one lab has requested no direct contact be made to mentors.

University-Based Programs

REAP

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

FY17 Finding: REAP has experienced great success with reaching historically underserved students in the program. However, in FY17 REAP experienced a slight decrease in female participants (61% compared to 73% in FY16), as well as Black/African-American participants (29% compared to 46% in FY16). REAP should continue to invest effort in this area to strengthen representation from these groups in FY18.

REAP FY18 Efforts and Outcomes: REAP experiences great success with reaching underserved students each year since it is a requirement for student participation. All students must meet 2 criteria to participate. If the U2 criteria are not met the student is disqualified and referred to another apprenticeship or other AEOP program. Female REAP participants in FY18 is 62% (85), a respectable percentage. Total female applicants for REAP is 61% (579), again a respectable percentage. Since students are required to meet two criteria, outreach emphasis is on U2 and not specific to race. However, it is important to note that 62% of the FY18 REAP participants are either African American or Hispanic/Latino.

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

FY17 Finding: REAP apprentices reported an overall positive experience in the program in FY17. Participants did share some suggestions for improving the program for the future. Suggestions included providing apprentices with more choice in the project they work on. Additionally, there were suggestions to improved communication and guidance received from the mentors. Similarly, mentors suggested considering having a contract with apprentices for accountability, and "selecting more serious students". It is unclear how much of this feedback can be integrated into the REAP model. However, it is recommended that REAP consider developing supports for students and mentors in these areas.

REAP FY18 Efforts and Outcomes: Best practice/guidelines for mentors and universities were created in FY17 and updated in FY18, with university directors to improve communication and guidance with mentors. All mentors receive this and continuous communication throughout the summer. Universities are more than welcome to "select more serious students", as student selection is entirely up to the mentors, once AAS screens for U2 criteria. In addition, students are instructed to follow the guidelines of the university. If students are not "accountable" and not following guidelines, discussions should take place between the student and the mentor. AAS will help facilitate, if necessary. The intent is to make this a learning experience in STEM practice, as well as soft skills.

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

FY17 Finding: Despite continued efforts to integrate more resources into REAP for promoting other AEOPs, this remains an area of need for additional effort in FY18. Less than half of mentors (39%) reported discussing AEOP in general with participants. Similarly, only a small percentage of mentors reported discussing Unite (27%) and URAP (23%) with participants. As a result, participants had little knowledge of other AEOPs, as 50% had heard of CQL, 46% eCM, and 39% JSHS. It is recommended that REAP focus on establishing additional supports for local programs to emphasize the AEOP pipeline frequently in the apprenticeship program – in meaningful ways.

REAP FY18 Efforts and Outcomes: FY17 and again in FY18, mentors were part of the full REAP experience. Mentors received a large pre summer document outlining requirements and expectations, guidelines, policies and tips. In addition, summer news is emailed to mentors.

HSAP

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

FY17 Finding: Despite considerable growth in interest in HSAP, evidenced by the nearly 50% increase in applications for FY17, there was a 20% decrease in the actual number of participants in FY17. HSAP failed to meet their enrollment goal of 70 apprentices as a result. HSAP should focus on growing infrastructure to support more potential participation in FY18.

HSAP FY18 Efforts and Outcomes: ARO has amended its Broad Agency Announcement to move the HSAP/URAP proposal deadline to 30 Sep from 10 Nov, in an effort to streamline the apprenticeship process from proposal submission through student placement in university labs next summer. Among other things this will expand the apprenticeship marketing window for PIs by expediting the proposal review/approval process by giving PIs ~60 additional days to drive students to the AEOP application portal.

FY17 Finding: The demographics of actual participants in HSAP reveal the program has more work to do to reach a greater percentage of underrepresented students. It is commendable that HSAP has been able to accommodate a majority of female apprentices. However, White and Asian groups are the majority in participants (42% and 25% respectively). This is a slight increase from FY16 in fact, while the percentage of African American students has remained at 15% and Hispanic/Latino apprentices held at 14%. HSAP should invest resources in FY18 to target underrepresented groups more strategically to recruit more diverse participation for the program.

