Army Educational Outreach Program

College Qualified Leaders

2016 Annual Program Evaluation Report

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Executive Summary

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

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

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

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

Summary of Findings

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

2016 CQL Evaluation Findings	
Participant Profiles	
CQL experienced decline in enrollment overall while seeing participation of females increase slightly while other groups remained steady with no increase.	Overall enrollment for CQL significantly decreased in FY16 by 40% (236 participants). However, overall applications grew 19%. CQL did make some progress in growing the number of female participants to 46% (compared to 40% in FY15). Although females continued to participate at a lower rate than males (in FY16 54% of participants were males, 46% were females), this increase in the participation of female students—a population that is historically underrepresented in STEM fields (particularly physical science and engineering fields) – is a significant gain. It is important to note that in FY16 CQL began phasing out graduate student participation and did not award any new graduate student CQL apprenticeships.
	CQL continued to serve students from historically underrepresented and underserved race/ethnicity groups, however the majority of enrolled apprentices (85%) identified themselves as "White" or "Asian." The percentage of Black or African American and Hispanic or Latino apprentices remained steady at 11% and 3% respectively. In sum, only 13% of enrolled participants identified themselves as being from an underrepresented or underserved minority groups (same as in FY15), indicating that continued focus needs to be invested in growing the diversity of CQL participants.

CQL participants reported limited past participation in other AEOPs, suggesting that recruiting apprentices from other AEOPs is an area with potential for growth.	Questionnaire data indicate that responding apprentices had participated in few AEOPs aside from CQL previously, although 32% report having participated in CQL in the past. While 19% reported having participated in GEMS, only 14% of respondents reported having participated in SEAP previously as compared with 32% of CQL apprentices who reported participating in SEAP in FY15. Program registration data indicated that 41% of enrolled CQL participants had participated in SEAP in FY15 and 17% had previously participated in GEMS.
CQL did not meet its targeted number of program applicants or mentors.	CQL received 467 of their targeted 650 applications in FY16. This was an increase in applicants from FY15 (550) but fewer than targeted. In CQL, student participation is dependent upon the number of available mentors. The CQL program had only 162 mentors in FY16, which limited the number of apprentices that could be accepted significantly. However, the 162 mentors served more than one apprentice on the rolling schedule of apprenticeships – meeting the 1:1 mentor requirement. The number of CQL mentors decreased in FY16 (176) from FY15 (369).
Actionable Program Evaluation	
CQL's primary mode of recruitment continues to be personal connections.	Apprentice questionnaire respondents indicated that they most commonly learned about CQL from a personal or university contact.
	Apprentice interview data support the notion that pre-existing relationships are key factors in apprentice awareness of CQL.
CQL apprentices were motivated to participate in CQL by a variety of factors.	Apprentices were motivated to participate in CQL by a wide variety of factors, however large majorities of apprentices indicated that the desire to learn something new or interesting, interest in STEM, and the desire to expand their laboratory or research skills were key motivators for participation.
CQL engaged apprentices in meaningful STEM learning.	Apprentices reported consistent learning in a variety of areas as a result of CQL, including learning about STEM topics, applying STEM to real-life situations, and learning about STEM careers.
	Apprentices reported consistently engaging in a variety of STEM practices during their CQL experience. For example, most apprentices reported engaging in activities such as using laboratory procedures and tools, working as part of a team, and carrying out investigations on most days or every day of their CQL experience.
	CQL provided more intensive opportunities for apprentices to learn about STEM and engage in STEM practices than they had within their typical school settings.
	Mentors reported using a wide variety of strategies to help make learning activities relevant to apprentices, support the needs of diverse learners, develop apprentices' collaboration and interpersonal skills, engage apprentices in authentic STEM activities, and support apprentices' STEM career and education pathways.

CQL promoted apprentice awareness of DoD STEM research and careers.	A large majority of CQL participants reported learning about at least one STEM career and most reported learning about 4 or more. Similarly, a large majority of apprentices reported learning about at least one DoD STEM job, with over half reporting they learned about 4 or more. Apprentices reported that their mentors and the CQL experience contributed the most to this impact.
Apprentices' awareness of other AEOPs increased as a result of their CQL participation, however mentors and apprentices overall have only limited awareness of other AEOP opportunities and AEOP resources.	Over half of responding apprentices reported that CQL influenced their awareness of AEOPs and, similarly, over half of apprentices reported being interested in future participation in AEOP initiatives. Apprentices reported that participation in CQL and their mentors were the most useful resources learning about other AEOPs, however, mentors overall reported limited familiarity with AEOP initiatives aside from CQL. Large proportions of apprentices and mentors reported having no experience with AEOP resources such as the AEOP website, the It Starts Here! Magazine, AEOP on social media, and the AEOP brochure.
Apprentices and mentors value the CQL experience, although aspects of program administration continue to be areas identified for improvement.	A large majority of responding apprentices reported being satisfied with their mentors and experiences during the CQL program. For example, 99% of responding apprentices reported being at least somewhat satisfied with their working relationship with their mentors and 89% with the amount of time they spent doing meaningful research.
	Both apprentices and mentors were asked about their overall satisfaction with the CQL program in an open-ended item on the questionnaire. Almost all respondents had positive perceptions of the program. However some apprentices described dissatisfaction with administrative aspects of the program. In particular, apprentices noted difficulties in getting computer access and difficulties in receiving stipend payments on time. When asked how the program could be improved, apprentice respondents indicated that improvements could be made in administrative tasks such as timely stipend payments, and faster computer access.
Outcomes Evaluation	
CQL apprentices reported gains in their STEM knowledge and competencies.	Large proportions of apprentices reported large or extreme gains in their STEM knowledge. For example, a majority of respondents reported large or extreme gains in their knowledge of what everyday research work is like in STEM, knowledge of how scientists and engineers work on real problems in STEM, in-depth knowledge of a STEM topic(s), and knowledge of research conducted in a STEM topic or field.
	Most apprentices reported large or extreme gains in their STEM competencies. For example, most apprentices reported large or extreme gains in their abilities to ask questions that can be answered with one or more scientific experiments; support an explanation with relevant scientific, mathematical, and/or engineering knowledge;

	Integrate information from technical or scientific texts and other media to support their explanation of an observation; and communicate about their experiments and explanations in different ways (through talking, writing, graphics, or mathematics).
CQL participants reported gains in apprentices' 21st Century Skills.	Apprentices reported large or extreme gains in several critical workplace skills, with most apprentices reporting large or extreme gains in areas such as the ability to make changes when things do not go as planned, sticking with a task until it is complete, and learning to work independently.
CQL participants reported increased confidence and identity in STEM.	Apprentices reported gains in their confidence and STEM identity. For example, most apprentices reported large or extreme gains in feeling prepared for more challenging STEM activities, the desire to build relationships with mentors in STEM fields, and having a sense of accomplishing something in STEM.
CQL participants reported increased interest in future STEM engagement.	Apprentices reported that that they were more likely to engage in STEM activities outside of school after participating in CQL. For example, a majority of apprentices indicated that they were more likely to mentor or teach other students about STEM, to talk with friends or family about STEM, and to work on a STEM project or experiment in a university or professional setting after participating in CQL.
CQL influenced apprentices' education aspirations, but did not change their career aspirations.	Apprentices expressed more interest in pursuing advanced degrees after their participation in CQL. In particular, apprentices were more likely to aspire to earn Ph.D. degrees after CQL as compared to their pre-CQL educational aspirations.
	Nearly all apprentices aspired to a career in a STEM field both before and after participating in CQL.
CQL participants reported interest in participating in AEOPs in the future.	A majority of apprentices reported being at least somewhat interested in participating in CQL, the SMART scholarship, and the NDSEG fellowship in the future. Although substantial numbers of apprentices indicated that they had never heard of the GEMS Near Peer Mentor program (36%) and URAP (41%), over a quarter of apprentices expressed some interest in participating in these programs in the future. Apprentices reported that participation in CQL and their mentors were most likely to impact their awareness of other AEOPs.
CQL apprentices have positive opinions about DoD researchers and research.	Apprentice perceptions of DoD researchers and research were overwhelmingly positive. All responding apprentices agreed or strongly agreed that DoD researchers advance science and engineering fields, and nearly all agreed or strongly agreed that DoD researchers solve real-world problems, that DoD research is valuable to society, and that DoD researchers develop new, cutting-edge technologies.

Responsiveness to FY15 Evaluation Recommendations

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

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

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

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

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

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

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

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

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

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

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

research. In addition, potential mentors should be made aware of these supports as an added incentive to participate in CQL.

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

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

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

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

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

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

CQL FY16 Efforts and Outcomes: In FY16, AAS worked with Battelle to improve the stipend payment process. A clear process was developed to pay stipends on time at the first of each month. We anticipate continuing the use of this process because it tracks stipend payments clearly for both the labs and the CAM. Lab coordinators report no difficulty with the system and students receive payments on time. Lab coordinators and student alike both pointed out that the timeframe for security clearance and computer access takes a great deal of time. While AAS has no direct control over these issues, we will suggest opening and closing the application earlier to allow for more time to process paperwork before a student begins an apprenticeship.

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

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

evaluation links must be sent to the mentors for completion and the importance of the evaluations. Again, a shorter survey and an incentive could prove to be helpful.

FY16 Recommendations

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

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

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

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

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

1. Since the number of available mentors places a limit on the number of apprentices the CQL program can accommodate, the program may want to consider what incentives it can provide for mentor participation. Mentors in focus groups suggested increased program outreach to potential mentors, program recognition of mentor efforts, and

support in the form of overhead funding for mentors as means to increase the pool of CQL mentors. Other mentor recruitment strategies the program may wish to consider include highlighting the potential benefits of apprentice involvement in mentors' projects, publicizing the work of apprentice-mentor teams, publicizing the professional accomplishments of former CQL apprentices, and recognizing mentors who exemplify outstanding mentorship practices. Possibly AAS can provide support to the LPCs to enact a strategy for providing recognition.

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

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

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

Introduction

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

AEOP Goals

Goal 1: STEM Literate Citizenry.

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

Goal 2: STEM Savvy Educators.

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

Goal 3: Sustainable Infrastructure.

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

This report documents the evaluation study of one of the AEOP programs, College Qualified Leaders (CQL). In FY16 CQL was managed by the Academy of Applied Science (AAS). The evaluation study was performed by Purdue University in cooperation with Battelle, the Lead Organization (LO) in the AEOP CA consortium.

Program Overview

The College Qualified Leaders (CQL) program, managed by the Academy of Applied Science (AAS), is an Army Educational Outreach Program (AEOP) that matches talented college students (herein referred to as apprentices) with practicing Army Scientists and Engineers (Army S&Es). It should be noted that, while the objective is to pair each apprentice with an Army S&E, in some cases other employees of CQL sites serve as mentors. The use of the term "mentor" throughout this report will refer to the Army S&E or other employee 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 relationship with the mentor and/or laboratory, and also allows new college students to enter the program. CQL offers apprentices the opportunity for summer, partial year, or year-round research at an Army laboratory, depending on class schedules and school location. CQL apprentices receive firsthand research experience and exposure to Army research

laboratories. CQL fosters desire in its participants to pursue further training and careers in STEM while specifically highlighting and encouraging careers in Army research.

In 2016, CQL 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. 2016 CQL Sites

2016 CQL Site	Command[†]	Location
US Army Research Laboratory – Aberdeen Proving Ground (ARL-APG)	RDECOM	Aberdeen, MD
US Army Research Laboratory – Adelphi (ARL-A)	RDECOM	Adelphi, MD
Walter Reed Army Institute of Research (WRAIR)	MRMC	Silver Spring, MD
US Army Medical Research Institute for Infectious Diseases (USAMRIID)	MRMC	Fort Detrick, MD
US Army Aviation & Missile Research Development and Engineering Center – Redstone Arsenal (AMRDEC)	RDECOM	Huntsville, AL
Engineer Research & Development Center Construction Engineering Research Laboratory (ERDC-CERL)	USACE	Champaign, IL
US Army Medical Research Institute of Chemical Defense (USAMRICD)	MRMC	Aberdeen, MD
US Army Center for Environmental Health Research (USACEHR)	MRMC	Fort Detrick, MD
Defense Forensic Science Center (DFSC)	USACIDC	Forest Park, GA
Edgewood Chemical Biological Center – Aberdeen Proving Grouond (ECBC-APG)	RDECOM	Aberdeen, MD

Edgewood Chemical Biological Center – Rock Island (ECBC-RI)	RDECOM	Rock Island, IL
Engineer Research & Development Center – Vicksburg, MS (ERDC-MS)	USACE	Vicksburg, MS
US Army Engineer Research & Development Center – Alexandria, VA (ERDC-GRL)	USACE	Alexandria, VA

† Commands: "MRMC" is the Medical Research and Material Command, "RDECOM" is the Research, Development and Engineering Command, and "USACE" is the U.S. Army Corps of Engineers

Table 2. 2016 CQL Site Applicant and Enrollment Numbers

2016 CQL Site	FY2015		FY2016	
	No. of Applicants	No. of Enrolled Participants	No. of Applicants	No. of Enrolled Participants and (Mentors)
US Army Research Laboratory – Aberdeen Proving Ground (ARL-APG)	139	91	137	45 (22)
US Army Research Laboratory – Adelphi (ARL-A)	166	107	154	74 (34)
Walter Reed Army Institute of Research (WRAIR)	96	86	132	22 (22)
US Army Medical Research Institute for Infectious Diseases (USAMRIID)	66	23	78	22 (22)
US Army Aviation & Missile Research Development and Engineering Center – Redstone Arsenal (AMRDEC)	70	23	61	18 (18)
Edgewood Chemical Biological Center – Aberdeen Proving Ground (ECBC-APG)	0	0	45	2 (2)
Edgewood Chemical Biological Center – Rock Island (ECBC-RI)	0	0	1	0 (0)
Engineer Research & Development Center Construction Engineering Research Laboratory (ERDC-CERL)	22	17	24	10 (10)
US Army Medical Research Institute of Chemical Defense (USAMRICD)	40	6	62	0 (0)
US Army Center for Environmental Health Research (USACEHR)	35	15	73	16 (16)
Defense Forensic Science Center (DFSC)	28	22	37	17 (6)
Engineer Research and Development Center – Vicksburg, MS (ERDC-MS)	9	3	27	9 (9)
US Army Engineer Research & Development Center – Alexandria, VA (ERDC-GRL)	24	N1	30	1 (1)
Total	**695**	**394**	**861***	**236 (162)**

*Students are allowed to apply to multiple labs. Individual application total was 467.

The 13 host sites received applications from more potential apprentices than they had positions for in the 2016 CQL program: 861 students applied and 236 enrolled, which represents a 19% increase in applicants and a 40% decrease in the number of enrolled participants compared to 2015 (695 students applied and 394 enrolled). Table 2 summarizes interest and final enrollment by site.

Table 2. 2016 CQL Apprentice Participant Profile		
Demographic Category		
Participant Gender (n = 236)		
Female	109	46%
Male	121	51%
Not Reported	6	3%
Respondent Race/Ethnicity (n =)		
Asian	47	20%
Black or African American	25	11%
Hispanic or Latino	6	3%
Native American or Alaska Native	0	0%
White	153	65%
Other race or ethnicity	1	1%
Choose not to report	1	1%
College setting (n =236)		
Urban	89	38%
Suburban	96	41%
Rural	29	12%
Frontier or Tribal School	0	0%
Online School	2	1%
Choose Not to Report	20	8%

The total cost of the 2016 CQL program was $2,360,394. This includes administrative costs to AAS of $124,976 and $2,235,418 for participant stipends. The average cost per 2016 CQL participant taken across all CQL sites was $10,002. Table 3 summarizes these expenditures.

Table 3. 2016 CQL Program Costs	
2016 CQL - Cost Per Participant	
Total Participants	236
Total Cost	$2,360,394
Cost Per Participant	**$10,002**

Evidence-Based Program Change

In FY16 all apprenticeship programs began being administered by the Academy of Applied Science and combined into an overall apprenticeship portfolio. Objectives and activities for the apprenticeship programs were developed and implemented collectively for all programs and included the following:

1. Expand apprenticeship opportunities for underserved populations in cooperation with HBCUs/MSIs and other affinity groups, and in cooperation with recruitment objectives of LPCs by disseminating program information to a broader and a more diverse audience. (Supports Priority 1)

- *Collaborate with HBCUs/MSIs and affinity groups on targeted marketing and recruitment in local communities by recruiting current directors/mentor and LPCs to assist in outreach to URM population.*
- *Increase participation from schools with high percentages of free/reduced lunch*
- *Increase number of mentors across all sites to expand program by improving mentor training, creating a peer recruitment effort and offering expanded incentives.*
- *Recruit, identify and heighten awareness of apprenticeship opportunities by working with one or more strategic partners to market/outreach to organizations and schools with high percentage of URM.*

Activities:

- RFPs were sent to over 200 HBCUs/MCIs. University host sites for HBCU/MSIs increased by 90% in 2016 (compared to 2015)
- Published apprenticeship opportunities to high schools and universities located near Army labs and universities using direct mail and email campaigns.
- Developed and distributed new flyers & welcoming narrative to attract participants to the AEOP website and AEOP program information, to over 500 high schools, PTAs and after school programs targeting more diverse population, specifically to those close to host universities and DoD laboratories.
- University host directors assisted with distribution of college level program information by posting at universities.

2. **Expand cross-marketing and outreach of apprenticeship programs to include other AEOP programs to mentors and LPCs.(Supports Priority 1 & 3)**

- *Develop and disseminate materials widely through print, social media and virtual presentations*

Activities:

- All directors/mentors, students and lab coordinators received AEOP brochures, AEOP notebooks, flash drives and lab coats to promote all AEOP programs.
- Apprenticeship announcements to over 500 high schools, PTAs and after school programs targeting more diverse population, specifically to those close to host universities and DoD laboratories, also included information about all AEOP programs.
- Directors/mentors, students and lab coordinators received weekly communications addressing the entire AEOP portfolio, program evaluation assistance, abstract tip submissions, AEOP Newsletter, Social Media guidelines and the 2016 Guide to STEM Careers.

- New social media campaign was developed, including an AAS Instagram account and hashtag campaign to engage participants. #AEOPapprentice Executed AEOP's Social Media Guidelines using relevant hashtags, i.e. #edchat, #science, #womeninSTEM, #USAEOP, etc.
- Cross marketing by sharing posts about all AEOP programs.
- Provided photos and newsworthy items to Widmeyer throughout the summer.

3. Encourage apprentices to continue pursuit of AEOP STEM/Army STEM careers (Supports Priority 1)

- *Create opportunities for Army researchers to engage with students, as guest speakers and to visit host university sites, and opportunities for apprentices in university based programs to visit Army sites*
- *Create standardized information on Army STEM career opportunities; distribute to all apprentices*
- *Work with LPCs to obtain success stories and best practices which showcase STEM careers*

Activities:

- Students gain first hand exposure to Army STEM careers through direct engagement with Army scientists and engineers in DoD laboratories.
- Initiated discussions with a university to develop a "meet and greet" for participants of all AEOP programs (at same university), to include an Army speaker. Will expand on this to include REAP, HSAP/URAP, JSHS, UNITE.
- Implemented a scavenger hunt to expose students to DoD STEM careers.
- Developed communications campaign to distribute weekly notices including the new Guide to STEM Careers and AEOP Newsletter, which also showcases Army STEM Career info.
- Coordinated with Widmeyer to develop stories and publicize via AEOP.

4. Encourage more students already in the AEOP pipeline to continue with an apprenticeship program (Supports Priority 1 & 3)

- *Use incentive, such as stipends, to retain and attract former AEOP participants*
- *Coordinate with the LO and LPCs to develop and implement marketing/ outreach campaigns to target students in the AEOP pipeline*
- *Improve website & CVENT Interface*

Activities:

- Developed and distributed (US Mail and email) new flyers to over 500 high schools, PTAs and after school programs targeting more diverse population and those close to university host sites and DoD labs.
- Directors assisted with distribution of college level program information by posting at universities.
- Reviewed and updated websites and Cvent to publicize opportunities to students. Reviewed AEOP website pages to ensure accuracy of application deadlines
- Apprenticeship announcement flyers were sent to over 3,000 alumni… GEMS, UNITE, JSS, SEAP, HSAP, REAP, JSHS. Application announcement also requested family and/or friend referral.
- Conducted email outreach campaign to target AEOP alumni and publicize apprenticeship opportunities.
- <u>ALL AEOP program alumni</u>

  57% students participated in an AEOP in prior years. SEAP: 74 CQL: 182 REAP: 34

5. Increase participant's knowledge of other AEOP programs and STEM careers (Supports Priority 1)

- Encourage peer-to-peer information sessions
- Provide virtual supplemental materials (such as marketing brochures and career testimonials)
- Present information to laboratory coordinators in other programs.

Activities:

- New program flyers were created and distributed to 500 high schools, 3,000 alumni and 80 after school programs located near high schools and DoD laboratories. Email also included a link to the AEOP website outlining other AEOP opportunities.
- Welcome packets were distributed to participants, which included: Lab coats, flash drives, notebooks, pens/pencils, AEOP brochures and all AEOP program opportunities.
- Weekly communication to participants highlighted all AEOP programs and AEOP STEM Career Guide, AEOP Newsletter, AEOP social media info about other AEOP opportunities.

