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ARMY EDUCATIONAL OUTREACH PROGRAM

Apprenticeship Programs

2020 Annual Program Evaluation Report
Executive Summary

July 2021

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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); Undergraduate Research Apprenticeship Program (URAP); and the AEOP Apprenticeship Course. The apprenticeship programs were managed by the Rochester Institute of Technology (RIT). A total of 187 students were enrolled in apprenticeship programs based in Army laboratories and center (CQL and SEAP) and 167 in university-based programs (REAP, HSAP, and URAP) in FY20. Another 104 high school students (102 of whom had been displaced from SEAP, REAP, and HSAP by circumstances related to the 2020 COVID-19 pandemic) participated in an online summer course in lieu of completing apprenticeships. 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 Rochester Institute of Technology (RIT), 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 and centers. CQL apprentices receive firsthand research experience and exposure to Army laboratories and centers. CQL fosters desire in its participants to pursue further training and careers in STEM while specifically highlighting and encouraging careers in Army research.

In 2020, 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 2020 Fast Facts

Description	STEM Apprenticeship Program – Summer or school year, at Army laboratories and centers with Army S&E mentors
Participant Population	College undergraduate students
Number of Applicants	582
Number of Participants	159
Number/Percentage Underserved Participants	41/26%
Placement Rate	27%
Total Number of Adults	89
Number of Army S&Es	89
Number of Army Research Laboratories & Centers	15
Number of Colleges/Universities	N.A.
Number of HBCU/MIs	N.A.
Total Cost	$1,482,699
Total Travel	$496
Participant Travel	$0
Total Awards	$1,413,821
Student Awards/Stipends	$1,413,821
Adult/Teacher/Mentor Awards	$0
Cost Per Student	$9,325

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 or longer summer apprenticeship at Army laboratories or centers. 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 laboratories and centers. 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 2020, 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 2020 Fast Facts	
Description	STEM Apprenticeship Program – Summer, at Army laboratories and centers with Army S&E mentors
Participant Population	9th-12th grade students
Number of Applicants	938
Number of Participants	28
Number/Percentage Underserved Participants	6/21%
Placement Rate	3%
Total Number of Adults	22
Number of Army S&Es	22
Number of Army Research Laboratories & Centers	3
Number of K-12 Schools	19
Number of K-12 Schools – Title I	7
Total Cost	$210,427
Total Travel*	$496
Participant Travel	$0
Total Awards	$141,549
Student Awards/Stipends	$141,549
Adult/Teacher/Mentor Awards	$0
Cost Per Student	$7,515

* Note: The reported travel costs for FY20 programs are from pre-pandemic travel (October 2019-February 2020) and from non-refundable travel expenses that were booked prior to shifting to virtual programming.

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.

Table 3. REAP 2020 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	527
Number of Participants	86
Number/Percentage Underserved Participants*	81/94%
Placement Rate	16%
Total Number of Adults	66
Number of College/University S&Es	66
Number of College/Universities	47
Number of HBCU/MSIs	23
Number of K–12 Schools	69
Number of K–12 Schools — Title I	37
Total Cost	$393,099
Total Travel**	$993
Participant Travel	$0
Total Awards	$265,821
Student Awards/Stipends	$211,821
Adult/Teacher/Mentor Awards	$54,000
Cost Per Student	$4,571

* Underserved calculation based upon Cvent participation data that reflects enrollment of n=165
* Note: The reported travel costs for FY20 programs are from pre-pandemic travel (October 2019-February 2020) and from non-refundable travel expenses that were booked prior to shifting to virtual programming.

High School Apprenticeship Program (HSAP)

HSAP, managed by U.S. Army DEVCOM-ARL-Army Research Office (ARO) and supported by the Rochester Institute of Technology (RIT), 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 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.

In 2020, 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 2020 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	434
Number of Participants	32
Number/Percentage Underserved Participants	15/47%
Placement Rate	7%
Total Number of Adults	26
Number of College/University S&Es	26
Number of K-12 Schools	30
Number of K-12 Schools – Title I	11

Number of Army-Funded College/University Laboratories	20
Number of College/Universities	20
Number of HBCU/MSIs	7
Total Cost	$181,626
Total Travel*	$110
Participant Travel	$0
Total Awards	$150,000
Student Awards/Stipends	$150,000
Adult/Teacher/Mentor Awards	$0
Cost Per Student	$5,676

* Note: The reported travel costs for FY20 programs are from pre-pandemic travel (October 2019-February 2020) and from non-refundable travel expenses that were booked prior to shifting to virtual programming.

University Research Apprenticeship Program (URAP)

The Undergraduate Research Apprentice Program (URAP), managed by the U.S. Army Research Office (ARO) and the Rochester Institute of Technology (RIT), 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.

Apprentices receive an educational stipend 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 Education Outreach Division.

In 2020, 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 2020 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	258
Number of Participants	49
Number/Percentage Underserved Participants	14/29%
Placement Rate	19%
Total Number of Adults	39
Number of College/University S&Es	39
Number of Army-Funded College/University Laboratories	30
Number of College/Universities	30
Number of HBCU/MSIs	6
Total Cost	$338,126
Total Travel*	$110
Participant Travel	$0
Total Awards	$292,500
Student Awards/Stipends	$292,500
Adult/Teacher/Mentor Awards	$0
Cost Per Student	$6,901

* Note: The reported travel costs for FY20 programs are from pre-pandemic travel (October 2019-February 2020) and from non-refundable travel expenses that were booked prior to shifting to virtual programming.

AEOP Summer Course

Course Description

In light of the COVID-19 pandemic, a significant number of AEOP high school participants were displaced from the AEOP apprenticeship programs for high school students (REAP, SEAP, and HSAP). To address the

2020 summer programming gap, the Rochester Institute of Technology (RIT) provided a virtual four-week (July 20 - August 14) credit-bearing course for 104 displaced high school apprentices.

The course, *Science in the Real World: Finding Your Voice*, engaged participants around themes connected to the AEOP goal of creating a STEM literate citizenry. Students explored the concepts and effects of science and technology on society, looked at how science and technology have affected and been affected by our values, and thought about how we know what we know in science and engineering (metacognition) as they completed hands-on experiments. As a supplement to the course, students participated in a seminar series featuring speakers related to course topics, STEM research areas, and Army/DoD laboratories. Virtual college and career readiness skill-building workshops were also provided. Twelve undergraduate students (past AEOP apprenticeship participants and RIT undergraduates in STEM) served as near-peer mentors and teaching assistants within the course experience. Students and near-peer mentors were provided with all course related materials and were awarded an educational stipend upon completion of the course.

Successful summer course participants earned two units of transcript credit at RIT. The course aimed to equip students with an understanding of the culture of science and engineering, an appreciation for doing STEM in the public interest (including knowledge of government research labs), exposure to high-need areas of STEM research, a deepened understanding of the process of producing scientific knowledge, and an increased preparedness for college and careers in STEM.

Table 6. AEOP Summer Course 2020 Fast Facts	
Description	Invited **435** REAP, HSAP and SEAP applicants, whose programs were canceled due to COVID, to apply to a 4 week, 2 credit bearing college STEM Citizenery course through RIT. 190 individuals applied within 2 days and 105 were accepted.
Participant Population	REAP, HSAP, and SEAP (and programs canceled due to COVID)
Number of Applicants	190
Number of Participants	104 (54 REAP, 17 HSAP, 31 SEAP)
Number/Percentage Underserved Participants	74/73%
Placement Rate	55%
Total Number of Adults	21
Number of K-12 Schools	78
Number of Title 1 K-12 Schools	21
Number of Army Research Laboratories & Centers	2
Number of Other Organizations	1

Summary of Findings

The 2020 evaluation of apprenticeship program collected data about participants; their perceptions of program processes, resources, and activities; and indicators of achievement in outcomes related to the AEOP's and the apprenticeship programs' objectives and intended outcomes. Findings for individual programs are provided in Tables 7-12.

CQL Findings

Table 7. 2020 CQL Evaluation Findings

Priority #1:

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

Fewer students applied for CQL apprenticeships in 2020 compared to 2019; a multi-year downward trend in the number of students placed in apprenticeships continues.	A total of 582 students applied for CQL apprenticeships, a decline from 2019 when 662 students applied, but a slight increase as compared to the 574 applicants in 2018.
	159 students (27% of applicants) were placed in CQL apprenticeships. This continues a downward trend in the number and placement rate of CQL apprentices since 2017 (2019 -204 [31%]; 2018 - 214 [37%]; 2017 – 229 [39%]).
	Apprentices were hosted at 17 sites, an increase over the 16 participating host sites in 2019 and the 13 participating host sites in 2018.
While CQL continues to serve students from diverse backgrounds, enrollment of apprentices from groups historically underserved and underrepresented in STEM decreased in 2020 as compared to 2019.	Slightly over a quarter of apprentices (26%) met the AEOP definition of students underserved or underrepresented (underserved) in STEM, a decrease from 2019 when 35% of apprentices met the underserved criteria, but an increase from the 20% who met the definition in 2018.
	Just over a third (35%) of participants identified as female, a decrease as compared to previous years (2019, 51%; 2018, 45%; 2017, 54%).
	A somewhat larger proportion of CQL apprentices identified themselves as White (59%) as compared to 2019 (54%); this is a decrease in comparison to 2018 (64%) and 2017 (67%). Likewise, the proportion of apprentices identifying themselves as Asian increased slightly (15%) as compared to 2019 (12%) and previous years (14% in both 2017 and 2018).
	The proportion of CQL apprentices identifying themselves as Black or African American (9%) decreased sharply as compared to 2019 (18%) and 2018 (13%) but was higher than in 2017 (7%). Participation by apprentices

