Army Educational Outreach Program

College Qualified Leaders

2015 Annual Program Evaluation Report

CQL_04_05012016

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Executive Summary

The College Qualified Leaders (CQL) program, managed by the American Society for Engineering Education (ASEE) in 2015, is an Army Educational Outreach Program (AEOP) that matches talented college students and recent graduates (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.

This report documents the evaluation of the FY15 CQL program. Virginia Tech, in collaboration with ASEE, collected the FY2015 evaluation data for the CQL program. Purdue University, the new evaluation lead, prepared the FY 2015 evaluation reports, which 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 surveys for students and mentors, eight interviews with apprentices, and an annual program report compiled by ASEE.

2015 CQL sites included the US Army Research Laboratory – Aberdeen Proving Ground (ARL-APG), the US Army Research Laboratory – Adelphi (ARL-A), the Walter Reed Army Institute of Research (WRAIR), the US Army Medical Research Institute for Infectious Diseases (USAMRIID), the US Army Aviation & Missile Research Development and Engineering Center – Redstone Arsenal (AMRDEC), the Engineering Research and Development Center Construction Engineering Research Laboratory (ERDC-CERL), the US Army Medical Research Institute of Chemical Defense (USAMRICD), the US Army Center for Environmental Health Research (USACEHR), the Defense Forensic Science Center (DFSC), the U.S. Army Engineer Research & Development Center – Geospatial Research Laboratory (ERDC-GRL), and the Engineering Research and Development Center in Vicksburg, MS (ERDC-MS).

2015 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	507
No. of Students (Apprentices)	394
Placement Rate	78%

No. of Mentors (Army S&Es and other adult mentors)	369
No. of Army Research Laboratories	11
No. of Colleges/Universities	120
No. of HBCU/MSIs	12
Total Cost	$4,212,439
Stipend Cost	$4,159,634
Cost Per Student Participant	$10,691

It should be noted that the CQL program requires a one-to-one mentor to apprentice ratio. In FY15, as in FY14, the number of apprentices exceeded the number of mentors, indicating that this requirement was not met.

Summary of Findings

The FY15 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.

2015 CQL Evaluation Findings	
Participant Profiles	
CQL had some success at serving students of historically underrepresented and underserved populations.	Overall enrollment for CQL increased in FY15 (394) compared to FY14 (307), despite an 8% decrease in applicants. The applicant placement rate improved 22% in FY15. The number of females participating in CQL increased substantially in FY15. Enrollment data indicate that 40% of all participants were female in FY15, an increase of 15% from FY14 (only 25% female enrollment). Although females continued to participate at a lower rate than males (in FY15 60% of participants were males, 40% were females), this increase in the participation of female students—a population that is historically underrepresented in engineering fields – is a significant gain. The number of participating colleges/universities for the CQL program grew to 120 (from 104 in FY14).
	CQL continued to serve students from historically underrepresented and underserved race/ethnicity groups, however the majority of enrolled apprentices identified themselves as "White" or "Asian." An area of growth for CQL was in the number of apprentices identifying themselves as Black or African American, which tripled from FY14 (9 in 2014 or 6% versus 27 in 2015 or 10%). CQL participants represented a total of 12 historically Black colleges and universities (HBCUs) and other minority serving institutions (MSIs), an increase of 14% over FY14.

	Conversely, participation of Hispanic or Latino students decreased in FY15, with 3% of apprentices identifying themselves as Hispanic or Latino in FY15 versus 9% in FY14. In sum, only 13% of enrolled participants identified themselves as being from an underrepresented or underserved minority groups, indicating that work remains to be done in devising strategies to recruit apprentices from these groups.
CQL made limited progress in recruiting past AEOP program participants.	Questionnaire data indicate that few responding apprentices had participated in other AEOP programs previously (93% to 98%). About 84% of apprentices noted participation in CQL at least once (although it's not clear whether the one time was including or in addition to current participation), and about 30% had participated more than once. While 32% of students had participated in SEAP at least once, only 13% had participated in GEMS in the past, representing a decline as compared to alumni participation in FY14 when 37% of participants were alumni of SEAP and 18% were alumni of GEMS.
CQL succeeded in reaching and exceeding its targeted number of program applicants.	There were 695 total applicants for CQL in FY15, a 12% increase from FY14. The applicant pool exceeded the target set in FY14 for 650 applicants in 2015, indicating that outreach efforts to grow number or applicants were successful. Likewise, there was an increase of 12% in enrolled participants in FY15 as compared to FY14. In CQL, student participation is dependent upon the number of available mentors. Therefore, the expansion in program participation is also attributable to the corresponding 12% increase in the number of mentor participants from FY14 to FY15. Even with this growth in the number of mentors, however, CQL fell short of meeting its required one-to-one mentor to apprentice ratio (there were 369 mentors and 394 apprentices in FY15, resulting in a mentor to apprentice ratio of .94:1).
Actionable Program Evaluation	
CQL grew their mentor pool in FY15 and pre-existing relationships continue to be a key factor in CQL recruitment.	The number of CQL mentors increased in FY15 (369) from FY14 (288). Mentor questionnaire respondents indicated students were most commonly recruited through colleagues, personal acquaintances, university faculty, and contact from the student.
	Apprentice questionnaire respondents indicated that they most commonly learned about CQL from someone who works at an Army laboratory, teachers or professors, immediate family members, university resources, friends, mentors, or past CQL participants. In addition, apprentice interview data support the notion that pre-existing relationships are instrumental in growing 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, reporting that the strongest motivators were interest in STEM, the desire to expand laboratory and research skills, and the opportunity to learn something new and interesting. Other highly motivating factors included the opportunity to use advanced laboratory technology, figuring out education or career goals, and interest in Stem careers with the Army. Interview data also suggested that apprentices were motivated by the opportunity to gain job and research experience.
CQL engaged apprentices in meaningful STEM learning.	Most apprentices (55-88%) reported learning about STEM topics, applications of STEM to real-life situations, STEM careers, and new discoveries in STEM on most days or every day of their CQL experience.
	Frequent opportunities to engage in a variety of STEM practices were provided to apprentices on most days or every day during their CQL experience. For example, 83% reported participating in hands-on STEM activities; 71% practicing using laboratory procedures, and tools; 71% working as part of a team; 72% carrying out an investigation; and 75% analyzing and interpreting data or information.
	CQL provided more frequent opportunities for apprentices to learn about STEM and be engaged in STEM practices than reported experiences 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, and engage apprentices in authentic STEM activities.
CQL promoted apprentice awareness of DoD STEM research and careers.	Nearly all CQL participants reported learning about at least one STEM career, and 44% reported learning about 4 or more. Similarly, 100% of students reported learning about at least one DoD STEM job, with 60% reporting they learned about 3 or more, an increase over FY14 results. Apprentices reported that mentors and the CQL experience contributed the most to this impact.
Apprentices' awareness of other AEOP scholarship programs increased, but CQL can improve mentor and apprentice awareness of and marketing of other AEOP opportunities.	Most mentor questionnaire respondents reported that participation in CQL or the CQL program administrator or site coordinator were the most useful resources for students to learn about AEOP initiatives. However, mentors overall reported limited awareness of AEOP initiatives. The majority of responding mentors (57%-81%) reported no exposure or experience with AEOP informational resources including the AEOP website, the It Starts Here! Magazine, the AEOP brochure, and AEOP social media. In spite of this, a large majority of responding mentors (95%) reported discussing URAP with apprentices, while 54% discussed NDSEG and 27% discussed SMART. The number of apprentice respondents who had heard of SMART and NSDEG (74% and 61% respectively) increased over FY14 levels and surpassed FY15 goals. Additionally, 49% of apprentices reported having heard of

	URAP.
Apprentices and mentors value the CQL experience, although program administration continues to be an area for improvement.	A large majority of responding apprentices reported satisfaction with their mentors and experiences during the CQL program. For example, over 90% of responding apprentices reported being at least "somewhat" satisfied with their mentor, the time they spent with their mentor, and the research experience overall.
	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 28% of apprentices described some level of dissatisfaction with administrative aspects of the program. In particular, apprentices noted difficulties in communicating with program administrators, problems receiving stipend payments, and delays in getting security clearance and computer access. When asked how the program could be improved, 65% of apprentice respondents cited that improvements could be made in administrative tasks such as stipend payments, communication, security clearance, and computer access.
Outcomes Evaluation	
CQL apprentices reported gains in their STEM knowledge and competencies.	Apprentices reported substantial gains in their STEM knowledge. A majority of respondents reported large or extreme gains in their knowledge of what everyday research work is like in STEM, how professionals work on real problems in STEM, research conducted in a STEM topic or field, in-depth knowledge of a STEM topic, and the research processes, ethics, and rules for conduct in STEM.
	Apprentices also reported gains in their STEM competencies, including the following: carrying out procedures for an investigation and recording data accurately; supporting an explanation with relevant scientific, mathematical, and/or engineering knowledge; identifying the strengths and limitations of data, interpretations, or arguments presented in technical or scientific texts; carrying out procedures for an experiment and recording data accurately, supporting an explanation with relevant scientific, mathematical and/or engineering knowledge; asking a question that can be answered with scientific experiments; considering different interpretations of data; integrating information from technical or scientific texts and other media to support explanations of an observation; communicating about experiments in different ways; and identifying the strengths and limitations of explanations in terms of how well they describe or predict observations.

CQL participants reported gains in apprentices' 21st Century Skills.	A clear majority of apprentices reported large or extreme gains in several critical workplace skills including the ability to make changes when things do not go as planned, learning to work independently, communicating effectively with others, sticking with a task until it is complete, and viewing failure as an opportunity to learn.
CQL participants reported increased confidence and identity in STEM.	Apprentices reported gains in their confidence and STEM identity, including large or extreme gains in feeling prepared for more challenging STEM activities, having a sense of accomplishing something in STEM, having confidence to try out new ideas or procedures, and having a desire to build relationships with mentors in STEM fields.
CQL participants reported increased interest in future STEM engagement.	Apprentices also reported that that they were more likely to engage in additional STEM activities outside of school after participating in CQL. A majority of apprentices indicated that they were more likely to work on a STEM project or experiment in a university or professional setting, talk with friends or family about STEM, mentor or teach other students about STEM, work on a STEM project or experiment in a university or professional setting, and use a computer to design or program something.
CQL influenced apprentices' education aspirations, but did not change their career aspirations.	Apprentices were asked about their education aspirations both before and after their participation in CQL. After CQL, apprentices indicated being more likely to go further in their schooling than they would have before, with the greatest change being in the proportions of apprentices who wanted to get a Ph.D. (28% before CQL, 38% after) and who wanted to get a medical related degree (27% before CQL, 36% after).
	Apprentices were asked to indicate what kind of work they expected to be doing at age 30 both before and after their participation in CQL. Although the vast majority of apprentices indicated interest in a STEM-related career, there was not distinct shift in career aspirations from before CQL to after.

CQL participants reported limited awareness of AEOP initiatives, but apprentices indicated interest in future AEOP opportunities.	Apprentices and mentors reported limited awareness of other AEOP initiatives with the exception of scholarship programs such as SMART and NDSEG. A large majority of apprentices (80%) were at least somewhat interested in participating in CQL in the future. More than half of apprentice respondents (52%) reported being at least somewhat interested in participating in SMART in the future while 47% indicated being at least somewhat interested in NDSEG, and 25% indicated being at least somewhat interested in URAP. Apprentices reported that their CQL participation and their mentors had the most impact on their awareness of AEOPs.
CQL apprentices have positive opinions about DoD researchers and research.	Apprentice perceptions of DoD researchers and research was overwhelmingly positive. A large majority of apprentices reported that they agreed or strongly agreed that DoD researchers solve real-world problems (93%), DoD researchers advance science and engineering fields (98%), DoD research is valuable to society (93%), and DoD researchers develop new, cutting edge technologies (95%).

Recommendations

Evaluation findings indicate that FY15 was a successful year overall for the CQL program. Most notably, the program experienced a 12% growth in both apprentice and mentor participation, surpassing the goal set in 2014. In addition, the number of apprentices identifying themselves as Black/African American tripled from FY14 to FY15, a significant step toward achieving the AEOP goal of expanding participation among underrepresented groups. The increase in participation of females from 25% to 40% from FY14 to FY15 is also a notable achievement. Efforts to inform students about other AEOPs appear to be improving as well, as the number of participants who had heard of SMART and NSDEG increased to 74% and 61% in FY15 (up from 64% and 54% in FY14). Apprentices and mentors alike continue to report high levels of satisfaction with the program and mentor-apprentice relationships, and both groups report strong apprentice gains in STEM competencies and knowledge as a result of the CQL experience.

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

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

1. In spite of the increase in the number of CQL participants from underrepresented groups, work remains to be done in achieving the CQL program goal of broadening the talent pool in STEM fields. It is noteworthy that in 2015, 27

participants, or 10%, identified themselves as Black or African American, representing a substantial increase from the 9 participants (6%) in 2014. The program may want to build upon this success by expanding successful strategies such as outreach to HBCUs/MSIs and implementing other new methods to actively recruit students nationwide. Although there was an increase in the number of female CQL participants in 2015, females continue to participate at lower rates than males, and targeting outreach efforts to women's colleges and groups such as Association for Women in Science (AWIS) and Society of Women Engineers (SWE) may increase the participation of females. Since some students noted that their late notice of acceptance created difficulties in securing housing, and several indicated that assistance in locating housing would be beneficial in facilitating the participation of geographically diverse apprentices, the program may wish to consider whether some support in locating housing can be incorporated into the application and acceptance process in order to attract a broader demographic pool of students. Additionally, by more actively recruiting beyond communities with an Army site, the program is likely to receive more applications, including more from groups that are historically underrepresented and underserved in STEM fields.

2. In addition, 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. The IPA may wish to revise recruitment and selection practices by, for example, masking applicants' names during application reviews, establishing a selection panel, and instituting other measures to ensure that applicants are selected on the basis of their qualifications and aptitudes rather than on the basis of their connections to research laboratories/personnel.

3. In order to continue to work toward the AEOP goal of broadening the STEM talent pool, the program should continue its work in phasing out the practice of granting apprenticeships to graduate students. Since these individuals already hold a STEM degree, they are existing members of the STEM talent pool and their participation in CQL does not promote the goal of broadening this pool.

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

1. While efforts to recruit mentors were met with success as indicated by the 12% increase in mentor participation from 2014 to 2015, apprentice participation continues to be limited by the number of available mentors. It is notable that even with the increase in mentor participation, CQL failed to meet its program requirement of a one-to-one mentor to apprentice ratio. In order to broaden participation and provide more opportunities to qualified candidates, mentor participation must continue to grow, and the program should ensure that the one-to-one mentor to apprentice ratio is met in order to ensure that each apprentice receives the high quality mentoring the program strives to provide. In order to grow and retain the pool of mentors, the program may want to consider what incentives it can provide for mentor participation. Such incentives could 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. Questionnaire responses indicated that mentors would welcome more support, both in terms of support and instruction in mentorship and by receiving targeted feedback from apprentice questionnaires. As a result, it may be productive to 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.