6. Improve the overall participant and mentor apprenticeship experience. (Supports Priority 1 & 3)

- Identify process improvements and best practices as a result of the consolidation effort.
- Improve communications and information exchange between IPAs via virtual seminars or other
- Establish effective incentive and bridging strategies (such as "exit interviews" and next step mentoring) for participants as they move throughout the pipeline. Next steps are being introduced through mentor and apprenticeship exit letters.

Activities:

- The consolidation of marketing efforts for all apprenticeship programs resulted in greater awareness of all AEOP opportunities.
- Centralized supply distribution.
- Created new media release form.
- Centralized application process for all apprenticeship applicants through the use of Cvent.
- Increased mentor recognition with certificates and/or letters of appreciation.
- Worked extensively with lab coordinators to foster better working relationship. Surveyed lab coordinators to improve stipend payment process. Established system to track monthly stipend payments.
- Surveyed each lab coordinator regarding needed program improvements/changes. Prompt response to requests established better communication and trust between the IPA and lab coordinators through weekly email correspondence and telephone contact.
- Announced new AEOP Travel Award to all participants.

FY16 Evaluation At-A-Glance

Purdue University, in collaboration with AAS, conducted a comprehensive evaluation of the CQL program. The CQL logic model below presents a summary of the expected outputs and outcomes for the CQL program in relation to the AEOP and CQL-specific priorities. This logic model provided guidance for the overall CQL evaluation strategy.

Inputs	Activities	Outputs	Outcomes (Short term)	Impact (Long Term)
• Army sponsorship • AAS providing oversight of site programming • Operations conducted by 11 Army Labs • 236 students participating in CQL apprenticeships • 162 individuals (Army S&Es and other adults) serving as CQL mentors • Stipends for apprentices to support meals and travel • Centralized branding and comprehensive marketing • Centralized evaluation	• Apprentices engage in authentic STEM research experiences through hands-on summer, partial year, and year-round apprenticeships at Army labs • Army S&Es supervise and mentor apprentices' research • Program activities that expose apprentices to AEOP programs and/or STEM careers in the Army or DoD	• Number and diversity of student participants engaged in CQL • Number and diversity of Army S&Es engaged in CQL • Apprentices, mentors, site coordinators, and AAS contributing to evaluation	• Increased apprentice STEM competencies (confidence, knowledge, skills, and/or abilities to do STEM) • Increased apprentice interest in future STEM engagement • Increased apprentice awareness of and interest in other AEOP opportunities • Increased apprentice awareness of and interest in STEM research and careers • Increased apprentice awareness of and interest in Army/DoD STEM research and careers • Implementation of evidence-based recommendations to improve CQL program	• Increased apprentice participation in other AEOP opportunities and Army/DoD-sponsored scholarship/ fellowship programs • Increased apprentice pursuit of STEM degrees • Increased apprentice pursuit of STEM careers • Increased apprentice pursuit of Army/DoD STEM careers • Continuous improvement and sustainability of CQL

The CQL evaluation study gathered information from apprentice and mentor participants about CQL processes, resources, activities, and their potential effects in order to address key evaluation questions related to program strengths and challenges, benefits to participants, and overall effectiveness in meeting AEOP and CQL program objectives.

Key Evaluation Questions

- What aspects of CQL motivate participation?
- What aspects of CQL structure and processes are working well?
- What aspects of CQL could be improved?
- Did participation in CQL:
  - Increase students' STEM competencies?
  - Increase students' positive attitudes toward STEM?
  - Increase students' interest in future STEM learning?
  - Increase students' awareness of and interest in other AEOP opportunities?
  - Increase students' awareness of and interest in Army/DoD STEM careers?

The assessment strategy for CQL included post-program apprentice and mentor questionnaires, site visits to three CQL sites, three focus groups with apprentices, three focus groups with mentors, and an Annual Program Report (APR) prepared by AAS using data from all CQL sites. Tables 4-8 outline the information collected in apprentice and mentor questionnaires and focus groups, as well as information from the APR that is relevant to this evaluation report.

Table 4. 2016 Apprentice Questionnaires

Category	Description
Profile	**Demographics:** Participant gender, grade level, and race/ethnicity
	Education Intentions: Degree level, confidence to achieve educational goals, field sought
AEOP Goal 1	**Capturing the Apprentice Experience:** In-school vs. In-program experience; mentored research experience and products
	STEM Competencies: Gains in Knowledge of STEM, Science & Engineering Practices; contribution of AEOP
	Transferrable Competencies: Gains in 21st Century Skills
	STEM Identity: Gains in STEM identity, intentions to participate in STEM, and STEM-oriented education and career aspirations; contribution of AEOP
	AEOP Opportunities: Past participation, awareness of, and interest in participating in other AEOP programs; contribution of AEOP, impact of AEOP resources
	Army/DoD STEM: Exposure to Army/DoD STEM jobs, attitudes toward Army/DoD STEM research and careers, change in interest for STEM and Army/DoD STEM jobs; contribution of AEOP, impact of AEOP resources
AEOP Goal 2 and 3	**Mentor Capacity:** Perceptions of mentor/teaching strategies (apprentices respond to a subset)
	Comprehensive Marketing Strategy: How apprentices learn about AEOP, motivating factors for participation, impact of AEOP resources on awareness of AEOPs and Army/DoD STEM research and careers
Satisfaction &	Benefits to participants, suggestions for improving programs, overall satisfaction

Suggestions	

Table 5. 2016 Mentor Questionnaires	
Category	**Description**
Profile	**Demographics:** Participant gender, race/ethnicity, occupation, past participation
Satisfaction & Suggestions	Awareness of CQL, motivating factors for participation, satisfaction with and suggestions for improving CQL programs, benefits to participants
AEOP Goal 1	**Capturing the Apprentice Experience:** In-program experience
	STEM Competencies: Gains in their apprentices' Knowledge of STEM, Science & Engineering Practices; contribution of AEOP
	Transferrable Competencies: Gains in their apprentices' 21st Century Skills
	AEOP Opportunities: Past participation, awareness of other AEOP programs; efforts to expose apprentices to AEOPs, impact of AEOP resources on efforts; contribution of AEOP in changing apprentice AEOP metrics
	Army/DoD STEM: Attitudes toward Army/DoD STEM research and careers, efforts to expose apprentices to Army/DoD STEM research/careers, impact of AEOP resources on efforts; contribution of AEOP in changing apprentice Army/DoD career metrics
AEOP Goal 2 and 3	**Mentor Capacity:** Perceptions of mentor/teaching strategies
	Comprehensive Marketing Strategy: How mentors learn about AEOP, usefulness of AEOP resources on awareness of AEOPs and Army/DoD STEM research and careers

Table 6. 2016 Apprentice Focus Groups	
Category	**Description**
Profile	Gender, race/ethnicity, grade level, past participation in CQL, past participation in other AEOP programs
Satisfaction & Suggestions	Awareness of CQL, motivating factors for participation, satisfaction with and suggestions for improving CQL programs, benefits to participants
AEOP Goal 1 and 2 Program Efforts	**Army STEM: AEOP Opportunities –** Extent to which apprentices were exposed to other AEOP opportunities
	Army STEM: Army/DoD STEM Careers – Extent to which apprentices were exposed to STEM and Army/DoD STEM jobs

Table 7. 2016 Mentor Focus Groups
Description
Gender, race/ethnicity, occupation, organization, role in SEAP, past participation in SEAP, past participation in other AEOP programs
Perceived value of SEAP, benefits to participants, suggestions for improving SEAP programs
Army STEM: AEOP Opportunities – Efforts to expose students to AEOP opportunities
Army STEM: Army/DoD STEM Careers – Efforts to expose students to STEM and Army/DoD STEM jobs
Mentor Capacity: Local Educators – Strategies used to increase diversity/support diversity in SEAP

Table 8. 2016 Annual Program Report	
Category	**Description**
Program	Description of program content, activities, and academic level
AEOP Goal 1 and 2 Program Efforts	**Underserved Populations:** Mechanisms for marketing to and recruitment of apprentices from underserved populations
	Army STEM: Army/DoD STEM Careers –Participation of Army engineers and/or Army research facilities in career fair activities
	Mentor Capacity: Local Educators - University faculty and apprentice involvement

Detailed information about methods and instrumentation, sampling and data collection, and analysis are described in the report narrative, with tables and footnotes providing results from tests for significance. Appendix A outlines the evaluation plan. Findings of statistical and/or practical significance are noted in respective data summaries. Focus group protocols are provided in Appendix B (apprentice) and Appendix C (mentor). Apprentice and mentor questionnaire instruments are located in Appendix D and Appendix E, respectively. Major trends in data analyses are reported herein.

Study Sample

Table 9 provides an analysis of apprentice and mentor participation in the CQL questionnaires, the response rate, and the margin of error at the 95% confidence level (a measure of how representative the sample is of the population). The margin of error for the mentor surveys is larger than generally considered acceptable, indicating that the samples may not be representative of their respective populations. Table 9 shows the number of apprentice and mentor respondents by site.

Table 9. 2016 CQL Questionnaire Participation				
Participant Group	**Respondents (Sample)**	**Total Participants (Population)**	**Participation Rate**	**Margin of Error @ 95% Confidence[1]**
Apprentices	95	236	40%	±7.79
Mentors	16	162	10%	±23.33

Three apprentice focus groups and three mentor focus groups were conducted at three CQL sites. Nineteen students participated in the three apprentice focus groups. Of these apprentices, nine were male and ten were female. Nine students were White, four were Black or African American, two were Asian, and three were other races/ethnicities. Three students were college sophomores, three were college seniors, four were college graduates, and the remaining students did not report their grade level. The three mentor focus groups were comprised of twelve mentors. Of the participating mentors, six were males and six females, ten were White and two were Black or African American. Focus groups were not intended to yield generalizable findings; rather they were intended to provide additional evidence of, explanation for, or illustrations of questionnaire data. They add to the overall narrative of CQL's efforts and impact, and highlight areas for future exploration in programming and evaluation.

Respondent Profiles

Apprentice Demographics

Apprentice and mentor participation in the questionnaire for each CQL site is displayed in Table 10. Demographic information collected from apprentice questionnaire respondents is summarized in Table 11. More males (53%) than females (47%) completed the questionnaire. More apprentices responding to the questionnaire identified with the race/ethnicity category of White (71%) than any other single race/ethnicity category, though there is substantial representation of the category of Asian apprentices (15%). The majority of respondents (56%) were college juniors and seniors.

Table 10. CQL Respondents and Participants by Site

2016 CQL Site	Apprentices		Mentors	
	No. of Participants	No. of Survey Respondents	No. of Participants	No. of Survey Respondents
US Army Research Laboratory – Aberdeen Proving Ground (ARL-APG) and Edgewood Chemical Biological Center – Aberdeen proving Ground (ECBC-APG)	**47**	23	**24**	3
US Army Research Laboratory – Adelphi (ARL-A)	74	23	34	6
Walter Reed Army Institute of Research (WRAIR)	22	8	22	0
US Army Medical Research Institute for Infectious Diseases (USAMRIID)	22	13	22	0
US Army Aviation & Missile Research Development and Engineering Center – Redstone Arsenal (AMRDEC)	18	3	18	0
Engineer Research & Development Center Construction Engineering Research Laboratory (ERDC-CERL)	10	3	10	0
US Army Medical Research Institute of Chemical Defense (USAMRICD)	0	0	0	0
US Army Center for Environmental Health Research (USACEHR)	16	3	16	3
Defense Forensic Science Center (DFSC)	17	7	6	0
Edgewood Chemical Biological Center – Rock Island (ECBC-RI)	0	0	0	0
Engineer Research & Development Center – Vicksburg, MS (ERDC-MS)	9	9	9	4
Engineer Research & Development Center – Geospatial Research Laboratory (ERDC-GRL) – Alexandria, VA	1	0	1	0
Total	236	**92**	162	**16**

Table 11. 2016 CQL Apprentice Respondent Profile		
Demographic Category	**Questionnaire Respondents**	
Respondent Gender (n=93)		
Male	49	53%
Female	44	47%
Choose not to report	0	0%
Respondent Race/Ethnicity (n=93)		
Asian	14	15%
Black or African American	7	8%
Hispanic or Latino	2	2%
Native American or Alaska Native	0	0%
Native Hawaiian or Other Pacific Islander	1	1%
White	66	71%
Other race or ethnicity	2	2%
Choose not to report	1	3%
Respondent Grade Level (n=92)		
College freshman	3	3%
College sophomore	14	15%
College junior	21	23%
College senior	30	33%
Graduate program	12	13%
Choose not to report	2	2%
Other	10	11%

Apprentices were asked about their previous participation AEOP programs. As can be seen in Table 12, 32% of responding apprentices reported participating in CQL, 19% in GEMS (compared to 13% in FY15), and 14% in SEAP (compared to 32% in FY15). Few apprentices reported participating in any of the other AEOP programs although 17% of apprentices reported having participated in other STEM programs in the past.

Table 12. Apprentice Reports of Participation in AEOPs (n=72)

	Response Percent	Response Total
Camp Invention	4.17 %	3
eCYBERMISSION	0.00 %	0
Junior Solar Sprint (JSS)	0.00 %	0
Gains in the Education of Mathematics and Science (GEMS)	19.44 %	14
UNITE	0.00 %	0
Junior Science & Humanities Symposium (JSHS)	1.39 %	1
Science & Engineering Apprenticeship Program (SEAP)	13.89 %	10
Research & Engineering Apprenticeship Program (REAP)	1.39 %	1
High School Apprenticeship Program (HSAP)	0.00 %	0
College Qualified Leaders (CQL)	31.94 %	23
Undergraduate Research Apprenticeship Program (URAP)	0.00 %	0
Science Mathematics & Research for Transformation (SMART) College Scholarship	0.00 %	0
I've never participated in any AEOP programs	38.89%	28
Other STEM Program	16.67 %	12

Mentor Demographics

Mentor demographic data for mentors responding to the questionnaire are summarized in Table 13. The number of male responding mentors was greater than the number of females (69% versus 25%). The majority of responding mentors identified themselves as White (67%) although 27% of mentors chose not to report their race/ethnicity. All but one responding mentors identified themselves as scientist, engineer, or mathematics professionals, and biological sciences (27%) and engineering (27%) were the most frequently reported primary areas of research followed by physical science (20%) and computer science (20%).

Table 13. 2016 CQL Mentor Respondent Profile		
Demographic Category	**Questionnaire Respondents**	
Respondent Gender (n = 16)		
Female	4	25%
Male	11	69%
Choose Not to Report	1	6%
Respondent Race/Ethnicity (n = 15)		
Asian	0	0%
Black or African American	1	7%
Hispanic or Latino	0	0%
Native American or Alaska Native	0	0%
Native Hawaiian or Other Pacific Islander	0	0%
White	10	67%
Other race or ethnicity, (specify):	0	0%
Choose not to report	4	27%
Respondent Occupation (n = 16)		
Scientist, Engineer, or Mathematics professional	15	94%
Teacher	0	0%
Other school staff	0	0%
University educator	0	0%
Scientist, Engineer, or Mathematician in training (undergraduate or graduate student, etc.)	1	6%
Other, (specify)	0	0%
Respondent Primary Area of Research (n = 15)		
Biological Science	4	27%
Physical science (physics, chemistry, astronomy, materials science)	3	20%
Engineering	4	27%
Medical, health, or behavioral science	0	0%
Earth, atmospheric, or oceanic science	1	7%
Environmental science	0	0%
Computer science	3	20%
Technology	0	0%
Mathematics or statistics	0	0%
Social science (psychology, sociology, anthropology, etc.)	0	0%
Other, (specify)	0	0%

Actionable Program Evaluation

The Actionable Program Evaluation is intended to provide assessment and evaluation of program processes, resources, and activities for the purpose of recommending improvements as the program moves forward. A focus of the Actionable Program Evaluation is efforts toward the long-term goal of CQL and all of the AEOPs to increase and diversify the future pool of talent capable of contributing to the nation's scientific and technological progress. Thus, it is important to consider how CQL is marketed and ultimately recruits participants, the factors that motivate them to participate in CQL, participants' perceptions of and satisfaction with activities, what value participants place on program activities, and what recommendations participants have for program improvement. The following sections report perceptions of apprentices and mentors that pertain to current programmatic efforts and recommend evidence-based improvements to help CQL achieve outcomes related to AEOP programs and objects.

Marketing and Recruiting Underrepresented and Underserved Populations

The CQL manager, AAS reported marketing to and recruiting students for CQL in a variety of ways. AAS marketed CQL at the following FY16 outreach events:

- RFPs were sent to over 200 HBCUs/MCIs. University host sites for HBCU/MSIs increased by 90% in 2016 (compared to 2015)
- Published apprenticeship opportunities to high schools and universities located near Army labs and universities using direct mail and email campaigns.
- Developed and distributed new flyers & welcoming narrative to attract participants to the AEOP website and AEOP program information, to over 500 high schools, PTAs and after school programs targeting more diverse population, specifically to those close to host universities and DoD laboratories.
- University host directors assisted with distribution of college level program information by posting at universities.
- All directors/mentors, students and lab coordinators received AEOP brochures, AEOP notebooks, flash drives and lab coats to promote all AEOP programs.
- Apprenticeship announcements to over 500 high schools, PTAs and after school programs targeting more diverse population, specifically to those close to host universities and DoD laboratories, also included information about all AEOP programs.
- Directors/mentors, students and lab coordinators received weekly communications addressing the entire AEOP portfolio, program evaluation assistance, abstract tip submissions, AEOP Newsletter, Social Media guidelines and the 2016 Guide to STEM Careers.
- New social media campaign was developed, including an AAS Instagram account and hashtag campaign to engage participants. #AEOPapprentice Executed AEOP's Social Media Guidelines using relevant hashtags, i.e. #edchat, #science, #womeninSTEM, #USAEOP, etc.
- Cross marketing by sharing posts about all AEOP programs.
- Provided photos and newsworthy items to Widmeyer throughout the summer.

The mentor questionnaire included an item asking how students were recruited for apprenticeships. As can be seen in Table 14, mentors most often indicated recruiting their apprentices through university faculty outside their workplace

(37%) followed by recruitment through a personal network such as workplace colleagues (31%) and personal acquaintances (25%). Applications from the AAS or AEOP were cited as a source by 19% of respondents. Nearly a third (31%) of respondents reported that they had no knowledge of how their apprentices were recruited.

Table 14. Mentor Reports of Recruitment Strategies (n=16)

	Response Percent	Response Total
Applications from Academy of Applied Science (AAS) or the AEOP	18.75 %	3
Personal acquaintance(s) (friend, family, neighbor, etc.)	25.00 %	4
Colleague(s) in my workplace	31.25 %	5
K-12 school teacher(s) outside of my workplace	0.00 %	0
University faculty outside of my workplace	37.50 %	6
Informational materials sent to K-12 schools or Universities outside of my workplace	0.00 %	0
Communication(s) generated by a K-12 school or teacher (newsletter, email blast, website)	0.00 %	0
Communication(s) generated by a university or faculty (newsletter, email blast, website)	6.25 %	1
STEM or STEM Education conference(s) or event(s)	0.00 %	0
Organization(s) that serve underserved or underrepresented populations	0.00 %	0
The student contacted me (the mentor) about the program	12.50 %	2
I do not know how student(s) were recruited for CQL	31.25 %	5
Other, (specify) [†]	18.75 %	3

[†] Other = job fair; ads on professional society websites; university contacts with us

In order to understand which recruitment methods are most effective, the questionnaire asked apprentices to select all of the different ways they heard about AEOP. Table 15 summarizes apprentices' responses. The most frequently mentioned sources of information about CQL were someone who works with the program (23%) followed by past participant of the program (22%). Other sources mentioned relatively frequently were someone who works with the Department of Defense (19%), the AEOP website (19%), a friend (13%), or someone who works at the school or university the apprentice attends (13%). These findings suggest that apprentices were most likely to learn about AEOP although a substantial number of students cited the AEOP website as a source of information.

Table 15. How Students Learned about AEOP (n=73)

	Response Percent	Response Total
Army Educational Outreach Program (AEOP) Website	19.18 %	14
AEOP on Facebook, Twitter, Instagram, or other social media	1.37 %	1
School or university newsletter, email, or website	8.22 %	6
Past participant of program	21.92 %	16
Friend	12.50 %	9
Family Member	11.20 %	14
Someone who works at the school or university I attend	12.80 %	16
Someone who works with the program	23.29 %	17
Someone who works with the Department of Defense (Army, Navy, Air Force, etc.)	19.20 %	24
Community group or program	1.37 %	1
Choose Not to Report	9.72 %	7

Apprentice focus group data reflected these findings, with apprentices most frequently mentioning that they learned about CQL through a personal or university contact. As two apprentices said,

> *I actually had a professor who contacted me. I was going to be in his class the upcoming semester. He goes, 'Hey, you seem like you might like this based on the classes your taking; so, want me to see if I can help you out?'.* (CQL Apprentice)

> *My aunt knows the head of the labs; it's his brother. My aunt works with someone, and his sister is my mentor. Through them, I got the her email and asked about lab openings and research and what I'd have to do in order to apply for it. Then she told me about the program.* (CQL Apprentice)

Other students reported forming mentor relationships through participating in other AEOPs such as SEAP. For example:

> *I learned about SEAP from my high school teacher. Then, while here, I learned about CQL.* (CQL Apprentice)

> *I was in SEAP before CQL, so it's like the next step up. After I did SEAP, I just decided to do CQL.* (CQL Apprentice)

Mentors were also asked how they learned about CQL (see Table 16). Most responding mentors (56%) learned about CQL through a supervisor or superior. Other sources of information for mentors included a colleague (25%), someone who works for the DoD (19%), a past CQL participant (19%), and the AEOP website (19%).