HSAP FY18 Efforts and Outcomes: Outreach was made by phone or email to over 5,000 counselors, science teachers at 600 high schools; 300 of those are Title I high schools, where there is a high population of U2 students. In addition, as indicated above, many STEM/Minority organizations provided

outreach to their U2 students. In FY18, 20% (111) of student applicants met the U2 criteria and 17% (8) were selected to participate in HSAP in FY18. During the application and selection process, HSAP/URAP PC will communicate to PIs via email to strongly consider selecting qualified U2 and those previously in AEOP pipeline as apprentices, IAW AEOP goals. HSAP/URAP PC will assist the PI by identifying AEOP pipeline participants using their application information. HSAP/URAP PC will continue to partner with ARO HBCU PC to promote HSAP/URAP and encourage program participation.

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

FY17 Finding: In FY17, HSAP apprentices and mentors both echoed findings that have been prevalent across the AEOP portfolio. Only a very few number of participants and mentors are accessing and/or utilizing AEOP social media, including the website. In regards to HSAP, 63% of mentors and 71% of apprentices did not experience AEOP social media at all. Therefore, the evaluation team recommends that HSAP work with the consortium members to determine a plan for the future utilization and marketing of AEOP social media and the website.

HSAP FY18 Efforts and Outcomes: HSAP implemented bi-weekly summer communication to encourage social media postings and provides taglines.

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

FY17 Finding: The FY17 evaluation findings indicate collective desire of the apprentices and mentors to improve communication across the program. This includes improving the delivery of information from the program leadership to the mentors and site directors, as well as information (program requirements, stipend payments, that is transmitted between AAS/ARO and the apprentices directly. It is recommended that AAS and ARO take steps to examine communication channels and determine how communication can be improved for HSAP.

HSAP FY18 Efforts and Outcomes: HSAP/URAP PC submitted proposed changes to ARO HSAP/URAP BAA language to better communicate program requirements – ARO approved and published recommended changes June 2018. HSAP/URAP PC amended and distributed an updated program timeline to all active PIs with 2018 RFP.

FY17 Finding: HSAP made progress in growing apprentice awareness of AEOPs, as 97% indicated that they had learned about AEOPs during the program. 74% indicated they were interested in URAP. However, HSAP participants were not made cognizant of some applicable AEOP opportunities during the program in FY17. In fact, 65% of HSAP apprentices had not heard of CQL, and 42% had not heard of the NDSEG Fellowship. Mentors reported that they did not discuss other AEOPs with their apprentices including: JSHS (88%), SEAP (88%), and CQL (92%). It is strongly recommended that HSAP work with their

staff and the consortium to develop a plan for marketing and informing participants frequently about other AEOP opportunities and resources.

HSAP FY18 Efforts and Outcomes: During outreach events, site visits and meet & greets, HSAP provided attendees and participants with the apprenticeship flyer and presented an AEOP portfolio overview.

URAP

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

FY17 Finding: AEOP Priority #1 is focused on growing the diversity of the pool of STEM talent in deep and meaningful ways. AEOP programs are charged with making this a primary focus of their recruitment and enrollment for the program. In FY17, the URAP program had only 24% of participants that were from underrepresented groups as defined by the AEOP. Additionally, while participation of White students decreased slightly, African American participation decreased by 2% (8% of total in FY17) while Hispanic/Latino apprentices grew to 15% in FY17 (from 13% in FY16). It is recommended that URAP invest considerable effort in FY18 in continuing to reach out to underrepresented populations to encourage their applications and participation in the program. It may be worthwhile to work with REAP, another AEOP apprentice program that has had great results in reaching diverse participant groups.

URAP FY18 Efforts and Outcomes: Outreach was made to over 300 universities; 100 of those are HBCU/MSIs. University directors and PIs also assisted in posting apprenticeship flyers online on university websites and in student work areas to promote the program. Fifty six, or 18% URAP applicants met the U2 criteria and only 5, or 8% of actual participants met the U2 criteria. In collaboration with the ARO's HBCU/MSI Program Manager continue to establish relationships with HBCU/MSI University partners (Department chairs, Chancellors, Deans and STEM professors) to introduce the HSAP/URAP and encourage participation.