2. In order to create a robust pipeline of AEOP programs in which students progress from other AEOP programs into CQL and beyond, the program may want to consider innovative ways to work with other AEOP programs to create a more seamless continuum of programs. Apprentice questionnaire data indicate that most apprentices had not participated in other AEOPs and, in fact, the proportion of CQL participants who were alumni of GEMS and SEAP declined from FY14 to FY15. In addition, CQL mentors and apprentices reported only limited knowledge of AEOP programs other than CQL. Apprentice responses indicating the importance of mentors in learning about other AEOPs attest to the importance of mentors in conveying information to apprentices and efforts should be made to ensure that mentors are informed about the range of AEOPs. Because of the time constraints these mentors face in working with apprentices, however, the program should also consider ways to educate apprentices about AEOP opportunities that do not rely on mentors. For instance, information about AEOPs could be incorporated into orientation materials, provided during the student symposium, and incorporated into alumni communications. 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. Administrative difficulties were noted in both FY14 and FY15 and, while students were positive overall about their CQL experiences, problems with receiving stipends in a timely fashion, lack of computer access, and security clearance issues colored the experience of over a quarter of all apprentices. There is evidence that these issues, particularly the late stipend payments, could impact program goals negatively as some students indicated that these problems served as a disincentive to future participation in CQL. Likewise, some mentors reported expending considerable time in assisting students with remedying pay issues. As the Academy of Applied Science assumes the administration of CQL, it should be mindful of these issues and leverage its past experience with administering apprenticeship programs to streamline processes and improve communication with apprentices. Some mentors

also suggested measures to streamline the recruiting and selection process. These suggestions focused on automating the selection process and reducing the amount of paperwork involved. Other suggestions included beginning the security clearance and computer access processes earlier so that these are complete before the start of the apprenticeship.

2. The continued low response rates for both the student and mentor questionnaires (32% and 10% in FY15) raise 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, the evaluation instruments may need to be streamlined to reduce the time commitment of respondents.

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 FY15 CQL was managed by the American Society for Engineering Education (ASEE). The Academy of Applied Sciences will assume this role for the FY16 year. The evaluation study was performed by Purdue University in cooperation with Battelle, the Lead Organization (LO) in the AEOP CA consortium. Data analyses and reports were prepared using data collected by the former LO, Virginia Tech (VT).

Program Overview

The College Qualified Leaders (CQL) program, managed by the American Society for Engineering Education (ASEE) in FY15, is an Army Educational Outreach Program (AEOP) that matches talented college students and recent graduates (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 adults employees of CQL sites served as mentors in FY15. The use of the term "mentor" throughout this report will refer to the Army S&E or other adult 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 2015, 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.

Apprenticeships were completed at 11 Army research laboratories in 5 states, summarized in Table 1.

Table 1. 2015 CQL Sites		
2015 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
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

The 11 host sites received applications from substantially more qualified students than they had positions for in the 2015 CQL program: 695 students applied and 394 enrolled, which represents a 20.9% increase in applicants and a 22.1% increase in the number of enrolled participants compared to 2014 (550 students applied and 307 enrolled). Table 2 summarizes interest and final enrollment by site.

Table 2. 2015 CQL Site Applicant and Enrollment Numbers				
2015 CQL Site	**FY2014**		**FY2015**	
	No. of Applicants	**No. of Enrolled Participants**	**No. of Applicants**	**No. of Enrolled Participants**
US Army Research Laboratory – Aberdeen Proving Ground (ARL-APG)	161	79	139	91
US Army Research Laboratory – Adelphi (ARL-A)	118	75	166	107
Walter Reed Army Institute of Research (WRAIR)	94	76	96	86
US Army Medical Research Institute for Infectious Diseases (USAMRIID)	40	18	66	23
US Army Aviation & Missile Research Development and Engineering Center – Redstone Arsenal (AMRDEC)	69	16	70	23
Engineer Research & Development Center Construction Engineering Research Laboratory (ERDC-CERL)	27	12	22	17
US Army Medical Research Institute of Chemical Defense (USAMRICD)	20	9	40	6
US Army Center for Environmental Health Research (USACEHR)	8	12	35	15
Defense Forensic Science Center (DFSC)	13	8	28	22
Engineer Research and Development Center – Vicksburg, MS (ERDC-MS)	NA	2	9	3
US Army Engineer Research & Development Center – Alexandria, VA (ERDC-GRL)	NA	NA	24	1
Total	**550**	**307**	**695**	**394**

The total cost of the 2015 CQL program was $4,212,439. This includes administrative costs to ASEE of $52,805 and $4,159,634 for participant stipends (including cost of required eye exams for apprentices in laser labs and work boots when required). The average cost per 2015 CQL participant taken across all CQL sites was $10,691. Table 3 summarizes these expenditures.

Table 3. 2015 CQL Program Costs	
2015 CQL - Cost Per Participant	
Total Participants	394
Total Cost	$4,212,439
Cost Per Participant	**$10,691**
2015 CQL - Cost Breakdown Per Participant	
Average Administrative Cost to ASEE Per Participant	$134
Average Participant Stipend (including eye exam and/or work boots if required)	$10,557
Cost Per Participant	**$10,691**

Evidence-Based Program Change

Based on recommendations from the FY14 summative evaluation report, the AEOP identified three key priorities for AEOP programs in FY15: 1) Increase outreach to populations that are historically underserved and underrepresented in STEM; 2) Increase participants' awareness of Army/DoD STEM careers; and 3) Increase participants' awareness of other AEOP opportunities. ASEE initiated the following program changes/additions to the FY15 administration of the CQL program in light of the key AEOP priorities, the FY14 CQL evaluation study, and site visits conducted by ASEE and the LO.

I. **Increase outreach to populations that are historically underserved and underrepresented in STEM.**
   a. ASEE engaged in the following promotional and outreach efforts to provide information about CQL to a diverse audience:
      i. Outreach efforts at career fairs serving diverse audiences
         1. University of Maryland Career Fair
         2. Howard University Career Fair
         3. North Carolina A&T State University Career Fair
      ii. Sent email blasts to 3,000 + teachers, guidance counselors, and principals.
   b. Wrote 2015-outreach plan for GEMS/SEAP/CQL.

II. **Increase participant's awareness of other AEOP opportunities.**
   a. ASEE emailed previous CQL participants with links to AEOP social media.
   b. Planned potential cross-promotional opportunities with other Individual Program Administrators (IPAs).

FY15 Evaluation At-A-Glance

Purdue University, in collaboration with ASEE and using data collected by Virginia Tech, 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 • ASEE providing oversight of site programming • Operations conducted by 11 Army Labs • 394 students participating in CQL apprenticeships • 369 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 ASEE 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 apprentices' STEM competencies?
  - Increase apprentices' interest in future STEM engagement?
  - Increase apprentices' awareness of and interest in other AEOP opportunities?

The assessment strategy for CQL included interviews with 8 apprentices, a post-program apprentice questionnaire, a post-program mentor questionnaire, and an Annual Program Report (APR) prepared by ASEE using data from all CQL sites. Tables 4-7 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. 2015 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 & Suggestions	Benefits to participants, suggestions for improving programs, overall satisfaction

Table 5. 2015 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. 2015 Apprentice Interviews	
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. 2015 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. Questionnaires are provided in Appendix B (apprentice) and Appendix C (mentor). The apprentice interview protocol is provided in Appendix D; the APR template is located in Appendix E. Major trends in data analyses are reported herein.

Study Sample

Table 8 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 both the apprentice and mentor surveys is larger than generally considered acceptable, indicating that the samples may not be representative of their respective populations. Apprentices from 10 of 11 CQL sites responded to questionnaires, as did mentors from 11 of the 11 sites. Table 9 shows the number of apprentice and mentor respondents by site.

Table 8. 2015 CQL Questionnaire Participation				
Participant Group	**Respondents (Sample)**	**Total Participants (Population)**	**Participation Rate**	**Margin of Error @ 95% Confidence[1]**
Apprentices	125[†]	394	32%	±7.25
Mentors	38	369	10%	±15.08

[†]Demographic information was not available for all survey respondents due to inconsistent use of Cvent for collecting this data at registration. Questionnaire participation data therefore reflects the number of individuals providing responses to the questionnaire. Some may not have associated demographic data linked to their survey responses.

A total of eight apprentice interviews were conducted. Among the eight interview participants, 6 were female and 2 male. It should be noted that the gender proportion in the interview sample (75% female, 25% male) was not representative of that in the population of CQL apprentices at large (40% female, 60% male). Interview participants ranged from a college sophomore to recent graduates and graduate-school students. Interviews 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.

Table 9.

2015 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)	91	26	78	4
US Army Research Laboratory – Adelphi (ARL-A)	107	30	129	2
Walter Reed Army Institute of Research (WRAIR)	86	7	38	11
US Army Medical Research Institute for Infectious Diseases (USAMRIID)	23	10	27	6
US Army Aviation & Missile Research Development and Engineering Center – Redstone Arsenal (AMRDEC)	23	11	20	7
Engineer Research & Development Center Construction Engineering Research Laboratory (ERDC-CERL)	17	7	24	1
US Army Medical Research Institute of Chemical Defense (USAMRICD)	6	3	18	1
US Army Center for Environmental Health Research (USACEHR)	15	7	5	1
Defense Forensic Science Center (DFSC)	22	3	21	2
Engineer Research & Development Center – Vicksburg, MS (ERDC-MS)	3	0	8	1
Engineer Research & Development Center – Geospatial Research Laboratory (ERDC-GRL) – Alexandria, VA	1	3	1	2
Total	**394**	**107**	**369**	**38**

Respondent Profiles

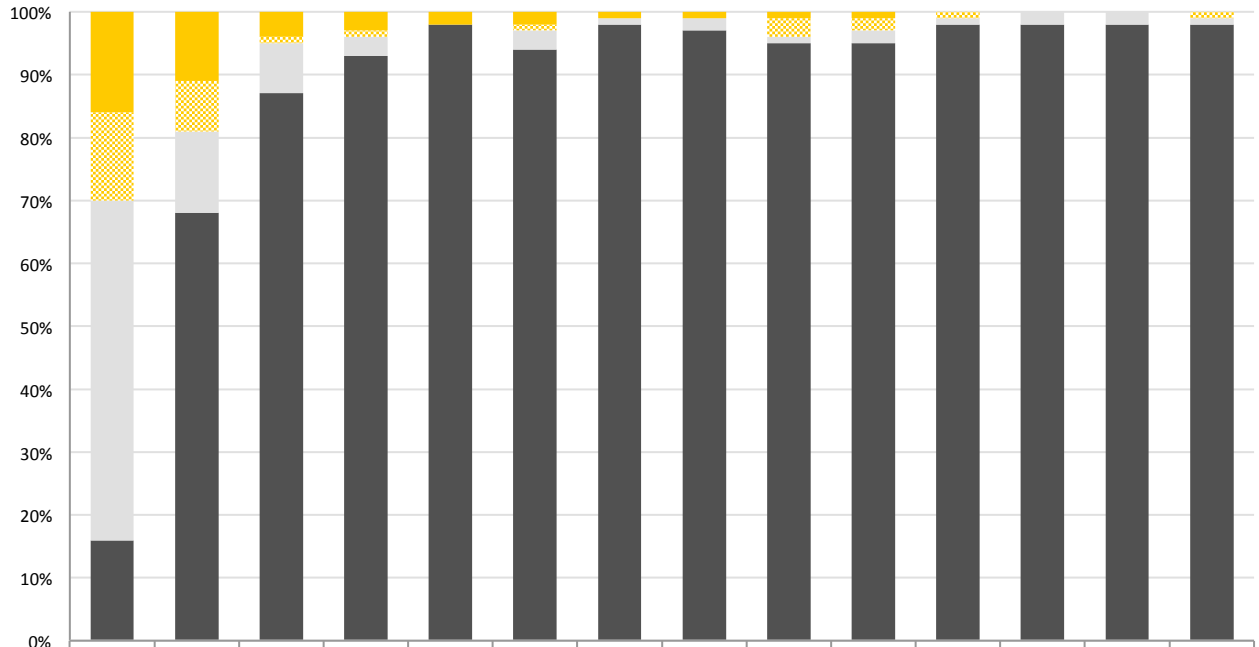
Apprentice Demographics

Demographic information collected from questionnaire respondents is summarized in Table 10. More males (57%) than females (43%) completed the questionnaire. More apprentices responding to the questionnaire identified with the race/ethnicity category of White (65%) than any other single race/ethnicity category, though there is substantial representation of the category of Black or African American (20%). The majority of respondents (65%) were in the 2nd to 4th year of college. FY15 evaluation data and enrollment data reveals that CQL had limited success in engaging female students (43% of questionnaire respondents, 40% of enrollment survey respondents). The same data suggest CQL had some success in providing outreach to students from historically underrepresented and underserved race/ethnicity groups (20% of questionnaire respondents as compared to 13% of respondents in 2014). While these numbers represent an increase from 2014, this remains an area for growth.

Table 10. 2015 CQL Apprentice Respondent Profile (n = 92)		
Demographic Category	**Questionnaire Respondents**	
Respondent Gender		
Male	52	57%
Female	40	43%
Choose not to report	0	0%
Respondent Race/Ethnicity		
Asian	4	4%
Black or African American	18	20%
Hispanic or Latino	6	7%
Native American or Alaska Native	1	1%
Native Hawaiian or Other Pacific Islander	0	0%
White	60	65%
Other race or ethnicity, (specify)	0	0%
Choose not to report	3	3%
Respondent Grade Level		
College freshman	15	16%
College sophomore	20	22%
College junior	26	28%
College senior	14	15%
Graduate program	13	14%
Other	4	4%
Choose not to report	0	0%

Apprentices were asked how many times they participated in each of the AEOP programs. As can be seen in Chart 1, 15% of responding apprentices reported participating in CQL once or more; 9% reported participating in SEAP or GEMS at least once. Few apprentices (5% or less) reported participating in any of the other AEOP programs. Compared to 2014, a lower percentage of 2015 responding apprentices had previously participated in any of the AEOP programs.

Chart 1: Student Participation in AEOP Programs (n =91)



	CQL	SEAP	GEMS	SMART College Scholarship	JSS	GEMS Near Peers	NDSEG Fellowship	HSAP	REAP	eCYBERMISSION	Camp Invention	JSHS	URAP	UNITE
Three or more times	16%	11%	4%	3%	2%	2%	1%	1%	1%	1%	0%	0%	0%	0%
Twice	14%	8%	1%	1%	0%	1%	0%	0%	3%	2%	1%	0%	0%	1%
Once	54%	13%	8%	3%	0%	3%	1%	2%	1%	2%	1%	2%	2%	1%
Never	16%	68%	87%	93%	98%	94%	98%	97%	96%	96%	98%	98%	98%	98%

Note: SEAP = Science & Engineering Apprenticeship Program; GEMS = Gains in the Education of Mathematics and Science; SMART = Science, Mathematics, and Research for Transformation; JSS = Junior Solar Sprint; NDSEG = National Defense Science & Engineering Graduate; HSAP = High School Apprenticeship Program; REAP = Research & Engineering Apprenticeship Program; JSHS = Junior Science and Humanities Symposium; URAP = Undergraduate Research Apprenticeship Program

Mentor Demographics

Mentor demographic data are summarized in Table 11. The number of male responding mentors was greater than the number of female responding mentors (27 males vs. 11 females or 71% vs. 29%). Nearly three-fourths of the responding mentors identified themselves as White (74%). The majority of responding mentors identified themselves as scientist, engineer, or mathematics professionals (90%); and a little less than half (45%) identified their primary area of research as biological science followed by engineering (18%). Diversity in respondent occupation and primary area of research was greater in FY15 in comparison to FY14.