Table 16. How Mentors Learned about CQL (n=16)

	Response Percent	Response Total
Army Educational Outreach Program (AEOP) website	18.75 %	3
AEOP on Facebook, Twitter, Pinterest, or other social media	0.00 %	0
A STEM conference or STEM education conference	0.00 %	0
An email or newsletter from school, university, or a professional organization	0.00 %	0
Past CQL participant	18.75 %	3
A student	0.00 %	0
A colleague	25.00 %	4
My supervisor or superior	56.25 %	9
A CQL site host or director	6.25 %	1
Workplace communications	25.00 %	4
Someone who works with the Department of Defense (Army, Navy, Air Force)	18.75 %	3
Other, (specify):	0.00 %	0

To examine whether mentors are expanding their participation in AEOPs, the questionnaire asked how many times they participated in each of the AEOP initiatives. Many mentors had either never heard of or never participated in most AEOPs such as JSHS, GEMS Near Peer Mentors, UNITE, and the NDSEG fellowship. Over half of mentors (51%) reported participating in CQL at least once, 47% had participated in SEAP, and 38% had participated in the SMART scholarship. A third of mentors (33%) had participated in GEMS at least once, and 27% had participated in e-Cybermission.

Factors Motivating Apprentice Participation

Apprentice questionnaires and interviews included questions to explore what motivated apprentices to participate in CQL. Specifically, the questionnaire asked participants why they chose to participate in the program. As can be seen in Table 17, the most frequently identified reasons for choosing to participate in SEAP were interest in STEM (82%), the desire to learn something new or interesting (81%), and desire to expand laboratory or research skills (79%) Other reasons for participation identified by more than half of apprentice respondents included the opportunity to use advanced laboratory technology (68%), learning in ways that are not possible in school (68%), exploring a unique work environment (68%), building college application or résumé (53%), and networking opportunities (53%).

Table 17. Factors Motivating Apprentices to Participate in CQL (n=72)

	Response Percent	Response Total
Teacher or professor encouragement	22.22 %	16
An academic requirement or school grade	4.17 %	3
Desire to learn something new or interesting	80.56 %	58
The mentor(s)	38.89 %	28
Building college application or résumé	52.78 %	38
Networking opportunities	52.78 %	38
Interest in science, technology, engineering, or mathematics (STEM)	81.94 %	59
Interest in STEM careers with the Army	51.34 %	37
Having fun	40.28 %	29
Earning stipends or awards for doing STEM	30.56 %	22
Opportunity to do something with friends	8.33 %	6
Opportunity to use advanced laboratory technology	68.06 %	49
Desire to expand laboratory or research skills	79.17 %	57
Learning in ways that are not possible in school	68.06 %	49
Serving the community or country	48.61 %	35
Exploring a unique work environment	68.06 %	49
Figuring out education or career goals	54.17 %	39
Seeing how school learning applies to real life	56.94 %	41
Recommendations of past participants	5.56 %	4
Choose Not to Report	4.17 %	3

Apprentices participating in focus groups were also asked why they chose to participate in CQL. Apprentices emphasized the value of research experience in their responses, and also mentioned that the stipend was valuable to them. For example,

> *For a lot of these people who are still in college, it's a great opportunity for them to get the research experience which helps with your next steps in your career…It's making me sharp again in the lab, and prepares me for my graduate program that I'm starting in the fall.* (CQL Apprentice)

I need the money for paying for my next semester of college...It's good experience as well. (CQL Apprentice)

The CQL Experience

The apprentice questionnaire included several items asking about the nature of apprentices' experience in CQL, and how that experience compared to their STEM learning opportunities in school. As can be seen in Table 18, over half of the responding apprentices indicated that they had at least some input in their project, either through working with their mentor and other research team members to design the project (17%), choosing from project options suggested by the mentor (17%), working with their mentor to design the project (15%), or designing a project on their own (1%). The remaining apprentices reported being assigned a project by their mentor (46%) or not having a project at all (3%).

Table 18. Apprentice Input on Design of Their Project (n=92)

	Response Percent	Response Total
I did not have a project	3.26 %	3
I was assigned a project by my mentor	45.65 %	42
I worked with my mentor to design a project	17.39 %	16
I had a choice among various projects suggested by my mentor	17.39 %	16
I worked with my mentor and members of a research team to design a project	15.22 %	14
I designed the entire project on my own	1.09 %	1

Although most apprentices worked in close proximity with others during their experience (see Table 19), they tended to work independently on their projects. For example, 24% of apprentices worked alone or with only their research mentor, 25% worked alone on their project and met with others regularly for reporting or discussion. Another 20% worked with a group all working on the same project, 16% worked with others in a shared laboratory space but worked on different projects, and 16% worked alone on a project that was closely connected with others' projects.

"I worked alongside a mentor who really understood his material. The internship was smooth, and I was lucky enough to be located near a diverse amount of Ph.D. students. They were able to chime in and help me with any problems that arose." -- CQL Apprentice

Table 19. Apprentice Participation in a Research Group (n=91)

	Response Percent	Response Total
I worked alone (or alone with my research mentor)	24.18 %	22
I worked with others in a shared laboratory or other space, but we work on different projects	16.48 %	15
I worked alone on my project and I met with others regularly for general reporting or discussion	23.08 %	21
I worked alone on a project that was closely connected with projects of others in my group	16.48 %	15
I work with a group who all worked on the same project	19.78 %	18

Apprentices were also asked about the types of activities they engaged in during their experience. As can be seen in Table 20, the vast majority of respondents indicated that most days or every day of their CQL experience they interacted with scientists or engineers (93%), applied STEM to real-life situations (88%), and learned about STEM topics that were new to them (87%). The majority of apprentices also reported that on most days or every day they learned about new discoveries in STEM (69%), communicated with other students about STEM (67%), and learned about STEM careers (54%). Mentors were asked similar questions about the nature of their apprentices' experiences. Overall, their responses paint a similar picture of the CQL experience although mentors were less likely than apprentices to report that apprentices learned about different careers that use STEM most days or ever day.[2]

"I learned a lot about how actual scientific research is conducted and about working with different researchers or scientists. The hands-on work experience I received will be essential for preparing me for future employment in a scientific career. The CQL program has been an enormous benefit to my understanding of STEM as a whole." -- CQL Apprentice

[2] Because of the low response rates on both the student and mentor questionnaires, it is not possible to determine whether any differences between the two datasets are real or an artifact of which students and mentors provided data.

Table 20. Nature of Apprentice Activities in CQL (n=90)

	Not at all	At least once	A few times	Most days	Every day	Response Total
Learn about science, technology, engineering, or mathematics (STEM) topics that are new to you	0.0%	1.1%	12.2%	46.7%	40.0%	
	0	1	11	42	36	**90**
Apply STEM learning to real-life situations	0.0%	2.2%	10.0%	35.6%	52.2%	
	0	2	9	32	47	**90**
Learn about new discoveries in STEM	0.0%	6.7%	24.4%	45.6%	23.3%	
	0	6	22	41	21	**90**
Learn about different careers that use STEM	2.2%	3.3%	40.0%	32.2%	22.2%	
	2	3	36	29	20	**90**
Interact with scientists or engineers	0.0%	2.2%	4.4%	12.2%	81.1%	
	0	2	4	11	73	**90**
Communicate with other students about STEM	1.1%	10.0%	22.2%	26.7%	40.0%	
	1	9	20	24	36	**90**

Because increasing the number of students who pursue STEM careers is one goal of the CQL program, the apprentice questionnaire also asked how many jobs/careers in STEM in general, and STEM jobs/careers in the DoD more specifically, apprentices learned about during their experience (see Tables 21 and 22). Most apprentices (95%) reported learning about at least one STEM job/career, and the majority (74%) reported learning about 3 or more. Similar numbers of apprentices (94%) reported learning about at least one DoD STEM job/career, although somewhat fewer (65%) reporting learning about 3 or more Army or DoD STEM jobs during CQL.

Table 20. Number of STEM Jobs/Careers Apprentices Learned about During CQL (n=89)

	Response Percent	Response Total
None	5.62 %	5
1	4.49 %	4
2	15.73 %	14
3	17.98 %	16
4	3.37 %	3
5 or more	52.81 %	47

Table 21. Number of Army of DoD STEM Jobs/Careers Apprentices Learned about During CQL (n=89)

	Response Percent	Response Total
None	6.74 %	6
1	5.62 %	5
2	22.47 %	20
3	14.61 %	13
4	3.37 %	3
5 or more	47.19 %	42

Apprentices were also asked which resources impacted their awareness of DoD STEM careers (see Table 22). Participation in CQL (81%) and apprentices' mentors (81%) were most often reported as being somewhat or very much responsible for impacting apprentices' awareness of DoD STEM careers. The vast majority of apprentices had not experienced or reported no impact of AEOP resources such as the AEOP brochure, the It Starts Here! magazine, and AEOP on social media. Another 39% had not experienced the AEOP website.

Table 22. Impact of Resources on Student Awareness of DoD STEM Careers (n=91-92)

	Did not experience	Not at all	A little	Somewhat	Very much	Response Total
Army Educational Outreach Program (AEOP) website	39.1%	10.9%	25.0%	15.2%	9.8%	
	36	10	23	14	9	**92**
AEOP on Facebook, Twitter, Pinterest or other social media	71.7%	15.2%	5.4%	5.4%	2.2%	
	66	14	5	5	2	**92**
AEOP brochure	74.7%	11.0%	7.7%	4.4%	2.2%	
	68	10	7	4	2	**91**
It Starts Here! Magazine	83.5%	11.0%	2.2%	2.2%	1.1%	
	76	10	2	2	1	**91**
My CQL mentor(s)	5.4%	0.0%	14.1%	21.7%	58.7%	
	5	0	13	20	54	**92**
Invited speakers or "career" events during CQL	39.6%	6.6%	19.8%	23.1%	11.0%	
	36	6	18	21	10	**91**

Participation in CQL	8.8%	0.0%	11.0%	28.6%	51.6%	
	8	0	10	26	47	**91**

Apprentices were also asked to indicate how often they engaged in various STEM practices during CQL. Results indicate that apprentices were actively engaged in STEM practices during the program (see Table 22). The majority of apprentices reported participating in all activities at least a few times with the exception of building or making a computer model (34% reported that they had not done this). Many apprentices reported engaging in activities most days or every day. For example, 85% participated in hands-on STEM activities most days or ever day, and 74% worked as part of a team, 80% analyzed data or information, and 77% identified questions or problems to investigate most days or every day of their CQL experience. Mentors were asked to respond to an item asking how frequently apprentices engaged in these activities and while their responses provide an overall similar picture of apprentices' activities, mentors' responses in some areas differed from apprentices'. For example, 60% of mentors indicated that students build or made a computer model most days or every day (compared with 33% of apprentices) and 93% of mentors indicated that students came up with creative explanations or solutions with this frequency (compared to 68% of apprentices). It is not clear whether these differences were due to differences in interpretation of the item or were related to which mentors and apprentices responded to the questionnaires.

Table 22. Student Engagement in STEM Practices in CQL (n=91-92)

	Not at all	At least once	A few times	Most days	Every day	Response Total
Use laboratory procedures and tools	10.9%	4.3%	9.8%	26.1%	48.9%	
	10	4	9	24	45	**92**
Participate in hands-on STEM activities	1.1%	3.3%	10.9%	28.3%	56.5%	
	1	3	10	26	52	**92**
Work as part of a team	1.1%	5.4%	19.6%	29.3%	44.6%	
	1	5	18	27	41	**92**
Identify questions or problems to investigate	2.2%	3.3%	17.4%	34.8%	42.4%	
	2	3	16	32	39	**92**
Design an investigation	12.1%	11.0%	20.9%	26.4%	29.7%	
	11	10	19	24	27	**91**
Carry out an investigation	7.7%	4.4%	15.4%	34.1%	38.5%	

	7	4	14	31	35	**91**
Analyze data or information	1.1%	2.2%	17.4%	32.6%	46.7%	
	1	2	16	30	43	**92**
Draw conclusions from an investigation	2.2%	2.2%	26.4%	35.2%	34.1%	
	2	2	24	32	31	**91**
Come up with creative explanations or solutions	0.0%	6.5%	26.1%	32.6%	34.8%	
	0	6	24	30	32	**92**
Build or make a computer model	33.7%	13.0%	20.7%	8.7%	23.9%	
	31	12	19	8	22	**92**

A composite score[3] was calculated for each of the two sets of items related to apprentices' STEM experiences in CQL, the first titled "Learning about STEM in CQL,"[4] and the second "Engaging in STEM Practices in CQL."[5] Response categories were converted to a scale of 1 = "Not at all" to 5 = "Every day" and the total across all items in each scale was calculated. The composite scores were used to test whether there were differences in apprentice experiences by gender and race/ethnic group (minority vs. non-minority apprentices). For both sets of items, there were no significant differences in composite scores by gender or race/ethnic group.

To examine how the CQL experience compares to their typical school experience, apprentices were asked how often they engaged in the same activities in school. These responses were also combined into two composite variables: "Learning about STEM in School,"[6] and "Engaging in STEM Practices in School"[7] that are parallel to the ones asking about CQL (see Chart 1). Scores were significantly higher on the "in CQL" versions of both composites than on the "in school" versions (learning effect size is large with d = 1.20; engagement effect size is large with d = 1.58)[8]. These data indicate that CQL provides apprentices with more intensive STEM learning experiences than they would typically receive in school.

[3] Using multiple statistical tests on related outcomes requires the use of a Type I error rate adjustment to reduce the likelihood of false positives (i.e., detecting a difference when one does not truly exist). However, Type I error rate adjustments lead to a reduction in statistical power (i.e., the ability to detect a difference if it does exist). The use of a composite score helps avoid both of these problems by reducing the total number of statistical tests used. In addition, composite scores are typically more reliable than individual questionnaire items.

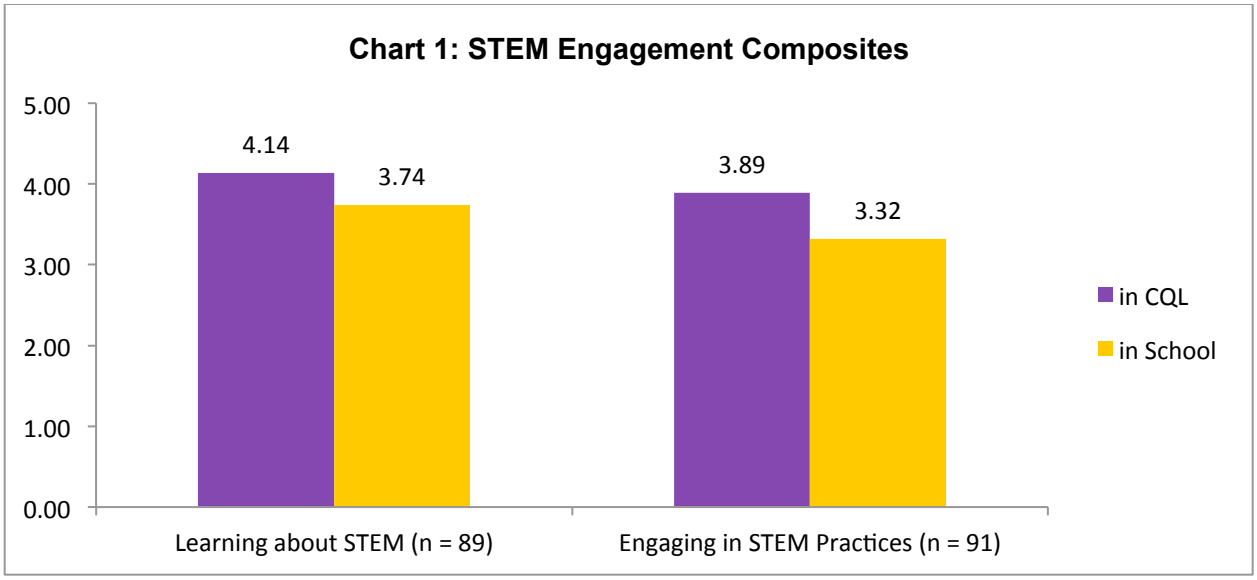
[4] The Cronbach's alpha reliability for these 6 items was 0.821.

[5] The Cronbach's alpha reliability for these 10 items was 0.856.

[6] Cronbach's alpha reliability for these 6 items was 0.772.

[7] Cronbach's alpha reliability for these 10 items was 0.905.

[8] Dependent Samples t-test for STEM Learning: t(89)=5.65, p<.001; Dependent Samples t-test for STEM Engagement: t(91)=7.52, p<.001.



The Role of Mentors

Mentors play a critical role in the CQL program. Mentors supervise and support apprentices' work, advise apprentices on educational and career paths, and generally serve as STEM role models for CQL apprentices. The majority of mentors (69%) responding to the mentor questionnaire reported working with one apprentice while 31% of mentors worked with between two and six apprentices.

Mentors were asked whether or not they used a number of strategies when working with their apprentices (note: the questionnaires used the term "students"; consequently, the data in this section are reported using that term as well).

These strategies comprised five main areas of effective mentoring:[3]

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

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

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

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

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

Large proportions of responding mentors used several strategies to help make the learning activities relevant to students (see Table 23). For example, all became familiar with students background and interests at the beginning of CQL and gave students real-life problems to investigate or solve. A large majority also selected readings or activities that related to students' backgrounds (80%) and encouraged students to suggest new readings, activities, or projects (73%).

Table 23. Mentors Using Strategies to Establish Relevance of Learning Activities (n=15)

	Yes - I used this strategy	No - I did not use this strategy	Response Total
Become familiar with my student(s) background and interests at the beginning of the CQL experience	100.0%	0.0%	
	15	0	**15**
Giving students real-life problems to investigate or solve	100.0%	0.0%	
	15	0	**15**
Selecting readings or activities that relate to students' backgrounds	80.0%	20.0%	
	12	3	**15**
Encouraging students to suggest new readings, activities, or projects	73.3%	26.7%	
	11	4	**15**
Helping students become aware of the role(s) that STEM plays in their everyday lives	46.7%	53.3%	
	7	8	**15**
Helping students understand how STEM can help them improve their own community	33.3%	66.7%	
	5	10	**15**
Asking students to relate real-life events or activities to topics covered in CQL	46.7%	53.3%	
	7	8	**15**

Similarly, mentors reported using a variety of strategies to support the diverse needs of students as learners. As can be seen in Table 24, nearly all responding mentors reported interacting with students and other personnel the same way regardless of their background (93%), and a large majority reported using a variety of teaching and/or mentoring activities to meet the needs of all students (87%); providing extra readings, activities, or learning support for students who lack essential background knowledge or skills (87%); and directing students to other individuals or programs for other support as needed (87%). Many mentors also identified students' learning styles at the beginning of the program (67%).

Table 24. Mentors Using Strategies to Support the Diverse Needs of Students as Learners (n=15)

	Yes - I used this strategy	No - I did not use this strategy	Response Total
Identify the different learning styles that my student (s) may have at the beginning of the CQL experience	66.7%	33.3%	
	10	5	**15**
Interact with students and other personnel the same way regardless of their background	93.3%	6.7%	
	14	1	**15**
Use a variety of teaching and/or mentoring activities to meet the needs of all students	86.7%	13.3%	
	13	2	**15**
Integrating ideas from education literature to teach/mentor students from groups underrepresented in STEM	33.3%	66.7%	
	5	10	**15**
Providing extra readings, activities, or learning support for students who lack essential background knowledge or skills	86.7%	13.3%	
	13	2	**15**
Directing students to other individuals or programs for additional support as needed	86.7%	13.3%	
	13	2	**15**
Highlighting under-representation of women and racial and ethnic minority populations in STEM and/or their contributions in STEM	26.7%	73.3%	
	4	11	**15**

Mentors also reported using many strategies to support students' development of collaboration and interpersonal skills (see Table 25). For example, 87% of mentors indicated that they had students explain difficult ideas to others, had students listen to the ideas of others with an open mind, and had students work on collaborative activities or projects as a member of a team. Many also had students exchange ideas with others whose backgrounds or viewpoints were different from their own (67%), had students give and receive constructive feedback with others (67%), and had students tell other people about their backgrounds and interests (60%).

Table 25. Mentors Using Strategies to Support Student Development of Collaboration and Interpersonal Skills (n=15)

	Yes - I used this strategy	No - I did not use this strategy	Response Total
Having my student(s) tell other people about their backgrounds and interests	60.0%	40.0%	
	9	6	**15**
Having my student(s) explain difficult ideas to others	86.7%	13.3%	
	13	2	**15**
Having my student(s) listen to the ideas of others with an open mind	86.7%	13.3%	
	13	2	**15**
Having my student(s) exchange ideas with others whose backgrounds or viewpoints are different from their own	66.7%	33.3%	
	10	5	**15**
Having my student(s) give and receive constructive feedback with others	66.7%	33.3%	
	10	5	**15**
Having students work on collaborative activities or projects as a member of a team	86.7%	13.3%	
	13	2	**15**
Allowing my student(s) to resolve conflicts and reach agreement within their team	53.3%	46.7%	
	8	7	**15**

When asked about strategies used to support student engagement in authentic STEM activities (see Table 26), all responding mentors reported allowing students to work independently to improve their self-management abilities. A large majority of responding mentors also used strategies such as supervising students while they practiced STEM research skills (93%), encouraged students to seek support from other team members (89%), and provided students with constructive feedback to improve their STEM competencies (87%).