FY17 Finding: Findings from the FY16 evaluation suggested that URAP develop a resource for mentors to utilize to promote AEOP opportunities, as well as other resources within the DoD. It does not appear that URAP followed this guidance, as the only mention of activities aligned with this was having universities post apprenticeship opportunities on their career assistance pages, which isn't related at all. In FY17, mentors did not report going beyond discussing AEOP in general with apprentices (77%). Only 32% of mentors discussed NDSEG and only 24% shared information about SMART. Therefore, it is again recommended that URAP (or apprenticeship programs collectively) develop tools for mentors to use to teach or inform their participants about AEOP programs including specific information on each opportunity.

URAP FY18 Efforts and Outcomes: In FY18, the apprenticeship DoD STEM Webinar was expanded and offered to students and mentors. Through several communications, university partners received the apprenticeship one page promo flyer, PI/mentor newsletters included information on other AEOP opportunities (travel award, REAP, SMART, etc.)

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

FY17 Finding: In FY17, URAP apprentices and mentors both echoed findings that have been prevalent across the AEOP portfolio. Only a very few number of participants and mentors are accessing and/or utilizing AEOP social media, including the website. In regards to URAP, 68% of mentors and 56% of apprentices did not experience AEOP social media at all. Therefore, the evaluation team recommends that URAP work with the consortium members to determine a plan for the future utilization and marketing of AEOP social media and the website.

URAP FY18 Efforts and Outcomes: URAP implemented bi-weekly summer communication to encourage social media postings and provides taglines.

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

FY17 Finding: The FY17 evaluation findings indicate collective desire of the apprentices and mentors to improve communication across the program. This includes improving the delivery of information from the program leadership to the mentors and site directors, as well as information (program requirements, stipend payments, that is transmitted between AAS/ARO and the apprentices directly. It is recommended that AAS and ARO take steps to examine communication channels and determine how communication can be improved for URAP.

URAP FY18 Efforts and Outcomes: HSAP/URAP PC submitted proposed changes to ARO HSAP/URAP BAA language to better communicate program requirements – ARO approved and published recommended changes June 2018. HSAP/URAP PC amended and distributed an updated program timeline to all active PIs with 2018 RFP. PI and student newsletter distribution plan executed in FY18 to enhance communication between all parties.

FY17 Finding: URAP participants were not made cognizant of other applicable AEOP opportunities during the program in FY17. In fact, 50% of URAP apprentices had not heard of CQL, the other college level apprenticeship program within AEOP. Further, less than 50% had been made aware of important scholarship programs including NDSG and SMART. It is strongly recommended that URAP work with their staff and the consortium to develop a plan for marketing and informing participants frequently about other AEOP opportunities and resources.

URAP FY18 Efforts and Outcomes: During outreach events, site visits and meet & greets, HSAP provided attendees and participants with the apprenticeship flyer, presented an overview of the SMART and NDSEG opportunities and directed students to those websites and POCs.

Overall Recommendations for FY18 Program Improvement/Growth

Evaluation findings for apprenticeship programs overall were very positive. All programs (CQL, SEAP, REAP, HSAP, URAP) enabled participants to experience growth in their STEM practices, STEM knowledge, STEM competencies, and STEM identities. In fact, there were significant differences in growth for some programs (i.e., CQL) in 21st Century Skills and STEM Competencies for first generation college students. Further, students in REAP from low socio-economic status background were significantly more likely to engage in future STEM opportunities than other students in REAP. These opportunities open doors for underserved students and this should continue to be a primary focus of AEOP apprenticeship programs.