Table 11. 2015 CQL Mentor Respondent Profile		
Demographic Category	**Questionnaire Respondents**	
Respondent Gender (n = 38)		
Female	11	29%
Male	27	71%
Respondent Race/Ethnicity (n = 38)		
Asian	3	16%
Black or African American	0	0%
Hispanic or Latino	1	5%
Native American or Alaska Native	0	0%
Native Hawaiian or Other Pacific Islander	0	0%
White	14	74%
Other race or ethnicity, (specify):	0	0%
Choose not to report	1	5%
Respondent Occupation (n = 38)		
Scientist, Engineer, or Mathematics professional	34	90%
Teacher	0	0%
Other school staff	0	0%
University educator	0	0%
Scientist, Engineer, or Mathematician in training (undergraduate or graduate student, etc.)	1	3%
Other, (specify) †	3	7%
Respondent Primary Area of Research (n = 38)		
Biological Science	17	45%
Physical science (physics, chemistry, astronomy, materials science)	1	3%
Engineering	7	18%
Medical, health, or behavioral science	3	8%
Earth, atmospheric, or oceanic science	0	0%
Agricultural science	0	0%
Environmental science	3	8%
Computer science	3	8%
Technology	1	3%
Mathematics or statistics	1	3%
Social science (psychology, sociology, anthropology, etc.)	0	0%
Other, (specify) ††	2	5%

†Other = Outreach Program Coordinator; Animal Model Specialist; NRC Fellow

††Other = No research; Forensic science

Actionable Program Evaluation

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. This section highlights information outlined in the Satisfaction & Suggestions sections of Tables 4-8.

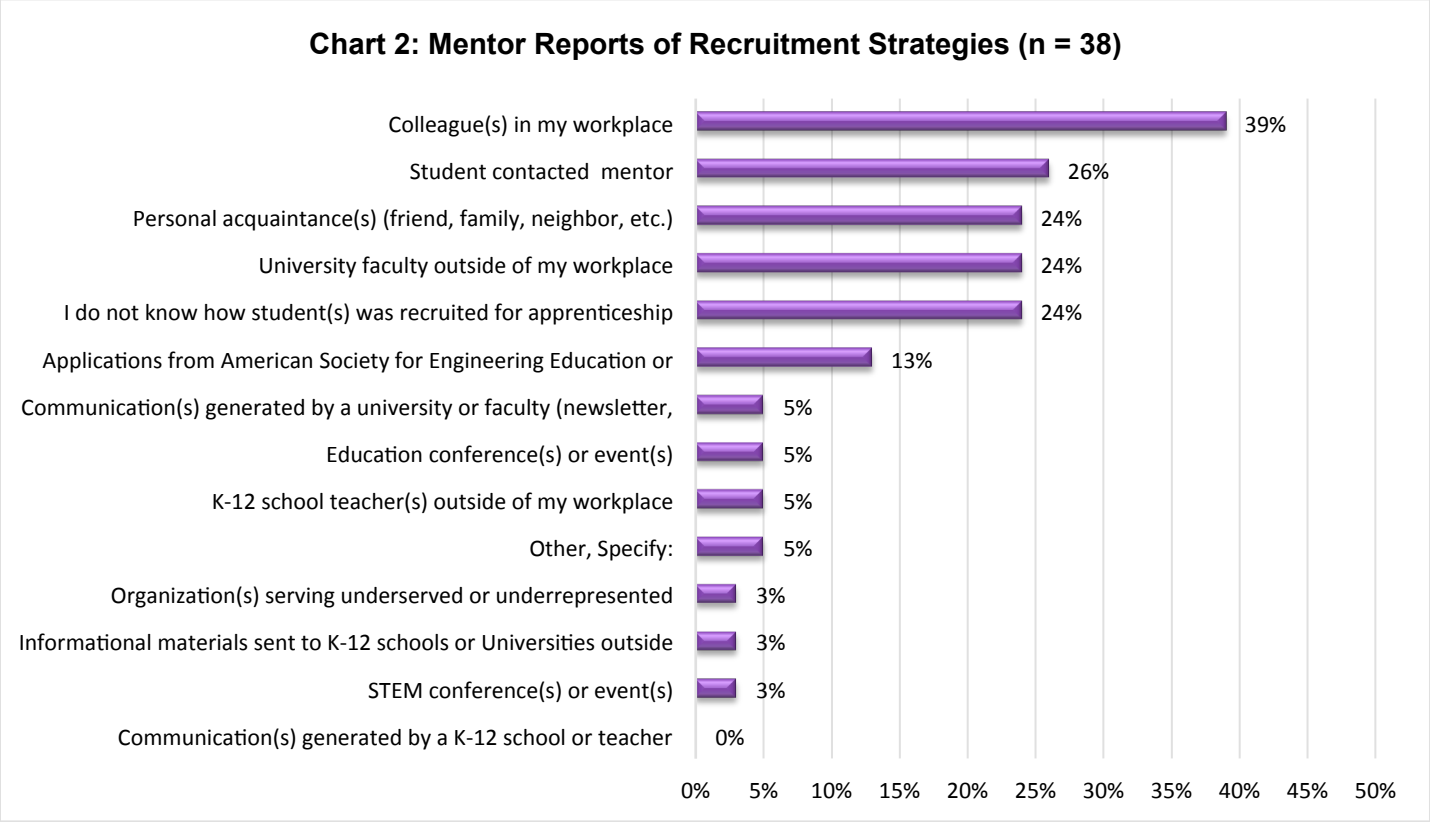
A focus of the Actionable Program Evaluation is efforts toward the long-term goal of CQL and all of the AEOPs to increase and diversify the future pool of talent capable of contributing to the nation's scientific and technology progress. Thus, it is important to consider how CQL is marketed and ultimately 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, ASEE reported marketing to and recruiting students for CQL in a variety of ways. ASEE marketed CQL at the following FY15 outreach events:

- University of Maryland Career Fair
- Howard University Career Fair
- North Carolina A&T State Career Fair

The mentor questionnaire included an item asking how students were recruited for apprenticeships. As can be seen in Chart 2, mentors most often indicated recruiting their apprentices through a personal network such as workplace colleagues (39%), direct contact from the student (26%), university faculty outside workplace (24%), and personal acquaintances (24%). While 24% reported that they had no knowledge of how their apprentices were recruited, this is lower than FY14 (32%) and there is greater diversity in mentor responses for how apprentices were recruited in comparison.

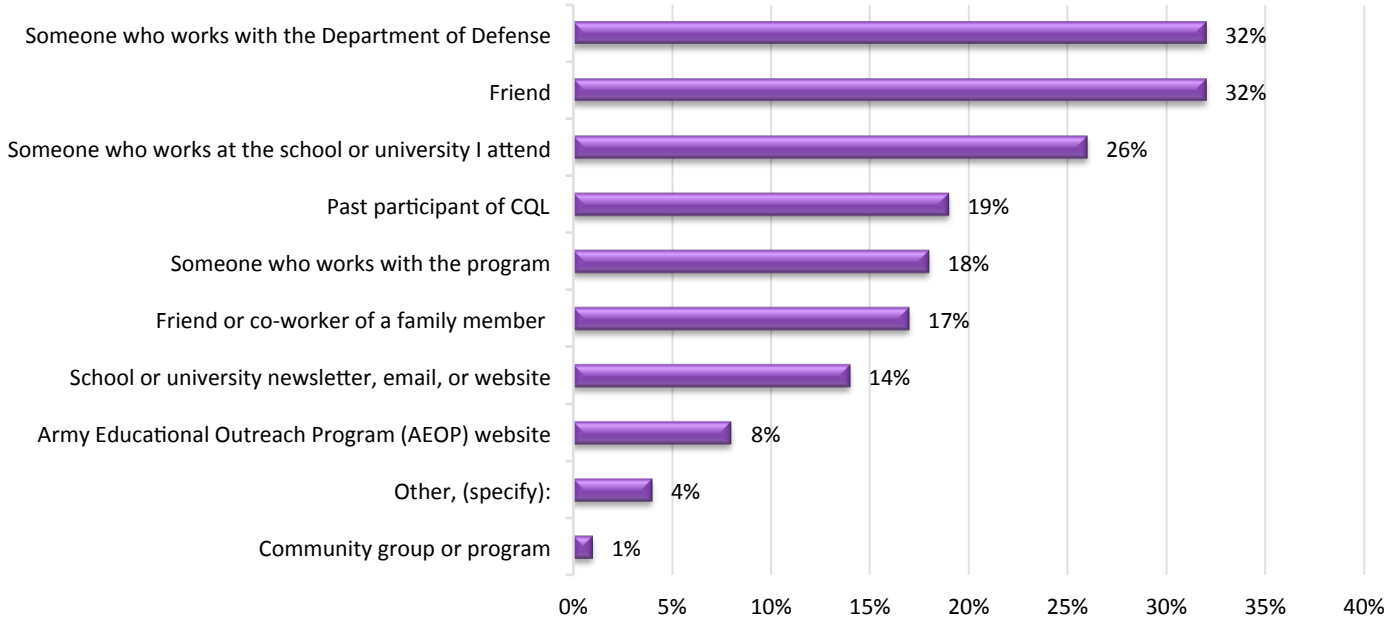


Other: "I personally recruited this student via a connection at my undergraduate institution;" "Chief Scientist outreach"

In order to understand which recruitment methods are most effective, the questionnaire asked apprentices to select all of the different ways they heard about CQL. Chart 3 summarizes apprentices' responses. The most frequently mentioned sources of information about CQL were someone who works with the Department of Defense (32%) and friends (32%). Other sources mentioned relatively frequently were someone who works at the school/university attended (26%); past participant of the program (19%); someone who works with program (18%); friend or co-worker of a family member (17%); and school or university newsletter, email, or website (14%). Taken together, these findings suggest that responding apprentices were most likely to learn about CQL through personal contacts or university media resources rather than other media sources.

These data were analyzed by apprentice gender and race/ethnicity to determine if different groups of apprentices learned about CQL in a different manner. No meaningful differences were found in how apprentices learned about CQL by either factor.

Chart 3: How Students Learned about CQL (n = 91)



Apprentice interview data reflect a variety of ways in which apprentices became aware of CQL. One participant reported learning about CQL through a pre-existing personal relationship with either a mentor:

> *"We have a family friend who works at [the site]. He came to be my very first mentor. That's how I heard about the program." (CQL apprentice)*

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

> *"I knew that…I'd probably be working with the same mentor that I had been working with the previous years. I know that he wanted me to continue the project I was working on. It seemed interesting and I just wanted to continue." (CQL apprentice)*

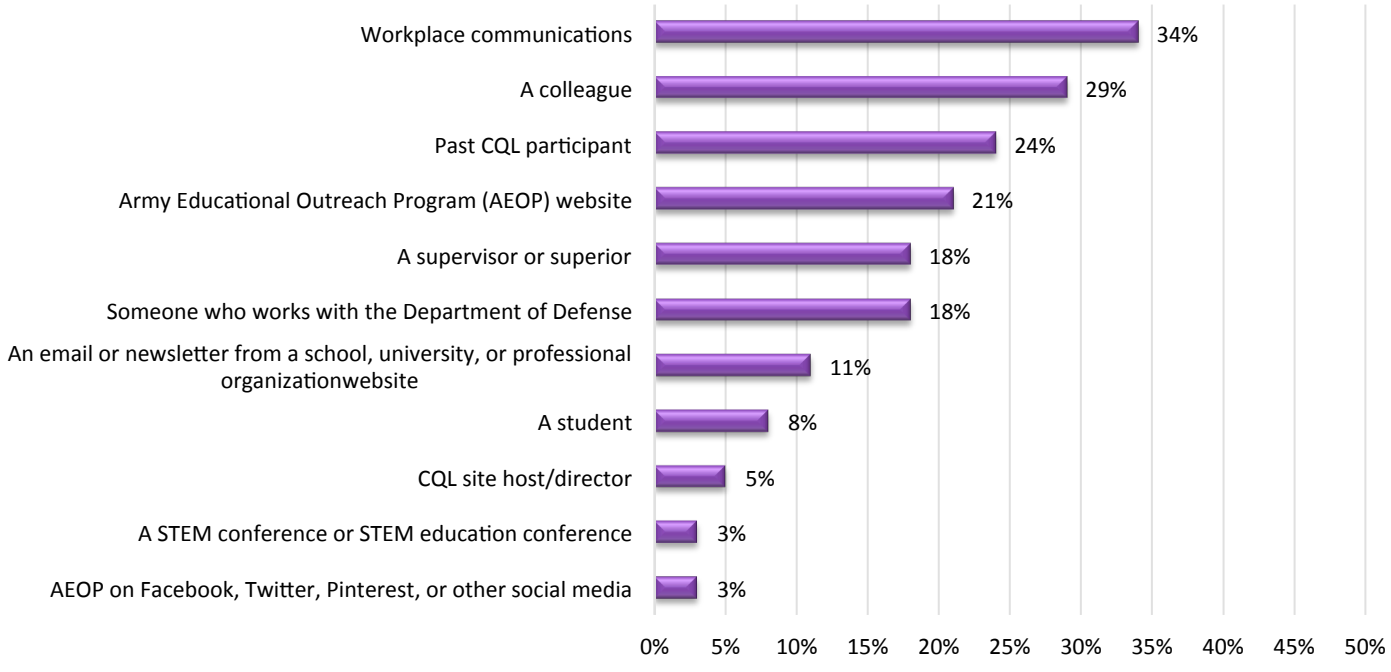
Friends who had previously participated in CQL and college professors were also cited as sources of information about the program. For example

"There was a former student [at my high school] who was doing it, that I was friends with…He knew I was interested in science, so I looked into it." (CQL apprentice)

"One of my professors knew of [Army scientist] somehow…so it was through [Army scientist] and my school that I got to know about the…CQL program" (CQL apprentice)

Mentors were also asked how they learned about CQL (see Chart 4). Responding mentors learned about CQL through more diverse methods in FY15 compared to FY14, indicating the primary sources as a workplace communications (34%), a colleague (29%), past CQL participant (24%), AEOP website (21%), a supervisor/superior (18%), or someone who works with the Department of Defense (18%).

Chart 4: How Mentors Learned about CQL (n = 38)



To examine whether mentors are expanding their participation in AEOP programs, the questionnaire asked how many times they participated in each of the AEOP programs. Approximately half of the responding mentors (55%) reported participating in an AEOP program between one and three or more times (42% participated once, 42% participated twice, and 21% participated three or more times). No participants indicated never participating in any AEOP program.

Despite responding mentors' continued participation in at least one AEOP program, for a third of the AEOP programs (10 of 15), including URAP and NDSEG in which their apprentices were eligible to participate, approximately one-third (42% and 34% respectively) indicated having never these specific programs.