Table 26. Mentors Using Strategies to Support Student Engagement in "Authentic" STEM Activities (n=15)

	Yes - I used this strategy	No - I did not use this strategy	Response Total
Teaching (or assigning readings) about specific STEM subject matter	73.3%	26.7%	
	11	4	**15**
Having my student(s) search for and review technical	80.0%	20.0%	

research to support their work	12	3	**15**
Demonstrating laboratory/field techniques, procedures, and tools for my student(s)	80.0%	20.0%	
	12	3	**15**
Supervising my student(s) while they practice STEM research skills	93.3%	6.7%	
	14	1	**15**
Providing my student(s) with constructive feedback to improve their STEM competencies	86.7%	13.3%	
	13	2	**15**
Allowing students to work independently to improve their self-management abilities	100.0%	0.0%	
	15	0	**15**
Encouraging students to learn collaboratively (team projects, team meetings, journal clubs, etc.)	66.7%	33.3%	
	10	5	**15**
Encouraging students to seek support from other team members	86.7%	13.3%	
	13	2	**15**

The last series of items about mentoring strategies focused on supporting students' STEM educational and career pathways (see Table 27). All of the responding mentors reported asking students about their educational and career interests. Many also discussed STEM career opportunities within the DoD or other government agencies (80%) and provided guidance about educational pathways that will prepare students for a STEM career (73%).

Table 27. Mentors Using Strategies to Support Student STEM Educational and Career Pathways (n=15)

	Yes - I used this strategy	No - I did not use this strategy	Response Total
Asking my student(s) about their educational and/or career goals	100.0%	0.0%	
	15	0	**15**
Recommending extracurricular programs that align with students' goals	26.7%	73.3%	
	4	11	**15**
Recommending Army Educational Outreach Programs that align with students' goals	40.0%	60.0%	
	6	9	**15**
Providing guidance about educational pathways that will	73.3%	26.7%	

prepare my student(s) for a STEM career	11	4	**15**
Discussing STEM career opportunities within the DoD or other government agencies	80.0%	20.0%	
	12	3	**15**
Discussing STEM career opportunities in private industry or academia	53.3%	46.7%	
	8	7	**15**
Discussing the economic, political, ethical, and/or social context of a STEM career	26.7%	73.3%	
	4	11	**15**
Recommending student and professional organizations in STEM to my student(s)	33.3%	66.7%	
	5	10	**15**
Helping students build a professional network in a STEM field	53.3%	46.7%	
	8	7	**15**
Helping my student(s) with their resume, application, personal statement, and/or interview preparations	46.7%	53.3%	
	7	8	**15**

A separate item on the mentor questionnaire asked which of the AEOP programs mentors explicitly discussed with their students during CQL. The most frequently discussed programs, mentioned by more than half of the mentors, were CQL (73%), and the SMART scholarship (40%). Table 28 shows all mentor responses regarding this question.

Table 28. Mentors Explicitly Discussing AEOPs with Students (n=15)

	Yes - I discussed this program with my student(s)	No - I did not discuss this program with my student(s)	Response Total
College Qualified Leaders (CQL)	73.3%	26.7%	
	11	4	**15**
GEMS Near Peer Mentor Program	6.7%	93.3%	
	1	14	**15**
Undergraduate Research Apprenticeship Program (URAP)	6.7%	93.3%	
	1	14	**15**
Science Mathematics, and Research for Transformation	40.0%	60.0%	

(SMART) College Scholarship	6	9	**15**
	21.4%	78.6%	
National Defense Science & Engineering Graduate (NDSEG) Fellowship	3	11	**14**
	26.7%	73.3%	
I discussed AEOP with my student(s) but did not discuss any specific program	4	11	**15**

Mentors were also asked how useful various resources were in their efforts to expose students to the different AEOPs. As can be seen in Table 29, participation in CQL (60%) and the program administrator or site coordinator (55%) were most often rated as "somewhat" or "very much" useful. Most mentors did not experience materials provided by the AEOP program, with no mentors having experienced AEOP on social media or the It Starts Here! magazine, and large proportions who had not experienced the AEOP brochure (87%). Over half (53%) of mentors found the AEOP website at least a little useful for this purpose, however.

Table 29. Usefulness of Resources for Exposing Students to AEOPs (n=15)

	Did not experience	Not at all	A little	Somewhat	Very much	Response Total
Army Educational Outreach Program (AEOP) website	46.7%	0.0%	20.0%	13.3%	20.0%	
	7	0	3	2	3	**15**
AEOP on Facebook, Twitter, Pinterest or other social media	100.0%	0.0%	0.0%	0.0%	0.0%	
	15	0	0	0	0	**15**
AEOP brochure	86.7%	0.0%	0.0%	0.0%	13.3%	
	13	0	0	0	2	**15**
It Starts Here! Magazine	100.0%	0.0%	0.0%	0.0%	0.0%	
	15	0	0	0	0	**15**
CQL Program administrator or site coordinator	33.3%	0.0%	13.3%	13.3%	40.0%	
	5	0	2	2	6	**15**
Invited speakers or "career" events	86.7%	0.0%	0.0%	13.3%	0.0%	
	13	0	0	2	0	**15**
Participation in CQL	33.3%	0.0%	6.7%	13.3%	46.7%	
	5	0	1	2	7	**15**

Mentors were also asked how useful these resources were for exposing students to DoD STEM careers (see Table 30). As with the previous item, mentors were most likely to rate participation in CQL as useful, with 67% selecting this as a "somewhat" or "very much" useful resource. The program administrator or site coordinator was perceived to be somewhat or very much useful by 27% of responding mentors. Again, the AEOP materials were less likely to be seen as very useful for this purpose and no mentors had experienced AEOP on social media, the AEOP brochure, and the It Starts Here! magazine.

Table 30. Usefulness of Resources for Exposing Students to DoD STEM Careers (n=15)

	Did not experience	Not at all	A little	Somewhat	Very much	Response Total
Army Educational Outreach Program (AEOP) website	73.3%	6.7%	0.0%	6.7%	13.3%	
	11	1	0	1	2	**15**
AEOP on Facebook, Twitter, Pinterest or other social media	100.0%	0.0%	0.0%	0.0%	0.0%	
	15	0	0	0	0	**15**
AEOP brochure	100.0%	0.0%	0.0%	0.0%	0.0%	
	15	0	0	0	0	**15**
It Starts Here! Magazine	100.0%	0.0%	0.0%	0.0%	0.0%	
	15	0	0	0	0	**15**
CQL Program administrator or site coordinator	66.7%	0.0%	6.7%	6.7%	20.0%	
	10	0	1	1	3	**15**
Invited speakers or "career" events	73.3%	0.0%	6.7%	20.0%	0.0%	
	11	0	1	3	0	**15**
Participation in CQL	20.0%	0.0%	13.3%	13.3%	53.3%	
	3	0	2	2	8	**15**

Satisfaction with CQL

Apprentices and mentors were asked how satisfied they were with a number of features of the CQL program. As can be seen in Table 31, the majority of responding apprentices were somewhat or very much satisfied with most of the listed program features. For example, 97% of apprentices were at least somewhat satisfied with the teaching or mentorship during program activities, 90% with the physical locations of CQL activities, and 90% with the variety of STEM topics available to them. On the other hand, 17% of students were not satisfied with administrative tasks such as in-processing

and networking, 7% were not satisfied with the stipends, and 5% were not satisfied with applying or registering for the program.

Table 31. Student Satisfaction with CQL Program Features (n=91-92)

	Did not experience	Not at all	A little	Somewhat	Very much	Response Total
Applying or registering for the program	1.1%	5.4%	14.1%	43.5%	35.9%	
	1	5	13	40	33	**92**
Other administrative tasks (in-processing, network access, etc.)	0.0%	17.4%	28.3%	35.9%	18.5%	
	0	16	26	33	17	**92**
Communicating with your CQL host site organizers	5.4%	5.4%	12.0%	35.9%	41.3%	
	5	5	11	33	38	**92**
The physical location(s) of CQL activities (lab)	2.2%	2.2%	5.4%	25.0%	65.2%	
	2	2	5	23	60	**92**
The variety of STEM topics available to you in CQL	2.2%	0.0%	8.7%	32.6%	56.5%	
	2	0	8	30	52	**92**
Teaching or mentoring provided during CQL activities	1.1%	1.1%	1.1%	27.2%	69.6%	
	1	1	1	25	64	**92**
Stipends (payment)	0.0%	6.5%	7.6%	26.1%	59.8%	
	0	6	7	24	55	**92**
Research abstract preparation requirements	4.3%	2.2%	13.0%	40.2%	40.2%	
	4	2	12	37	37	**92**
Research presentation process	5.5%	1.1%	12.1%	39.6%	41.8%	
	5	1	11	36	38	**91**

Apprentices were also asked about the availability of their mentors. As can be seen in Table 32, all but one apprentice indicated that their mentors were available half of the time or more, and 60% of apprentices reported that their mentor was always available.

Table 32. Apprentice Reports of Availability of Mentors (n=53)

	Response Percent	Response Total
I did not have a mentor	0.00 %	0
The mentor was never available	0.00 %	0
The mentor was available less than half of the time	1.09 %	1
The mentor was available about half of the time of my project	13.04 %	12
The mentor was available more than half of the time	26.09 %	24
The mentor was always available	59.78 %	55

Similarly, apprentices were asked about their satisfaction with their research experience (see Table 33). The majority of apprentices indicated being satisfied "very much" with all experiences during their apprenticeship (ranging from 64% - 83%). The vast majority of apprentices reported being satisfied at least "somewhat" satisfied with each experience (ranging from 85%-99%).

Table 33. Apprentice Satisfaction with Their Experience (n=91-92)

	Did not experience	Not at all	A little	Somewhat	Very much	Response Total
My working relationship with my mentor	0.0%	0.0%	1.1%	16.3%	82.6%	
	0	0	1	15	76	**92**
My working relationship with the group or team	12.0%	1.1%	2.2%	12.0%	72.8%	
	11	1	2	11	67	**92**
The amount of time I spent doing meaningful research	0.0%	1.1%	9.9%	25.3%	63.7%	
	0	1	9	23	58	**91**
The amount of time I spent with my research mentor	0.0%	0.0%	4.3%	28.3%	67.4%	
	0	0	4	26	62	**92**
The research experience overall	0.0%	0.0%	2.2%	23.9%	73.9%	
	0	0	2	22	68	**92**

An open-ended item on the questionnaire asked apprentices about their overall satisfaction with their CQL experience. Almost all of the 34 apprentices who responded to the question had something positive to say about their experience, although nine apprentices (26%) added caveats. In general, positive comments focused on the actual experience of working at the site while negative comments focused on administrative and organizational issues. Positive comments were

commonly quite general in nature, such as, "I am very satisfied with the very valuable experience I had when participating in CQL" (CQL apprentice). Other common themes included appreciation for mentors and/or other staff and the value of the work experience and learning in CQL. For example,

> *I am very satisfied with my CQL experience. I definitely have emerged with a larger skill set and more knowledge…This was all heavily influenced by the quality of my mentor and how much she invested in me.* (CQL Apprentice)

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

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

Of the ten apprentices who described concerns in their responses, nine were geared toward administrative aspects of the program and one apprentice expressed dissatisfaction with the mentor relationship. Among the administrative concerns were descriptions of issues related to the exclusion of graduate students from CQL, late or incorrect stipend payments, gaining clearance and access to do their work, and a lack of communication about presentations. In the words of four apprentices:

> *As a graduate student it was really unfortunate that they pulled the rug out from under us suddenly. Not a good way to end the program, especially since it was supposed to last another year until my graduation.* (CQL Apprentice)

> *I was extremely satisfied until CQL decided that it would no longer allow graduate students to participate. There were issues with my payments at the end, for example only receiving half a paycheck for the entire month which really put me under a lot of stress with bills and food.* (CQL Apprentice)

> *I enjoyed my CQL experience immensely, largely in part to the excellent teams I worked for. I found the research engaging and exciting, and I feel as though I have learned a lot. The organization of the program could be improved. Few were aware of the branch presentation competition, and some students missed out on the opportunity to present due to the last-minute notification. In addition, it was hard to figure out the dates and deadlines for the poster presentation, and in some cases, the Form-1 had to be put into three different folders on the shared drives.* (CQL Apprentice)

> *I am disappointed by the amount of time I have spent with no work to do because of bureaucracy or because I had to wait for other people to do their jobs and had no meaningful work to do in the meantime. My first summer, it*

took six weeks for me to get a computer account and I was not able to start working until that was taken care of. (CQL Apprentice)

When asked to identify three ways in which the program could be improved, 33 apprentices provided at least one suggestion. The most common theme in the responses to this open-ended item, described in 16 responses, related to the amount of paperwork necessary for participation, computer access, and organizational issues. Another 8 responses focused on late or incorrect stipend payments.

Apprentices participating in focus groups were also asked about how the CQL program could be improved. Their responses highlighted many of the same issues described above, including issues with timely payment of stipends and communication. As one apprentice commented,

It's very confusing. Your first summer here, you don't really know anything, and you walk into things blind…the whole contract system is really not ideal, and very inflexible…[we] thought we had a start date that was planned on, and we thought was set for months. They just said, 'No sorry, you can't come in. We don't know when you can come in.' … and so we were just sitting around, wondering what was going on. (CQL Apprentice)

Focus group participants added that assistance with identifying housing, larger stipends, increased publicity of the program, and more scheduling flexibility are areas for improvement in CQL.

Mentors also generally reported being somewhat or very much satisfied with the program components they experienced (see Table 34). More than half of mentors reported being somewhat or very much satisfied with most program features such as the research presentation process (76%), communicating with CQL organizers (69%), and the application or registration process (69%). One notable exception to the high levels of mentor satisfaction is stipends, any area in which 31% of mentors indicated that they were "not at all" satisfied.

Table 34. Mentor Satisfaction with CQL Program Features (n=15)

	Did not experience	Not at all	A little	Somewhat	Very much	Response Total
Application or registration process	25.0%	0.0%	6.3%	25.0%	43.8%	
	4	0	1	4	7	**16**
Other administrative tasks (in-processing, network access, etc.)	12.5%	12.5%	6.3%	37.5%	31.3%	
	2	2	1	6	5	**16**
Communicating with Academy of Applied Science (AAS)	68.8%	6.3%	6.3%	6.3%	12.5%	
	11	1	1	1	2	**16**

Communicating with CQL organizers	18.8%	6.3%	6.3%	25.0%	43.8%	
	3	1	1	4	7	**16**
Support for instruction or mentorship during program activities	20.0%	0.0%	13.3%	33.3%	33.3%	
	3	0	2	5	5	**15**
Stipends (payment)	25.0%	31.3%	6.3%	18.8%	18.8%	
	4	5	1	3	3	**16**
Research abstract preparation requirements	25.0%	6.3%	0.0%	37.5%	31.3%	
	4	1	0	6	5	**16**
Research presentation process	18.8%	6.3%	0.0%	37.5%	37.5%	
	3	1	0	6	6	**16**

The mentor questionnaire also included open-ended items asking mentors to share their opinions about the program. Like apprentices, all but one mentor had something positive to say when asked about their overall satisfaction with the CQL experience. For example,

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

Of the four mentors who added caveats to their positive comments and the one response that was not positive, mentor comments focused on late stipend payments and issues in-processing and computer access. For example,

> *I am very disappointed in how the payments of stipends were carried out this year. It is simply unacceptable that my student did not get paid on time, as expected, each month. At one point she was worried about making rent because her payment was so late and she had to pay her tuition for the upcoming term at university.* (CQL Mentor)

> *[I was] generally satisfied however faced significant issues with in-processing and computer access for the student. There needs to be evidence of improvement before considering participating in next year's program* (CQL Mentor)

Another open-ended item asked mentors to identify the three most important strengths of CQL; 11 mentors identified at least one benefit. While several important benefits of the program were listed, the most frequently described (mentioned 15 times) was the opportunity for apprentices to experience research and STEM careers in a real-world setting. Other

strengths of the program included networking opportunities for apprentices (4 responses) and the opportunity to act as mentors (4 responses).

Mentors were also asked to identify three ways in which CQL could be improved. The 9 mentors who identified at least one area for improvement focused on application and in-processing procedures including computer access (6 responses) and the on-time payment of stipends (4 responses). Other improvements mentors mentioned included providing more teamwork and collaborative opportunities for students (2 responses) and providing evaluation and feedback mechanisms between mentors and students (2 responses).

Mentors participating in focus groups echoed these calls for improvement. Mentors at two sites added that they would like graduate students to be eligible for the CQL program and mentors at one site indicated that the limitation on using reimbursable funds for CQL students is problematic for them. Mentors at one site also indicated that they believe that the timeline for abstracts and presentations could be expanded to allow more time to complete these tasks.

In sum, the Actionable Program Evaluation findings for FY16 indicate the CQL program was successful in engaging apprentices in authentic STEM experiences. Apprentices were actively engaged in learning about STEM and in STEM practices through authentic work experiences, more than they would typically experience in school. Mentors employed strategies to help make the learning activities relevant to apprentices, support the diverse needs of apprentices as learners, support apprentices' development of collaboration and interpersonal skills, and support apprentice engagement in authentic STEM activities. Overall, apprentices and mentors were somewhat or very much satisfied with their experience in the CQL program. An exception to this high level of satisfaction is apprentice and mentor reports of dissatisfaction with administrative features of the program including the timeliness of apprentice stipend payments and computer access.

Recruitment efforts were less fruitful in FY16, particularly in respect to recruiting students overall (60% decline) and from underrepresented and underserved populations (these groups only comprised 13% of participating group). Mentors and apprentices tended to learn about CQL through pre-existing relationships with other individuals (e.g., colleagues, friends, university staff, family members, pre-existing relationship with a mentor), rather than through broader recruitment efforts and AEOP materials.

> *"I always benefit from any interactions with students so I think [CQL] is mutually beneficial…I've had over 50 students that I've mentored per se in my timeframe here. It's not uncommon for my students to reach back 10, 15 years later and I still have a relationship with them both personally and professionally"* -- CQL Mentor

Outcomes Evaluation

The evaluation of CQL included measurement of several outcomes relating to AEOP and program objectives, including impacts on apprentices' STEM competencies (e.g., knowledge and skills), STEM identity and confidence, interest in and intent for future STEM engagement (e.g., further education, careers), attitudes toward research, and their knowledge of and interest in participating in additional AEOP opportunities.[4] STEM competencies are necessary for a STEM-literate citizenry. STEM competencies include foundational knowledge, skills, and abilities in STEM, as well as the confidence to apply them appropriately. STEM competencies are important for those engaging in STEM enterprises, but also for all members of society as critical consumers of information and effective decision makers in a world that is heavily reliant on STEM. The evaluation of CQL also measured apprentices' self-reported gains in STEM competencies and engagement in opportunities intended to develop what is considered to be a critical STEM skill in the 21st century—collaboration and teamwork.

STEM Knowledge and Skills

Apprentices reported gains in their STEM knowledge, with a large majority indicating large or extreme gains in each area about which they were asked (see Table 35). Apprentices reported large or extreme gains in their knowledge of what everyday research work is like in STEM (93%), knowledge of how scientists and engineers work on real problems in STEM (87%), in-depth knowledge of a STEM topic(s) (85%), knowledge of research conducted in a STEM topic or field (77%), and knowledge of research processes, ethics, and rules for conduct in STEM (77%). Mentors also reported similar impacts on their apprentices' STEM knowledge.

Table 35. Student Report of Impacts on STEM Knowledge (n=91-92)

	No gain	A little gain	Some gain	Large gain	Extreme gain	Response Total
In depth knowledge of a STEM	0.0%	2.2%	13.0%	53.3%	31.5%	

[4] The outcomes measured in the evaluation study were informed by the following documents:

Committee on STEM Education. (2013*). Federal Science, Technology, Engineering, and Mathematics (STEM) education 5-year strategic plan: A report from the Committee on STEM Education, National Science and Technology Council.* Washington, DC: The White House, Office of Science and Technology Policy.

National Research Council. (2009). Learning Science in Informal Environments: People, Places, and Pursuits. Committee on Learning Science in Informal Environments. Philip Bell, Bruce Lewenstein, Andrew W. Shouse, and Michael A. Feder, Editors. Board on Science Education, Center for Education. Division of Behavioral and Social Sciences and Education. Washington, DC: The National Academies Press.

President's Council of Advisors on Science and Technology (P-CAST). (February 2012). *Engage to Excel: Producing One Million Additional College Graduates with Degrees in Science, Technology, Engineering, and Mathematics.* Executive Office of the President.

Report of the Academic Competitiveness Council (ACC). (2007). U.S. Department of Education. Available on the Department's Web site at: http://www.ed.gov/about/inits/ed/competitiveness/acc-mathscience/index.html.

topic(s)	0	2	12	49	29	**92**
Knowledge of research conducted in a STEM topic or field	0.0%	3.3%	10.9%	53.3%	32.6%	
	0	3	10	49	30	**92**
Knowledge of research processes, ethics, and rules for conduct in STEM	1.1%	6.5%	16.3%	44.6%	31.5%	
	1	6	15	41	29	**92**
Knowledge of how scientists and engineers work on real problems in STEM	0.0%	1.1%	12.0%	45.7%	41.3%	
	0	1	11	42	38	**92**
Knowledge of what everyday research work is like in STEM	0.0%	0.0%	7.7%	41.8%	50.5%	
	0	0	7	38	46	**91**

These apprentice questionnaire items were combined into a composite variable[5] to test for differential impacts across subgroups of apprentices. There were no significant differences between male and female apprentices or between racial/ethnic groups; in other words, these subgroups of apprentices reported similar impacts of the program on their STEM knowledge.