	identifying as Hispanic or Latino remained relatively constant (5% in 2020; 6% in 2019; 6% in 2018; 5% in 2017).
	As in previous years, nearly all apprentices (94%) identified English as their first language, and a relatively small proportion (18%) were first generation college attendees. Fewer than a quarter (21%) were Pell grant recipients, a proxy for low-income status.
Apprentices reported engaging in STEM practices more frequently in CQL than in their typical college or university experiences.	More than 70% of apprentices (71%-98%) said they participated "at least once" in all STEM practices about which they were asked. Nearly all apprentices reported frequently (weekly or every day) interacting with STEM researchers (94%) and working with a STEM researcher or company on a real-world STEM research project (92%).
	Apprentice-reported engagement in STEM practices in CQL was significantly higher than engagement in the same practices in school (large effect size). These findings indicate that CQL provides apprentices with more intensive engagement in STEM than they typically experience in their college or university coursework.
Apprentices reported gains in their STEM knowledge as a result of participating in CQL; female apprentices and apprentices from minority groups associated with underserved criteria reported larger gains than their peers.	More than 90% of CQL apprentices indicated that they had experienced medium or large gains in each area of STEM knowledge. Nearly all apprentices reported at least medium gains in knowledge of how scientists and engineers work on real problems in STEM (98%) and knowledge of what everyday research work is like in STEM (96%).
	No significant differences in STEM knowledge gains were found by overall underserved status, however female apprentices and apprentices from minority groups associated with underserved criteria reported larger gains than their peers (large and medium effect sizes respectively).
Apprentices reported gains in their STEM competencies as a result of participating in CQL.	More than 70% of participating apprentices (71%-89%) reported at least medium gains for all STEM competencies, and 85% or more of responding apprentices reported medium or large gains in using knowledge/creativity to suggest a solution to a problem (85%) and identifying limitations of methods/tools used for collecting data (89%).
Apprentices reported that CQL participation had positive impacts on their 21st Century skills.	Half or more of apprentices (50%-94%) reported at least medium gains for all 21st Century skills items except for creating media products (23%) and analyzing media (37%). CQL apprentices experienced the greatest impacts (medium or large gains) in 21st Century Skills such as solving problems (92%) and incorporating feedback into their work effectively (94%).

Apprentices reported gains in their STEM identities as a result of participating in CQL.	Three-quarters or more of CQL apprentices (75%-98%) reported medium or large gains across all items of the STEM identity scale. More than 90% of apprentices reported at least medium gains in their desire to build relationships with mentors who work in STEM (98%) as a result of CQL.
Priority #2: *Support and empower educators with unique Army research and technology resources.*	
CQL mentors used a range of mentoring strategies with apprentices.	CQL mentors reported using strategies associated with each of the five areas of effective mentoring about which they were asked: 1. At least two-thirds of CQL mentors (67%-100%) reported using all strategies except one (asking students to relate real life events to CQL topics – 33%) to help make learning activities relevant to students. 2. Half or more of CQL mentors (50%-100%) reported using all strategies to support the diverse needs of students as learners with the exception of the strategy of highlighting under-representation of women and racial/ethnic minority populations in STEM which only 33% of mentors reported using. 3. With the exception of one item (allowing students to resolve conflicts within their team – 33%), half or more of CQL mentors (50%-100%) reported using all strategies to support students' development of collaboration and interpersonal skills. 4. Half or more (50%-100%) of CQL mentors said they implemented all strategies to support students' engagement in authentic STEM activities. 5. Half or more of CQL mentors (50%-100%) reported using seven of the strategies focused on supporting students' STEM educational and career pathways. A third or fewer (17%-33%) reported implementing the following strategies: recommending extracurricular programs that align with students' goals (33%); recommending student and professional organizations in STEM to students (33%); and discussing the economic, political, ethical, and/or social context of a STEM career (17%).
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 three-quarters or more of CQL apprentices (73%-98%) reported being at least somewhat satisfied with all program features listed. The areas in which greatest satisfaction was reported were the amount of stipend (98%); the variety of STEM topics available in CQL (98%); and the timeliness of receiving stipends (94%).
	Nearly all CQL apprentices reported that their mentors were available at least half of the time (96%), and nearly two-thirds (62%) said their mentors were always available.
	A large majority of apprentices (90%-100%) reported being at least somewhat satisfied with each element of their CQL experience. All

	apprentices were at least somewhat satisfied with their working relationship with their mentors (100%).
	Nearly all apprentices (98%) made positive comments about their satisfaction with CQL in response to open-ended questions. The most frequently mentioned benefits of CQL cited by apprentices were hands-on lab experiences, the STEM skills apprentices gained, the networking and/or the mentoring they experienced, STEM learning, and the career information they received.
	In open-ended responses, the improvements most frequently suggested by apprentices were to provide more or better communication from the program, to provide more opportunities for apprentices to interact with one another and improving or streamlining in-processing procedures.
CQL mentors were 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.	Half or more of responding mentors (50%-83%) reported being at least somewhat satisfied with all program features except for research abstract preparation requirements (33%), a feature that half of CQL mentors (50%) reported not having experienced. Areas in which mentors reported the greatest satisfaction (somewhat or very much) were the amount of stipends for apprentices (83%); communication with program organizers (83%); the application/registration process (83%); and other administrative tasks (83%).
	All three mentors who responded to an open-ended question about their satisfaction responded positively. The most frequently mentioned strengths of CQL were the STEM and research skills, the experience apprentices receive, and apprentices' opportunities to network.
	Several mentors participating in phone interviews commented on their experiences with mentoring apprentices online. These mentors made positive comments about this format overall and noted that apprentices found ways to network with each other online. The potential for the online format to extend apprenticeships throughout the school year was noted. Difficulties in assisting apprentices having difficulties with their work in the online format were also noted.
	In open-ended responses, the improvements most frequently suggested by mentors were to increase the program's outreach or publicity and to improve communication from the site directors and/or staff.
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.	CQL apprentices most frequently learned about AEOP through someone who works with the DoD (42%); someone who works with the program (38%); and past participants of the program (38%).
	Half of mentors (50%) reported that they learned about AEOP from a past participant and a third (33%) through workplace communications.
Apprentices were motivated to participate in CQL primarily by the learning opportunities and their interest in STEM.	The most frequently selected motivators were related to apprentice educational interests and learning, including the following: the desire to learn something new/interesting (58%); interest in STEM (56%); and the desire to expand laboratory/research skills (53%).
Most CQL apprentices had not participated in AEOP in the past, however most are interested in participating in AEOP in the future.	Nearly half (47%) of CQL apprentices noted they had not previously participated in AEOP. Smaller proportions indicated having participated in the following programs: CQL (33%), GEMS (11%), and SEAP (9%).
	Approximately three-quarters or more of apprentices were at least somewhat interested in participating in CQL again (85%) and in SMART (71%). Half (50%) indicated they were at least somewhat interested in NDSEG, and more than a third were similarly interested in URAP (42%) and the GEMS NPM program (37%).
	The resources apprentices most frequently cited as being somewhat or very much useful for their awareness of AEOP were participation in CQL (98%), CQL mentors (96%), the AEOP website (83%), and presentations shared in CQL (75%). More than half of responding apprentices had not experienced AEOP on social media (65%).
Most mentors discussed CQL and the SMART scholarship with apprentices, however few discussed any other AEOP.	Mentors responding to the questionnaire reported discussing CQL (83%) and SMART (50%) with their apprentices.
	The resource mentors most frequently cited as being somewhat or very much useful for making apprentices aware of AEOP was CQL participation (100%), followed by AEOP program administrators (67%) the AEOP website (67%), and AEOP on social media (67%) as resources for exposing apprentices to AEOP.
Most apprentices learned about STEM careers generally and DoD STEM careers specifically during CQL.	A large proportion of CQL apprentices (96%) reported learning about at least one STEM job/career, and most (81%) reported learning about three or more general STEM careers. Similarly, a large proportion of apprentices (94%) indicated they learned about at least one DoD STEM job/career, with fewer (63%) learning about three or more STEM careers in the Army or DoD.

	Two-thirds or more of apprentices reported the following four resources as somewhat or very much impactful on their awareness of STEM careers in the Army or DoD: the AEOP website (65%); presentations shared in program (71%); participation in CQL (88%); and the CQL mentors (96%). More than half of CQL apprentices said they had not experienced AEOP resources such as the ARO website (56%) and AEOP on social media (65%).
	CQL mentors were most likely to rate participation in CQL (83%), the AEOP website (67%), AEOP program administration (50%), and invited speakers (50%) as at least somewhat useful resources for exposing students to STEM careers in the Army or DoD.
CQL apprentices expressed positive opinions about DoD research and researchers.	CQL apprentices held extremely positive opinions about DoD researchers and research with more than 95% agreeing to all statements regarding the work of DoD researchers and the research conducted.
Apprentices reported that they were more likely to engage in various STEM activities after participating in CQL.	Nearly all apprentices (89%-100%) reported that after participating in CQL they were more likely or much more likely to engage in all STEM activities about which they were asked.
All CQL apprentices planned to at least complete a bachelor's degree, and many reported an interest in a graduate or terminal degree.	All CQL apprentices (100%) reported wanting to at least earn a bachelor's degree and many indicated a desire to earn a master's (38%) or terminal degree (37%) in their field.
CQL apprentices reported that participating in the program impacted their confidence and interest in STEM and STEM careers.	Approximately 70% or more of apprentices (69%-96%) agreed that CQL contributed in some way to each impact about which they were asked. Areas of greatest impact were increased confidence in STEM knowledge, skills, and abilities (96%) and a greater appreciation of DoD STEM research (90%).