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 wanted to participate in the program and to select their top three reasons. As can be seen in Table 12, every survey respondent selected the desire to expand laboratory or research skills as one of their top three reasons (100%). Other reasons for participation with more than half of survey respondents selecting them are: interest in STEM (92%); desire to learn something new or interesting (78%); opportunity to use advanced laboratory technology (54%); and figuring out education or career goals (54%).

Table 12. Factors Motivating Apprentices "Very Much" to Participate in CQL (n = 91)

Item	Questionnaire Respondents
Desire to expand laboratory or research skills	100%
Interest in science, technology, engineering, or mathematics (STEM)	92%
Desire to learn something new or interesting	78%
Opportunity to use advanced laboratory technology	54%
Figuring out education or career goals	54%
Interest in STEM careers with the Army	45%
The CQL mentor(s)	37%
Learning in ways that are not possible in school	35%
Building resume	35%
Networking opportunities	35%
Serving the community or country	24%
Exploring a unique work environment	21%
Seeing how school learning applies to real life	16%
An academic requirement or school grade	12%
Earning stipends or awards for doing STEM	10%
Teacher or professor encouragement	10%
Having fun	5%
Other: Get Published	1%

In interviews, apprentices were also asked why they chose to participate in CQL. Apprentices cited a variety of motivations for participating in CQL. Two apprentices noted that their former participation in SEAP was a motivator while two others noted that the location and the stipend influenced their decisions to participate in CQL. For example:

> *"I needed something close to home…I also wanted something that paid well." (CQL apprentice)*

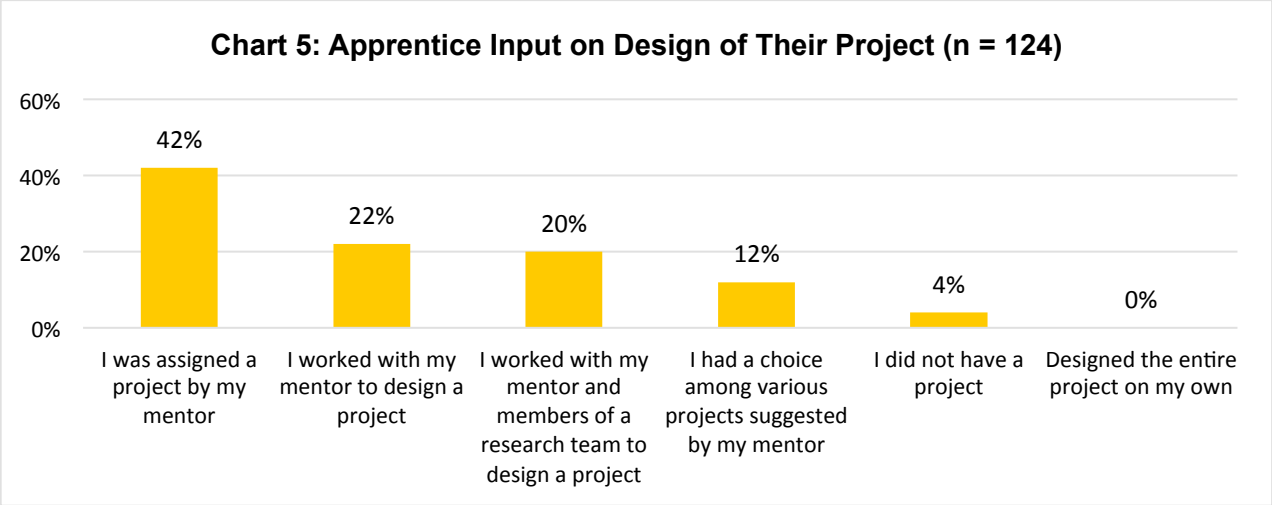
Three apprentices noted that they perceived CQL as an opportunity to expand their skills. One of these apprentices noted:

> *"I wanted something different; that was really something I could expand my skills" (CQL apprentice)*

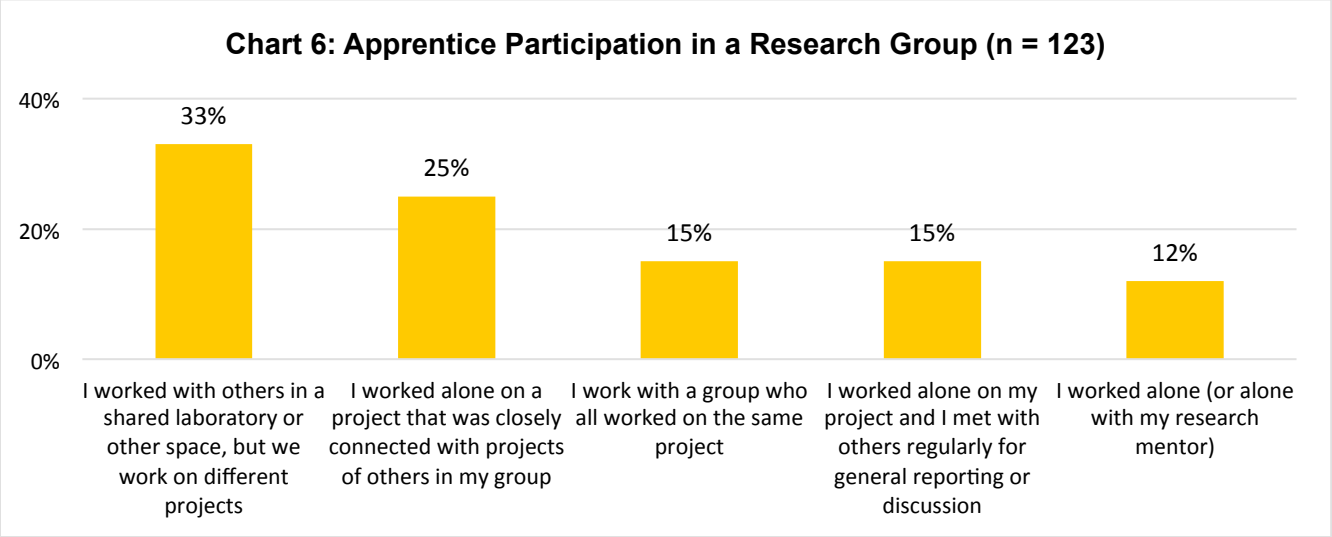
One participant also reported participating in CQL because it met a degree requirement for her undergraduate program.

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. When asked what field their CQL experience focused on, 42% of responding apprentices selected science, 39% engineering, 18% technology, and 1% mathematics. As can be seen in Chart 5, 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 (22%), working with their mentor to design the project (20%), or choosing from project options suggested by the mentor (12%). The remaining apprentices reported being assigned a project by their mentor (42%) or not having a project at all (4%).



Although most apprentices worked in close proximity with others during their experience (see Chart 6), they tended to work independently on their projects. For example, 33% reported working in a shared laboratory/space with others, but on different projects. Similarly, 25% indicated working alone on a project closely connected to other projects in their group, while 15% reported working alone with regular meetings for reporting progress and 12% worked alone (or with their research mentor). Only 15% indicated they worked with a group on the same project.



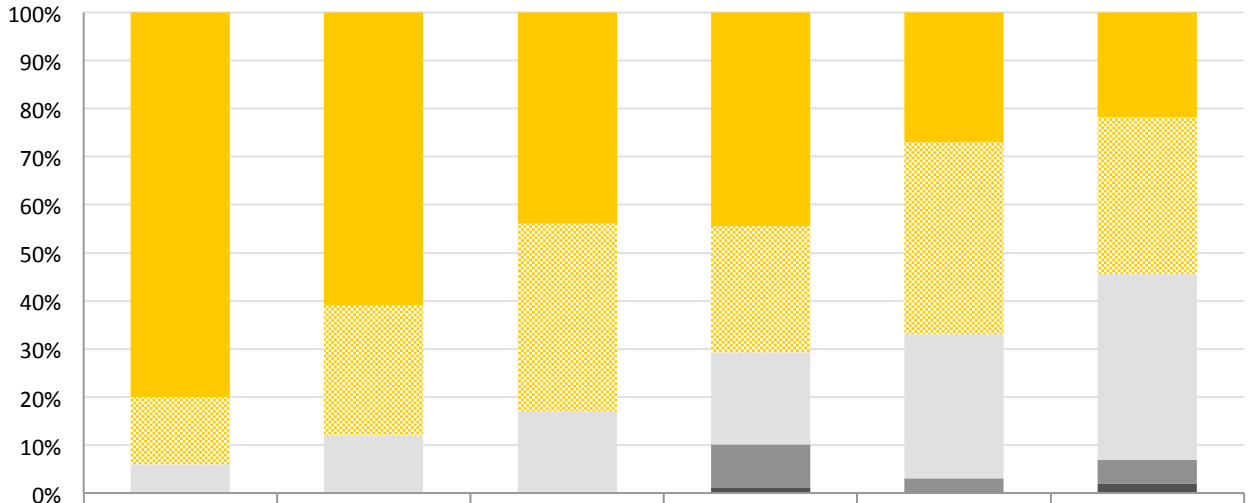
Apprentices were also asked about the types of activities they engaged in during their experience. As can be seen in Chart 7, the vast majority of respondents indicated that most days or every day they interacted with scientists or engineers (94%), applied STEM learning to real-life situations (88%), and learned about STEM topics that were new to them (82%). The majority of apprentices also reported that on most days or every day they learned about new discoveries in STEM (67%) and learned about STEM careers (55%). Mentors were asked similar questions about the nature of their apprentices' experiences. Overall, their responses paint a similar picture of the CQL experience (responses to these items can be found in Appendix C).[2]

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. As can be seen in Table 13, all apprentices reported

[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.

learning about at least one STEM job/career, and the majority (65%) reported learning about 3 or more. Similarly, all apprentices reported learning about at least one DoD STEM job/career, with 60% reporting learning about 3 or more.

Chart 7: Nature of Student Activities in CQL (n = 123-124)



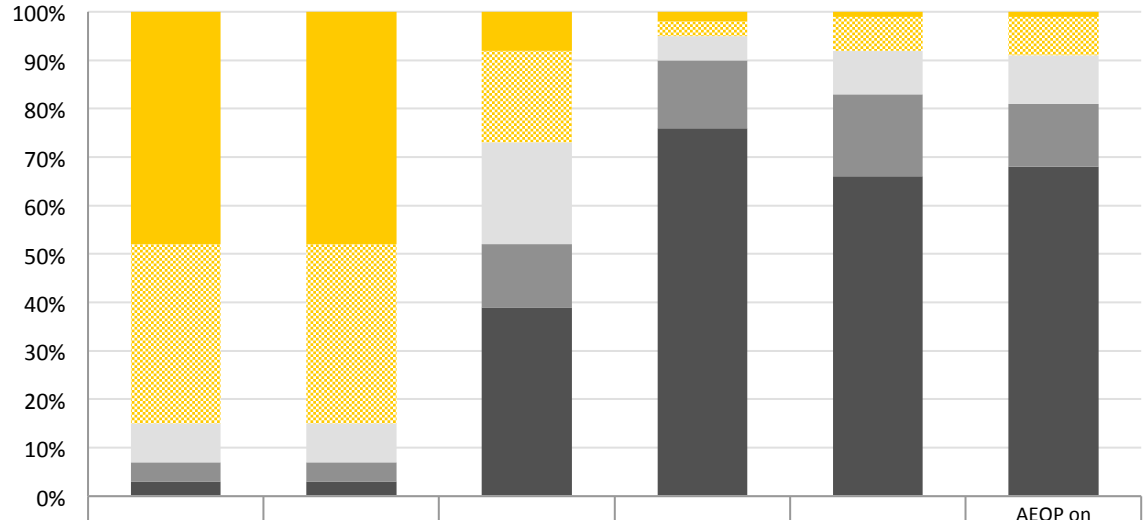
	Interact with scientists or engineers	Apply STEM knowledge to real life situations	Learn about STEM topics that are new to you	Communicate with other students about STEM	Learn about new discoveries in STEM	Learn about different STEM careers
Every day	80%	61%	44%	44%	27%	22%
Most days	14%	27%	39%	26%	40%	33%
A few times	6%	12%	17%	19%	30%	39%
At least once	0%	0%	0%	9%	3%	5%
Not at all	0%	0%	0%	1%	0%	2%

Table 13. Number of STEM Jobs/Careers Apprentices Learned about During CQL (n = 119)		
	STEM Jobs/Careers	**DoD STEM Jobs/Careers**
None	0%	0%
1	14%	20%
2	21%	20%
3	17%	16%
4	4%	7%
5 or more	44%	37%

Apprentices were also asked which resources impacted their awareness of DoD STEM careers. Participation in CQL (85%) and apprentices' mentors (81%) were most often reported as being somewhat or very much responsible for this impact (see Chart 8). In contrast, the AEOP resources (website, social media, and brochure) were not particularly impactful as, for each source, more than 50% of apprentices reported not experiencing it or it having no impact on their awareness of DoD STEM careers.

The questionnaire also asked apprentices how often they engaged in various STEM practices during CQL. Results indicate that apprentices were actively engaged in doing STEM during the program, and thus nearly 60% or more of apprentices reported participating in all activities most days to every day (see Chart 9). Overall, data from the mentor questionnaire (included in Appendix C) provide a similar sense of which practices CQL apprentices participated in most often. However, mentors' estimations of how often apprentices engaged in the practices appeared higher for several items (practice using laboratory or field techniques, procedures and tools; work as part of a team; carry out an investigation; and make or build a computer model). Again, it is not clear whether these differences were due to differences in interpretation or were related to which mentors and apprentices responded to the questionnaires.