Apprentices were also asked about CQL's impacts on their STEM competencies, i.e., apprentices' abilities to use STEM practices. Apprentices were presented with different sets of items depending on the focus of their CQL experience (science vs. technology, engineering, or mathematics). Table 36 shows the percentage of responding apprentices reporting large or extreme gains in science-related practices. More than half of the responding apprentices reported at least large gains on all items with the exception of using computer models of objects or systems to test cause and effect relationships (29% reported large or extreme gains). Mentors' reports of apprentices' gains in these areas were similar.

Table 36. Apprentices Reporting Gains in Their STEM Competencies – Science Practices (n=38)

	No gain	A little gain	Some gain	Large gain	Extreme gain	Response Total
Asking a question that can be answered with one or more scientific experiments	0.0%	5.3%	26.3%	36.8%	31.6%	
	0	2	10	14	12	**38**
Using knowledge and creativity to suggest a testable explanation (hypothesis) for an observation	0.0%	5.3%	23.7%	44.7%	26.3%	
	0	2	9	17	10	**38**

[5] The Cronbach's alpha reliability for these 5 items was 0.871.

	No gain	A little gain	Some gain	Large gain	Extreme gain	Response Total
Making a model of an object or system showing its parts and how they work	13.2%	21.1%	31.6%	26.3%	7.9%	
	5	8	12	10	3	**38**
Designing procedures for an experiment that are appropriate for the question to be answered	5.3%	18.4%	21.1%	26.3%	28.9%	
	2	7	8	10	11	**38**
Identifying the limitations of the methods and tools used for data collection	0.0%	7.9%	26.3%	28.9%	36.8%	
	0	3	10	11	14	**38**
Carrying out procedures for an experiment and recording data accurately	2.6%	5.3%	15.8%	26.3%	50.0%	
	1	2	6	10	19	**38**
Using computer models of objects or systems to test cause and effect relationships	42.1%	7.9%	21.1%	15.8%	13.2%	
	16	3	8	6	5	**38**
Organizing data in charts or graphs to find patterns and relationships	10.5%	10.5%	7.9%	34.2%	36.8%	
	4	4	3	13	14	**38**
Considering different interpretations of data when deciding how the data answer a question	2.6%	13.2%	15.8%	44.7%	23.7%	
	1	5	6	17	9	**38**
Supporting an explanation for an observation with data from experiments	0.0%	7.9%	15.8%	39.5%	36.8%	
	0	3	6	15	14	**38**
Supporting an explanation with relevant scientific, mathematical, and/or engineering knowledge	0.0%	2.6%	15.8%	39.5%	42.1%	
	0	1	6	15	16	**38**
Identifying the strengths and limitations of explanations in terms of how well they describe or predict observations	0.0%	5.3%	28.9%	31.6%	34.2%	
	0	2	11	12	13	**38**
Defending an argument that conveys how an explanation best describes an observation	2.6%	5.3%	26.3%	34.2%	31.6%	
	1	2	10	13	12	**38**
Identifying the strengths and limitations of data, interpretations, or arguments presented in technical or scientific texts	0.0%	7.9%	15.8%	39.5%	36.8%	
	0	3	6	15	14	**38**

	No gain	A little gain	Some gain	Large gain	Extreme gain	Response Total
Integrating information from technical or scientific texts and other media to support your explanation of an observation	0.0%	7.9%	15.8%	42.1%	34.2%	
	0	3	6	16	13	**38**
Communicating about your experiments and explanations in different ways (through talking, writing, graphics, or mathematics)	0.0%	2.6%	7.9%	34.2%	55.3%	
	0	1	3	13	21	**38**

Table 37 shows data for apprentices whose experience focused on the other STEM areas (technology, engineering, and mathematics) regarding impacts on their abilities related to key engineering practices. A majority of responding apprentices reported large or extreme gains in most engineering practices. Mentors' reports of apprentice gains were similar to apprentices' reports although they were more likely to report extreme gains in some areas, such as using knowledge and creativity to propose a testable solution for a problem and designing procedures for an experiment that are appropriate for the question to be answered, and less likely to report extreme gains in areas such as making a model of an object or system to show its parts and how they work and identifying the strengths and limitations of solutions in terms of how well they meet design criteria. These differences may be an artifact of the small mentor sample size; these mentors' apprentices may not have been representative of the entire population of apprentices.

Table 37. Apprentices Reporting Gains in Their STEM Competencies – Engineering Practices (n=50-51)

	No gain	A little gain	Some gain	Large gain	Extreme gain	Response Total
Defining a problem that can be solved by developing a new or improved object, process, or system	3.9%	3.9%	29.4%	41.2%	21.6%	
	2	2	15	21	11	**51**
Using knowledge and creativity to propose a testable solution for a problem	2.0%	7.8%	27.5%	39.2%	23.5%	
	1	4	14	20	12	**51**
Making a model of an object or system to show its parts and how they work	15.7%	5.9%	27.5%	27.5%	23.5%	
	8	3	14	14	12	**51**
Designing procedures for an experiment that are appropriate for the question to be answered	10.0%	12.0%	22.0%	36.0%	20.0%	
	5	6	11	18	10	**50**
Identifying the limitations of the methods and tools used for data collection	5.9%	11.8%	19.6%	43.1%	19.6%	
	3	6	10	22	10	**51**

	No gain	A little gain	Some gain	Large gain	Extreme gain	Response Total
Carrying out procedures for an experiment and recording data accurately	9.8%	5.9%	21.6%	43.1%	19.6%	
	5	3	11	22	10	**51**
Using computer models of an object or system to investigate cause and effect relationships	21.6%	15.7%	17.6%	25.5%	19.6%	
	11	8	9	13	10	**51**
Considering different interpretations of the data when deciding if a solution works as intended	3.9%	13.7%	29.4%	25.5%	27.5%	
	2	7	15	13	14	**51**
Organizing data in charts or graphs to find patterns and relationships	2.0%	13.7%	35.3%	21.6%	27.5%	
	1	7	18	11	14	**51**
Supporting a solution for a problem with data from experiments	4.0%	4.0%	30.0%	34.0%	28.0%	
	2	2	15	17	14	**50**
Supporting a solution with relevant scientific, mathematical, and/or engineering knowledge	3.9%	3.9%	33.3%	29.4%	29.4%	
	2	2	17	15	15	**51**
Identifying the strengths and limitations of solutions in terms of how well they meet design criteria	3.9%	9.8%	25.5%	37.3%	23.5%	
	2	5	13	19	12	**51**
Defend an argument that conveys how a solution best meets design criteria	5.9%	11.8%	27.5%	31.4%	23.5%	
	3	6	14	16	12	**51**
Identifying the strengths and limitations of data, interpretations, or arguments presented in technical or scientific texts	3.9%	3.9%	29.4%	37.3%	25.5%	
	2	2	15	19	13	**51**
Integrating information from technical or scientific texts and other media to support your solution to a problem	0.0%	9.8%	27.5%	35.3%	27.5%	
	0	5	14	18	14	**51**
Communicating information about your design experiments and solutions in different ways (through talking, writing, graphics, or math equations)	5.9%	11.8%	27.5%	31.4%	23.5%	
	3	6	14	16	12	**51**

Composite scores were calculated for each set of STEM practices items[12] on the apprentice questionnaire to examine whether the CQL program had differential impacts on subgroups of apprentices. For science competencies, there were no significant differences between groups based on race/ethnicity for, however there were significant differences between gender groups with males reporting significantly greater perceptions of their skills compared to females (effect size is large with d = 0.77). For engineering competencies there was a significant difference between minority and non-minority groups with minority apprentices reporting significantly greater perceptions of their skills compared to White apprentices (effect size is large with d = 0.73).

The apprentice questionnaire also asked apprentices about the impact of CQL on their "21st Century Skills" that are necessary across a wide variety of fields. As can be seen in Table 38, more than half of responding apprentices reported large or extreme gains on each of these skills, including making changes when things do not go as planned (85%), learning to work independently (81%, and sticking with a task until it is finished (74%). There is a significant difference in 21st Century Skills by race/ethnicity with Minority apprentices reporting significantly greater perceptions of their 21st Century Skills compared to White apprentices (effect size is medium with d = 0.56). There were no differences found by gender.[13] Mentors' reports of apprentice gains in these areas were similar but tended to be somewhat higher than apprentices' own reports.

Table 38. Apprentice Report of Impacts on 21st Century Skills (n=88-89)

	No gain	A little gain	Some gain	Large gain	Extreme gain	Response Total
Learning to work independently	1.1%	3.4%	14.6%	39.3%	41.6%	
	1	3	13	35	37	**89**
Setting goals and reflecting on performance	2.2%	5.6%	22.5%	39.3%	30.3%	
	2	5	20	35	27	**89**
Sticking with a task until it is finished	1.1%	4.5%	20.2%	38.2%	36.0%	
	1	4	18	34	32	**89**
Making changes when things do not go as planned	0.0%	4.5%	10.2%	44.3%	40.9%	
	0	4	9	39	36	**88**

[12] The science practices composite has a Cronbach's alpha reliability of 0.909; the engineering practices composite has a Cronbach's alpha reliability of 0.952. Independent Samples t-test for Science Competency Gender Difference: t(35)=2.28, p=.029. Independent Samples t-test for Engineering Competency Race/Ethnicity Difference: t(40)=2.31, p=.026.

[13] The Cronbach's alpha reliability for these items was 0.931. Independent Samples t-test for Engineering Competency Race/Ethnicity Difference: t(69)=2.34, p=.022.

Working well with people from all backgrounds	4.5%	10.2%	21.6%	27.3%	36.4%	
	4	9	19	24	32	**88**
Including others' perspectives when making decisions	3.4%	4.5%	23.9%	37.5%	30.7%	
	3	4	21	33	27	**88**
Communicating effectively with others	1.1%	4.5%	24.7%	30.3%	39.3%	
	1	4	22	27	35	**89**
Viewing failure as an opportunity to learn	0.0%	4.5%	25.8%	31.5%	38.2%	
	0	4	23	28	34	**89**

STEM Identity and Confidence

A key emphasis for AEOP programs is on growing participant STEM identity and awareness since this has been linked to developing future interest and potential participation in STEM as a field of study and future career. [14] Because of this, the apprentice questionnaire included a series of items intended to measure the impact of CQL on apprentices' STEM identity. These data are displayed in Table 39 and suggest that the program has had a positive impact in this area. More than half of responding apprentices reported large or extreme gains in all areas, including feeling prepared for more challenging activities in STEM (82%), the desire to build relationships with mentors who work in STEM (82%), and a sense of accomplishing something in STEM (76%). There were no significant differences in impact based on gender or race/ethnicity on the composite created from these items.[15]

Table 39. Apprentice Report of Impacts on STEM Identity (n=89)

	No gain	A little gain	Some gain	Large gain	Extreme gain	Response Total
Interest in a new STEM topic	2.2%	9.0%	29.2%	29.2%	30.3%	
	2	8	26	26	27	**89**
Deciding on a path to pursue a STEM career	6.7%	7.9%	20.2%	27.0%	38.2%	
	6	7	18	24	34	**89**
Sense of accomplishing something in STEM	1.1%	5.6%	18.0%	33.7%	41.6%	

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

[15] The Cronbach's alpha reliability for these 8 items was 0.918.

	1	5	16	30	37	**89**
Feeling prepared for more challenging STEM activities	0.0%	5.6%	12.4%	46.1%	36.0%	
	0	5	11	41	32	**89**
Confidence to try out new ideas or procedures on my own in a STEM project	1.1%	4.5%	18.0%	37.1%	39.3%	
	1	4	16	33	35	**89**
Patience for the slow pace of STEM research	4.5%	5.6%	19.1%	36.0%	34.8%	
	4	5	17	32	31	**89**
Desire to build relationships with mentors who work in STEM	0.0%	2.2%	15.7%	36.0%	46.1%	
	0	2	14	32	41	**89**
Connecting a STEM topic or field to my personal values	3.4%	10.1%	18.0%	33.7%	34.8%	
	3	9	16	30	31	**89**

Interest and Future Engagement in STEM

Another key goal of the AEOP program is to develop a STEM-literate citizenry. To do so, participants need to be engaged in and out of school with high quality STEM activities. In order to examine the impact of CQL on apprentices' interest in future engagement in STEM, the questionnaire asked them to reflect on whether the likelihood of their engaging in STEM activities outside of school changed as a result of their experience (see Table 40). The vast majority of apprentices indicated that they were no less likely to engage in any of these activities as a result of participating in CQL. The majority of apprentices indicated they were more likely to engage in most of the activities listed. For example, 82% of apprentices reported being more or much more likely to talk with friends or family about STEM, 80% to mentor or teach other students about STEM, and 73% to work on a STEM project or experiment in a university or professional setting. A composite score was created from these items,[16] and composite scores were compared across subgroups of apprentices. There were no statistically significant differences by gender or by race/ethnicity.

Table 40. Change in Likelihood Students Will Engage in STEM Activities Outside of School (n=88-89)

	Much less likely	Less likely	About the same before and after	More likely	Much more likely	Response Total
Watch or read non-fiction STEM	0.0%	0.0%	54.5%	27.3%	18.2%	

[16] These 10 items had a Cronbach's alpha reliability of 0.894.

	0	0	48	24	16	**88**
Tinker (play) with a mechanical or electrical device	2.2%	2.2%	46.1%	29.2%	20.2%	
	2	2	41	26	18	**89**
Work on solving mathematical or scientific puzzles	1.1%	3.4%	47.7%	33.0%	14.8%	
	1	3	42	29	13	**88**
Use a computer to design or program something	1.1%	4.5%	33.7%	36.0%	24.7%	
	1	4	30	32	22	**89**
Talk with friends or family about STEM	0.0%	0.0%	18.0%	47.2%	34.8%	
	0	0	16	42	31	**89**
Mentor or teach other students about STEM	0.0%	0.0%	20.2%	47.2%	32.6%	
	0	0	18	42	29	**89**
Help with a community service project related to STEM	0.0%	0.0%	34.8%	38.2%	27.0%	
	0	0	31	34	24	**89**
Participate in a STEM camp, club, or competition	1.1%	1.1%	43.8%	30.3%	23.6%	
	1	1	39	27	21	**89**
Take an elective (not required) STEM class	0.0%	0.0%	40.4%	34.8%	24.7%	
	0	0	36	31	22	**89**
Work on a STEM project or experiment in a university or professional setting	0.0%	0.0%	27.0%	30.3%	42.7%	
	0	0	24	27	38	**89**

Apprentices were also asked how interested they were in participating in future AEOP programs (See Table 41). Over three-quarters of apprentices (83%) indicated being at least somewhat interested in participating in CQL again, 63% in the SMART scholarship, 49% in the NDSEG fellowship, and 37% in the GEMS Near Peer Mentor program. Over a third of apprentices had never heard of the NDSEG fellowship (44%), URAP (41%) and the GEMS Near Peer Mentor Program (36%).

Table 41. Student Interest in Future AEOP Programs (n=86-89)

	I've never heard of this program	Not at all	A little	Somewhat	Very much	Response Total
College Qualified Leaders (CQL)	1.1%	10.1%	5.6%	15.7%	67.4%	
	1	9	5	14	60	**89**

GEMS Near Peer Mentor Program	35.6%	18.4%	9.2%	19.5%	17.2%	
	31	16	8	17	15	**87**
Undergraduate Research Apprenticeship Program (URAP)	40.7%	11.6%	9.3%	15.1%	23.3%	
	35	10	8	13	20	**86**
Science Mathematics, and Research for Transformation (SMART) College Scholarship	25.6%	5.8%	5.8%	19.8%	43.0%	
	22	5	5	17	37	**86**
National Defense Science & Engineering Graduate (NDSEG) Fellowship	44.3%	2.3%	4.5%	13.6%	35.2%	
	39	2	4	12	31	**88**

Apprentices were asked which resources impacted their awareness of the various AEOPs. As can be seen in Table 42, participating in CQL and the apprentices' mentors were the most likely to impact apprentices' awareness of AEOPs, with 77% and 68% of responding apprentices respectively indicating that these resources had at least some impact. A large majority of responding apprentices had not experienced AEOP resources such as It Starts Here! Magazine (84%), and AEOP on social media (74%).

Table 42. Impact of Resources on Student Awareness of AEOPs (n=91-92)

	Did not experience	Not at all	A little	Somewhat	Very much	Response Total
Army Educational Outreach Program (AEOP) website	31.5%	5.4%	34.8%	19.6%	8.7%	
	29	5	32	18	8	**92**
AEOP on Facebook, Twitter, Pinterest or other social media	73.6%	14.3%	4.4%	6.6%	1.1%	
	67	13	4	6	1	**91**
AEOP brochure	74.4%	8.9%	8.9%	4.4%	3.3%	
	67	8	8	4	3	**90**
It Starts Here! Magazine	84.4%	12.2%	1.1%	1.1%	1.1%	
	76	11	1	1	1	**90**
My CQL mentor(s)	6.5%	4.3%	21.7%	22.8%	44.6%	
	6	4	20	21	41	**92**
Invited speakers or "career" events during	49.5%	13.2%	15.4%	15.4%	6.6%	

CQL	45	12	14	14	6	**91**
Participation in CQL	7.7%	2.2%	13.2%	28.6%	48.4%	
	7	2	12	26	44	**91**

Attitudes toward Research

AEOP apprentices' attitudes about the importance of DoD research are considered an important prerequisite to their continued interest in the field and potential involvement in DoD or STEM careers in the future. In order to gauge apprentices' attitudes in this area, the questionnaire also asked about their opinions of what DoD researchers do and the value of DoD research more broadly (see Table 43). The data indicate that responding apprentices have overwhelmingly favorable opinions of DoD research and researchers. For example, all agreed or strongly agreed that DoD researchers advance science and engineering fields, 99% that they solve real-world problems, 98% that DoD research is valuable to society, and 95% that DoD researchers develop new, cutting-edge technologies.

Table 43. Student Opinions about DoD Researchers and Research (n=88)

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree	Response Total
DoD researchers advance science and engineering fields	0.0%	0.0%	0.0%	39.8%	60.2%	
	0	0	0	35	53	**88**
DoD researchers develop new, cutting edge technologies	0.0%	0.0%	4.5%	40.9%	54.5%	
	0	0	4	36	48	**88**
DoD researchers solve real-world problems	0.0%	0.0%	1.1%	31.8%	67.0%	
	0	0	1	28	59	**88**
DoD research is valuable to society	0.0%	0.0%	2.3%	28.4%	69.3%	
	0	0	2	25	61	**88**

Education and Career Aspirations

Apprentice education and career aspirations were also a focal point of the evaluation. In terms of education, the questionnaire asked apprentices how far they wanted to go in school before and after participating in CQL (see Table 43). When asked to think back on how far they wanted to go in school before participating in CQL, 30% indicated they aspired to a Bachelor's degree while 66% wanted an education beyond a Bachelor's degree (i.e., more education after college, a master's degree, or an advanced or professional degree). After participation in CQL, only 9% of students aspired to a

Bachelor's degree while 90% of students indicated that they wanted more education after college. In particular the proportion of students aspiring a Ph.D. rose from 26% to 36%.

Table 43. Apprentice Education Aspirations Before and After CQL (n=51)

	Before CQL		After CQL	
	Response Percent	Response Total	Response Percent	Response Total
Go to a trade or vocational school	0.00 %	0	0.00 %	0
Go to college for a little while	3.33 %	3	0.00 %	0
Finish college (get a Bachelor's degree)	30.00 %	27	8.89 %	8
Get more education after college	5.56 %	5	6.67 %	6
Get a master's degree	25.56 %	23	32.22 %	29
Get a Ph.D.	24.44 %	22	35.56 %	32
Get a medical-related degree (M.D.), veterinary degree (D.V.M), or dental degree (D.D.S)	6.67 %	6	8.89 %	8
Get a combined M.D. / Ph.D.	3.33 %	3	4.44 %	4
Get another professional degree (law, business, etc.)	1.11 %	1	3.33 %	3

Apprentices were asked what kind of work they expect to be doing at age 30, both reflecting on their aspirations before participating in CQL and after CQL (see Table 44). The vast majority of responding apprentices expressed interest in STEM-related careers both before and after participating in CQL. There was not a distinct shift in the proportion of apprentices aspiring to a STEM-related career although there were slight shifts in aspirations such as an increase from 38% to 40% of apprentices aspiring to a career in engineering. The overall lack of shift in apprentices' career aspirations may be related to the nature of the CQL program and the apprentices it attracts; that is, apprentices are undergraduate students or recent college graduates who were predominately motivated to participate in the program because they were already interested in STEM careers.