SEAP Findings

Table 8. 2020 SEAP Evaluation Findings	
Priority #1: *Broaden, deepen, and diversify the pool of STEM talent in support of our Defense Industry Base*	
The COVID-19 pandemic had a profound effect on the placement of SEAP apprentices in 2020. Fewer applications	Fifteen Army labs or centers accepted applications for SEAP apprentices in 2020. The COVID-19 pandemic had a profound effect on the placement of SEAP apprentices in 2020 and apprentices were hosted at only three of these sites (10 sites in 2019 and 11 sites in 2018).

were received than in 2019, and the number of students placed in apprenticeships declined precipitously.	A total of 938 students applied for SEAP apprenticeships in 2020, a decrease of 27% as compared to 2019 when 1,286 students applied but an 8% increase compared to the 872 applications received in 2018 (852 applications received in 2017). Of these applicants, only 28, or 3%, were placed in apprenticeships. This is a marked decrease in both the number of apprentices placed and the placement rate as compared to previous years (108 [8%] in 2019; 114 [13%] in 2018; 113 [13%] in2017).
	In response to the cancelation of many apprenticeship positions for high school students due to the pandemic, RIT planned and hosted an online summer course for displaced AEOP high school apprentices who wished to participate. This course served 31 students who had applied for SEAP apprenticeships.
While SEAP continued to serve apprentices from groups historically underrepresented and underserved in STEM, the proportions of female students and the proportion of students meeting the AEOP definition of underserved declined in 2020 as compared to previous years.	Unlike previous years, less than half (36%) of SEAP apprentices were female (52% in 2019, 53% in 2018, and 54% in 2017).
	As in previous years, the most frequently represented races/ethnicities were White (32%) and Asian (39%), although 2020 was the first year that the most frequently represented race/ethnicity was Asian (24% in 2019, 27% in 2018, 32% in 2017).
	The proportion of apprentices identifying themselves as Black or African American (14%), began to reverse a multi-year downward trend (10% in 2019; 12% in 2018; 17% in 2017). The proportion of apprentices identifying themselves as Hispanic or Latino in 2020 (4%) was similar to previous years (4% in 2019, 4% in 2018, 3% in 2017).
	As in 2019, a majority of apprentices (82%) attended suburban schools (68% in 2019) and few (4%) received free or reduced-price school lunches (FARMS) (10% in 2019). All apprentices spoke English as their first language (100%) and none would be first-generation college attendees.
	Less than a quarter of SEAP apprentices (21%) met the AEOP definition of underserved, a decrease as compared to previous years (32% in 2019, 27% in 2018).
Apprentice and mentor participation in the evaluation survey was very low and was likely limited by the small number of participants in 2020.	Only three apprentices and three mentors participated in the SEAP evaluation survey in 2020. Because of the small sample size of apprentices, no statistical comparisons of findings between groups could be conducted.
SEAP apprentices reported engaging in STEM practices more frequently in SEAP than	With the exception of one item (presenting STEM research to a panel of judges from industry or military), at least two out of three responding SEAP apprentices indicated they had engaged in each STEM activity at least once.

in their typical school experiences.	STEM practices in which all three SEAP apprentices reported engaging in frequently (most days or every day) during SEAP were: working with a STEM researcher or company on a real-world STEM research project (100%); designing and carrying out an investigation (100%); analyzing data or information and drawing conclusions (100%); and solving real world problems (100%).
	Apprentice engagement in STEM practices in SEAP were higher than their engagement in the same practices in school, however, these differences could not be assessed statistically due to the small sample size. Descriptive statistics suggest that SEAP provides apprentices with more intensive engagement in STEM than they typically experience in school
Apprentices reported gains in their STEM knowledge as a result of participating in SEAP.	All SEAP apprentices (100%) reported a high degree of STEM knowledge gains (medium or large) as a result of participating in CQL for all items except for gains in their knowledge of what everyday research work is like in STEM (67%)
Apprentices reported gains in their STEM competencies as a result of participating in SEAP.	Two-thirds or more of SEAP apprentices (67%-100%) indicated medium or large gains in all STEM competencies about which they were asked except for creating a hypothesis that can be tested in an experiment (33%).
Apprentices reported that SEAP participation had positive impacts on their 21st Century skills.	Two or three responding apprentices (67%-100%) reported at least medium gains across all 21st Century skills items except for working creatively with others (33%); using creative ideas to make a product (33%); leading others in a team (33%); analyzing media (0%); and creating media products (0%).
Apprentices reported gains in their STEM identities as a result of participating in SEAP.	Two to three of the responding SEAP apprentices (67%-100%) reported at least medium gains on all survey items associated with STEM Identity
Priority #2: *Support and empower educators with unique Army research and technology resources.*	
SEAP Mentors used a range of mentoring strategies with apprentices.	The three responding SEAP mentors reported using strategies associated with each of the five areas of effective mentoring about which they were asked: 1. Two or three SEAP mentors (67%-100%) indicated they used all but two of the strategies to help make learning activities relevant to students. The two strategies used by only one mentor were: encouraging students to suggest new readings, activities, or projects (33%); and helping students understand how STEM can help them improve their own community (33%). 2. Two or three SEAP mentors (67%-100%) reported that they used all strategies to support the diverse needs of students as learners except for integrating ideas from education literature to teach/mentor students from underrepresented groups in STEM (0%) and highlighting

	under-representation of women and racial/ethnic minority populations in STEM (0%). 3. Two or three SEAP mentors (67%-100%) noted implementing all but two strategies to support students' development of collaboration and interpersonal skills. The two strategies used by only one SEAP mentor were having students exchange ideas with others whose backgrounds/viewpoints are different (33%) and having students give/receive constructive feedback with others (33%). 4. Two or three mentors (67%-100%) indicated they used all strategies to support students' engagement in authentic STEM activities except for supervising students while they practice STEM research skills (33%); and encouraging students to learn collaboratively (33%). 5. Two or three SEAP mentors (67%-100%) reported that they used most strategies focused on supporting students' STEM educational and career pathways with the exception of the following: helping students with their resumé, application, personal statement, and/or interview preparations (33%); discussing STEM career opportunities in private industry or academia (33%); and discussing the economic, political, ethical, and/or social context of a STEM career (0%).
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.	Two or three of SEAP apprentices (67%-100%) reported being at least somewhat satisfied with all program features. All three apprentices reported being at least somewhat satisfied with more than half of the features listed, including the following: applying for the program (100%); the variety of STEM topics available (100%); the teaching/mentoring provided (100%); amount of the stipend (100%); and the timeliness of receiving the stipend (100%).
	All SEAP apprentices (100%) reported that their mentors were always available.
	All three SEAP apprentices reported being at least somewhat satisfied with each area of their apprenticeship experience with the exception of the working relationship with the group/team, an area in which only two of the three apprentices (67%) at least somewhat satisfied.
	Because all apprentices interviewed participated in fully online apprenticeships, they were asked to comment on their experience with the online format. All apprentices noted that they had ultimately had good experiences with their online apprenticeships and most commented favorably on their access to their mentors.
	All three SEAP apprentices who responded to open-ended questions made positive comments about their satisfaction with SEAP. The most frequently mentioned benefits were gaining experience in the real-world application of STEM and gaining specific STEM skills.

	In open-ended responses to an item asking apprentices to list improvements to SEAP, no single improvement was suggested more than once. Suggested improvements included improving communication from the program, clarifying expectations for posters and abstracts, and providing more opportunities to connect with other apprentices and/or see other apprentices' work.
SEAP mentors were 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.	Two or three of the responding mentors (67%-100%) reported being at least somewhat satisfied with all features except for the following: timeliness of stipend pay (67% did not experience); support for instruction during program activities (33% did not experience); and research presentation process (33% did not experience).
	The one mentor interviewed commented favorably upon the online format of SEAP in 2020, and reported holding daily online meetings with apprentices, adding that apprentices were able to contact mentors at his site easily throughout the day. This mentor reported also reported that his site had intentionally provided ways for apprentices to connect with one another.
	The one mentor who responded to an open-ended questionnaire item asking about overall satisfaction with SEAP responded favorably and cited the program administration as a source of satisfaction. Mentors noted several strengths of SEAP, including the apprentice selection process, the program's administration, apprentices' exposure to real-world research, and apprentices' opportunities to network.
	Mentors suggested as improvements coordinating with other labs to hold weekly research seminars and addressing difficulties associated with hosting minor apprentices at Army sites, suggesting that the availability of online apprenticeships might encourage some sites to more readily accept minor apprentices.
Priority #3: *Develop and implement a cohesive, coordinated and sustainable STEM education outreach infrastructure across the Army*	
SEAP apprentices learned about AEOP primarily through the AEOP website and personal contacts; mentors learned about AEOP from past participants.	The most frequently selected sources of information (selected by two of the three apprentices completing the survey) were the AEOP website (67%) and friends (67%).
	All three responding mentors (100%) indicated they learned about AEOP from past participants.
Apprentices were motivated to participate in SEAP primarily by the learning opportunities and their interest in STEM.	Apprentices indicated that their motivations for participating in SEAP were related to their educational interests and learning, including their interest in STEM (100%); the desire to learn something new/interesting (67%); and learning in ways not possible in school (67%).

No apprentices had participated in AEOP other than SEAP in the past but were interested in participating in AEOP in the future.	All three survey respondents indicated they had never participated in any AEOP program.
	Two of the three SEAP apprentices (67%) reported being at least somewhat interested in participating in CQL, URAP, and SMART. Two of the three (67%) had never heard of NDSEG and the GEMS NPM program
	The resources apprentices most frequently indicated were somewhat or very much impactful on their awareness of AEOP were participation in SEAP (67%), SEAP mentors (67%), the AEOP website (67%), and presentations shared in SEAP (100%).
No mentors discussed specific AEOP other than SMART and CQL with apprentices.	The only programs SEAP mentors reported discussing with their apprentices were SMART (67%) and CQL (67%). Two-thirds (67%) of mentors reported talking about AEOP in general with their apprentices 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 AEOP were participation in SEAP (100%) and AEOP program administrators (36%). All three responding mentors reported that they did not experience AEOP printed materials (67%) or AEOP on social media (67%) as resources for exposing apprentices to AEOP.
SEAP apprentices learned about STEM careers generally and STEM careers within the DoD during SEAP.	All three responding SEAP apprentices (100%) indicated learning about at least one STEM job/career, and two (67%) reported learning about e or more general STEM careers. Similarly, all apprentices (100%) reported learning about at least one DoD STEM job/career, and two (67%) reported learning about three or more Army or DoD STEM jobs or careers
	Two-thirds of apprentices (two individuals) reported that the following resources were somewhat to very much useful for making them aware of DoD STEM careers: the AEOP website (67%); presentations shared in the program (67%); participation in SEAP (67%); and SEAP mentors (67%).
	When asked to select resources useful for making apprentices aware of DoD STEM careers, mentors selected participating in SEAP (100%), the AEOP website (67%), and AEOP program administrators (67%). All three responding mentors reported having not experienced AEOP social media.
Apprentices expressed positive opinions about DoD research and researchers.	SEAP apprentices' opinions about DoD researchers and research were overwhelmingly positively with all three responding apprentices (100%) strongly agreeing with each statement 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.	Either all three or two of three SEAP apprentices responding to the evaluation survey (67%-100%) indicated they were more likely or much more likely to engage in each STEM activity listed after their SEAP experience
All SEAP apprentices planned to at least complete a bachelor's degree, and all reported an interest in earning a terminal degree.	When asked their formal education aspirations, all three responding SEAP apprentices (100%) reported wanting to at least earn a bachelor's degree. While none (0%) reported wanting to end their higher education with a master's degree, all three (100%) reported a desire to earn a terminal degree in their field.
SEAP apprentices reported that participating in the program impacted their confidence and interest in STEM and STEM careers.	Two or three of the responding SEAP apprentices (67%-100%) agreed that SEAP contributed in some way to each impact about which they were asked. Areas of greatest impact (all three agreed) were more interested in participating in STEM activities outside of school requirements (100%) and a greater appreciation of DoD STEM research (100%).