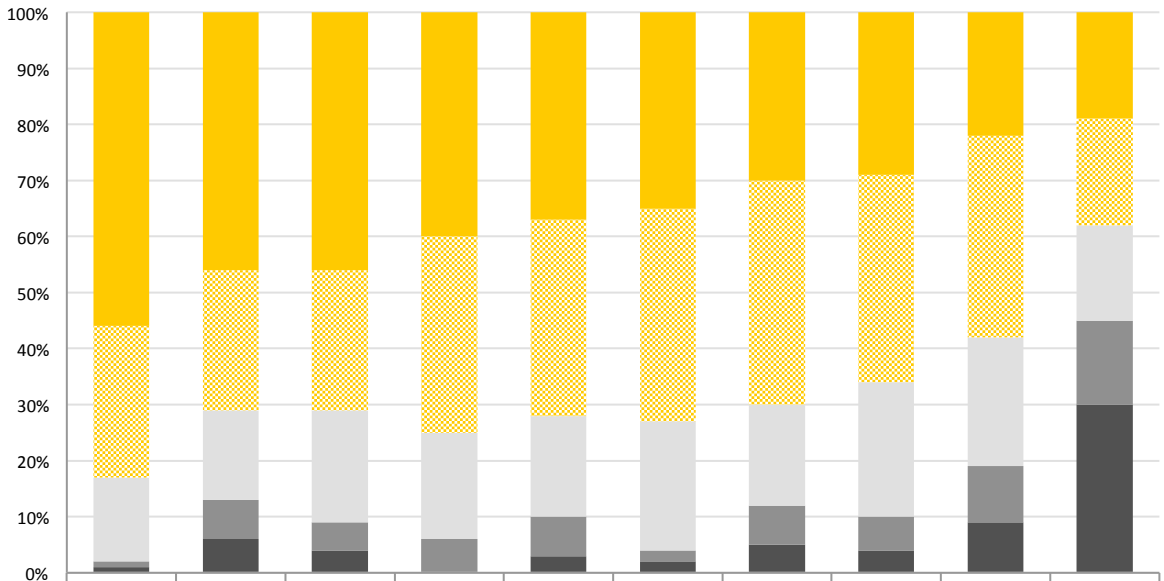
Chart 8: Impact of Resources on Student Awareness of DoD STEM Careers (n = 123-124)



	Participation in CQL	My mentor(s)	AEOP website	It Starts Here! Magazine	AEOP brochure	AEOP on Facebook, Twitter, Pinterest or other social media
Very Much	48%	48%	8%	2%	1%	1%
Somewhat	37%	37%	19%	3%	7%	8%
A little	8%	8%	21%	5%	9%	10%
Not at all	4%	4%	13%	14%	17%	13%
Did not experience	3%	3%	39%	76%	66%	68%

"The opportunity to participate in cutting-edge research and to be mentored by an extremely knowledgeable DoD researcher was extraordinary. First-hand research with a DoD research laboratory and with STEM research in the DoD was eye-opening. I have a much greater understanding of STEM research and of STEM careers within the DoD, and I have a much greater desire to participate in both." -- CQL Apprentice

Chart 9: Student Engagement in STEM Practices in CQL (n = 123-124)



	Participate in hands-on STEM activities	Use laboratory procedures and tools	Work as part of a team	Analyze and interpret data or information	Carry out an investigation	Identify questions or problems to investigate	Draw conclusions from an investigation	Come up with creative explanations or solutions	Design an investigation	Build or make a computer model
Every day	56%	46%	46%	40%	37%	35%	30%	29%	22%	19%
Most days	27%	25%	25%	35%	35%	38%	40%	37%	36%	19%
A few times	15%	16%	20%	19%	18%	23%	18%	24%	23%	17%
At least once	1%	7%	5%	6%	7%	2%	7%	6%	10%	15%
Not at all	1%	6%	4%	0%	3%	2%	5%	4%	9%	30%

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

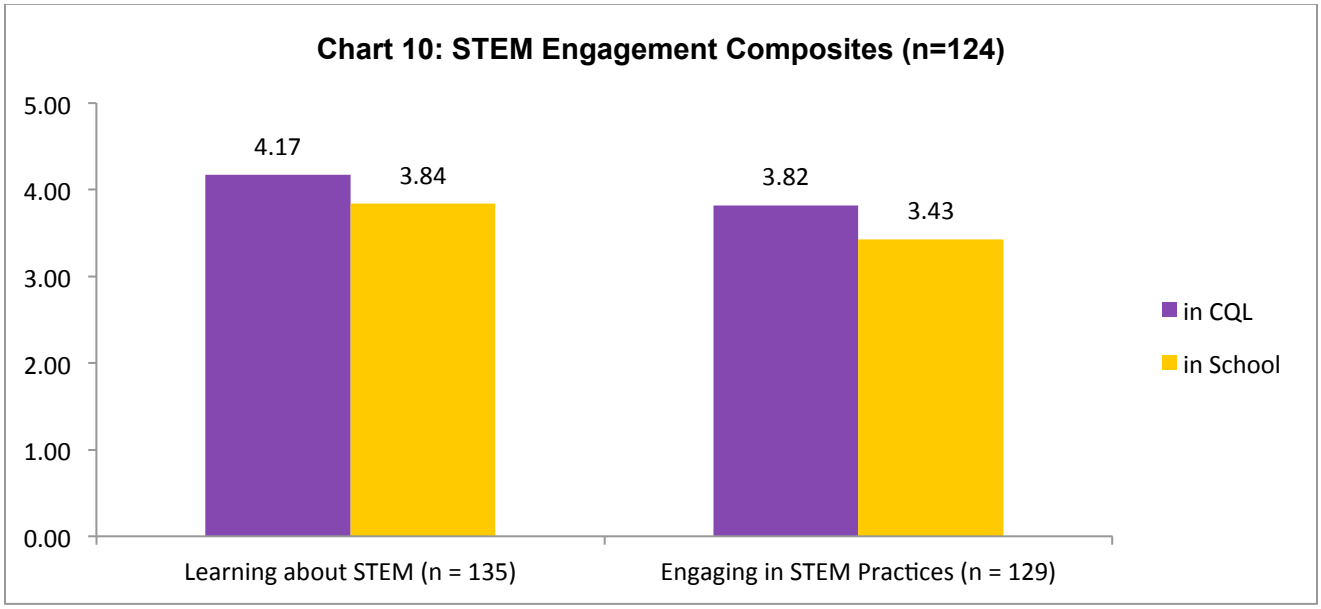
[3] Using multiple statistical tests on related outcomes requires the use of a Type I error rate adjustment to reduce the likelihood of false positives (i.e., detecting a difference when one does not truly exist). However, Type I error rate adjustments lead to a reduction in statistical power (i.e., 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 0.785.

[5] The Cronbach's alpha reliability for these 10 items was 0.843.

differences in composite scores by race/ethnic group. Regarding gender there was not a significant difference in Learning about STEM in CQL. However, males (*M*=39.73, *SD*=6.81) reported significantly higher scores for Engaging in STEM Practices in CQL compared to females (*M*=36.58, *SD*=7.07); *t*(90)=2.17, *p*<.05, two-tailed. While this significant difference was found, the difference does not seem to be of practical significance as males (3.97) and females (3.66) are both reporting an average score of nearly "most days" across items.

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 (individual item responses can be found in Appendix B). 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. As can be seen in Chart 10, scores were significantly higher on the "in CQL" versions of both composites than on the "in school" versions (large effects of d = 0.909 standard deviations and d = 0.967 standard deviations respectively)[8]. These data indicate that CQL provides apprentices with more intensive STEM learning experiences than they would typically receive in school.



[6] Cronbach's alpha reliability for these 6 items was 0.793.

[7] Cronbach's alpha reliability for these 10 items was 0.884.

[8] Two-tailed dependent samples t-test, Learning about STEM, $t(124) = 5.04$, $p < 0.001$, Engaging in STEM practices, $t(124) = 5.36$, $p < 0.001$

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 (62%) responding to the mentor questionnaire reported working with at least one apprentice.

Large proportions of responding mentors used several strategies to help make the learning activities relevant to students (see Table 14).[10] For example, nearly all reported also giving students real-life problems to investigate or solve (95%). Many became familiar with students background and interests at the beginning of CQL (87%); and encouraged students to suggest new readings, activities, or projects (78%). The majority (or close to the majority) used all other strategies for establishing relevance (49% - 70%).

Table 14. Mentors Using Strategies to Establish Relevance of Learning Activities (n = 37)

Item	Questionnaire Respondents
Giving students real-life problems to investigate or solve	95%
Become familiar with my student(s) background and interests at the beginning of CQL	87%
Encouraging students to suggest new readings, activities, or projects	78%
Helping students become aware of the role(s) that STEM Plays in their everyday lives	70%
Selecting readings or activities that related to students' backgrounds	65%
Asking students to related to real-life events or activities to topics covered in CQL	62%
Helping students understand how STEM can help them improve their own community	49%

Similarly, mentors reported using a variety of strategies to support the diverse needs of students as learners. As can be seen in Table 15, nearly all responding mentors reported treating all students the same way, regardless of their background (87%); and using a variety of teaching and/or mentoring activities to meet the needs of all students (84%). Many mentors found out about students' learning styles at the beginning of the program (78%); provided extra readings, activities, or other support for students lacking essential background knowledge or skills (76%); and directed students to other individuals or programs for additional support as needed (76%).

[10] The student questionnaire included a subset of these items from each of the five categories. The student data are different from the mentor data (sometimes higher, sometimes lower), and can be found in Appendix B. It is not clear if the differences are due to which students and mentors responded or differences in apprentice and mentor perspectives.

Table 15. Mentors Using Strategies to Support the Diverse Needs of Students as Learners (n = 37)	
Interact with students and other personnel the same way regardless of their background	87%
Use a variety of teaching and/or mentoring activities to meet the needs of all students	84%
Identify the different learning styles that my student(s) may have at the beginning of the CQL experience	78%
Providing extra readings, activities, or learning support for students who lack essential background knowledge or skills	76%
Directing students to other individuals or programs for additional support as needed	76%
Integrating ideas from education literature to teach/mentor students from groups underrepresented in STEM	43%
Highlighting underrepresentation of women and racial and ethnic minority populations in STEM and/or their contributions in STEM	43%

Mentors reported using many strategies to support students' development of collaboration and interpersonal skills (see Table 16). For example, nearly all of those responding to the questionnaire indicated having students listen to the ideas of others with an open mind (95%), work as members of a team on activities or projects (89%), and participate in giving and receiving feedback (87%). Many also had students explain difficult ideas to others (84%), tell others about their backgrounds and interests (81%), exchange ideas with others whose backgrounds or viewpoints were different from their own (78%), and allow students to resolve conflicts and reach agreements within their team (73%).

Table 16. Mentors Using Strategies to Support Student Development of Collaboration and Interpersonal Skills (n = 37)	
Item	**Questionnaire Respondents**
Having my student(s) listen to the ideas of others with an open mind	95%
Having students work on collaborative activities or projects as a member of a team	89%
Having my student(s) give and receive constructive feedback with others	87%
Having my student(s) explain difficult ideas to others	84%
Having my student(s) tell other people about their backgrounds and interests	81%
Having my student(s) exchange ideas with others whose backgrounds or viewpoints are different from their own	78%
Allowing my student(s) to resolve conflicts and reach agreement within their team	73%

When asked about strategies used to support student engagement in authentic STEM activities (see Table 17), almost all responding mentors reported encouraging students to demonstrating the use of laboratory or field techniques, procedures and tools students are expected to use (95%); giving constructive feedback to improve students' STEM competencies (92%); and allowing students to work independently to improve their self-management abilities (92%). In addition, many responding mentors reported encouraging students to learn collaboratively (89%), seek support from other team members (89%), and search for and review technical research to support their work (84%). Supervising students while they practice STEM research skills (78%), and teaching or assigning readings about specific STEM subject matter (65%) were also widely used strategies.

Table 17. Mentors Using Strategies to Support Student Engagement in "Authentic" STEM Activities (n = 37)

Item	Questionnaire Respondents
Demonstrating laboratory/field techniques, procedures, and tools for my student(s)	95%
Providing my student(s) with constructive feedback to improve their STEM competencies	92%
Allowing students to work independently to improve their self-management abilities	92%
Encouraging students to learn collaboratively (team projects, team meetings, journal clubs, etc.)	89%
Encouraging students to seek support from other team members	89%
Having my student(s) search for and review technical research to support their work	84%
Supervising my student(s) while they practice STEM research skills	78%
Teaching (or assigning readings) about specific STEM subject matter	65%

The last series of items about mentoring strategies focused on supporting students' STEM educational and career pathways (see Table 18). Nearly all of the responding mentors reported asking students about their educational and career interests (97%). Many also provided guidance to students about educational pathways that would prepare them for a STEM career (78%); helped students build effective STEM networks (78%); discussed STEM career opportunities outside of the DoD or other government agencies (76%); recommended extracurricular programs that align with students' goals (65%); discussed STEM career opportunities in private industry or academia (62%); and helped student(s) with their resume, application, personal statement and/or interview preparations (62%).

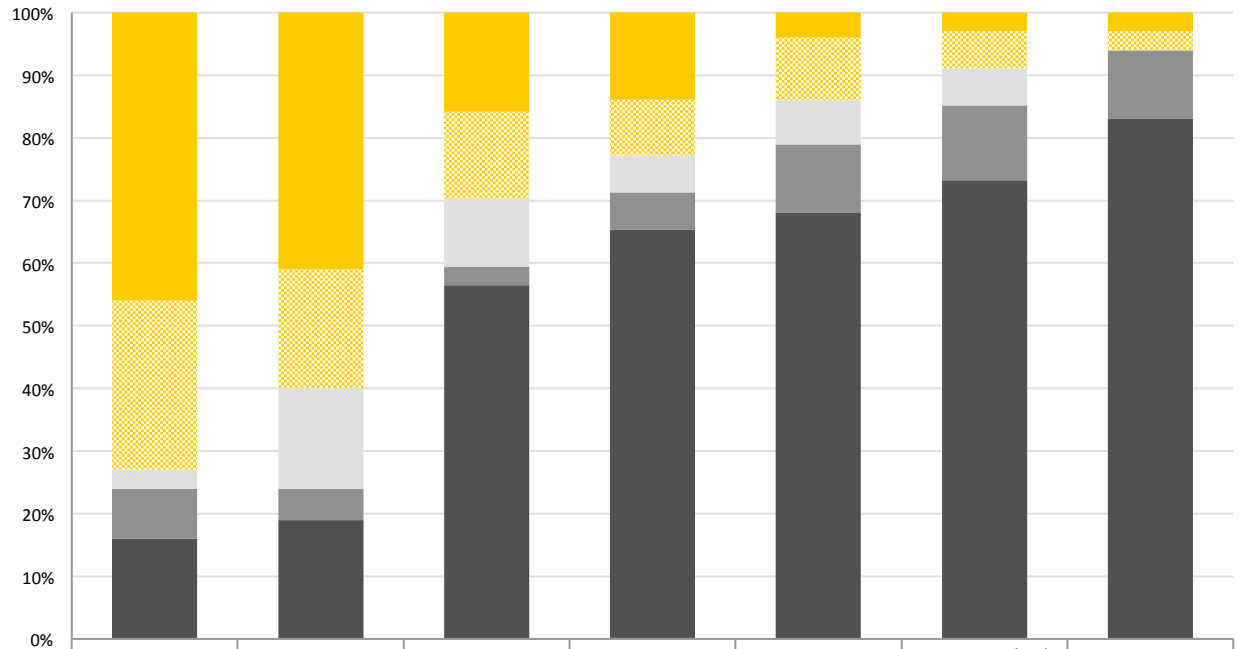
Table 18. Mentors Using Strategies to Support Student STEM Educational and Career Pathways (n = 37)	
Item	**Questionnaire Respondents**
Asking my student(s) about their educational and/or career goals	97%
Providing guidance about educational pathways that will prepare my student(s) for a STEM career	78%
Helping students build a professional network in a STEM field	78%
Discussing STEM career opportunities within the DoD or other government agencies	76%
Recommending extracurricular programs that align with students' goals	65%
Discussing STEM career opportunities in private industry or academia	62%
Helping my student(s) with their resume, application, personal statement, and/or interview preparations	62%
Recommending student and professional organizations in STEM to my student(s)	51%
Recommending Army Educational Outreach Programs that align with students' goals	49%

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 URAP (95%), CQL (73%), and NDSEG (54%). Table 19 shows all mentor responses regarding this question.