Table 44. Apprentice Career Aspirations Before and After CQL (n=90)

	Before CQL		After CQL	
	Response Percent	Response Total	Response Percent	Response Total
Undecided	2.22 %	2	3.33 %	3
Science (no specific subject)	4.44 %	4	0.00 %	0
Physical science (physics, chemistry,	8.89 %	8	8.89 %	8

Biological science	7.78 %	7	8.89 %	8
Earth, atmospheric or oceanic science	1.11 %	1	1.11 %	1
Environmental science	0.00 %	0	1.11 %	1
Computer science	7.78 %	7	8.89 %	8
Technology	5.56 %	5	4.44 %	4
Engineering	37.78 %	34	40.00 %	36
Mathematics or statistics	1.11 %	1	2.22 %	2
Medicine (doctor, dentist, veterinarian, etc.)	7.78 %	7	8.89 %	8
Health (nursing, pharmacy, technician, etc.)	1.11 %	1	1.11 %	1
Social science (psychologist, sociologist, etc.)	2.22 %	2	1.11 %	1
Teaching, STEM	5.56 %	5	2.22 %	2
Teaching, non-STEM	0.00 %	0	0.00 %	0
Business	0.00 %	0	1.11 %	1
Law	1.11 %	1	1.11 %	1
Military, police, or security	0.00 %	0	0.00 %	0
Art (writing, dancing, painting, etc.)	0.00 %	0	0.00 %	0
Skilled trade (carpenter	0.00 %	0	0.00 %	0
Other, (specify) †	5.56 %	5	5.56 %	5

† Before CQL Other = Forensic Science
† Before CQL Other = Forensic Science; Research in Engineering Applications

CQL participants were also asked the extent to which they expect to use their STEM knowledge, skills, and/or abilities in their work when they are age 30. As can be seen in Table 45, all apprentices expect to use STEM in their careers. A large majority (93%) expect to use STEM more than half of the time in their work, while only 7% expect to use STEM half or less of the time.

Table 45. Apprentices Expecting to Use STEM in Their Work at Age 30 (n=51)

	Response Percent	Response Total
not at all	0.00 %	0
up to 25% of the time	1.12 %	1
up to 50% of the time	5.62 %	5
up to 75% of the time	38.20 %	34
up to 100% of the time	55.06 %	49

Overall Impact

Finally, CQL participants were asked about the impact of the program on them overall. An examination of the data revealed that apprentices thought the program had a substantial impact on them (see Table 46). A majority of responding apprentices indicated that CQL contributed to gains in each of the areas listed. For example, 99% of apprentices responded that CQL contributed to their appreciation of Army or DoD STEM research; 98% responded that CQL contributed to them being more confident in their STEM knowledge, skills, and abilities; 98% that CQL contributed to their awareness of DoD STEM research and careers; and 85% that CQL contributed to their interest in pursuing a STEM career with the Army or DoD. These items were combined into a composite variable[18] to test for differences among subgroups of apprentices; no significant differences were found by gender or race/ethnicity.

Table 46. Apprentice Opinions of CQL Impacts (n=86)

	Disagree - This did not happen	Disagree - This happened but not because of SEAP	Agree - SEAP contributed	Agree - SEAP was primary reason	Response Total
I am more confident in my STEM knowledge, skills, and abilities	2.3%	0.0%	66.3%	31.4%	
	2	0	57	27	**86**
I am more interested in participating in STEM activities outside of school requirements	4.7%	9.3%	65.1%	20.9%	
	4	8	56	18	**86**
I am more aware of other AEOPs	16.3%	7.0%	51.2%	25.6%	
	14	6	44	22	**86**
I am more interested in participating in other AEOPs	16.3%	4.7%	55.8%	23.3%	
	14	4	48	20	**86**
I am more interested in taking STEM classes in school	7.0%	19.8%	57.0%	16.3%	
	6	17	49	14	**86**
I am more interested in earning a STEM degree	2.3%	26.7%	52.3%	18.6%	
	2	23	45	16	**86**
I am more interested in pursuing a	2.3%	16.3%	61.6%	19.8%	

[18] The Cronbach's alpha reliability for these 10 items was 0.877.

career in STEM	2	14	53	17	**86**
I am more aware of Army or DoD STEM research and careers	1.2%	1.2%	54.7%	43.0%	
	1	1	47	37	**86**
I have a greater appreciation of Army or DoD STEM research	0.0%	1.2%	51.2%	47.7%	
	0	1	44	41	**86**
I am more interested in pursuing a STEM career with the Army or DoD	11.6%	3.5%	52.3%	32.6%	
	10	3	45	28	**86**

An open-ended item on the questionnaire asked apprentices to list the three most important ways they benefited from CQL. Forty-three apprentices provided at least one answer to the question. These responses addressed a variety of themes, however the most frequently mentioned benefits were the learning and/or skills apprentices gained during their CQL participation (mentioned 33 times) and the real-world, hands-on experience they gained (mentioned 29 times). Other relatively frequently mentioned benefits were networking opportunities (mentioned 17 times) and the opportunity to gain career information (mentioned 14 times).

Apprentices' comments during focus groups echoed these benefits. For example:

> *I'd probably say learning [is the biggest benefit to CQL]…[this is] one of my first real lab experiences and has been a little bit of a learning curve, but I've been able to keep up with it, which has been really cool.* (CQL Apprentice)

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

> *Connections are pretty valuable…I don't think I would have found out about a lot of the other DoD opportunities without being here.* (CQL Apprentice)

> *I think [CQL] was a great way to meet people in the field. We have a lot of people [who]...have connections with other labs at universities that would be great for grad school.* (CQL Apprentice)

Summary of Findings

The FY16 evaluation of CQL collected data about participants; their perceptions of program processes, resources, and activities; and indicators of achievement in outcomes related to AEOP and program objectives. A summary of findings is provided in Table 47.

Table 47. 2016 CQL Evaluation Findings	
Participant Profiles	
CQL experienced decline in enrollment overall while seeing participation of females increase slightly while other groups remained steady with no increase.	Overall enrollment for CQL significantly decreased in FY16 by 40% (236 participants). However, overall applications grew 19%. CQL did make some progress in growing the number of female participants to 46% (compared to 40% in FY15). Although females continued to participate at a lower rate than males (in FY16 54% of participants were males, 46% were females), this increase in the participation of female students—a population that is historically underrepresented in STEM fields (particularly physical science and engineering fields) – is a significant gain. It is important to note that in FY16 CQL began phasing out graduate student participation and did not award any new graduate student CQL apprenticeships.
	CQL continued to serve students from historically underrepresented and underserved race/ethnicity groups, however the majority of enrolled apprentices (85%) identified themselves as "White" or "Asian." The percentage of Black or African American and Hispanic or Latino apprentices remained steady at 11% and 3% respectively. In sum, only 13% of enrolled participants identified themselves as being from an underrepresented or underserved minority groups (same as in FY15), indicating that continued focus needs to be invested in growing the diversity of CQL participants.

CQL participants reported limited past participation in other AEOPs, suggesting that recruiting apprentices from other AEOPs is an area with potential for growth.	Questionnaire data indicate that responding apprentices had participated in few AEOPs aside from CQL previously, although 32% report having participated in CQL in the past. While 19% reported having participated in GEMS, only 14% of respondents reported having participated in SEAP previously as compared with 32% of CQL apprentices who reported participating in SEAP in FY15. Program registration data indicated that 41% of enrolled CQL participants had participated in SEAP in FY15 and 17% had previously participated in GEMS.
CQL did not meet its targeted number of program applicants or mentors.	CQL received 467 of their targeted 650 applications in FY16. This was an increase in applicants from FY15 (550) but fewer than targeted. In CQL, student participation is dependent upon the number of available mentors. The CQL program had only 162 mentors in FY16, which limited the number of apprentices that could be accepted significantly. However, the 162 mentors served more than one apprentice on the rolling schedule of apprenticeships – meeting the 1:1 mentor requirement. The number of CQL mentors decreased in FY16 (176) from FY15 (369).
Actionable Program Evaluation	
CQL's primary mode of recruitment continues to be personal connections.	Apprentice questionnaire respondents indicated that they most commonly learned about CQL from a personal or university contact.
	Apprentice interview data support the notion that pre-existing relationships are key factors in apprentice awareness of CQL.
CQL apprentices were motivated to participate in CQL by a variety of factors.	Apprentices were motivated to participate in CQL by a wide variety of factors, however large majorities of apprentices indicated that the desire to learn something new or interesting, interest in STEM, and the desire to expand their laboratory or research skills were key motivators for participation.
CQL engaged apprentices in meaningful STEM learning.	Apprentices reported consistent learning in a variety of areas as a result of CQL, including learning about STEM topics, applying STEM to real-life situations, and learning about STEM careers.
	Apprentices reported consistently engaging in a variety of STEM practices during their CQL experience. For example, most apprentices reported engaging in activities such as using laboratory procedures and tools, working as part of a team, and carrying out investigations on most days or every day of their CQL experience.
	CQL provided more intensive opportunities for apprentices to learn about STEM and engage in STEM practices than they had within their typical school settings.
	Mentors reported using a wide variety of strategies to help make learning activities relevant to apprentices, support the needs of diverse learners, develop apprentices' collaboration and interpersonal skills, engage apprentices in authentic STEM activities, and support apprentices' STEM career and education pathways.

CQL promoted apprentice awareness of DoD STEM research and careers.	A large majority of CQL participants reported learning about at least one STEM career and most reported learning about 4 or more. Similarly, a large majority of apprentices reported learning about at least one DoD STEM job, with over half reporting they learned about 4 or more. Apprentices reported that their mentors and the CQL experience contributed the most to this impact.
Apprentices' awareness of other AEOPs increased as a result of their CQL participation, however mentors and apprentices overall have only limited awareness of other AEOP opportunities and AEOP resources.	Over half of responding apprentices reported that CQL influenced their awareness of AEOPs and, similarly, over half of apprentices reported being interested in future participation in AEOP initiatives. Apprentices reported that participation in CQL and their mentors were the most useful resources learning about other AEOPs, however, mentors overall reported limited familiarity with AEOP initiatives aside from CQL. Large proportions of apprentices and mentors reported having no experience with AEOP resources such as the AEOP website, the It Starts Here! Magazine, AEOP on social media, and the AEOP brochure.
Apprentices and mentors value the CQL experience, although aspects of program administration continue to be areas identified for improvement.	A large majority of responding apprentices reported being satisfied with their mentors and experiences during the CQL program. For example, 99% of responding apprentices reported being at least somewhat satisfied with their working relationship with their mentors and 89% with the amount of time they spent doing meaningful research.
	Both apprentices and mentors were asked about their overall satisfaction with the CQL program in an open-ended item on the questionnaire. Almost all respondents had positive perceptions of the program. However some apprentices described dissatisfaction with administrative aspects of the program. In particular, apprentices noted difficulties in getting computer access and difficulties in receiving stipend payments on time. When asked how the program could be improved, apprentice respondents indicated that improvements could be made in administrative tasks such as timely stipend payments, and faster computer access.
Outcomes Evaluation	
CQL apprentices reported gains in their STEM knowledge and competencies.	Large proportions of apprentices reported large or extreme gains in their STEM knowledge. For example, a majority of respondents reported large or extreme gains in their knowledge of what everyday research work is like in STEM, knowledge of how scientists and engineers work on real problems in STEM, in-depth knowledge of a STEM topic(s), and knowledge of research conducted in a STEM topic or field.
	Most apprentices reported large or extreme gains in their STEM competencies. For example, most apprentices reported large or extreme gains in their abilities to ask questions that can be answered with one or more scientific experiments; support an explanation with relevant scientific, mathematical, and/or engineering knowledge;

	Integrate information from technical or scientific texts and other media to support their explanation of an observation; and communicate about their experiments and explanations in different ways (through talking, writing, graphics, or mathematics).
CQL participants reported gains in apprentices' 21st Century Skills.	Apprentices reported large or extreme gains in several critical workplace skills, with most apprentices reporting large or extreme gains in areas such as the ability to make changes when things do not go as planned, sticking with a task until it is complete, and learning to work independently.
CQL participants reported increased confidence and identity in STEM.	Apprentices reported gains in their confidence and STEM identity. For example, most apprentices reported large or extreme gains in feeling prepared for more challenging STEM activities, the desire to build relationships with mentors in STEM fields, and having a sense of accomplishing something in STEM.
CQL participants reported increased interest in future STEM engagement.	Apprentices reported that that they were more likely to engage in STEM activities outside of school after participating in CQL. For example, a majority of apprentices indicated that they were more likely to mentor or teach other students about STEM, to talk with friends or family about STEM, and to work on a STEM project or experiment in a university or professional setting after participating in CQL.
CQL influenced apprentices' education aspirations, but did not change their career aspirations.	Apprentices expressed more interest in pursuing advanced degrees after their participation in CQL. In particular, apprentices were more likely to aspire to earn Ph.D. degrees after CQL as compared to their pre-CQL educational aspirations.
	Nearly all apprentices aspired to a career in a STEM field both before and after participating in CQL.
CQL participants reported interest in participating in AEOPs in the future.	A majority of apprentices reported being at least somewhat interested in participating in CQL, the SMART scholarship, and the NDSEG fellowship in the future. Although substantial numbers of apprentices indicated that they had never heard of the GEMS Near Peer Mentor program (36%) and URAP (41%), over a quarter of apprentices expressed some interest in participating in these programs in the future. Apprentices reported that participation in CQL and their mentors were most likely to impact their awareness of other AEOPs.
CQL apprentices have positive opinions about DoD researchers and research.	Apprentice perceptions of DoD researchers and research were overwhelmingly positive. All responding apprentices agreed or strongly agreed that DoD researchers advance science and engineering fields, and nearly all agreed or strongly agreed that DoD researchers solve real-world problems, that DoD research is valuable to society, and that DoD researchers develop new, cutting-edge technologies.

Responsiveness to FY15 Evaluation Recommendations

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

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

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

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

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

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

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

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

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

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

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

research. In addition, potential mentors should be made aware of these supports as an added incentive to participate in CQL.

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

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

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

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

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

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

CQL FY16 Efforts and Outcomes: In FY16, AAS worked with Battelle to improve the stipend payment process. A clear process was developed to pay stipends on time at the first of each month. We anticipate continuing the use of this process because it tracks stipend payments clearly for both the labs and the CAM. Lab coordinators report no difficulty with the system and students receive payments on time. Lab coordinators and student alike both pointed out that the timeframe for security clearance and computer access takes a great deal of time. While AAS has no direct control over these issues, we will suggest opening and closing the application earlier to allow for more time to process paperwork before a student begins an apprenticeship.

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

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

evaluation links must be sent to the mentors for completion and the importance of the evaluations. Again, a shorter survey and an incentive could prove to be helpful.

FY16 Recommendations

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

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

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

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

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

1. Since the number of available mentors places a limit on the number of apprentices the CQL program can accommodate, the program may want to consider what incentives it can provide for mentor participation. Mentors in focus groups suggested increased program outreach to potential mentors, program recognition of

mentor efforts, and support in the form of overhead funding for mentors as means to increase the pool of CQL mentors. Other mentor recruitment strategies the program may wish to consider include highlighting the potential benefits of apprentice involvement in mentors' projects, publicizing the work of apprentice-mentor teams, publicizing the professional accomplishments of former CQL apprentices, and recognizing mentors who exemplify outstanding mentorship practices. Possibly AAS can provide support to the LPCs to enact a strategy for providing recognition.

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

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

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

Appendices

Appendix A

FY16 CQL Evaluation Plan

Questionnaires

Purpose:
As per the approved FY16 AEOP APP, the external evaluation of CQL includes two post-program questionnaires:

1. AEOP Youth Questionnaire to be completed by students (apprentices); and
2. AEOP Mentor Questionnaire to be completed by Army S&Es and/or other laboratory personnel that supervise, guide, or support apprentices during their CQL research activities.

Questionnaires are the primary method of data collection for AEOP evaluation and collect information about participants' experiences with and perceptions of program resources, structures, and activities; potential benefits to participants; and strengths and areas of improvement for programs.

From FY14 to FY16, questionnaire assessments were revised and shortened while maintaining alignment with:

- Army's strategic plan and AEOP Priorities 1 (STEM Literate Citizenry), 2 (STEM Savvy Educators) *and* 3 (Sustainable Infrastructure);
- Federal guidance for evaluation of Federal STEM investments (e.g., implementation and outcomes evaluation, outcomes evaluation of STEM-specific competencies, transferrable competencies, identifying with STEM, intentions to engage in STEM-related activities, and educational/career pathways);
- Best practices and published assessment tools in STEM education, informal STEM education, STEM outreach, and evaluation research communities;
- AEOP's vision to improve the quality of the data collected, focusing on changes in intended student outcomes and contributions of AEOPs like CQL effecting those changes.

Deployment of common questionnaires with items that are appropriate for all AEOP programs allows evaluators to compare findings across AEOPs and, if administered in successive years, to establish longitudinal studies of student outcomes through the pipeline of AEOP programming. Questionnaires incorporate batteries of items from established assessments that have been validated in published research making external comparisons possible.

All AEOPs are expected to administer a Youth and a Mentor questionnaire provided to them by the evaluating organization. AEOP-wide Youth and Mentor questionnaires have two versions each; an "advanced" version (for JSHS and apprenticeship programs) and a "basic" version (for GEMS, JSS, and UNITE). Similar item sets are used in both versions, with slight modifications to item wording or the number of items used to accommodate the needs of participants from each individual program. Additionally, program-specific questionnaires have been customized to gather information about programmatic structures, resources, and activities that are unique to each AEOP.

Focus Groups Site Visits/Onsite Focus Groups

Purpose:
As per the approved FY16 AEOP APP, the external evaluation of CQL includes site visits/onsite focus groups.

Site visits provide the evaluation team with first-hand opportunities to speak with students and their mentors. We are able to observe the AEOPs in action. The information gleaned from these visits assists us in illustrating and more deeply understanding the findings of other data collected (from questionnaires). In total, the evaluation findings are used to highlight program successes and inform program changes so that the AEOPs can be even better in the future.

Evaluation Activities during CQL Site Visits:

- One or two 45 minute focus group with 6-8 apprentice participants;
- One 45-minute focus group with 6-8 mentors;
- 30-60 minutes to observe the program (specifically, to see students engaged in program activities, preferably with their mentors); and
- 10-15 minute transitions between each evaluation activity for moving groups in and out and providing evaluators with time to organize paperwork and take nature breaks.

Data Analyses
Quantitative and qualitative data were compiled and analyzed after all data collection concluded. Evaluators summarized quantitative data with descriptive statistics such as numbers of respondents, frequencies and proportions of responses, average response when responses categories are assigned to a 6-point scale (e.g., 1 = "Strongly Disagree" to 6 = "Strongly Agree"), and standard deviations. Emergent coding was used for the qualitative data to identify the most common themes in responses.

Evaluators conducted inferential statistics to study any differences among participant groups (e.g., by gender or race/ethnicity) that could indicate inequities in the CQL program. Statistical significance indicates whether a result is unlikely to be due to chance alone. Statistical significance was determined with t-tests, chi-square tests, and various non-parametric tests as appropriate, with significance defined at $p < 0.05$. Because statistical significance is sensitive to the number of respondents, it is more difficult to detect significant changes with small numbers of respondents. Practical significance, also known as effect size, indicates the magnitude of an effect, and is typically reported when differences are statistically significant. The formula for effect sizes depends on the type of statistical test used, and is specified, along with generally accepted rules of thumb for interpretation, in the body of the report.

Appendix B

FY16 CQL Apprentice Focus Group Protocol

2016 College Qualified Leaders (CQL) Evaluation Study Apprentice Focus Group Protocol

Facilitator: My name is [evaluator] and I'd like to thank you for meeting with us today! We are really excited to learn more about your experiences in CQL. In case you have not been in an evaluation interview before, I'd like to give you some ground rules that I like to use in interviews. They seem to help the interview move forward and make everyone a little more comfortable:

- What is shared in the interview stays in the interview.
- It is important for us to hear the positive and negative sides of all issues.
- This is voluntary - you may choose not to answer any question, or stop participating at any time.
- We will be audio recording the session for note-taking purposes only. Audio will be destroyed.
- Do you have any questions before we begin?

Key Questions

1. **Why did you choose to participate in CQL this year?**
    - How did you hear about CQL?
    - Who did you hear about it from?

The Army Educational Outreach Program (AEOP) is a primary sponsor of CQL. We do these interviews to help the AEOP create reports and defend funding for the program. They need specific information to defend the money for the program.

2. **We need to understand more about how CQL is teaching students about STEM career opportunities in the Army and Department of Defense.**
    - During CQL, did you learn anything about STEM careers in the Army or Department of Defense?
    - How did you learn about them (e.g., field trips, invited speakers, other activities, etc.)?
    - Are you interested in pursuing a career in STEM with the Army or Department of Defense?
3. **The AEOP sponsors a wide range of national STEM outreach programs other than CQL. You are definitely eligible to participate in some of these programs and we need to know if you learned about them during CQL.**
    - During CQL, did you learn about any of the outreach programs that the AEOP sponsors? (SMART, NDSEG, URAP, etc.)
    - How did you learn about them?
    - Do you think that you will try to participate in any of those programs?
4. **Were you happy that you chose to participate in CQL this year?**
    - What, specifically do you think you got out of participating in CQL?
    - Were there any other benefits of participating in CQL?

5. **Do you have any suggestions for improving CQL for other students in the future?**
6. **Last Chance - Have we missed anything? Tell us anything you want us to know that we didn't ask about.**

Appendix C

FY16 CQL Mentor Focus Group Protocol

2016 College Qualified Leaders (CQL) Evaluation Study Mentor Focus Group Protocol

Facilitator: My name is [evaluator] and I'd like to thank you for meeting with us today! We are really excited to learn more about your experiences in CQL. In case you haven't been in a focus group before, I'd like to give you some ground rules that I like to use in focus groups. They seem to help the group move forward and make everyone a little more comfortable:

- What is shared in the room stays in the room.
- Only one person speaks at a time.
- If you disagree please do so respectfully.
- It is important for us to hear the positive and negative sides of all issues.
- We will be audio recording the session for note-taking purposes only. Audio will be destroyed.
- Do you have any questions about participating in the focus group?