REAP Findings

Table 9. 2020 REAP Evaluation Findings	
Priority #1: *Broaden, deepen, and diversify the pool of STEM talent in support of our Defense Industry Base*	
Many fewer students were placed in REAP apprenticeships at fewer institutions than in previous years due to the COVID-19 pandemic, however the number of applications received was comparable to 2019.	In 2020, REAP received 802 applications from 527 students. This is a slight decrease in the number of applications as compared to 2019 when 857 applications were received (949 in 2018).
	A total of 86 students (16% of applicants) were placed in REAP apprenticeships at 47 colleges and universities around the country, a marked decrease as compared to 2019 when 168 students were placed in apprenticeships at 55 colleges and universities and 2018 when 138 students were placed at 53 institutions in 2018. The 49% decrease in the number of students placed in apprenticeships in 2020 as compared to 2019 can be largely attributed to campus shutdowns and/or restrictions placed on many college and university labs as a result of the COVID-19 pandemic in 2020.
	Of the institutions hosting apprentices in 2020, 23 (49%) were historically black colleges and universities (HBCUs) or minority serving institutions (MSIs), compared to 29 (53%) in 2019 and 31 (57%) in 2018.
	In response to the cancelation of many apprenticeship positions for high school students due to the pandemic, RIT planned and hosted an online

	summer course for displaced AEOP apprentices that served 54 students who had applied for REAP apprenticeships.
REAP continues to serve apprentices from groups historically underserved and underrepresented in STEM, with increases in the proportions of female and Hispanic/Latino students served; a large majority of apprentices met the AEOP definition of underserved.	All but three REAP apprentices for whom data were available (94%) met the criteria for underserved status under the AEOP definition (99% in 2019).
	The proportion of female participants (70%) in 2020 was similar to 2019 when 67% of participants were female (62% in 2018, 61% in 2017).
	The proportion of apprentices identifying themselves as Black or African American (36%) declined somewhat compared to 2019 (44%) and 2018 (40%) but remained higher than in 2017 (29%). Participation by Hispanic or Latino apprentices (33% in 2020) continues to increase as compared to previous years (26% in 2019, 22% in 2018, and 15% in 2017). The proportion of REAP apprentices identifying themselves as White (4%) was lower than in previous years (9% in 2019, 8% in 2018, 27% in 2017). The proportion of REAP apprentices identifying as Asian (14%) remained at 2019 levels (14% in 2019, 20% in 2018, 27% in 2017).
	Half of REAP apprentices (50%) qualified for free or reduced-price school lunches (FARMS) (56% in 2019), a third (33%) spoke a language other than English as their first language (30% in 2019), and over a quarter (29%) would be first generation college attendees (36% in 2019).
	No significant differences were found by underserved status or individual demographic categories of underserved status for any 2020 evaluation survey items.
Apprentices reported engaging in STEM practices more frequently in REAP than in their typical school experiences.	Nearly half or more of REAP apprentices (47%-100%) reported participating at least once during their program in all STEM practices. All REAP apprentices responding to the evaluation survey indicated regularly (most days or every day) interacting with STEM researchers (100%) and analyzing data/information and drawing conclusions (100%).
	Apprentices reported that their engagement in STEM practices in REAP was significantly higher than their engagement in the same practices in school (large effect size). These findings indicate that REAP provides apprentices with more intensive engagement in STEM than they typically experience in school.
Apprentices reported gains in their STEM knowledge as a result of participating in REAP.	All REAP apprentices (100%) reported some degree of STEM knowledge gains as a result of participating in REAP. More than 90% indicated medium or large gains in every survey area of STEM knowledge.
Apprentices reported gains in their STEM competencies as a result of participating in REAP.	More than 70% of participating apprentices (71%-100%) noted at least medium gains across competencies. All responding apprentices reported

	medium or large gains in supporting an explanation with STEM knowledge (100%).
REAP Apprentices reported that REAP participation had positive impacts on their 21st Century skills.	More than half of apprentices (59%-100%) reported at least medium gains across all items except for creating media products (36%) and analyzing media (35%). REAP apprentices were most likely to report medium or large gains in the following 21st Century Skills: solving problems (100%); interacting effectively in a respectful/professional manner (100%); setting goals and utilizing time wisely (100%); working independently and completing tasks on time (100%); and producing results (100%).
Apprentices reported gains in their STEM identities as a result of participating in REAP.	More than 85% of REAP apprentices (88%-100%) reported at least medium gains on all STEM identity survey items. All apprentices noted at least medium gains in their feeling of preparedness for more challenging STEM activities (100%).
Priority #2: *Support and empower educators with unique Army research and technology resources.*	
REAP mentors used a range of mentoring strategies with apprentices.	A majority of REAP mentors reported using all strategies associated with each of the five areas of effective mentoring about which they were asked: 1. Three-quarters or more of REAP mentors (79%-100%) indicated implementing all strategies to help make learning activities relevant to students. 2. Nearly three-quarters or more of REAP mentors (71%-93%) noted using all strategies to support the diverse needs of students as learners. 3. More than three-quarters of REAP mentors (79%-100%) reported using all strategies to support students' development of collaboration and interpersonal skills. 4. more than 85% of REAP mentors (86%-100%) indicated implementing all strategies to support students' engagement in authentic STEM activities. 5. Approximately two-thirds or more of REAP mentors (64%-100%) noted trying all strategies focused on supporting students' STEM educational and career pathways.
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.	More than half of REAP apprentices (53%-100%) noted being at least somewhat satisfied with all program features listed except for physical location, which 59% did not experience. All REAP apprentices reported being very much satisfied with their amount of stipend pay (100%).
	All REAP apprentices reported that their mentors were available more than half of the time (100%), and more than three-quarters (88%) reported that their mentors were always available.

	Almost all REAP apprentices (94%-100%) reported being at least somewhat satisfied with all components of their research experience. All REAP apprentices (100%) reported being at least somewhat satisfied with all components of their experience except their working relationship with the group/team (94% at least somewhat satisfied).
	All apprentices who responded to open-ended questions made positive comments about their satisfaction with REAP. The most frequently cited benefits of REAP were the career and/or college information they gained, the STEM learning they experienced, gaining specific STEM skills or research skills, gaining real-world and hands-on experience, and the opportunity to network with professors and mentors.
	Apprentices who provided feedback during interviews on the virtual format of REAP apprenticeships all made positive comments, although the consensus was that they would have liked to complete their apprenticeships in person.
	In open-ended responses, the improvements most frequently suggested by apprentices were to provide more interaction with other students; to provide more teaching or learning resources; and to improve communication from the program, including more timely communication and providing clearer instructions and guidelines.
REAP mentors were satisfied with program features that they had experienced and identified a number of strengths of the REAP program. Mentors also offered various suggestions for program improvements.	Approximately two-thirds or more of mentors (64%-93%) noted they were at least somewhat satisfied with all features of REAP about which they were asked. The aspect REAP mentors were most satisfied (somewhat or very much) with was the research abstract preparation requirements (93%).
	All but one mentor made positive comments about REAP in their responses to an open-ended question asking about their satisfaction with the program. The most frequently mentioned strengths of REAP were apprentices' opportunity to participate in real-life research, apprentices' STEM learning and exposure to STEM generally, teamwork, and the program stipends.
	In open-ended responses, the improvements most frequently suggested by mentors were focused on stipends, including suggestions for providing larger mentor and student stipends. Other frequently mentioned suggestions included providing more time for recruiting, interviewing, and/or placing students in apprenticeships; having more involvement by sponsoring agencies (Battelle and the DoD) in the program; having students give presentations or write papers; providing applicants with more information about sites and projects at the point of application; and expanding the program to serve more students.
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 the AEOP website, personal contacts, and, for apprentices, school communications.	The most frequently selected sources of information about AEOP for apprentices, selected by a quarter or more, were the AEOP website (38%); past participants (31%); family members (33%); and school newsletters, emails, or websites (25%).
	Half (50%) of REAP mentors indicated they learned about AEOP through the AEOP website, and 21% had learned about AEOP through a colleague, a supervisor, or someone who works for the DoD.
Apprentices were motivated to participate in REAP primarily by the learning opportunities and their interest in STEM.	Half or more of apprentices reported being motivated to participate in REAP by their personal educational interests and learning; the most frequently reported motivators were interest in STEM (81%) and the desire to expand laboratory/research skills (50%).
Most apprentices had not participated in AEOP other than REAP, but most were interested in participating in other AEOP in the future.	Half (50%) of REAP apprentices reported they had not previously participated in any AEOP. Smaller proportions indicated having participated in Unite (25%) and GEMS (6%).
	More than half of apprentices indicated they were at least somewhat interested in participating in GEMS NPM (53%), CQL (53%), NDSEG (59%), SMART (71%), and URAP (82%). Over a third had not heard of CQL (41%), NDSEG (35%), and GEMS NPM (47%).
	Two-thirds or more of REAP apprentices (65%-100%) indicated all resources listed were at least somewhat impactful on their awareness of AEOP except for AEOP social media (6% useful, 65% did not experience). All apprentices (100%) said participation in REAP was at least somewhat impactful.
More mentors discussed specific AEOP with their apprentices than in 2019, and most discussed AEOP generally.	At least half of mentors reported discussing the following specific AEOP with apprentices: URAP (64%), HSAP (57%), SMART (57%), and NDSEG (57%). Additionally, nearly three-quarters (71%) of mentors said they discussed AEOP in general. In 2019, only a third or less of REAP mentors discussed any of the specific AEOP with their apprentices.
	Nearly all mentors reported that REAP participation (93%) and the AEOP website (93%) were at least somewhat useful for exposing students to AEOP. Additionally, at least half indicated AEOP program administrators (57%) and AEOP printed materials (67%) were at least somewhat useful for this purpose. Most mentors said they did not experience AEOP on social media (64%) or invited speakers (64%).