Table 19. Mentors Explicitly Discussing AEOPs with Students (n = 34-37)	
Item	**Questionnaire Respondents**
Undergraduate Research Apprenticeship Program (URAP)	95%
College Qualified Leaders (CQL)	73%
National Defense Science & Engineering Graduate (NDSEG) Fellowship	54%
Science Mathematics, and Research for Transformation (SMART) College Scholarship	27%
I discussed AEOP with my student(s) but did not discuss any specific program	24%
GEMS Near Peer Mentor Program	19%

Mentors were also asked how useful various resources were in their efforts to expose students to the different AEOPs. As can be seen in Chart 11, participation in CQL (73%) and the program administrator or site coordinator (59%) were most often rated as "somewhat" or "very much" useful. Materials provided by the AEOP program tended not to be seen as very useful, with large proportions (more than 50%) of mentors indicating they did not experience these resources (i.e., AEOP website, social media, brochure, and magazine).

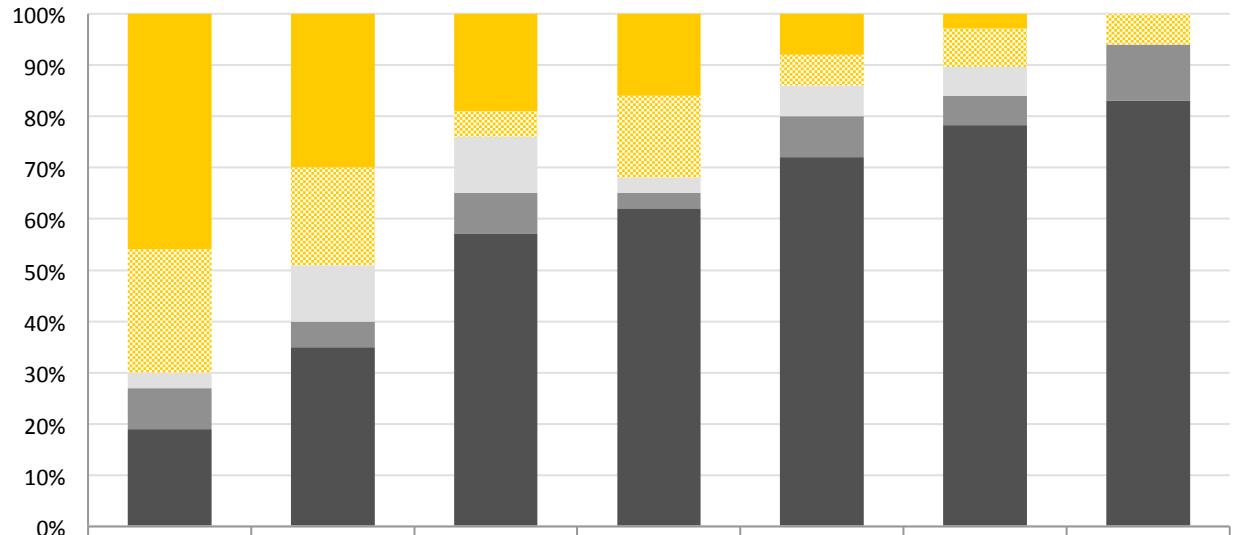
Chart 11: Usefulness of Resources for Exposing Students to AEOPs (n = 36-37)



	Participation in CQL	CQL program administrator	AEOP website	Invited speakers or "career" events	AEOP brochure	AEOP on Facebook, Twitter, Pinterest or other social media	It Starts Here! Magazine
Very Much	46%	41%	16%	14%	4%	3%	3%
Somewhat	27%	19%	14%	9%	10%	6%	3%
A little	3%	16%	11%	6%	7%	6%	0%
Not at all	8%	5%	3%	6%	11%	12%	11%
Did not experience	16%	19%	57%	66%	68%	74%	83%

Mentors were also asked how useful these resources were for exposing students to DoD STEM careers (see Chart 12). As with the previous item, mentors were most likely to rate participation in CQL as useful, with 70% selecting "somewhat" or "very much." The program administrator or site coordinator (49%) was seen as "somewhat" or "very much" useful by nearly half of responding mentors. Again, the AEOP materials were less likely to be seen as very useful for this purpose (a range of 6-16% selecting "somewhat" useful and none selecting "very much"), with over 60% of mentors indicating they did not experience each of these resources.

Chart 12: Usefulness of Resources for Exposing Students to DoD STEM Careers (n = 36-37)

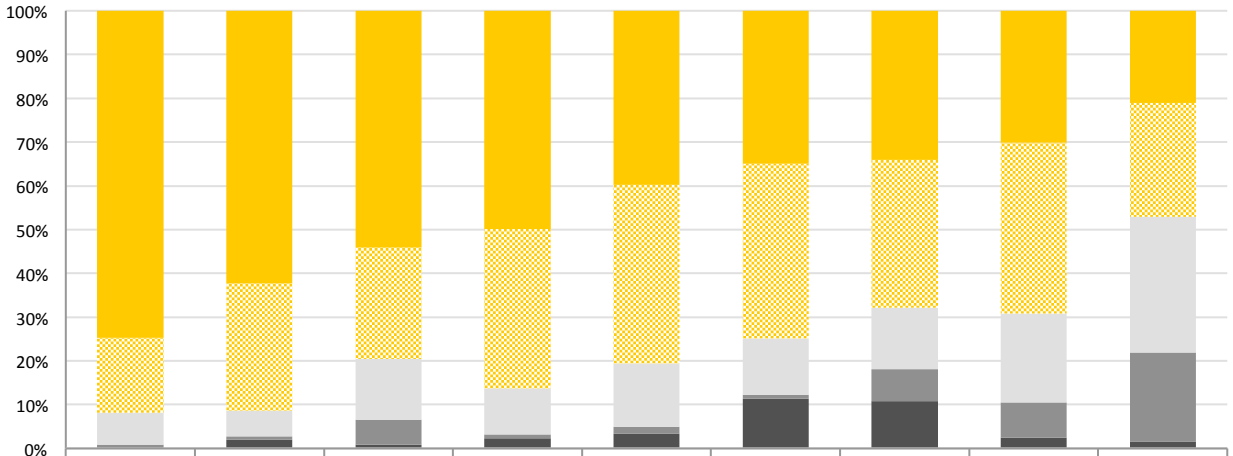


	Participation in CQL	CQL Program administrator or site coordinator	Invited speakers or "career" events	AEOP website	AEOP brochure	AEOP on Facebook, Twitter, Pinterest or other social media	It Starts Here! Magazine
Very Much	46%	30%	19%	16%	8%	3%	0%
Somewhat	24%	19%	5%	16%	6%	8%	6%
A little	3%	11%	11%	3%	6%	6%	0%
Not at all	8%	5%	8%	3%	8%	6%	11%
Did not experience	19%	35%	57%	62%	72%	83%	83%

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 Chart 13, the majority of responding apprentices were somewhat or very much satisfied with most of the listed program features. For example, 92% of apprentices were at least somewhat satisfied with instruction or mentorship during program activities and the variety of STEM topics available to them in CQL. Apprentices also felt somewhat or very much satisfied with all other features except for other administrative tasks (in-processing, network access, etc.) (47%).

Chart 13: Student Satisfaction with CQL Program Features (n = 122-123)



	Teaching or mentoring during CQL activities	The variety of STEM topics available to you in CQL	Stipends (payment)	The physical location(s) of CQL activities	Research abstract preparation requirements	Research presentation process	Communicating with your CQL host site organizers	Appying or registering for the program	Other administrative tasks (in-processing, network access, etc.)
Very Much	75%	62%	54%	50%	40%	35%	34%	30%	21%
Somewhat	17%	29%	25%	37%	41%	40%	34%	39%	26%
A little	7%	6%	14%	11%	15%	13%	14%	20%	31%
Not at all	1%	1%	6%	1%	2%	1%	7%	8%	20%
Did not experience	0%	2%	1%	2%	3%	11%	11%	2%	2%

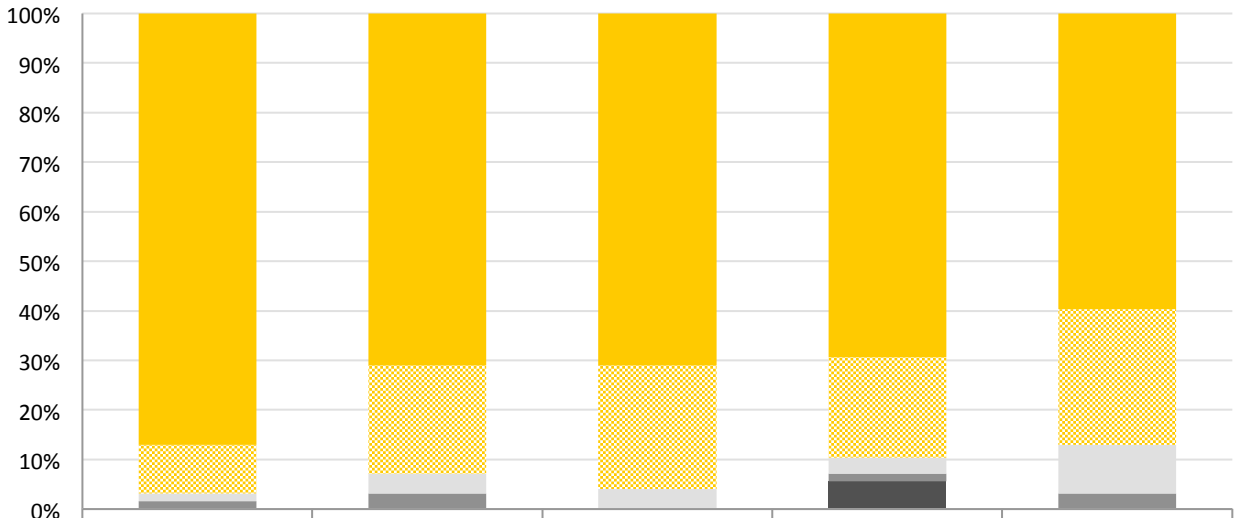
Apprentices were also asked about their satisfaction with access to their mentor. As can be seen in Table 20, 62% of responding apprentices indicated their mentor was always available, and 29% that their mentor was available more than half of the time. Few apprentices indicated that their mentor was available half of the time or less.

Table 20. Apprentice Reports of Availability of Mentors (n = 124)

Item	Questionnaire Respondents
The mentor was always available	62%
The mentor was available more than half of the time	29%
The mentor was available about half of the time of my project	5%
The mentor was available less than half of the time	5%

Similarly, apprentices were asked about their satisfaction with their mentors and the research experience (see Chart 14). The majority of apprentices indicated being satisfied "very much" with all experiences from their apprenticeship (ranging from 60% - 87%). The vast majority reported being satisfied at least "somewhat" with each experience (ranging from 87% - 97%).

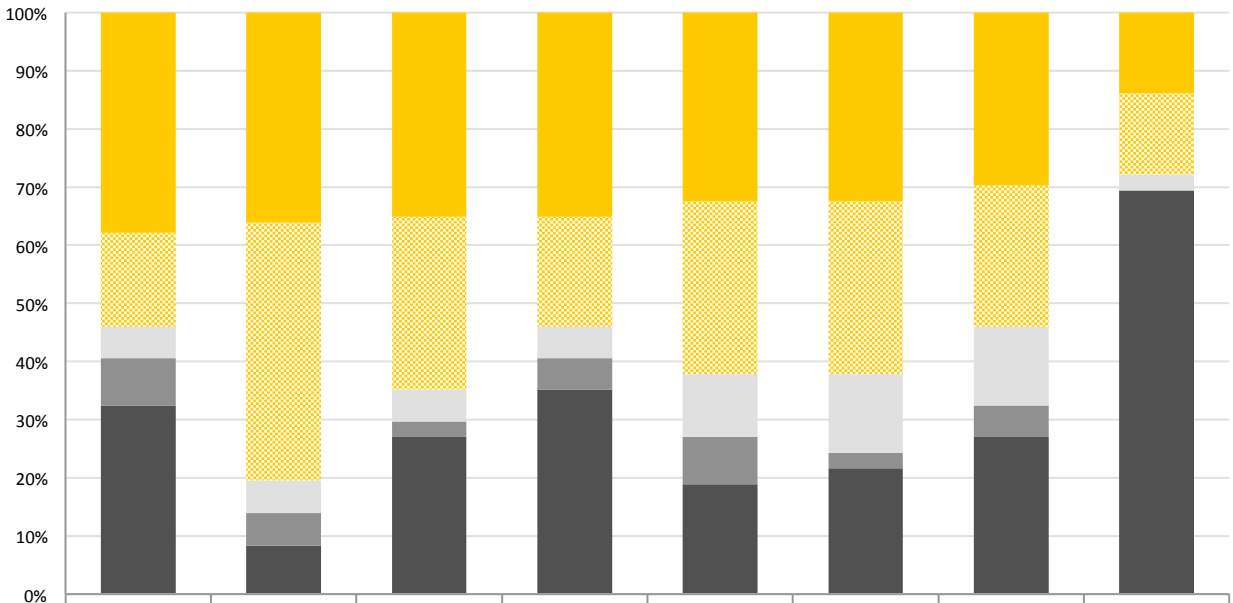
Chart 14: Apprentice Satisfaction with Their Experience (n = 123-124)



	My working relationship with my mentor	The amount of time I spent with my research mentor	The research experience overall	My working relationship with the group or team	The amount of time I spent doing meaningful research
Very Much	87%	71%	71%	69%	60%
Somewhat	10%	22%	25%	20%	27%
A little	2%	4%	4%	3%	10%
Not at all	2%	3%	0%	2%	3%
Did not experience	0%	0%	0%	6%	0%

Mentors also generally reported being somewhat or very much satisfied with the program components they experienced (see Chart 15). In fact, more than 50% reported being somewhat or very much satisfied with all program features except for communicating with the American Society for Engineering Education (ASEE) for which 28% reported satisfaction (the majority of respondents, 69%, indicated that they did not experience this communication). Similarly, across other items dissatisfaction was not commonly reported. Instead, if respondent perception was not somewhat or very much satisfied it was reported as not experienced.