Key Questions:

1. **When you think about CQL, what kind of value does this program add**?
    - How do you think students benefit from participating in SEAP?
    - Can you think of a particular student or group of students that benefit the most from SEAP?
    - How have you benefited from participating in SEAP?

One of the primary sponsors of the CQL program is the Army Educational Outreach Program (AEOP). The AEOP needs specific information to create reports and defend funding for its outreach programs, CQL included.

2. **We need to understand more about how CQL is helping students know more about STEM career opportunities in the Department of Defense, especially civilian positions.**
    - Have you seen any efforts by CQL to educate participants about the Army, DoD, or careers in the DoD?
    - What strategies seem to be the most effective for SEAP students?
    - Do you have any suggestions for helping CQL teach students about careers in the DoD?

The AEOP sponsors a wide range of national STEM outreach programs that these students qualify for.

3. **The AEOP needs to know if CQL is teaching students about the other STEM outreach programs that it sponsors.**
    - First, are you aware of the other programs offered by the AEOP? (e.g., GEMS Near Peer Mentors, SMART, etc.)
    - Have you seen any efforts at CQL to educate adults or students about the other AEOP programs?
    - What seems to work the best? The worst?
    - Any suggestions for helping the AEOP educate these students about the other programs?
4. **The AEOP is trying to make sure that its programs become more effective at reaching adult and youth participants from underserved and underrepresented groups (racial/ethnic groups, low SES, etc.).**
    - Have you seen any efforts by CQL to help engage underserved or underrepresented groups of adults and youth?
    - What strategies seem to work the best? The worst?
    - Any suggestions for helping CQL reach new populations of adult and youth participants?
5. **What suggestions do you have for improving CQL?**
6. **Last Chance - Have we missed anything? Tell us anything you want us to know that we didn't ask about.**

Appendix D

FY16 CQL Apprentice Survey Instrument

Contact Information		
Please verify the following information:		
*First Name:		
*Last Name:		
*Email Address:		
All fields with an asterisk (*) are required.		

*1. Do you agree to participate in this survey? (required)(*Required)		
Select one.		
○	Yes, I agree to participate in this survey	
○	No, I do not wish to participate in this survey	Go to end of chapter

3. What grade will you start in the fall? (select one)	
Select one.	
○	College freshman
○	College sophomore
○	College junior
○	College senior
○	Graduate program
○	Choose not to report
○	Other, (specify)::

4. What is your gender?	
Select one.	
○	Male
○	Female
○	Choose not to report

5. What is your race or ethnicity?	
Select one.	
○	Hispanic or Latino
○	Asian
○	Black or African American
○	Native American or Alaska Native
○	Native Hawaiian or Other Pacific Islander
○	White
○	Choose not to report
○	Other race or ethnicity, (specify)::

6. At which of the following CQL sites did you participate? (Select ONE)	
Select one.	
○	ALABAMA – U.S. Army Aviation & Missile Research, Development & Engineering Center (AMRDEC) - Redstone, AL
○	GEORGIA – U.S. Army Criminal Investigation Command - Defense Forensic Science Center (DFSC) – Forest Park, GA
○	ILLINOIS – U.S. Army Engineer Research & Development Center – Construction Engineering Research Laboratory (ERDC-CERL) - Champaign, IL
○	MARYLAND – U.S. Army Medical Research Institute of Chemical Defense (USAMRICD) – Aberdeen Proving Ground/Edgewood, MD
○	MARYLAND – U.S. Army Center for Environmental Health Research (USACEHR) – Fort Detrick, MD
○	MARYLAND – U.S. Army Medical Research Institute of Infectious Diseases (USAMRIID) – Fort Detrick, MD
○	MARYLAND – U.S. Army Medical Research and Materiel Command – Walter Reed Army Institute of Research (WRAIR) – Silver Spring, MD
○	MARYLAND – U.S. Army Research Laboratory (ARL) – Aberdeen Proving Ground, MD
○	MARYLAND – U.S. Army Research Laboratory (ARL) – Adelphi, MD
○	MISSISSIPPI – U.S. Army Engineer Research & Development Center (ERDC) – Vicksburg, MS
○	VIRGINIA – U.S. Army Engineer Research & Development Center - Geospatial Research Laboratory (ERDC-GRL) – Alexandria, VA

7. How often did you do each of the following in STEM classes in college?

Select one per row.

	Not at all	*At least once*	*A few times*	*Most days*	*Every day*
Learn about science, technology, engineering, or mathematics (STEM) topics that are new to you	○	○	○	○	○
Apply STEM learning to real-life situations	○	○	○	○	○
Learn about new discoveries in STEM	○	○	○	○	○
Learn about different careers that use STEM	○	○	○	○	○
Interact with scientists or engineers	○	○	○	○	○
Communicate with other students about STEM	○	○	○	○	○

8. How often did you do each of the following in CQL this year?

Select one per row.

	Not at all	*At least once*	*A few times*	*Most days*	*Every day*
Learn about science, technology, engineering, or mathematics (STEM) topics that are new to you	○	○	○	○	○
Apply STEM learning to real-life situations	○	○	○	○	○
Learn about new discoveries in STEM	○	○	○	○	○
Learn about different careers that use STEM	○	○	○	○	○
Interact with scientists or engineers	○	○	○	○	○
Communicate with other students about STEM	○	○	○	○	○

9. How often did you do each of the following in STEM classes in college?

Select one per row.

	Not at all	*At least once*	*A few times*	*Most days*	*Every day*
Use laboratory procedures and tools	○	○	○	○	○
Participate in hands-on STEM activities	○	○	○	○	○
Work as part of a team	○	○	○	○	○
Identify questions or problems to investigate	○	○	○	○	○
Design an investigation	○	○	○	○	○
Carry out an investigation	○	○	○	○	○
Analyze data or information	○	○	○	○	○
Draw conclusions from an investigation	○	○	○	○	○
Come up with creative explanations or solutions	○	○	○	○	○
Build or make a computer model	○	○	○	○	○

10. How often did you do each of the following in CQL this year?

Select one per row.

	Not at all	*At least once*	*A few times*	*Most days*	*Every day*
Use laboratory procedures and tools	○	○	○	○	○
Participate in hands-on STEM activities	○	○	○	○	○
Work as part of a team	○	○	○	○	○
Identify questions or problems to investigate	○	○	○	○	○
Design an investigation	○	○	○	○	○
Carry out an investigation	○	○	○	○	○
Analyze data or information	○	○	○	○	○
Draw conclusions from an investigation	○	○	○	○	○
Come up with creative explanations or solutions	○	○	○	○	○
Build or make a computer model	○	○	○	○	○

11. How much did each of the following resources help you learn about Army Educational Outreach Programs (AEOPs)?

Select one per row.

	Did not experience	*Not at all*	*A little*	*Somewhat*	*Very much*
Army Educational Outreach Program (AEOP) website	○	○	○	○	○
AEOP on Facebook, Twitter, Pinterest or other social media	○	○	○	○	○
AEOP brochure	○	○	○	○	○
It Starts Here! Magazine	○	○	○	○	○
My CQL mentor(s)	○	○	○	○	○
Invited speakers or “career” events during CQL	○	○	○	○	○
Participation in CQL	○	○	○	○	○

12. How much did each of the following resources help you learn about STEM careers in the Army or Department of Defense (DoD)?

Select one per row.

	Did not experience	*Not at all*	*A little*	*Somewhat*	*Very much*
Army Educational Outreach Program (AEOP) website	○	○	○	○	○
AEOP on Facebook, Twitter, Pinterest or other social media	○	○	○	○	○
AEOP brochure	○	○	○	○	○
It Starts Here! Magazine	○	○	○	○	○
My CQL mentor(s)	○	○	○	○	○
Invited speakers or “career” events during CQL	○	○	○	○	○
Participation in CQL	○	○	○	○	○

13. How SATISFIED were you with the following CQL features?

Select one per row.

	Did not experience	*Not at all*	*A little*	*Somewhat*	*Very much*
Applying or registering for the program	○	○	○	○	○
Other administrative tasks (in-processing, network access, etc.)	○	○	○	○	○
Communicating with your CQL host site organizers	○	○	○	○	○
The physical location(s) of CQL activities (lab)	○	○	○	○	○
The variety of STEM topics available to you in CQL	○	○	○	○	○
Teaching or mentoring provided during CQL activities	○	○	○	○	○
Stipends (payment)	○	○	○	○	○
Research abstract preparation requirements	○	○	○	○	○
Research presentation process	○	○	○	○	○

14. How much input did you have in selecting your CQL research project?

Select one.

○	I did not have a project
○	I was assigned a project by my mentor
○	I worked with my mentor to design a project
○	I had a choice among various projects suggested by my mentor
○	I worked with my mentor and members of a research team to design a project
○	I designed the entire project on my own

15. How often was your mentor available to you during CQL?

Select one.

○	I did not have a mentor
○	The mentor was never available
○	The mentor was available less than half of the time
○	The mentor was available about half of the time of my project
○	The mentor was available more than half of the time
○	The mentor was always available

16. To what extent did you work as part of a group or team during CQL?

Select one.

○	I worked alone (or alone with my research mentor)
○	I worked with others in a shared laboratory or other space, but we work on different projects
○	I worked alone on my project and I met with others regularly for general reporting or discussion
○	I worked alone on a project that was closely connected with projects of others in my group
○	I work with a group who all worked on the same project

17. How SATISFIED were you with each of the following:

Select one per row.

	Did not experience	*Not at all*	*A little*	*Somewhat*	*Very much*
My working relationship with my mentor	○	○	○	○	○
My working relationship with the group or team	○	○	○	○	○
The amount of time I spent doing meaningful research	○	○	○	○	○
The amount of time I spent with my research mentor	○	○	○	○	○
The research experience overall	○	○	○	○	○

18. The list below includes effective teaching and mentoring strategies. From the list, please indicate which strategies that your mentor(s) used when working with you in CQL:

Select one per row.

	Yes - my mentor used this strategy with me	*No - my mentor did not use this strategy with me*
Helped me become aware of STEM in my everyday life	○	○
Helped me understand how I can use STEM to improve my community	○	○
Used a variety of strategies to help me learn	○	○
Gave me extra support when I needed it	○	○
Encouraged me to share ideas with others who have different backgrounds or viewpoints than I do	○	○
Allowed me to work on a team project or activity	○	○
Helped me learn or practice a variety of STEM skills	○	○
Gave me feedback to help me improve in STEM	○	○
Talked to me about the education I need for a STEM career	○	○
Recommended Army Educational Outreach Programs that match my interests	○	○
Discussed STEM careers with the DoD or government	○	○

19. Which of the following statements apply to your research experience in CQL? (Choose ALL that apply)

Select all that apply.

☐	I presented a talk or poster to other students or faculty
☐	I presented a talk or poster at a professional symposium or conference
☐	I attended a symposium or conference
☐	I wrote or co-wrote a paper that was/will be published in a research journal
☐	I wrote or co-wrote a technical paper or patent
☐	I will present a talk or poster to other students or faculty
☐	I will present a talk or poster at a professional symposium or conference
☐	I will attend a symposium or conference
☐	I will write or co-write a paper that was/will be published in a research journal
☐	I will write or co-write a technical paper or patent
☐	I won an award or scholarship based on my research

20. As a result of your CQL experience, how much did you GAIN in the following areas?

Select one per row.

	No gain	*A little gain*	*Some gain*	*Large gain*	*Extreme gain*
In depth knowledge of a STEM topic(s)	○	○	○	○	○
Knowledge of research conducted in a STEM topic or field	○	○	○	○	○
Knowledge of research processes, ethics, and rules for conduct in STEM	○	○	○	○	○
Knowledge of how scientists and engineers work on real problems in STEM	○	○	○	○	○
Knowledge of what everyday research work is like in STEM	○	○	○	○	○

21. Which category best describes the focus of your student(s) CQL activities?

Select one.

○	Science	(Go to question number 22.)
○	Technology	(Go to question number 23.)
○	Engineering	(Go to question number 23.)
○	Mathematics	(Go to question number 23.)

22. As a result of your CQL experience, how much did you GAIN in your ability to do each of the following?

Select one per row.

If answered, go to question number 24.

	No gain	*A little gain*	*Some gain*	*Large gain*	*Extreme gain*
Asking a question that can be answered with one or more scientific experiments	○	○	○	○	○
Using knowledge and creativity to suggest a testable explanation (hypothesis) for an observation	○	○	○	○	○
Making a model of an object or system showing its parts and how they work	○	○	○	○	○
Designing procedures for an experiment that are appropriate for the question to be answered	○	○	○	○	○
Identifying the limitations of the methods and tools used for data collection	○	○	○	○	○
Carrying out procedures for an experiment and recording data accurately	○	○	○	○	○
Using computer models of objects or systems to test cause and effect relationships	○	○	○	○	○
Organizing data in charts or graphs to find patterns and relationships	○	○	○	○	○
Considering different interpretations of data when deciding how the data answer a question	○	○	○	○	○
Supporting an explanation for an observation with data from experiments	○	○	○	○	○
Supporting an explanation with relevant scientific, mathematical, and/or engineering knowledge	○	○	○	○	○

22. As a result of your CQL experience, how much did you GAIN in your ability to do each of the following?

Identifying the strengths and limitations of explanations in terms of how well they describe or predict observations	○	○	○	○	○
Defending an argument that conveys how an explanation best describes an observation	○	○	○	○	○
Identifying the strengths and limitations of data, interpretations, or arguments presented in technical or scientific texts	○	○	○	○	○
Integrating information from technical or scientific texts and other media to support your explanation of an observation	○	○	○	○	○
Communicating about your experiments and explanations in different ways (through talking, writing, graphics, or mathematics)	○	○	○	○	○

23. As a result of your CQL experience, how much did you GAIN in your ability to do each of the following?

Select one per row.

	No gain	*A little gain*	*Some gain*	*Large gain*	*Extreme gain*
Defining a problem that can be solved by developing a new or improved object, process, or system	○	○	○	○	○
Using knowledge and creativity to propose a testable solution for a problem	○	○	○	○	○
Making a model of an object or system to show its parts and how they work	○	○	○	○	○
Designing procedures for an experiment that are appropriate for the question to be answered	○	○	○	○	○
Identifying the limitations of the methods and tools used for data collection	○	○	○	○	○
Carrying out procedures for an experiment and recording data accurately	○	○	○	○	○
Using computer models of an object or system to investigate cause and effect relationships	○	○	○	○	○
Considering different interpretations of the data when deciding if a solution works as intended	○	○	○	○	○
Organizing data in charts or graphs to find patterns and relationships	○	○	○	○	○
Supporting a solution for a problem with data from experiments	○	○	○	○	○
Supporting a solution with relevant scientific, mathematical, and/or engineering knowledge	○	○	○	○	○

23. As a result of your CQL experience, how much did you GAIN in your ability to do each of the following?

Identifying the strengths and limitations of solutions in terms of how well they meet design criteria	○	○	○	○	○
Defend an argument that conveys how a solution best meets design criteria	○	○	○	○	○
Identifying the strengths and limitations of data, interpretations, or arguments presented in technical or scientific texts	○	○	○	○	○
Integrating information from technical or scientific texts and other media to support your solution to a problem	○	○	○	○	○
Communicating information about your design experiments and solutions in different ways (through talking, writing, graphics, or	○	○	○	○	○

24. As a result of your CQL experience, how much did you GAIN in each of the skills/abilities listed below?

Select one per row.

	No gain	*A little gain*	*Some gain*	*Large gain*	*Extreme gain*
Learning to work independently	○	○	○	○	○
Setting goals and reflecting on performance	○	○	○	○	○
Sticking with a task until it is finished	○	○	○	○	○
Making changes when things do not go as planned	○	○	○	○	○
Working well with people from all backgrounds	○	○	○	○	○
Including others' perspectives when making decisions	○	○	○	○	○
Communicating effectively with others	○	○	○	○	○
Viewing failure as an opportunity to learn	○	○	○	○	○

25. As a result of your CQL experience, how much did you GAIN in the following areas?

Select one per row.

	No gain	*A little gain*	*Some gain*	*Large gain*	*Extreme gain*
Interest in a new STEM topic	○	○	○	○	○
Deciding on a path to pursue a STEM career	○	○	○	○	○
Sense of accomplishing something in STEM	○	○	○	○	○
Feeling prepared for more challenging STEM activities	○	○	○	○	○
Confidence to try out new ideas or procedures on my own in a STEM project	○	○	○	○	○
Patience for the slow pace of STEM research	○	○	○	○	○
Desire to build relationships with mentors who work in STEM	○	○	○	○	○
Connecting a STEM topic or field to my personal values	○	○	○	○	○

26. AS A RESULT OF YOUR CQL experience, are you MORE or LESS likely to engage in the following activities in science, technology, engineering, or mathematics (STEM) outside of school requirements or activities?

Select one per row.

	Much less likely	*Less likely*	*About the same before and after*	*More likely*	*Much more likely*
Watch or read non-fiction STEM	○	○	○	○	○
Tinker (play) with a mechanical or electrical device	○	○	○	○	○
Work on solving mathematical or scientific puzzles	○	○	○	○	○
Use a computer to design or program something	○	○	○	○	○
Talk with friends or family about STEM	○	○	○	○	○
Mentor or teach other students about STEM	○	○	○	○	○
Help with a community service project related to STEM	○	○	○	○	○
Participate in a STEM camp, club, or competition	○	○	○	○	○
Take an elective (not required) STEM class	○	○	○	○	○
Work on a STEM project or experiment in a university or professional setting	○	○	○	○	○

27. Before you participated in CQL, how far did you want to go in school?	
Select one.	
○	Go to a trade or vocational school
○	Go to college for a little while
○	Finish college (get a Bachelor's degree)
○	Get more education after college
○	Get a master's degree
○	Get a Ph.D.
○	Get a medical-related degree (M.D.), veterinary degree (D.V.M), or dental degree (D.D.S)
○	Get a combined M.D. / Ph.D.
○	Get another professional degree (law, business, etc.)

28. After you have participated in CQL, how far do you want to go in school?	
Select one.	
○	Go to a trade or vocational school
○	Go to college for a little while
○	Finish college (get a Bachelor's degree)
○	Get more education after college
○	Get a master's degree
○	Get a Ph.D.
○	Get a medical-related degree (M.D.), veterinary degree (D.V.M), or dental degree (D.D.S)
○	Get a combined M.D. / Ph.D.
○	Get another professional degree (law, business, etc.)

29. When you are 30, to what extent do you expect to use your STEM knowledge, skills, and/or abilities in your job?

Select one.

○	not at all
○	up to 25% of the time
○	up to 50% of the time
○	up to 75% of the time
○	up to 100% of the time

30. Before you participated in CQL, what kind of work did you want to do when you are 30? (select one)

Select one.

○	Undecided
○	Science (no specific subject)
○	Physical science (physics, chemistry, astronomy, materials science)
○	Biological science
○	Earth, atmospheric or oceanic science
○	Environmental science
○	Computer science
○	Technology
○	Engineering
○	Mathematics or statistics
○	Medicine (doctor, dentist, veterinarian, etc.)
○	Health (nursing, pharmacy, technician, etc.)
○	Social science (psychologist, sociologist, etc.)
○	Teaching, STEM
○	Teaching, non-STEM
○	Business
○	Law
○	Military, police, or security
○	Art (writing, dancing, painting, etc.)
○	Skilled trade (carpenter
○	Other, (specify)::

31. After you participated in CQL, what kind of work do you want to do when you are 30? (select one)

Select one.

○	Undecided
○	Science (no specific subject)
○	Physical science (physics, chemistry, astronomy, materials science)
○	Biological science
○	Earth, atmospheric or oceanic science
○	Environmental science
○	Computer science
○	Technology
○	Engineering
○	Mathematics or statistics
○	Medicine (doctor, dentist, veterinarian, etc.)
○	Health (nursing, pharmacy, technician, etc.)
○	Social science (psychologist, sociologist, etc.)
○	Teaching, STEM
○	Teaching, non-STEM
○	Business
○	Law
○	Military, police, or security
○	Art (writing, dancing, painting, etc.)
○	Skilled trade (carpenter, electrician, plumber, etc.)
○	Other, (specify)::

32. How interested are you in participating in the following programs in the future?

Select one per row.

	I've never heard of this program	*Not at all*	*A little*	*Somewhat*	*Very much*
College Qualified Leaders (CQL)	○	○	○	○	○
GEMS Near Peer Mentor Program	○	○	○	○	○
Undergraduate Research Apprenticeship Program (URAP)	○	○	○	○	○
Science Mathematics, and Research for Transformation (SMART) College Scholarship	○	○	○	○	○
National Defense Science & Engineering Graduate (NDSEG) Fellowship	○	○	○	○	○

33. How many jobs/careers in STEM did you learn about during CQL?

Select one.

○	None
○	1
○	2
○	3
○	4
○	5 or more

34. How many Army or Department of Defense (DoD) STEM jobs/careers did you learn about during CQL?

Select one.

○	None
○	1
○	2
○	3
○	4
○	5 or more

35. How much do you agree or disagree with the following statements about Department of Defense (DoD) researchers and research:

Select one per row.

	Strongly Disagree	*Disagree*	*Neither Agree nor Disagree*	*Agree*	*Strongly Agree*
DoD researchers advance science and engineering fields	○	○	○	○	○
DoD researchers develop new, cutting edge technologies	○	○	○	○	○
DoD researchers solve real-world problems	○	○	○	○	○
DoD research is valuable to society	○	○	○	○	○

36. Which of the following statements describe you after participating in the CQL program?

Select one per row.