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%) indicated learning about at least one STEM job/career during their apprenticeship, and approximately two-thirds (65%) learned about three or more STEM careers in general. Much smaller proportions of apprentices (53%), however, reported learning about at least one DoD STEM job/career, and even fewer (24%) noted learning about three or more Army or DoD STEM jobs/careers.
	Two-thirds or more of REAP apprentices reported that the following resources were somewhat or very much impactful on their awareness of DoD STEM careers: participation in REAP (94%); REAP mentors (82%); the AEOP website (82%); and presentations shared in REAP (65%). More than half of REAP apprentices said they had not experienced AEOP resources such as the ARO website (59%) and AEOP on social media (59%).
	Mentors were most likely to rate participation in REAP participation (86%), the AEOP website (86%), AEOP program administration (57%), and AEOP printed materials (50%) as at least somewhat useful resources for exposing students to DoD STEM careers.
Apprentices expressed positive opinions about DoD research and researchers.	REAP apprentices' opinions about DoD researchers and research were overwhelmingly positively with all or nearly all (94%-100%) expressing agreement with each item 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.	More than 85% of apprentices (88%-100%) reported being more likely or much more likely to engage in all STEM activities after REAP. All REAP apprentices (100%) noted an increased likelihood of participating in the following activities: working on solving mathematical or scientific puzzles; using a computer to design/program somethings; helping with a community service project related to STEM; and working on a STEM project/experiment in a university/professional setting.
All REAP apprentices planned to at least complete a bachelor's degree and many reported an interest in earning a graduate or terminal degree.	All REAP apprentices (100%) said they wanted to earn at least a bachelor's degree. Many indicated a desire to earn a master's degree (29%) or terminal degree (59%) in their field.
REAP apprentices reported that participating in the program impacted their confidence and interest in STEM and STEM careers.	More than half of REAP apprentices (59%-100%) agreed that REAP contributed in some way to each impact about which they were asked. The greatest area of impact, with all apprentices agreeing, was feeling more confident in their STEM knowledge, skills, and abilities (100%).

HSAP Findings

Table 10. 2020 HSAP Evaluation Findings	
Priority #1: *Broaden, deepen, and diversify the pool of STEM talent in support of our Defense Industry Base*	
Although fewer applications were submitted for HSAP apprenticeships than in previous years in 2020 and fewer institutions hosted apprentices, more students were placed in apprenticeships than in 2019.	In 2020, the program received a total of 434 student applications for HSAP apprenticeships, a 35% decrease as compared to the 670 student applications received in 2019 and a 22% decrease as compared to the 559 applications in 2018.
	A total of 32 students (7% of applicants) were placed in apprenticeships, a 10% increase over the 29 students placed (4% placement rate) in 2019, but a 33% decrease in enrollment as compared to 2018 when 48 students were placed.
	The HSAP program was affected by campus shutdowns and/or restrictions placed on many college and university labs as a result of the COVID-19 pandemic in 2020. In response to the cancelation of many apprenticeship positions for high school students due to the pandemic, RIT planned and hosted an online summer course for displaced AEOP apprentices that served 17 students who had applied for HSAP apprenticeships.
	Few apprentices (n=8) and only one mentor participated in the evaluation survey. Because of the small sample size of apprentice respondents, no statistical comparisons of evaluation survey findings between groups could be conducted.
Fewer colleges and universities hosted HSAP apprentices than in previous years, and fewer of those institutions were HBCUs/MSIs.	A total of 20 universities hosted HSAP apprentices in 2020, a 20% decrease as compared to 2019 when 25 institutions hosted HSAP apprentices and a 39% decrease from 2018 when 33 institutions hosted apprentices. Seven of the 20 host universities (35%) were HBCU/MSIs, compared to 10 of 25 (40%) in 2019 and 13 of 33 (39%) in 2018.
Fewer HSAP apprentices met the AEOP definition of underserved than in previous years, and enrollment demographics indicate that the program served fewer females and students from underserved	Less than half of apprentices (47%) met the AEOP definition for underserved status, a decrease as compared to previous years (66% in 2019, 54% in 2018).
	As opposed to previous years, less than half of apprentices (44%) were female in 2020 (62% in 2019, 60% in both 2018 and 2017).

minority groups than in the past.	As in previous years, the most commonly reported races/ethnicities were White and Asian, however fewer apprentices were White (19%) and more were Asian (50%) compared to previous years (31% White, 21% Asian in 2019; 31% White, 33% Asian in 2018; 42% White, 25% Asian in 2017).
	The proportion of students identifying as Black or African American declined markedly in 2020 (6% in 2020, 14% in 2019, 15% in both 2018 and 2017). The percentage of apprentices identifying as Hispanic or Latino (16%) decreased as compared to 2019 (24%) but was slightly higher than in previous years (15% in 2018, 14% in 2017).
	More than half of HSAP apprentices (66%) spoke English as their first language (86% in 2019), few (16%) received free and reduced-price school lunches (FARMS) (21% in 2019), and very few (6%) would be first generation college attendees (14% in 2019).
Apprentices reported engaging in STEM practices more frequently in HSAP than in their typical school experiences.	Half or more of HSAP apprentices (50%-100%) reported participating at least once in all STEM practices during their apprenticeships. STEM practices that more than 85% of apprentices reported being frequently (most days or every day) engaged in during HSAP were: designing their own research/investigation based on their own question(s) (88%); interacting with STEM researchers (88%); analyzing data/information and drawing conclusions (88%); and solving real world problems (100%).
	Apprentices reported significantly higher frequency of engagement in STEM practices in HSAP as compared to in school (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.	All HSAP apprentices (100%) reported some degree of STEM knowledge gains as a result of participating in HSAP. Nearly 90% or more (88%-100%) indicated medium or large gains in every survey area of STEM knowledge. For example, all apprentices reported at least medium gains in knowledge of how scientists and engineers work on real problems in STEM (100%) and in-depth knowledge of a STEM topic (100%).
Apprentices reported gains in their STEM competencies as a result of participating in HSAP.	Half or more of participating apprentices (50%-100%) noted at least medium gains for all STEM competencies. All responding HSAP apprentices reported medium or large gains in two domains: defining a problem that can be solved by developing a new product/process (100%) and supporting an explanation with STEM knowledge (100%).

Apprentices reported that HSAP participation had positive impacts on their 21st Century.	More than half of apprentices (63%-100%) reported at least medium gains for all 21st Century skills items except for creating media products (0%) and analyzing media (38%). HSAP impacted all apprentices (medium or large gains) in 21st Century Skills such as the following: using technology as a tool (100%); incorporating feedback into their work effectively (100%); setting goals and utilizing time wisely (100%); working independently and completing tasks on time (100%); taking initiative (100%); and prioritizing, planning, and managing projects (100%).
Apprentices reported gains in their STEM identities as a result of participating in HSAP.	Three-quarters or more of HSAP apprentices (75%-100%) reported at least medium gains on all surveyed STEM identity items. All apprentices reported at least medium gains in their sense of accomplishing something in STEM (100%) and desire to build relationships with mentors who work in STEM (100%).
Priority #2: *Support and empower educators with unique Army research and technology resources.*	
The responding HSAP mentor used a range of mentoring strategies with apprentices.	The one responding HSAP mentor reported using strategies associated with each of the five areas of effective mentoring about which he was asked: 1. The mentor used all strategies, except giving students real-life problems to investigate or solve, to help make learning activities relevant to students. 2. The mentor used all strategies related to supporting the diverse needs of students as learners with the exception of integrating ideas from education literature to teach/mentor students from groups underrepresented in STEM; identifying different learning styles of students at the beginning of the program; and interacting with students and other personnel the same way regardless of background. 3. The mentor used all strategies to support student development of collaboration and interpersonal skills. 4. The mentor used each strategy to support student engagement in authentic STEM activities except for having students search for technical research to support their work. 5. The mentor used fewer than half of the strategies to support students' STEM educational and career pathways. The three strategies this mentor reported using were: asking their student about educational/career goals; providing guidance about educational pathways that will prepare their student for a STEM career; and discussing the economic, political, ethical, and/or social context of a STEM career.
HSAP apprentices were satisfied with program features that they had experienced and identified a number of benefits of HSAP. Apprentices also	Approximately two-thirds or more of HSAP apprentices (63%-100%) reported that they were at least somewhat satisfied with all program features listed. Features all HSAP apprentices reported being most satisfied with (somewhat or very much) included: applying or registering for the program (100%); the variety of STEM topics available (100%); the

offered various suggestions for program improvement.	teaching/mentoring provided (100%); and the amount of the stipend (100%).
	All HSAP apprentices reported that their mentors were available more than half of the time (100%), and more than three-quarters (88%) reported their mentors were always available.
	All HSAP apprentices (100%) indicated they were somewhat or very much satisfied with all elements of their research experience. All apprentices were "very much" satisfied with their working relationship with their mentors.
	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 STEM skills and research skills apprentices gained, apprentices' STEM learning, the college and career information they received, and the opportunity to connect with other students.
	Apprentices participating in phone interviews commented positively on their experience with the virtual format of their apprenticeships. Some apprentices noted that communication was more difficult virtually than in person, but most felt that their mentors were accessible. One apprentice commented that the virtual format did not accommodate interactions between apprentices well and that she would have liked more time for interactions between students and faculty and between students.
	In open-ended responses, the improvements most frequently suggested by apprentices focused on communication from the program, including suggestions for more communication and clearer abstract requirements. Other suggestions included allowing more time for applying STEM skills rather than receiving instruction, more seminars or speakers, allowing apprentices more input into the project design or providing more choices of topics, and providing opportunities for apprentices to interact or collaborate.
The responding HSAP mentor was satisfied with program features he had experienced; HSAP mentors identified strengths of HSAP and offered various suggestions for program improvements.	With the exception of two items, the one HSAP mentor responding to the evaluation survey was somewhat or very much satisfied with all program features.
	The mentor who responded to open-ended questionnaire items made positive comments about HSAP. Mentors mentioned the following as program strengths: apprentices' exposure to STEM research, the encouragement apprentices receive to consider STEM careers, the opportunity to develop STEM skills, apprentices' exposure them to academic settings, and the AEOP support for research.