Chart 15: Mentor Satisfaction with CQL Program Features (n = 37)



	Stipends (payment)	Research abstract preparation requirements	Support for instruction or mentorship during program activities	Application or registration process	Research presentation process	Communications with CQL organizers	Other administrative tasks	Communications with ASEE
Very Much	38%	36%	35%	35%	32%	32%	30%	14%
Somewhat	16%	44%	30%	19%	30%	30%	24%	14%
A little	5%	6%	5%	5%	11%	14%	14%	3%
Not at all	8%	6%	3%	5%	8%	3%	5%	0%
Did not experience	32%	8%	27%	35%	19%	22%	27%	69%

An open-ended item on the questionnaire asked apprentices about their overall satisfaction with their CQL experience. Almost all of the 87 apprentices who responded to the question had something positive to say about their experience (94%), although some also made negative comments (30%). In general, positive comments focused on the actual experience working at the site, while negative comments focused on administrative issues. Positive comments most commonly were quite general in nature (42 of 82), such as, "I greatly enjoyed my CQL experience; I would recommend it to anyone. I am grateful for the experience" (CQL apprentice). Other common themes included complimenting their mentors and/or other lab staff with whom they worked (23 of 82), noting that the work experience in the labs was positive (17 of 82), and indicating that they learned a lot through the program (15 of 82). For example:

SEAP and CQL have been the most influential academic experiences of my life. I cannot thank AEOP enough for helping young students like me experience work like this that benefits me in so many ways. I have a much better idea of real careers I could follow to put my capabilities to their best use. I have had a great experience this summer, and I hope to continue working in AEOP programs. (CQL apprentice)

The opportunity to participate in cutting-edge research and to be mentored by an extremely knowledgeable DoD researcher was extraordinary. First-hand experience with a DoD research laboratory and with STEM research in the DoD was eye-opening. I have a much greater understanding of STEM research and of STEM careers within the DoD, and I have a much greater desire to participate in both. The CQL program is a unique opportunity to participate in STEM research before graduation from university, an opportunity with little availability made even more impressive because the STEM research is performed within the DoD. Few programs are as useful to students as the CQL program, and I would like to see the program grow in the coming years. (CQL apprentice)

The program was a great learning experience and all mentors and co-workers were easy to talk to and eager to share their experiences, their work, and the benefits of working as part of the DoD. (CQL apprentice)

I have had an amazing CQL experience. I now have fallen in love with research and have decided on it as a career path, whereas before participating in this program I was not interested in research or research as a career whatsoever. This experience has been life-changing and opened my eyes to many possibilities that are open to me… I have grown as a scientist and as a person and I owe it all to the CQL experience I was fortunate enough to have. I only hope more students can learn about this opportunity and get the same benefit that I have. (CQL apprentice)

In contrast, about 28% of the apprentices who responded to this question described concerns with administrative aspects of the program. Among these concerns were descriptions of issues related to receiving payments, gaining clearance and access to do their work, and a general lack of communication. In the words of four apprentices:

I am extremely happy with the research I was able to complete in the summer experience with CQL…with that being said; the QL program needs a complete overhaul. The administrative staff does not return emails or phone calls and the communication is terrible. I found out that I would be working at [the site] 2 or 3 weeks before my start date. That is not enough time to find a new place to live. I had no instructions for what to do or where to go my first day of work. The payment schedule was unclear and had to continually ask about when I would be paid. (CQL apprentice)

I love working at [the site] but the CQL experience is unfortunately not excellent. There are several organizational issues within the CQL program that really make it hard to appreciate. My pay was a week and a half late last pay period, and this is the second time this has happened to me. I really can't be dependent on pay that doesn't come in on time…also; students were at no point made aware of the schedule. The students within my branch only learned the summer schedule halfway in the summer when our mentors gave us their copies of the CQL handbook, which they themselves had only just received. (CQL apprentice)

Overall I had a great CQL experience. I learned a lot from my mentor and all of the other employees…This interneship has also persuaded me to want to attend graduate school after obtaining my B.S. The security clearance process was frustrating. I had to be escorted for the first week of my internship, and I did not have a CAC so I lost out on valuable research time. The amount of paperwork and the quick response that is expected while you are still in school is ridiculous. I spent over 10-12 hours doing paperwork, scanning forms and completing trainings, and things were still not done when I arrived for my first day. Thankfully, I had an amazing experience with my mentor which made up for all of these issues that occurred the first weeks I was here. (CQL apprentice)

The research part of my experience was great. I learned a lot and I want to continue to work in STEM. However, I would not recommend the CQL program to any incoming students wanting a positive experience. In every summer of participation CQL consistently delayed (or forgot) stipend payments for students. Since housing is not provided for summer students it is absolutely crucial that students get the financial support needed to find an apartment (acquiring one often requires proof of income). (CQL apprentice)

"The project was a great learning experience and all the mentors and co-workers were easy to talk to and eager to share their experiences, their work, and the benefits of working as part of the DoD." -- CQL Apprentice

When asked to identify three ways in which the program could be improved, 93 apprentices provided at least one suggestion. The most common theme, by far, in the responses to this open-ended item, described by 60 respondents (65%) related to the logistical issues. For example, 20 apprentices (33% of apprentices commenting on logistical issues) made comments related to communication, 24 apprentices (26%) made comments related to payment procedures, and 21 apprentices (23%) pointed to problems gaining access and clearance. For instance:

> *Better communication throughout the process; provide contact point that responds; earlier notification of start and end dates. (CQL apprentice)*
>
> *Make sure the appropriate application is on the AEOP website as early as January/February. (CQL apprentice)*
>
> *More efficient administrative approach; more communication between CQL staff and mentors; better-defined pay dates and prompt deliver of pay particularly for traveling students. (CQL apprentice)*
>
> *The stipend is great, but more info on how it is taxed needs to be made obvious (CQL apprentice)*
>
> *Better communication between CQL and the individuals processing their information; better instructions on what needs to be done for stipend payments, CAC distribution, etc. (CQL apprentice)*
>
> *Make the security badging process less intense; one kid was escort-only all summer. (CQL apprentice)*

Additionally, 4 apprentices (4%) specifically noted that they believe that assistance in locating housing would improve the CQL apprentice experience. Outside of logistical issues, other suggestions related to project expectations and requirements, including the nature and clarity of those requirements (12% of apprentice respondents), and providing more opportunities for apprentices to interact with each other in or out of work (12%). Examples include:

> *In order to have my poster and presentation ready, I had to stop research a month before I expected. (CQL apprentice)*
>
> *Conveying research topics to CQL interns before arrival for better preparation. (CQL apprentice)*
>
> *Make more clear the expectations for the abstract and paper. (CQL apprentice)*
> *Better communication about the symposium and workshops to the students, not just the mentors. (CQL apprentice)*

Provide a way for the students in the program to interact with each other more. (CQL apprentice)

Students should discuss their projects with other students more often to learn from each other. (CQL apprentice)

CQL should have more cooperation with other participants/more teamwork; CQL should encourage more friendships between the participants; CQL should have more brown-bag lunches for participants to attend. (CQL apprentice)

During phone interviews, apprentices were also asked about how the CQL program could be improved. Their responses highlighted many of the same issues described above, including issues with clearance and computer access, lack of clarity about expectations and requirements, and issues with timely payment of stipends and direct deposit processing. Another theme that emerged in interviews was that apprentices felt that their pace of work was inconsistent, citing periods of time in which they had little work to do. For example:

Sometimes it is pretty slow. There are definitely some slow days, but there are definitely other days that I've had where I am busy, or I am doing something that seems worthwhile. (CQL apprentice)

I had some downtime, not just this year, but in past years too. Maybe it's because…I need to be doing something at almost all times. That was a little bit of an annoyance. (CQL apprentice)

Sometimes I found myself with literally all of my work done, and just sitting around trying to find busy work to make my 8 hours for the day. I would say maybe alter the contract a bit to be either an hourly pay…or give them more responsibility. (CQL apprentice)

The mentor questionnaire included open-ended items asking their opinions about the program. One item asked them to identify the three most important benefits of CQL; 22 mentors identified at least one benefit. Although several important benefits of the program were listed, the most frequently described were the opportunity for apprentices to experience research and STEM careers in a real-world setting (15 of 22, or 68%) as well as providing apprentices with opportunities to build networks in their fields and exposing them to DoD careers (6 of 22, or 27%). Mentors were also asked to note three ways in which CQL should be improved for future participants. The 18 individuals who responded to this question offered varied suggestions, however the majority comments were focused on improving logistics and organization (10 of 18 responses, or 56%), including facilitating student computer access (4 responses) and ensuring that apprentices receive stipends in a timely manner (4 responses), and improving the application and selection process

(4 responses). Other responses included providing opportunities for apprentices to share their experiences, providing opportunities for apprentices to network with professional researchers, assisting apprentices with housing expenses in order to attract non-local apprentices, providing materials to mentors to enhance their mentoring skills, and lengthening the program. One respondent suggested, "it would help get mentor buy-in to see publicized bio-sketches of successful CQL students" (CQL mentor).

Mentors were also asked to share their overall satisfaction with their CQL experience, which was reported to be mostly positive. Of the 17 individuals who responded to this question, 41% were complimentary of the apprentices, 40% noted that the experience was enjoyable and beneficial for them personally, and 18% described benefits to the lab or the DoD workforce pipeline. For example:

> *The program provides a great opportunity for our over-achieving college students who demonstrate a desire and technical capability to become our next wave of STEM professionals in DoD. (CQL mentor)*
>
> *Overall, I am satisfied with this program. It has enabled our laboratory to interact with talented students in engineering and the physical sciences. The students I have had the privilege to work with have made meaningful research contributions to the laboratory and were a pleasure to work with as team members. (CQL mentor)*
>
> *[This site] benefits from having the best and brightest undergrads, grad students, and PhD candidates conduct leading edge research…freeing the practitioners to concentrate on the analysis, decision making [and] analysis. (CQL mentor)*

The Actionable Program Evaluation findings for FY15 indicate the CQL program is 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. As part of this engagement, a clear majority of 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. However, apprentices and mentors reported dissatisfaction with administrative functions, such as receiving stipends and gaining clearance and access in a timely manner, which negatively impacted the experience for at least some apprentices. In short, these apprentices were generally quite pleased with the work they did and their interactions with mentors and other lab personnel, but were frustrated with administrative issues that detracted from, and in some cases interfered with, that work experience.

Recruitment efforts were improved in FY15, particularly in respect to recruiting students from underrepresented and underserved populations. While the majority of participants came from groups traditionally well represented in STEM fields (males and Whites), the number of apprentices identifying as Black or African American tripled from 2014 (9 apprentices, or 6%) to 2015 (27 apprentices, or 10%). In addition, both mentors and apprentices tended to learn about CQL through pre-existing relationships with other individuals (e.g., colleagues, friends, professors, family members, pre-existing relationship with a mentor), rather than through broader recruitment efforts (e.g., websites, social media, brochures). The prevalence of these pre-existing relationships in recruiting apprentices may limit opportunities to include more students from underrepresented and underserved populations.

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.[3] 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.

[3] 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.

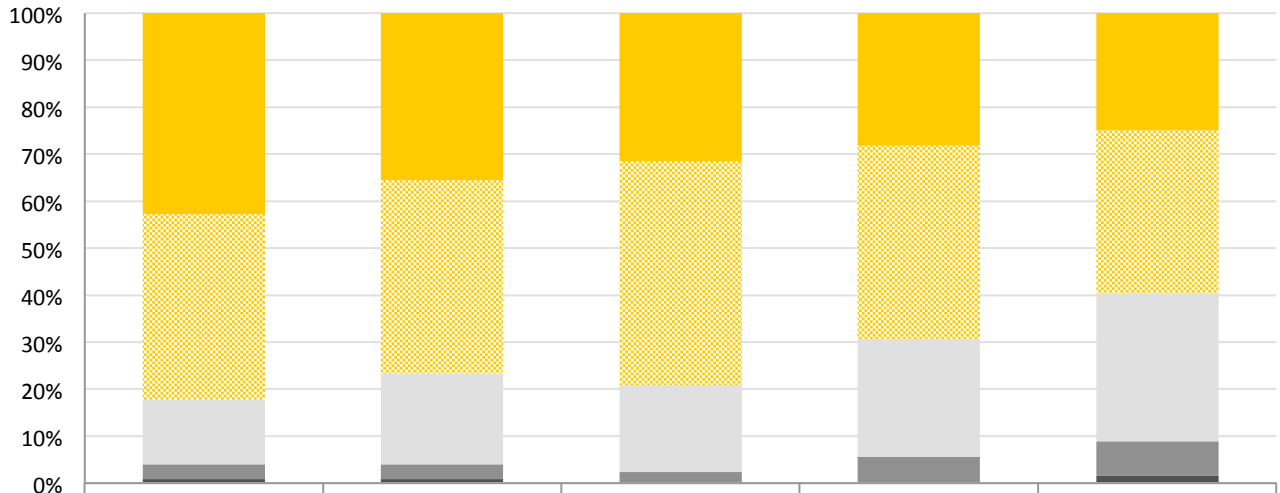
President's Council of Advisors on Science and Technology (P-CAST). (February 2012). *Engage to Excel: Producing One Million Additional College Graduates with Degrees in Science, Technology, Engineering, and Mathematics.* Executive Office of the President.

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.

STEM Knowledge and Skills

The majority of CQL apprentices reported gains in their STEM knowledge, with a clear majority indicating large or extreme gains in each area (more than 60% on each item). First, large or extreme gains were reported by 82% of apprentices in their knowledge of what everyday research work is like in STEM. Second, positive gains were reported for their knowledge of research conducted in a STEM topic or field (79%), and their knowledge of how scientists and engineers work on real problems in STEM (77%). Similarly, mentors reported impacts on their apprentices' STEM knowledge, although they tended to estimate slightly larger gains than apprentices noted themselves except for the item "Knowledge of what everyday research work is like in STEM" in which students reported a greater gain than did mentors (See Appendix C). As a reminder, it is not clear whether the difference is meaningful, or an artifact of which mentors and apprentices responded to the questionnaire.

Chart 16: Student Report of Impacts on STEM Knoweldge (n = 124)



	Knowledge of what everyday research work is like in STEM	Knowledge of how scientists and engineers work on real problems in STEM	Knowledge of research conducted in a STEM topic or field	In depth knowledge of a STEM topic(s)	Knowledge of research processes, ethics, and rules for conduct in STEM
Extreme gain	43%	36%	32%	28%	25%
Large gain	40%	41%	48%	41%	35%
Some gain	14%	19%	19%	25%	32%
A little gain	3%	3%	2%	6%	7%
No gain	1%	1%	0%	0%	2%

These apprentice questionnaire items were combined into a composite variable[4] to test for differential impacts across subgroups of apprentices. There were no significant differences between male and female apprentices or between minority and non-minority apprentices; in other words, these subgroups of apprentices reported similar impacts of the program on their STEM knowledge.

The apprentice questionnaire also asked about perceived impacts on STEM skills, 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 21 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 many of the items. For example, 71% reported at least large gains in identifying the limitations of the methods and tools used for data collection. Similarly, 60% or more reported at least large gains on their ability to carry out procedures for an experiment and record data accurately (65%); ability to identify the strengths and limitations of data, interpretations, or arguments presented in technical or scientific texts (65%); supporting an explanation with relevant scientific, mathematical, and/or engineering knowledge (62%); and asking a question that can be answered with one or more scientific experiments (60%). More than 50% of responding apprentices reported large or extreme gains in several other STEM competencies including designing procedures for an experiment that are appropriate for the question to be answered (58%); communicating about experiments and explanations in different ways (58%); and using knowledge and creativity to suggest a testable explanation (hypothesis) for an observation (54%). Fewer responding apprentices reported at least large gains on their ability to organize data in charts or graphs to find patterns and relations (48%), making a model of an object or system showing its parts and how they work (38%) and using computer models of objects or systems to test cause and effect relationships (27%). For almost all of these items, mentors' reports of apprentices' gains appeared somewhat higher than apprentices' own reports (see Appendix C). These differences may be due to data quality concerns described previously, or differences in perspectives between apprentices and mentors.

"I have thoroughly enjoyed my research experience and I have learned a lot about what being a scientist means. I learned that in the research field, publishing is one of the most important parts for a senior scientist. I liked the CQL experience because it allowed me to be a little more independent.." -- CQL Apprentice

[4] The Cronbach's alpha reliability for these 5 items was 0.883.