Overall, participant satisfaction with the programs was positive. Apprenticeship programs improved their processing of stipends resulting in decreased reports of dissatisfaction in this area. Some programs experienced increased applications and placements for apprentices in FY18 (REAP, URAP) while others held steady (SEAP). While these successes are commendable, there are some areas that remain with potential for growth and/or improvement for apprenticeship programs. The evaluation team therefore offers the following recommendations for FY19 and beyond:

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

1. Apprenticeship programs should continue to focus in on growing the pool of underserved applicants and participants overall. The REAP program should be used as a guide for making progress in this area. REAP has successfully reached underserved populations for several years now. In FY18, REAP was comprised of 96% underserved student population, including 62% female, 55% free and/or reduced lunch recipients, and 36% prospective first generation college students. By comparison, other apprenticeship programs included much lower percentages of underserved students (CQL, 16%; SEAP 27%; HSAP 54%; and URAP 18%). CQL, SEAP, and HSAP included less than 20% of potential first generation students (16%, 2%, and 8% respectively) for example. It is imperative that apprenticeship programs work to become more inclusive of underserved students in the future.

2. CQL and SEAP continue to be programs that recruit and include participants through connections to past participants, DoD employees, and personal connections. It is recommended that these programs invest more effort to require laboratory sites to utilize a more open recruitment and acceptance policy to bring in new students who are not connected to the laboratories or DoD employees to broaden the ability for others to benefit from these high-quality experiences.

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

Across the apprenticeship programs, mentors did not implement effective mentoring strategies with their apprentices in a consistent manner. Individual programs ranged on the low end of implementation from less than 40% use (SEAP), to less than 50% use (CAL, REAP, URAP) and around 50% use (HSAP). Though the importance of the use of these strategies has been communicated, mentors continue to report the lack of full implementation within the apprenticeship program. It is recommended that the consortium leadership (Battelle and CCDC) and the AEOP programs work together to develop a formal mentor online training (not live) that is brief in duration (15-20 minutes) that mentors are required to complete prior to becoming a mentor (one time). This can also be used for other programs such as Unite, JSHS, etc. The evaluation team has hosted webinars for mentors for the past three years to train them on the use of the 21st Century Assessment and several have been willing to attend. Other components of the training could also include other challenging areas of program implementation, including teaching about the AEOP portfolio programs (which will be included as a recommendation under Priority Three below.

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

1. Apprenticeshp program participation in the annual AEOP evaluation is still much lower than desirable. In FY18, only four mentors completed the HSAP survey. Another concern is the very low participation for FY18 in the 21st Century Skills Assessment. Despite a good pilot year in FY17, apprenticeship programs individually had less than 20 students who had a pre and post assessment completed in FY18 (CQL, 3; SEAP, 6; REAP, 11; HSAP, 6; URAP, 8). This is our most important data to collect in the AEOP evaluations for apprentices, as it provides an actual assessment of student growth. It is strongly recommended that the apprenticeship program administrators convey the requirement to mentors and hold them accountable for providing this data in FY19.

2. Across all apprenticeship programs in FY18, the majority of mentors are not discussing specific AEOP programs with students (CQL, 65%; SEAP, 85%; REAP 55%; HSAP, 75%; URAP, 70%). This is very concerning, as it impedes student ability to learn about future opportunites within AEOP, including college-level program, mentoring opportunities, and scholarships. It is strongly recommended that the apprenticeship programs require mentors to provide students with a full orientation to the AEOP programs and resources that are available to them.

3. Multiple apprenticeship programs (CQL, SEAP, URAP) suggested an improvement to the program would be to provide opportunities for apprentices to connect in meaningful ways. Therefore, it is recommended that the program administrator connect with alumni management and

marketing/communications to explore ways to connect apprentices while they are in programs, which will help to facilitate connections after the program when they become alumni. We also recommend that the consortium consider an annual event/meeting to bring together apprentices either virtually or face-to-face to share their research with others in a "conference" format.

4. Apprentices from all programs indicated very little engagement with AEOP on social media. Given the investment in building up social media presence on things such as Twitter and Facebook, it is recommended that the consortium explore ways to engage more apprentices and participants overall in social media. This is a missed opportunity to connect and provide more learning opportunities to participants, as well as a way to grow their knowledge of the AEOPs.