	Mentors who participated in phone interviews responded positively about the virtual format of HSAP for 2020 but noted that creating connections between students was particularly challenging. Mentors employed various online mentoring tools, including virtual syllabi for research, virtual meeting tools, and online seminars.
	The program improvements suggested by mentors included increasing the number of HSAP apprentices participating online, offering the apprenticeship course simultaneously with the apprenticeship, providing virtual seminars to connect apprentices across the country, expanding the program to include more students, creating a hybrid virtual/in person program, providing stipends for graduate student mentors, ensuring that sites receive information from the program in a timely fashion, and clarifying expectations for abstract.
Priority #3: *Develop and implement a cohesive, coordinated and sustainable STEM education outreach infrastructure across the Army*	
Apprentices and mentors learned about AEOP through their school, the AEOP website or AEOP staff, and from a supervisor.	The most frequently selected sources of information about AEOP for apprentices, each selected by 50% of respondents were the AEOP website and someone who works at the school they attend.
	The one responding mentor reported that he learned about AEOP from a supervisor and an AEOP site host/director.
Apprentices were motivated to participate in HSAP primarily by the learning opportunities and their interest in STEM.	Approximately two-thirds or more of apprentices selected interest in STEM (75%), the desire to learn something new/interesting (63%); and the desire to expand laboratory/research skills (63%) as motivating factors for their participation in HSAP.
Most apprentices had not participated in AEOP previously, but most were interested in participating in AEOP in the future.	Three-quarters (75%) of apprentices reported they had not previously participated in any AEOP. A quarter (25%) had participated in Camp Invention previously, and a small proportion indicated having participated in HSAP previously (13%).
	Except for CQL (39%) and GEMS NPM (39%), half or more of apprentices reported being at least somewhat interested in the other AEOP (50%-88%). At the same time, half or more of HSAP apprentices reported having never heard of most AEOP (NDSEG – 50%, GEMS NPM – 63%, CQL – 63%).
	Large proportions of apprentices reported the following four resources to be particularly impactful (somewhat or very much) for exposing them to AEOP: participation in HSAP (100%), HSAP mentors (100%), the AEOP website (100%), and presentations shared in HSAP (63%). Half or more of

	responding apprentices had not experienced AEOP on social media (88%) or AEOP printed materials (50%).
The responding mentors had only discussed HSAP with his apprentices.	The responding mentor had not discussed any AEOP other than HSAP with apprentices.
	The responding mentor indicated the AEOP website and participation in HSAP were very much useful for exposing apprentices to AEOP. All other resources were not experienced by this mentor for this purpose.
Apprentices learned about STEM careers during HSAP, although they learned more about STEM careers generally than STEM careers specifically within the DoD.	All HSAP apprentices (100%) indicated they learned about at least one STEM job/career, while approximately a third (38%) noted learning about three or more general STEM careers. Three-quarters of apprentices (75%) reported learning about at least one DoD STEM job/career, and a quarter (25%) reported learning about three or more Army or DoD STEM jobs/careers.
	Half or more of apprentices reported the following resources as somewhat or very much impactful for their awareness of STEM careers in the DoD: the AEOP website (50%); presentations shared in program (63%); HSAP mentors (75%); and participation in HSAP (88%). More than half of HSAP apprentices said they had not experienced AEOP resources such as the ARO website (63%), AEOP printed materials (75%), and AEOP on social media (75%).
	The one responding HSAP mentor indicated he had experienced only the AEOP website as a useful resource for exposing apprentices to DoD STEM careers. He reported having not experienced any of the other resources for this purpose.
Apprentices expressed positive opinions about DoD research and researchers.	HSAP apprentices expressed extremely positive opinions about DoD researchers and research with all (100%) agreeing with each statement 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.	All apprentices reported that they were more likely or much more likely to participate in each STEM activity about which they were asked with the exception of watching or reading non-fiction STEM (88%) and talking with friends/family about STEM (88%).
All HSAP apprentices planned to at least complete a bachelor's degree, and many reported an interest in earning a graduate or terminal degree.	All HSAP apprentices (100%) reported wanting to at least earn a bachelor's degree. Many indicated a desire to earn a master's degree (13%) or terminal degree (75%) in their field.

HSAP apprentices reported that participating in the program impacted their confidence and interest in STEM and STEM careers.	Approximately two-thirds or more (63%-100%) of HSAP apprentices agreed that the program contributed in some way to each impact about which they were asked. All apprentices said HSAP contributed to their increased confidence in their STEM knowledge, skills, and abilities (100%) and gave them a greater appreciation of Army/DoD STEM research (100%).

URAP Findings

Table 11. 2020 URAP Evaluation Findings	
Priority #1: *Broaden, deepen, and diversify the pool of STEM talent in support of our Defense Industry Base*	
The number of URAP applicants and apprentices decreased as compared to previous years.	In 2020, URAP received 258 student applicants for URAP apprenticeships, an 8% decrease from the 281 applicants received in 2019, and a 20% decrease as compared to the 321 who applied in 2018.
	A total of 49 applicants (19% of applications) were placed in apprenticeships in 2020, a 9% decrease compared to the 54 students placed in 2019 and a 27% decrease in placement compared to 2018 when 67 students were placed.
	URAP enrollment was affected by campus shutdowns and/or restrictions placed on many college and university labs as a result of the COVID-19 pandemic in 2020
Fewer colleges and universities hosted URAP apprentices in 2020 than in previous years, and fewer were HBCUs/MSIs than in previous years.	A total of 30 institutions (29 universities and one institute for psychiatric research) hosted apprentices, a 27% decrease as compared to the 41 host institutions in 2019 and a 38% decrease compared to the 48 host institutions in 2018. Of these institutions, six (20%) were HBCU/MSIs, a decrease as compared to previous years (10, or 24% in 2019; 22, or 46% in 2018).
The proportion of female URAP apprentices and apprentices who met the AEOP definition of underserved grew relative to previous years, however the proportion of apprentices from underserved minority group declined relative to previous years.	Over a quarter (29%) of URAP apprentices met the AEOP definition of underserved, an increase compared to previous years (22% in 2019, 18% in 2018).
	The proportion of female apprentices in 2020 (45%) grew relative to the two previous years (39% in 2019, 39% in 2018, 58% in 2017).
	The proportion of apprentices identifying as White (35%) decreased as compared to previous years (57% in 2019, 64% in 2018, 53% in 2017). The

	proportion of apprentices identifying as Asian (37%) increased sharply as compared to previous years (19% in 2019, 9% in 2018, 14% in 2017).
	The proportion of apprentices identifying as Black or African American (4%) continued a multi-year decline (6% in 2019, 9% in 2018, 8% in 2017). The proportion of apprentices identifying as Hispanic or Latino (12%) decreased from 2019 (15% in 2019, 10% in 2018, 15% in 2017).
	As in 2019, most apprentices (82% for both 2019 and 2020) spoke English as their first language, and few (14% in 2020, 13% in 2019) were first generation college attendees. A quarter (25%) of apprentices were Pell Grant recipients.
Apprentices reported engaging in STEM practices more frequently in URAP than in their typical college or university experiences.	More than half of URAP apprentices (56%-100%) reported participating in all STEM practices at least once during their program with the exception of presenting their STEM research to a panel of judges (0%). STEM practices that more than 90% of apprentices reported being frequently (most days or every day) engaged in included: working with a STEM researcher or company on a real-world STEM research project (94%); working collaboratively as part of a team (94%); and analyzing data/information and drawing conclusions (100%).
	Apprentices reported significantly more frequent engagement in STEM practices in URAP as compared to in their college or university coursework (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 met the AEOP definition of underserved reported greater gains than non-underserved apprentices.	Three quarters or more (75%-100%) of apprentices reported medium or large gains in each surveyed area of STEM knowledge. For example, all apprentices reported at least medium gains in knowledge of how scientists and engineers work on real problems in STEM (100%) and in their in-depth knowledge of a STEM topic (100%).
	Although no significant differences in gains in STEM knowledge were found by any of the individual demographic components of underserved status, apprentices who met the AEOP definition of underserved reported significantly greater gains than non-underserved apprentices (large effect size).
Apprentices reported gains in their STEM competencies as a result of participating in URAP; apprentices who met the AEOP definition of underserved	More than half of participating URAP apprentices (56%-94%) noted at least medium gains across competencies. More than 90% of responding apprentices reported medium or large gains in two domains: using knowledge/creativity to suggest a solution to a problem (94%) and defining a problem than can be solved by developing a new product/process (94%).