	Disagree - This did not happen	*Disagree - This happened but not because of SEAP*	*Agree - SEAP contributed*	*Agree - SEAP was primary reason*
I am more confident in my STEM knowledge, skills, and abilities	○	○	○	○
I am more interested in participating in STEM activities outside of school requirements	○	○	○	○
I am more aware of other AEOPs	○	○	○	○
I am more interested in participating in other AEOPs	○	○	○	○
I am more interested in taking STEM classes in school	○	○	○	○
I am more interested in earning a STEM degree	○	○	○	○
I am more interested in pursuing a career in STEM	○	○	○	○
I am more aware of Army or DoD STEM research and careers	○	○	○	○
I have a greater appreciation of Army or DoD STEM research	○	○	○	○
I am more interested in pursuing a STEM career with the Army or DoD	○	○	○	○

37. What are the three most important ways that CQL has helped you?	
Benefit #1:	
Benefit #2:	
Benefit #3:	

38. What are the three ways that CQL should be improved for future participants?	
Improvement #1:	
Improvement #2:	
Improvement #3:	

39. Please tell us about your overall satisfaction with your CQL experience.

Appendix E

CQL Mentor Survey Instrument

Contact Information		
Please verify the following information:		
*First Name:		
*Last Name:		
*Email Address:		
All fields with an asterisk (*) are required.		

*1. Do you agree to participate in this survey? (required)(*Required)	
Select one.	
○	Yes, I agree to participate in this survey
○	No, I do not wish to participate in this survey

2. Please provide your email address: (optional)

3. What is your gender?	
Select one.	
○	Male
○	Female
○	Choose not to report

4. What is your race or ethnicity?	
Select one.	
○	Hispanic or Latino
○	Asian
○	Black or African American
○	Native American or Alaska Native
○	Native Hawaiian or Other Pacific Islander
○	White
○	Choose not to report
○	Other race or ethnicity, (specify)::

5. Which of the following BEST describes the organization you work for? (select ONE)	
Select one.	
○	No organization
○	Private Industry
○	Department of Defense or other government agency
○	Non-profit

○	Other, (specify):

6. Which of the following BEST describes your current occupation (select ONE)		
Select one.		
○	Teacher	
○	Other school staff	
○	University educator	(Go to question number 7.)
○	Scientist, Engineer, or Mathematician in training (undergraduate or graduate student, etc.)	(Go to question number 7.)
○	Scientist, Engineer, or Mathematics professional	(Go to question number 7.)
○	Other, (specify)::	(Go to question number 7.)

7. Which of the following best describes your primary area of research?	
Select one.	
○	Physical science (physics, chemistry, astronomy, materials science, etc.)
○	Biological science
○	Earth, atmospheric, or oceanic science
○	Environmental science
○	Computer science
○	Technology
○	Engineering
○	Mathematics or statistics
○	Medical, health, or behavioral science
○	Social Science (psychology, sociology, anthropology)
○	Other, (specify)::

8. At which of the following CQL sites did you participate? (Select ONE)

Select one.

○	ALABAMA – U.S. Army Aviation & Missile Research, Development & Engineering Center (AMRDEC) - Redstone, AL
○	GEORGIA – U.S. Army Criminal Investigation Command - Defense Forensic Science Center (DFSC) – Forest Park, GA
○	ILLINOIS – U.S. Army Engineer Research & Development Center – Construction Engineering Research Laboratory (ERDC-CERL) - Champaign, IL
○	MARYLAND – U.S. Army Medical Research Institute of Chemical Defense (USAMRICD) – Aberdeen Proving Ground/Edgewood, MD
○	MARYLAND – U.S. Army Center for Environmental Health Research (USACEHR) – Fort Detrick, MD
○	MARYLAND – U.S. Army Medical Research Institute of Infectious Diseases (USAMRIID) – Fort Detrick, MD
○	MARYLAND – U.S. Army Medical Research and Materiel Command – Walter Reed Army Institute of Research (WRAIR) – Silver Spring, MD
○	MARYLAND – U.S. Army Research Laboratory (ARL) – Aberdeen Proving Ground, MD
○	MARYLAND – U.S. Army Research Laboratory (ARL) – Adelphi, MD
○	MISSISSIPPI – U.S. Army Engineer Research & Development Center (ERDC) – Vicksburg, MS
○	VIRGINIA – U.S. Army Engineer Research & Development Center - Geospatial Research Laboratory (ERDC-GRL) – Alexandria, VA

9. Which of the following BEST describes your role during CQL?

Select one.

○	Research Mentor
○	Research Team Member but not a Principal Investigator (PI)
○	Other, (specify)::

10. How many CQL students did you work with this year?

_____ students.

11. How did you learn about CQL? (Check all that apply)

Select all that apply.

☐	Army Educational Outreach Program (AEOP) website
☐	AEOP on Facebook, Twitter, Pinterest, or other social media
☐	A STEM conference or STEM education conference
☐	An email or newsletter from school, university, or a professional organization
☐	Past CQL participant
☐	A student
☐	A colleague
☐	My supervisor or superior
☐	A CQL site host or director
☐	Workplace communications
☐	Someone who works with the Department of Defense (Army, Navy, Air Force)
☐	Other, (specify)::

12. How many times have YOU PARTICIPATED in any of the following Army Educational Outreach Programs (AEOPs) in any capacity? If you have heard of an AEOP but never participated select "Never." If you have not heard of an AEOP select "Never heard of it."

Select one per row.

	Never	*Once*	*Twice*	*Three or more times*	*I've never heard of this program*
Camp Invention	○	○	○	○	○
eCYBERMISSION	○	○	○	○	○
Junior Solar Sprint (JSS)	○	○	○	○	○
West Point Bridge Design Contest (WPBDC)	○	○	○	○	○
Junior Science & Humanities Symposium (JSHS)	○	○	○	○	○
Gains in the Education of Mathematics and Science (GEMS)	○	○	○	○	○
GEMS Near Peers	○	○	○	○	○
UNITE	○	○	○	○	○
Science & Engineering Apprenticeship Program (SEAP)	○	○	○	○	○
Research & Engineering Apprenticeship Program (REAP)	○	○	○	○	○
High School Apprenticeship Program (HSAP)	○	○	○	○	○
College Qualified Leaders (CQL)	○	○	○	○	○
Undergraduate Research Apprenticeship Program (URAP)	○	○	○	○	○
Science Mathematics, and Research for Transformation (SMART) College Scholarship	○	○	○	○	○
National Defense Science & Engineering Graduate (NDSEG) Fellowship	○	○	○	○	○

13. Which of the following were used for the purpose of recruiting your student(s) for apprenticeships? (select ALL that apply)

Select all that apply.

☐	Applications from Academy of Applied Science (AAS) or the AEOP
☐	Personal acquaintance(s) (friend, family, neighbor, etc.)
☐	Colleague(s) in my workplace
☐	K-12 school teacher(s) outside of my workplace
☐	University faculty outside of my workplace
☐	Informational materials sent to K-12 schools or Universities outside of my workplace
☐	Communication(s) generated by a K-12 school or teacher (newsletter, email blast, website)
☐	Communication(s) generated by a university or faculty (newsletter, email blast, website)
☐	STEM or STEM Education conference(s) or event(s)
☐	Organization(s) that serve underserved or underrepresented populations
☐	The student contacted me (the mentor) about the program
☐	I do not know how student(s) were recruited for CQL
☐	Other, (specify)::

14. How SATISFIED were you with the following CQL features?

Select one per row.

	Did not experience	*Not at all*	*A little*	*Somewhat*	*Very much*
Application or registration process	○	○	○	○	○
Other administrative tasks (in-processing, network access, etc.)	○	○	○	○	○
Communicating with Academy of Applied Science (AAS)	○	○	○	○	○
Communicating with CQL organizers	○	○	○	○	○
Support for instruction or mentorship during program activities	○	○	○	○	○
Stipends (payment)	○	○	○	○	○
Research abstract preparation requirements	○	○	○	○	○
Research presentation process	○	○	○	○	○

15. The list below describes mentoring strategies that are effective ways to establish the relevance of learning activities for students. From the list below, please indicate which strategies you used when working with your student(s) in CQL.

Select one per row.

	Yes - I used this strategy	*No - I did not use this strategy*
Become familiar with my student(s) background and interests at the beginning of the CQL experience	○	○
Giving students real-life problems to investigate or solve	○	○
Selecting readings or activities that relate to students' backgrounds	○	○
Encouraging students to suggest new readings, activities, or projects	○	○
Helping students become aware of the role(s) that STEM plays in their everyday lives	○	○
Helping students understand how STEM can help them improve their own community	○	○
Asking students to relate real-life events or activities to topics covered in CQL	○	○

16. The list below describes mentoring strategies that are effective ways to support the diverse needs of students as learners. From the list below, please indicate which strategies you used when working with your student(s) in CQL.

Select one per row.

	Yes - I used this strategy	*No - I did not use this strategy*
Identify the different learning styles that my student (s) may have at the beginning of the CQL experience	○	○
Interact with students and other personnel the same way regardless of their background	○	○
Use a variety of teaching and/or mentoring activities to meet the needs of all students	○	○
Integrating ideas from education literature to teach/mentor students from groups underrepresented in STEM	○	○
Providing extra readings, activities, or learning support for students who lack essential background knowledge or skills	○	○
Directing students to other individuals or programs for additional support as needed	○	○
Highlighting under-representation of women and racial and ethnic minority populations in STEM and/or their contributions in STEM	○	○

17. The list below describes mentoring strategies that are effective ways to support students development of collaboration and interpersonal skills. From the list below, please indicate which strategies you used when working with your student(s) in CQL.

Select one per row.

	Yes - I used this strategy	*No - I did not use this strategy*
Having my student(s) tell other people about their backgrounds and interests	○	○
Having my student(s) explain difficult ideas to others	○	○
Having my student(s) listen to the ideas of others with an open mind	○	○
Having my student(s) exchange ideas with others whose backgrounds or viewpoints are different from their own	○	○
Having my student(s) give and receive constructive feedback with others	○	○
Having students work on collaborative activities or projects as a member of a team	○	○
Allowing my student(s) to resolve conflicts and reach agreement within their team	○	○

18. The list below describes mentoring strategies that are effective ways to support students' engagement in "authentic" STEM activities. From the list below, please indicate which strategies you used when working with your student(s) in CQL.

Select one per row.

	Yes - I used this strategy	*No - I did not use this strategy*
Teaching (or assigning readings) about specific STEM subject matter	○	○
Having my student(s) search for and review technical research to support their work	○	○
Demonstrating laboratory/field techniques, procedures, and tools for my student(s)	○	○
Supervising my student(s) while they practice STEM research skills	○	○
Providing my student(s) with constructive feedback to improve their STEM competencies	○	○
Allowing students to work independently to improve their self-management abilities	○	○
Encouraging students to learn collaboratively (team projects, team meetings, journal clubs, etc.)	○	○
Encouraging students to seek support from other team members	○	○

19. This list describes mentoring strategies that are effective ways to support students' STEM educational and career pathways. The list also includes items that reflect AEOP and Army priorities. From this list, please indicate which strategies you used when working with your student(s) in CQL.

Select one per row.

	Yes - I used this strategy	*No - I did not use this strategy*
Asking my student(s) about their educational and/or career goals	○	○
Recommending extracurricular programs that align with students' goals	○	○
Recommending Army Educational Outreach Programs that align with students' goals	○	○
Providing guidance about educational pathways that will prepare my student(s) for a STEM career	○	○
Discussing STEM career opportunities within the DoD or other government agencies	○	○
Discussing STEM career opportunities in private industry or academia	○	○
Discussing the economic, political, ethical, and/or social context of a STEM career	○	○
Recommending student and professional organizations in STEM to my student(s)	○	○
Helping students build a professional network in a STEM field	○	○
Helping my student(s) with their resume, application, personal statement, and/or interview preparations	○	○

20. How useful were each of the following in your efforts to expose student(s) to Army Educational Outreach Programs (AEOPs) during CQL?

Select one per row.

	Did not experience	*Not at all*	*A little*	*Somewhat*	*Very much*
Army Educational Outreach Program (AEOP) website	○	○	○	○	○
AEOP on Facebook, Twitter, Pinterest or other social media	○	○	○	○	○
AEOP brochure	○	○	○	○	○
It Starts Here! Magazine	○	○	○	○	○
CQL Program administrator or site coordinator	○	○	○	○	○
Invited speakers or “career” events	○	○	○	○	○
Participation in CQL	○	○	○	○	○

21. How USEFUL were each of the following in your efforts to expose your student(s) to Department of Defense (DoD) STEM careers during CQL?

Select one per row.

	Did not experience	*Not at all*	*A little*	*Somewhat*	*Very much*
Army Educational Outreach Program (AEOP) website	○	○	○	○	○
AEOP on Facebook, Twitter, Pinterest or other social media	○	○	○	○	○
AEOP brochure	○	○	○	○	○
It Starts Here! Magazine	○	○	○	○	○
CQL Program administrator or site coordinator	○	○	○	○	○
Invited speakers or "career" events	○	○	○	○	○
Participation in CQL	○	○	○	○	○

22. Which of the following AEOPs did YOU EXPLICITLY DISCUSS with your student(s) during CQL? (check ALL that apply)

Select one per row.

	Yes - I discussed this program with my student(s)	*No - I did not discuss this program with my student(s)*
College Qualified Leaders (CQL)	○	○
GEMS Near Peer Mentor Program	○	○
Undergraduate Research Apprenticeship Program (URAP)	○	○
Science Mathematics, and Research for Transformation (SMART) College Scholarship	○	○
National Defense Science & Engineering Graduate (NDSEG) Fellowship	○	○
I discussed AEOP with my student(s) but did not	○	○

discuss any specific program		

23. How much do you agree or disagree with the following statements about Department of Defense (DoD) researchers and research?

Select one per row.

	Strongly Disagree	*Disagree*	*Neither Agree nor Disagree*	*Agree*	*Strongly Agree*
DoD researchers advance science and engineering fields	○	○	○	○	○
DoD researchers develop new, cutting edge technologies	○	○	○	○	○
DoD researchers solve real-world problems	○	○	○	○	○
DoD research is valuable to society	○	○	○	○	○

24. How often did YOUR STUDENT(S) have opportunities to do each of the following in CQL?

Select one per row.

	Not at all	*At least once*	*A few times*	*Most days*	*Every day*
Learn new science, technology, engineering, or mathematics (STEM) topics	○	○	○	○	○
Apply STEM knowledge to real-life situations	○	○	○	○	○
Learn about new discoveries in STEM	○	○	○	○	○
Learn about different careers that use STEM	○	○	○	○	○
Interact with scientists or engineers	○	○	○	○	○
Communicate with other students about STEM	○	○	○	○	○
Use laboratory or field techniques, procedures, and tools	○	○	○	○	○
Participate in hands-on STEM activities	○	○	○	○	○
Work as part of a team	○	○	○	○	○
Identify questions or problems to investigate	○	○	○	○	○
Design an investigation	○	○	○	○	○
Carry out an investigation	○	○	○	○	○
Analyze data or information	○	○	○	○	○
Draw conclusions from an investigation	○	○	○	○	○
Come up with creative explanations or solutions	○	○	○	○	○
Build or make a computer model	○	○	○	○	○

25. AS A RESULT OF THEIR CQL EXPERIENCE, how much did your student(s) GAIN in the following areas?

Select one per row.

	No gain	*A little gain*	*Some gain*	*Large gain*	*Extreme gain*
In depth knowledge of a STEM topic(s)	○	○	○	○	○
Knowledge of research conducted in a STEM topic or field	○	○	○	○	○
Knowledge of research processes, ethics, and rules for conduct in STEM	○	○	○	○	○
Knowledge of how professionals work on real problems in STEM	○	○	○	○	○
Knowledge of what everyday research work is like in STEM	○	○	○	○	○

26. Which category best describes the focus of your student(s) CQL activities?

Select one.

○	Science	(Go to question number 27.)
○	Technology	(Go to question number 28.)
○	Engineering	(Go to question number 28.)
○	Mathematics	(Go to question number 28.)

27. AS A RESULT OF THEIR CQL EXPERIENCE, how much did your student(s) GAIN in their abilities to do each of the following?

Select one per row.

If answered, go to question number 29.

	No gain	*A little gain*	*Some gain*	*Large gain*	*Extreme gain*
Asking a question that can be answered with one or more scientific experiments	○	○	○	○	○
Using knowledge and creativity to suggest a testable explanation (hypothesis) for an observation	○	○	○	○	○
Making a model of an object or system showing its parts and how they work	○	○	○	○	○
Designing procedures for an experiment that are appropriate for the question to be answered	○	○	○	○	○
Identifying the limitations of the methods and tools used for data collection	○	○	○	○	○
Carrying out procedures for an experiment and recording data accurately	○	○	○	○	○
Using computer models of objects or systems to test cause and effect relationships	○	○	○	○	○
Organizing data in charts or graphs to find patterns and relationships	○	○	○	○	○
Considering different interpretations of data when deciding how the data answer a question	○	○	○	○	○
Supporting an explanation for an observation with data from experiments	○	○	○	○	○
Supporting an explanation with relevant scientific, mathematical, and/or engineering knowledge	○	○	○	○	○
Identifying the strengths and limitations of explanations in terms of how well they describe or predict observations	○	○	○	○	○

27. AS A RESULT OF THEIR CQL EXPERIENCE, how much did your student(s) GAIN in their abilities to do each of the following?

Defending an argument that conveys how an explanation best describes an observation	○	○	○	○	○
Identifying the strengths and limitations of data, interpretations, or arguments presented in technical or scientific texts	○	○	○	○	○
Integrating information from technical or scientific texts and other media to support your explanation of an observation	○	○	○	○	○
Communicating about your experiments and explanations in different ways (through talking, writing, graphics, or mathematics)	○	○	○	○	○

28. AS A RESULT OF THEIR SEAP EXPERIENCE, how much did your student(s) GAIN in their ability to do each of the following?

Select one per row.

	No gain	*A little gain*	*Some gain*	*Large gain*	*Extreme gain*
Defining a problem that can be solved by developing a new or improved object, process, or system	○	○	○	○	○
Using knowledge and creativity to propose a testable solution for a problem	○	○	○	○	○
Making a model of an object or system to show its parts and how they work	○	○	○	○	○
Designing procedures for an experiment that are appropriate for the question to be answered	○	○	○	○	○
Identifying the limitations of the methods and tools used for data collection	○	○	○	○	○
Carrying out procedures for an experiment and recording data accurately	○	○	○	○	○
Using computer models of an object or system to investigate cause and effect relationships	○	○	○	○	○
Considering different interpretations of the data when deciding if a solution works as intended	○	○	○	○	○
Organizing data in charts or graphs to find patterns and relationships	○	○	○	○	○
Supporting a solution for a problem with data from experiments	○	○	○	○	○
Supporting a solution with relevant scientific, mathematical, and/or engineering knowledge	○	○	○	○	○
Identifying the strengths and limitations of solutions in terms of how well they meet design criteria	○	○	○	○	○
Defend an argument that conveys how a solution best meets design criteria	○	○	○	○	○

28. AS A RESULT OF THEIR SEAP EXPERIENCE, how much did your student(s) GAIN in their ability to do each of the following?

Identifying the strengths and limitations of data, interpretations, or arguments presented in technical or scientific texts	○	○	○	○	○
Integrating information from technical or scientific texts and other media to support your solution to a problem	○	○	○	○	○
Communicating information about your design experiments and solutions in different ways (through talking, writing, graphics, or math equations)	○	○	○	○	○

29. AS A RESULT OF THE CQL EXPERIENCE, how much did your student(s) GAIN (on average) in the skills/abilities listed below?

Select one per row.

	No gain	*A little gain*	*Some gain*	*Large gain*	*Extreme gain*
Learning to work independently	○	○	○	○	○
Setting goals and reflecting on performance	○	○	○	○	○
Sticking with a task until it is finished	○	○	○	○	○
Making changes when things do not go as planned	○	○	○	○	○
Including others' perspectives when making decisions	○	○	○	○	○
Communicating effectively with others	○	○	○	○	○
Confidence with new ideas or procedures in a STEM project	○	○	○	○	○
Patience for the slow pace of research	○	○	○	○	○
Desire to build relationships with professionals in a field	○	○	○	○	○
Connecting a topic or field with their personal values	○	○	○	○	○

30. Which of the following statements describe YOUR STUDENT(S) after participating in the CQL program?

Select one per row.

	Disagree - This did not happen	*Disagree - This happened but not because of CQL*	*Agree - CQL contributed*	*Agree - CQL was primary reason*
More confident in STEM knowledge, skills, and abilities	○	○	○	○
More interested in participating in STEM activities outside of school requirements	○	○	○	○
More aware of other AEOPs	○	○	○	○
More interested in participating in other AEOPs	○	○	○	○
More interested in taking STEM classes in school	○	○	○	○
More interested in earning a STEM degree	○	○	○	○
More interested in pursuing a career in STEM	○	○	○	○
More aware of DoD STEM research and careers	○	○	○	○
Greater appreciation of DoD STEM research	○	○	○	○
More interested in pursuing a STEM career with the DoD	○	○	○	○

31. What are the three most important strengths of CQL?	
Strength #1:	
Strength #2:	
Strength #3:	

32. What are the three ways CQL should be improved for future participants?	
Improvement #1:	
Improvement #2:	
Improvement #3:	

33. Please tell us about your overall satisfaction with your CQL experience.

Appendix F

Academy of Applied Science (AAS)
FY16 Evaluation Report Response