reported greater gains than non-underserved apprentices.	Although no significant differences in gains in STEM competencies were found by any of the individual demographic components of underserved status, apprentices who met the AEOP definition of underserved reported significantly greater gains than non-underserved apprentices (large effect size).
Apprentices reported that URAP participation had positive impacts on their 21st Century skills; apprentices who met the AEOP definition of underserved and female apprentices reported greater gains than their peers.	Half or more of apprentices (50%-100%) reported at least medium gains across all items except for creating media products (13%) and analyzing media (25%). CQL impacted all apprentices (medium or large gains) in the 21st Century skills area of adapting to change when things do not go as planned (100%).
	Apprentices who met the AEOP definition of underserved reported greater gains in their 21st Century skills than non-underserved apprentices (large effect size), and females reported greater gains than males (large effect size).
Apprentices reported gains in their STEM identities as a result of participating in URAP; apprentices who identified as belonging to a racial or ethnic minority group included in the underserved definition reported greater gains.	More than 80% of URAP apprentices (81%-100%) indicated at least medium gains on all survey items associated with STEM identity (Table 68). All reported at least medium gains in their feeling prepared for more challenging STEM activities (100%).
	While no significant differences were found by overall underserved status, apprentices who identified as belonging to a racial or ethnic minority group included in the AEOP definition of underserved reported significantly greater gains than their peers (large effect size).
Priority #2: ***Support and empower educators with unique Army research and technology resources.***	
URAP mentors used a range of mentoring strategies with apprentices.	A majority of URAP mentors reported using strategies associated with each of the five areas of effective mentoring about which they were asked: 1. Nearly two-thirds or more (60%-90%) of URAP mentors reported that they implemented all strategies to help make learning activities relevant to students. 2. Half or more (50%-100%) of URAP mentors reported that they used all strategies to support the diverse needs of students as learners. 3. More than two-thirds of URAP mentors (70%-100%) indicated implementing all strategies to support students' development of collaboration and interpersonal skills. 4. More than three-quarters (80%-100%) of URAP mentors reported using all strategies to support students' engagement in authentic STEM activities. 5. Half or more of URAP mentors (50%-90%) reported using all strategies focused on supporting students' STEM educational and career

	pathways except for recommending AEOP that align with students' goals (40%).
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.	Three-quarters or more of URAP apprentices (75%-100%) reported being at least somewhat satisfied with all program features listed except for physical location (50% did not experience, 50% somewhat/very much satisfied). Features that all apprentices were satisfied with were the application/registration for program (100%) and the variety of STEM topics available (100%).
	Nearly all apprentices indicated that their mentors were available at least half of the time (94%), and more than two-thirds (69%) responded that their mentors were always available.
	All responding URAP apprentices reported high levels of satisfaction (somewhat or very much) for each aspect of their research experience. All apprentices indicated that they were "very much" satisfied with their apprenticeship experience overall.
	All apprentices who responded to open-ended questions made positive comments about their satisfaction with URAP. The most frequently cited benefits of URAP were the value of the networking opportunities and their relationships with their mentors, the research experience and skills they gained, STEM learning, and gaining career information.
	Apprentices participating in phone interviews also commented upon their satisfaction with the virtual format of the program. All apprentices made positive comments about the online format. While most apprentices noted that they would have preferred to complete their apprenticeships on site, they reported feeling engaged with the research process.
	Apprentices suggested a wide variety of improvements in open-ended responses. The most frequently mentioned improvements related to communication with the program, including suggestions for more frequent communication and more communication about guidelines and requirements. Other suggestions included providing more career information, providing more interactions between apprentices, providing ways for apprentices to share their work with others or for apprentices to learn about others' research, and improvements to the stipend (e.g., timely payment, biweekly payment, and more clear communication about the stipend).
URAP mentors were satisfied with program features that they had experienced and	More than three-quarters of URAP mentors (80%-90%) indicated they were at least somewhat satisfied with all program components they had experienced. Program features mentors reported being most satisfied with

identified a number of strengths of the URAP program. Mentors also offered various suggestions for program improvements.	(somewhat or very much) were the timeliness of stipend payment to apprentices (90%); research abstract preparation requirements (90%); and the research presentation process (90%).
	All mentors who responded to open-ended items made positive comments about URAP. The most frequently mentioned strength was apprentices' exposure to research and the research experience apprentices gain in URAP, followed by mentors' opportunity to work with talented students, and the DoD information apprentices gain.
	Mentors participating in phone interviews who commented on the virtual format of URAP were positive about the experience but noted that formulating ways for apprentices to interact with one another online is a challenge. Mentors noted a variety of ways they engaged with students, including holding daily or biweekly meetings, giving students regular feedback, and having daily discussions using videoconferencing.
	In open-ended responses, mentors' most frequently mentioned suggestions were to provide more outreach or advertising to increase the number of applicants, to provide opportunities for apprentices to present their research, to communicate more clearly about requirements for the abstracts, and to extend the program's length (e.g., through the school year).
Priority #3: ***Develop and implement a cohesive, coordinated and sustainable STEM education outreach infrastructure across the Army***	
Apprentices and mentors learned about AEOP primarily through their school or workplace or from DoD contacts.	The most frequently selected sources of information about AEOP for apprentices were someone who works at the school/university they attend (83%), followed by someone who works with the program (25%).
	The two most commonly selected responses for how mentors learned about AEOP were their supervisor/superior (30%) and someone who works with the DoD (30%).
Apprentices were motivated to participate in URAP primarily by the learning opportunities and their interest in STEM.	Half or more of apprentices noted they were motivated to participate in URAP because of a desire to learn something new/interesting (58%) and an interest in STEM (50%).
Only one URAP apprentice reported having participated in another AEOP in the past, but many expressed interest in future participation, although large proportions had not	Nearly all apprentices (92%) reported they had never participated in any other AEOP. Only one respondent indicated they had previously participated in JSHS (8%).
	Most apprentices were interested in participating in URAP again (94%) and over 40% were interested in SMART (44%). Half of more of apprentices said

heard of AEOP other than URAP.	they had not heard of programs other than URAP: CQL (69%), GEMS-NPM (63%), NDSEG (63%), and SMART (50%).
	Half or more reported the following four resources as particularly impactful (somewhat or very much) on their awareness of AEOP: URAP mentors (100%); the AEOP website (94%); participation in URAP (81%); and presentations shared in URAP (50%). More than half of responding apprentices had not experienced AEOP on social media (69%) or AEOP printed materials (56%).
Few mentors discussed any specific AEOP other than URAP with their apprentices.	A majority of mentors (70%) reported speaking with their apprentices about URAP (70%), and two mentors (20%) discussed SMART and NDSEG with apprentices. Another 40% had discussed AEOP generally, but without reference to any specific program.
	More than half of mentors reported that URAP participation (80%) was at least somewhat useful for making apprentices aware of AEOP, followed by the AEOP website (60%). Most mentors indicated that they did not experience invited speakers (70%) or AEOP on social media (60%) as resources for exposing apprentices to AEOP.
Apprentices learned about STEM careers during URAP, although they learned about more STEM careers generally than STEM careers specifically within the DoD.	A large proportion of URAP apprentices (81%) indicated learning about at least one STEM job/career during URAP, and approximately a third (31%) reported that they learned about three or more STEM careers in general. Considerably fewer apprentices (31%) reported learning about at least one DoD STEM job/career, and none (0%) reported learning about three or more Army or DoD STEM jobs/careers.
	Approximately two-thirds of apprentices reported the following resources as somewhat or very much impactful on their awareness of DoD STEM careers: the AEOP website (63%); URAP mentors (63%); and participation in URAP (69%). Half or more of URAP apprentices said they had not experienced AEOP resources such as AEOP on social media (69%) and AEOP printed materials (50%).
	Mentors were most likely to rate participation in URAP (70%) and the AEOP website (70%) as at least somewhat useful resources for exposing apprentices to DoD STEM careers. More than half of responding URAP mentors had not experienced invited speakers (70%) and AEOP on social media (60%).
Apprentices expressed positive opinions about DoD research and researchers.	URAP apprentices expressed extremely positive opinions about DoD researchers and research with all (100%) agreeing with all statements about DoD research and researchers.

Apprentices reported that they were more likely to engage in various STEM activities in the future after participating in URAP; apprentices who met the AEOP definition of underserved, females, and low-income apprentices were more likely to report increased likelihood of future engagement than non-underserved apprentices.	All or nearly all URAP apprentices (94%-100%) indicated that after participating in URAP they were more likely to engage with all activities about which they were asked. The only activity for which less than 100% of apprentices reported increased likelihood of engagement was participating in a STEM camp, club, or competition (94% were more likely to engage).
	Apprentices who met the AEOP definition of underserved, female apprentices, and low-income apprentices reported greater likelihood of future engagement than others (all large effect sizes).
All URAP apprentices planned to at least complete a bachelor's degree, and many reported an interest in earning a graduate or terminal degree.	All URAP apprentices (100%) reported aspiring to earn at least a bachelor's degree. Many said they desired to earn a master's degree (44%) 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.	Nearly 70% or more (69%-100%) of URAP apprentices agreed that participating in URAP contributed in some way to each impact listed. All apprentices reported that participating in URAP contributed to their increased confidence in their STEM knowledge, skills, and abilities (100%).

Summer Apprenticeship Course Findings

Table 12. 2020 Summer Apprenticeship Course Evaluation Findings	
Priority #1: *Broaden, deepen, and diversify the pool of STEM talent in support of our Defense Industry Base*	
Students displaced from the three high school AEOP apprenticeship programs participated in the Summer Apprenticeship Course.	The apprenticeship course *Science in the Real World: Finding Your Voice* served 104 students. Of these students, 54 were displaced REAP students, 17 were displaced HSAP students, and 31 were displaced SEAP students. Two additional students who had not applied to apprenticeship programs were also accepted for the course.
The apprenticeship course served students from diverse backgrounds, and most met the AEOP definition of underserved.	Nearly three-quarters (73%) of students met the AEOP definition of underserved.
	Nearly three quarters of students enrolled in the apprenticeship course were female (74.5%) and just over a quarter (25.5%) were male.
	The most frequently reported race ethnicity was Asian (45%) followed by Black or African American (27%), White (11%), and Hispanic or Latino (10%).

	Most students (68%) attended suburban schools, and most (56%) were in the 11th grade. Less than a third (29%) received free or reduced-price school lunches (FARMS). Most students in the course (71%) spoke English as their first language, and relatively few (19%) would-be first-generation college attenders.
Students reported gains in their STEM knowledge as a result of participating in the apprenticeship course; students who would-be first-generation college attendees and ELL students experienced larger gains.	Approximately 70% of students or more (70%-95%) reported either medium or large gains in every area of STEM knowledge on the survey. The area with the largest knowledge gain was students' knowledge of research processes, ethics, and rules for conduct in STEM (95%).
	No significant differences in STEM knowledge gains were found by overall underserved status, however students who did not have a parent who attended college and students for whom English was not a first language reported larger gains than their peers (medium and large effect sizes respectively).
Students reported that participating in the apprenticeship course had positive impacts on their 21st Century skills.	More than half of students reported high levels (medium to large) of 21st Century skills gains (58%-97%) across survey items as a result of participating in the course with the exception of creating media products (17% - medium/large gains). Three items for which nearly all participants reported at least medium gains were: communicating clearly (94%); evaluating others' evidence, arguments, and beliefs (95%); and collaborating with others effectively in diverse teams (97%).
Students reported gains in their STEM identities as a result of participating in the apprenticeship course.	Approximately three-quarters or more of students (72%-95%) reported medium or large gains on all items associated with STEM identity. Nearly all students reported at least medium gains in their desire to build relationships with mentors who work in STEM (95%).
Priority #2: *Support and empower educators with unique Army research and technology resources.*	
Apprenticeship course student were satisfied with program features that they had experienced and identified a number of benefits of the course. Students also offered various suggestions for program improvement.	More than 90% of students (94%-100%) indicated being somewhat or very much satisfied with all program features. Features with which all students reported being at least somewhat satisfied included the ability of course to meet their expectations (100%) and small group meetings with near peer mentors (100%).
	When asked to comment on their overall satisfaction with the course, all 36 students had something positive to say. Students who identified the sources of their satisfaction with the course mentioned the opportunity to meet new people, their learning, the speakers, the NPMs, the career information

	they received, and their new perspective on social issues related to STEM. Students most consistently commented upon the opportunity to network (with other students, their mentors, and professors) the value of the speakers, and their broadened perspectives about STEM.
	In open-ended responses, the improvements most frequently suggested by students were related to course assignments and activities (e.g., more time for assignments, more interactive activities), connections with others (e.g., more connections with peers, NPMs, and professors), course content (e.g., more science focus or more variety in topics), communication (e.g., clarifying expectations, providing syllabi and rubrics), and course format or organization (e.g., making the course longer).
Students reported that their mentors were available to them regularly and that mentors used a variety of mentoring strategies during the course.	All but one respondent said their mentor was available at least half of the time (97%), and more than three-quarters (78%) noted their mentor was always available.
	A large majority of students (72%-100%) reported that their mentors in the course used each of the mentoring strategies about which they were asked. All students reported that mentors encouraged them to share ideas with others who had different backgrounds or viewpoints than they (100%) and gave them feedback to help them improve in STEM.
Apprenticeship course student expressed the desire to work with NPMs throughout the school year in various ways.	A large majority of students (91%) responded that they would like to connect with NPMs throughout the school year. Those that expanded on the reasons for their responses commented that the NPMs were useful resources for college and other information.
	Students who provided details about how they would like to work with NPMs most frequently indicated that they would like to connect with NPMs regarding college information (e.g., college application information, assistance with writing essays). Other suggestions for how NPMs would work with students included providing information about STEM opportunities or networking), general advice and guidance, assistance or tutoring with STEM courses or study habits, and discussing STEM issues and current events.
Apprenticeship course students expressed the desire to have webinars available to them throughout the school year; students' interests in topics varied.	Nearly all students (98%) were interested in having webinars available to them during the school year.
	Students were interested in webinars about college (e.g., admissions information and application information), STEM career information (e.g., personal stories of people in STEM careers, types of STEM careers), general STEM topics (e.g., specific disciplinary content, policy issues), information about internships and co-ops, and information about soft skills.
Priority #3: *Develop and implement a cohesive, coordinated and sustainable STEM education outreach infrastructure across the Army*	

Apprenticeship course participants enrolled in the course for a variety of reasons and indicated interest in future enrollment in a similar course that did not offer college credit.	Approximately three-quarters or more of students reported the following motivations for taking the course: doing something in STEM (79%), college credit (75%), something to do with the cancellation of apprenticeships (75%), and the stipend (72%).
	Nearly all responding students (92%) said they would choose to enroll in a similar course without college credit tied to it.
Most apprenticeship course students had not participated in AEOP in the past; however, most are interested in participating in AEOP in the future.	Two-thirds (67%) of students said they had not previously participated in any AEOP, however smaller proportions indicated having participated in the following programs: GEMS (15%), Camp Invention (12%), REAP (6%), eCM (3%), and JSHS (3%).
	More than half of students (61%-86%) were at least somewhat interested in participating in AEOP in the future. The programs that students reported being most interested in were GEMS NPM (86%), REAP (83%), SEAP (83%), SMART (81%), and HSAP (81%).
	The resources students most frequently cited as being somewhat or very much useful for their awareness of AEOP were participation in the summer course (97%); presentations from the summer course (97%); summer course instructors (95%); and the AEOP website (86%). More than half of students reported not experiencing AEOP social media for this purpose.
Most apprenticeship course participants learned about STEM careers generally and DoD STEM careers specifically during the course.	Large proportions of students (97%) reported learning about at least one STEM job/career and nearly all (94%) also noted learning about three or more general STEM careers. Similarly, a large majority of students (94%) reported they learned about at least one DoD STEM job/career, although fewer (56%) indicated that they learned about three or more Army or DoD STEM jobs/careers during the course.
	More than 90% of students reported that the following three resources were at least somewhat impactful on their awareness of DoD STEM careers: participation in the summer course (97%); presentations shared in the summer course (95%); and summer course instructors (92%). More than a third of students reported they had not experienced AEOP resources such as the AEOP on social media (64%) and AEOP printed materials (36%).
Apprenticeship course participants expressed positive opinions about DoD research and researchers.	Student opinions about DoD researchers and research were overwhelmingly positively with more than 97% agreeing with all statements regarding the work of DoD researchers and the research conducted.

Apprenticeship course participants reported that they were more likely to engage in various STEM activities after participating in the course.	Students reported extremely high levels of likelihood (89%-100%) for engaging in the future with STEM activities outside of their regular school courses listed as a result of participating in the apprenticeship course
All apprenticeship course students planned to at least complete a bachelor's degree, and many reported an interest in a graduate or terminal degree.	All students (100%) reported wanting to at least earn a bachelor's degree and many indicated a desire to earn a master's (25%) or terminal degree (64%).
Apprenticeship course participants reported that participating in the course impacted their confidence and interest in STEM and STEM careers.	Approximately three-quarters or more of students (72%-100%) agreed that the summer course contributed in some way to each impact. Areas of greatest impact, with more than 90% of students agreeing that the program impacted them, were more confidence in STEM knowledge, skills, and abilities (100%) and a greater appreciation of DoD STEM research (92%).

Overall Recommendations for FY21 Program Improvement/Growth

Evaluation findings for apprenticeship programs overall were very positive. All programs enabled participants to experience some growth in their STEM practices, STEM knowledge, STEM competencies, and STEM identities. 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 FY21 and beyond:

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

As expected, most of the apprenticeship programs in FY20 experienced a decline in both applications and participation due to the impact of COVID-19 on access to apprenticeship program host sites on university campuses and at Army/DoD laboratories, and participation of mentors to deliver the program virtually. However, the number of applications despite COVID-19 still greatly exceeded the number of apprenticeships that were available for students due to a lower number of sites and mentors. HSAP was able to navigate the move to a virtual program while growing participation slightly in FY20 to 32 apprentices (compared to 29 in FY19). All other AEOP apprenticeship programs declined in number of students included in FY20 including CQL 159 (compared to 194 in FY19), REAP 86 (compared to 168), SEAP 28 (compared to 108 in FY19), and URAP 49 (compared to 54 in FY19). The demand for AEOP apprenticeships continues to exceed current capacity. Therefore, it is recommended that RIT and the consortium consider strategies to increase the scale of opportunity for apprenticeships. Further, given

that COVID-19 may create additional need in FY21 for delivery of apprenticeships in a virtual format, coupled with the positive feedback on the online program delivery, it is suggested that this option be explored for growing the AEOP apprenticeship program overall.

In regard to participation of individuals from historically underserved backgrounds according to the AEOP definition, most apprenticeship programs experienced a decline in percentages of underserved participants, with the exception of URAP in FY20 at 29% (22% in FY19). Program declines ranged from slight drops including CQL at 26% FY20 (compared to 35% in FY19); SEAP at 21% in FY20 (compared to 32% in FY19); and REAP at 94% in FY20 (compared to 99% inFY19). HSAP experienced a larger decrease in FY20, experiencing a nearly 20% decline with 47% underserved participants. Clearly the AEOP were met with challenges due to COVID-19. However, it is critical for mentors, program directors, and others involved in the selection process to keep in mind this important priority for AEOP overall when making acceptance/placement decisions.

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

Overall, participants reported having a successful experience participating in their AEOP apprenticeship program. However, one common finding across programs was the lack of mentor emphasis on academic program and career pathway discussions/information/activities. It is recommended that RIT consider the development (along with AEOP consortium overall) of materials, activities, and resources that apprenticeship mentors and adults leading AEOP can use in the course of their program delivery to provide both exposure and support for students who are thinking about (high school) and in some cases planning (college) their future while participating in these apprenticeships. It is possible that this may be a focus area that the entire consortium may want to consider collaborating to address.

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

Apprenticeship participation in the annual AEOP evaluation for FY20 was considerably lower than in previous years, possibly exasperated by COVID-19. Some programs had less than five respondents for participants and mentors which makes it very difficult to conduct typical analyses. In addition, as in previous years, overall, apprenticeship program participants reported they were not introduced to other AEOP opportunities. It is recommended that all AEOP apprenticeship programs develop a plan and support for FY21 to increase participation in the AEOP evaluation accordingly and continue to work with mentors to provide resources to enable them to disseminate information about other AEOP with their students.