Table 21. Apprentices Reporting Large or Extreme Gains in their STEM Competencies – Science Practices (n = 52)	
Item	**Questionnaire Respondents**
Identifying the limitations of the methods and tools used for data collection	71%
Carrying out procedures for an experiment and recording data accurately	65%
Identifying the strengths and limitations of data, interpretations, or arguments presented in technical or scientific texts	65%
Supporting an explanation with relevant scientific, mathematical, and/or engineering knowledge	62%
Asking a question that can be answered with one or more scientific experiments	60%
Considering different interpretations of data when deciding how the data answer a question	60%
Integrating information from technical or scientific texts and other media to support your explanation of an observation	60%
Designing procedures for an experiment that are appropriate for the question to be answered	58%
Identifying the strengths and limitations of explanations in terms of how well they describe or predict observations	58%
Communicating about your experiments and explanations in different ways (through talking, writing, graphics, or mathematics)	58%
Using knowledge and creativity to suggest a testable explanation (hypothesis) for an observation	54%
Supporting an explanation for an observation with data from experiments	54%
Defending an argument that conveys how an explanation best describes an observation	54%
Organizing data in charts or graphs to find patterns and relationships	48%
Making a model of an object or system showing its parts and how they work	38%
Using computer models of objects or systems to test cause and effect relationships	27%

Table 22 shows data for apprentices whose experience focused on the other STEM areas (technology, engineering, and mathematics) regarding self-reported impacts on their abilities related to key engineering practices. A majority of responding apprentices reported large or extreme gains in most of the engineering practices. For example, 60% or more indicated large or extreme gains in their ability to communicate information about their design experiments and solutions in different ways (65%); use knowledge and creativity to propose a testable solution for a problem (65%);

Identify the limitations of the methods and tools used for data collection (64%); and defining a problem that can be solved by developing a new or improved object, process, or system (61%).

Unlike items related to apprentices' gains in science practices, for most items related to gains in key engineering practices, mentors' reports of apprentice gains were slightly lower than apprentices' own reports (see Appendix C). These inconsistencies may again be related to data quality concerns described previously, or may be related to differences in perspectives between apprentices and mentors. Another explanation may be that apprentices had lower estimates of their competencies in engineering practices prior to CQL (perhaps because of limited prior opportunities to engage in those practices) than their mentors did (basing their initial estimates on what they saw apprentices doing at the beginning of the internship), thus apprentices may have seen themselves as having greater gains than those estimated by their mentors.

Table 22. Apprentices Reporting Large or Extreme Gains in their STEM Competencies – Engineering Practices (n = 72)

Item	Questionnaire Respondents
Communicating information about your design experiments and solutions in different ways (through talking, writing, graphics, or math equations)	65%
Using knowledge and creativity to propose a testable solution for a problem	65%
Identifying the limitations of the methods and tools used for data collection	64%
Defining a problem that can be solved by developing a new or improved object, process, or system	61%
Integrating information from technical or scientific texts and other media to support your solution to a problem	58%
Supporting a solution with relevant scientific, mathematical, and/or engineering knowledge	57%
Carrying out procedures for an experiment and recording data accurately	56%
Considering different interpretations of the data when deciding if a solution works as intended	53%
Organizing data in charts or graphs to find patterns and relationships	51%
Using computer models of an object or system to investigate cause and effect relationships	50%
Supporting a solution for a problem with data from experiments	50%
Identifying the strengths and limitations of data, interpretations, or arguments presented in technical or scientific texts	50%
Designing procedures for an experiment that are appropriate for the question to be answered	49%
Identifying the strengths and limitations of solutions in terms of how well they meet design criteria	47%
Defend an argument that conveys how a solution best meets design criteria	46%
Making a model of an object or system to show its parts and how they work	46%

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. There were no significant differences between male and female apprentices or between minority and non-minority apprentices on either composite.

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 Chart 17, 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 (77%), learning to work independently (70%), and sticking with a task until it is finished (70%). Apprentices reported similar gains regardless of gender or race/ethnicity.[13] For most of the items, mentor reports of apprentice gains in this area are somewhat higher than apprentices' own reports (see Appendix C).

STEM Identity and Confidence

A key emphasis for AEOP programs is on growing participant STEM identity and awareness, as this has been linked to developing future interest and potential participation in STEM as a field of study and future career. [14] As a result, the apprentice questionnaire included a series of items intended to measure the impact of CQL on apprentices' STEM identity. These data are shown in Chart 18 and suggest that the program has had a positive impact in this area as at least half of responding apprentices reported large or extreme gains in each area. For example, 76% of responding apprentices reported a desire to build relationships with mentors, 69% reported feeling prepared for more challenging STEM activities, and 70% reported a sense of accomplishing something in STEM. Similarly, substantial proportions of apprentices reported large or greater gains on their confidence to do try out new ideas or procedures (64%), having patience for the slow pace of STEM research (61%), and interest in a new STEM topic (59%). Comparing results on the composite created from these items,[15] there were no significant differences in impact based on gender or race/ethnicity.

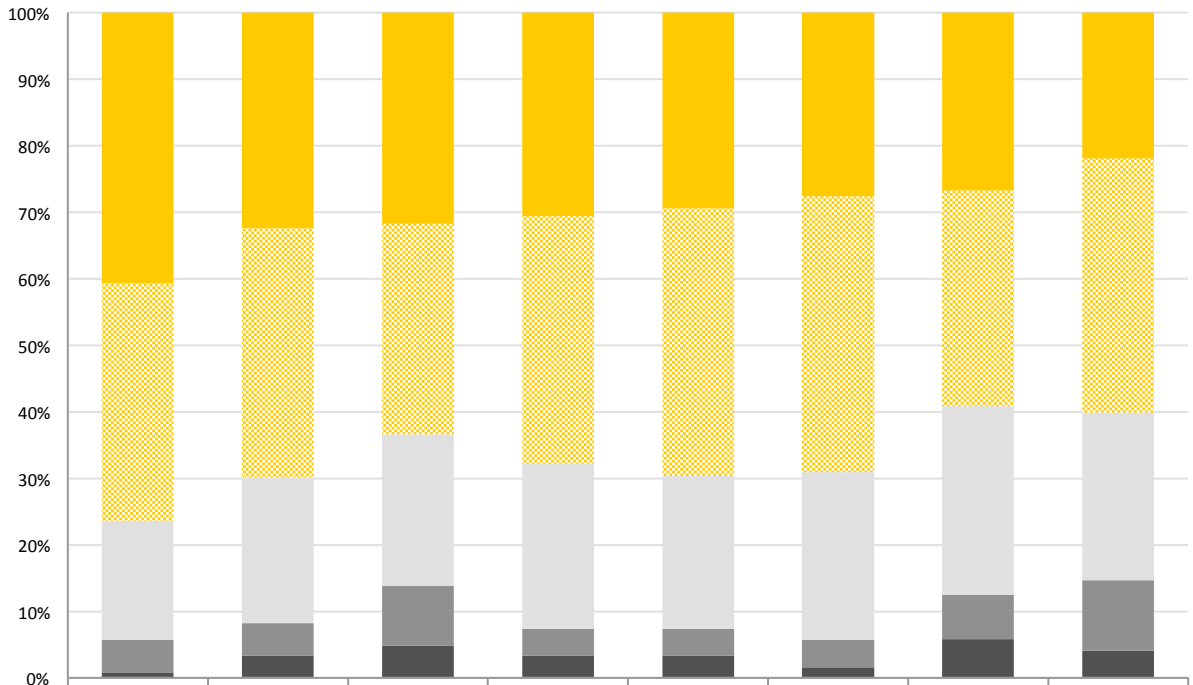
[12] The science practices composite has a Cronbach's alpha reliability of 0.956; the engineering practices composite has a Cronbach's alpha reliability of 0.960.

[13] The Cronbach's alpha reliability for these 8 items was 0.937.

[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.

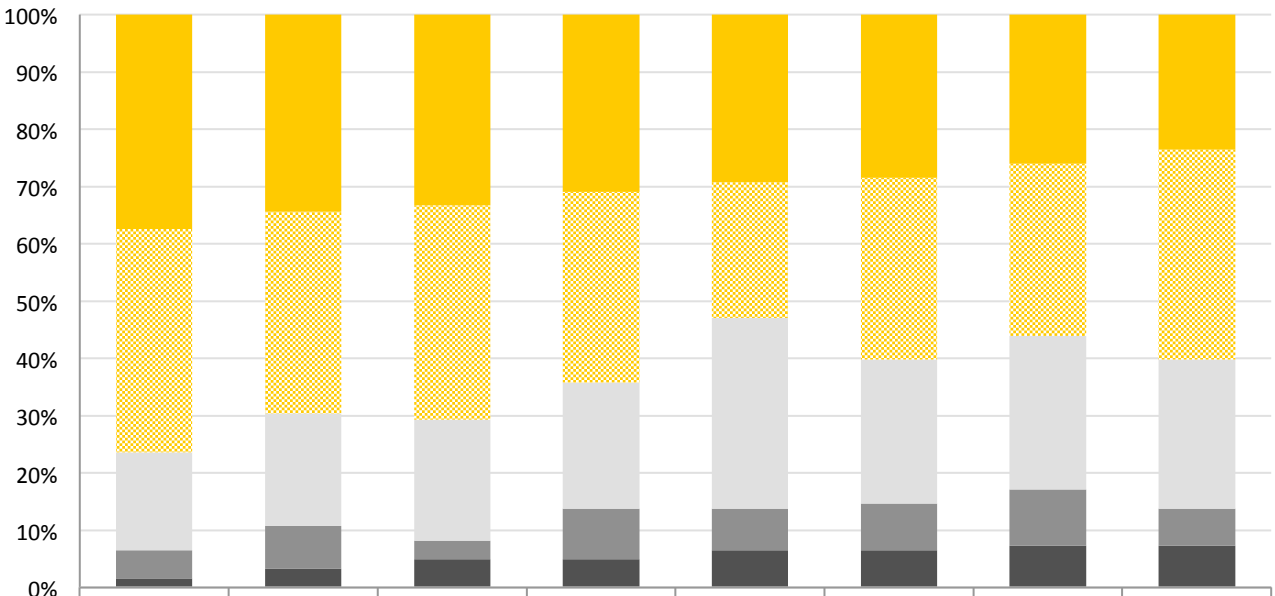
[15] The Cronbach's alpha reliability for these 8 items was 0.926.

Chart 17: Student Report of Impacts on 21st Century Skills (n = 124)



	Making changes when things do not go as planned	Learning to work independently	Working well with people from all backgrounds	Viewing failure as an opportunity to learn	Sticking with a task until it is finished	Communicating effectively with others	Including others perspectives when making decisions	Setting goals and reflecting on performance
Extreme gain	41%	33%	32%	31%	30%	28%	27%	22%
Large gain	36%	37%	32%	37%	40%	42%	33%	38%
Some gain	18%	22%	23%	25%	23%	25%	28%	25%
A little gain	5%	5%	9%	4%	4%	4%	7%	11%
No gain	1%	3%	5%	3%	3%	2%	6%	4%

Chart 18: Student Report of Impacts on STEM Identity (n = 122-123)



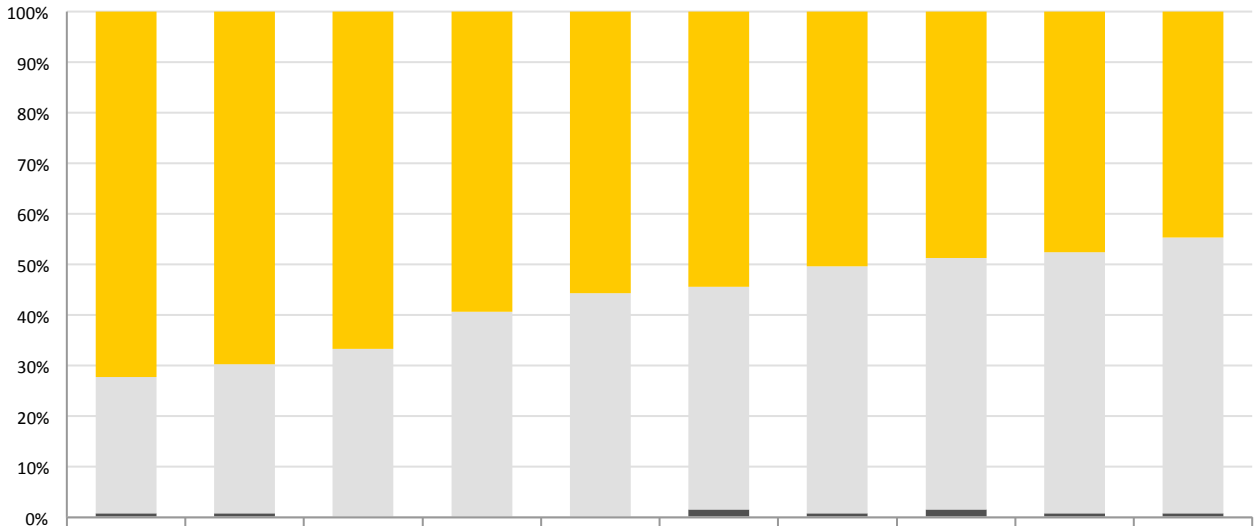
	Desire to build relationships with mentors who work in STEM	Feeling prepared for more challenging STEM activities	Sense of accomplishing something in STEM	Confidence to try out new ideas or procedures on my own in a STEM project	Deciding on a path to pursue a STEM career	Interest in a new STEM topic	Connecting a STEM topic or field to my personal values	Patience for the slow pace of STEM research
Extreme gain	37%	34%	33%	31%	29%	29%	26%	24%
Large gain	39%	35%	37%	33%	24%	32%	30%	37%
Some gain	17%	20%	21%	22%	33%	25%	27%	26%
A little gain	5%	7%	3%	9%	7%	8%	10%	7%
No gain	2%	3%	5%	5%	7%	7%	7%	7%

Interest and Future Engagement in STEM

Another key goal of the AEOP program is to develop a STEM-literate citizenry. Therefore, AEOP apprentices are frequently engaged in high quality STEM experiences both within and outside of school. 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. As can be seen in Chart 19, the vast majority of apprentices indicated that they were no less likely to engage in any of these activities as a result of CQL; for about half the activities, the majority indicated they were more likely to engage in the activities, but for the other half, the majority indicated the likelihood they would engage in the activities was about the same. For example, 59% reported being more likely to take an elective STEM course, 56% to help with a community service

project related to STEM, and 54% to use a computer to design or program something. In contrast, 72% reported being more likely to work on a STEM project or experiment in a university or professional setting, 70% to talk with family or friends about STEM, and 67% to mentor or teach other students about STEM. 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. However, there was a statistically significant difference by race/ethnicity with minority apprentices (*M*=37.27, *SD*=4.80) reporting greater interest in future engagement compared to non-minority apprentices (*M*=36.88, *SD*=5.78); *t*(90)=2.45, *p*<.05, two-tailed (a moderate effect size, d=0.517). It is possible that this difference may be, in part, an indicator of minority apprentices believing they have gained more from the project and/or having more confidence in their STEM competencies, so may be worth further investigation.

Chart 19: Change in Likelihood Students Will Engage in STEM Activities Outside of School (n = 122-123)

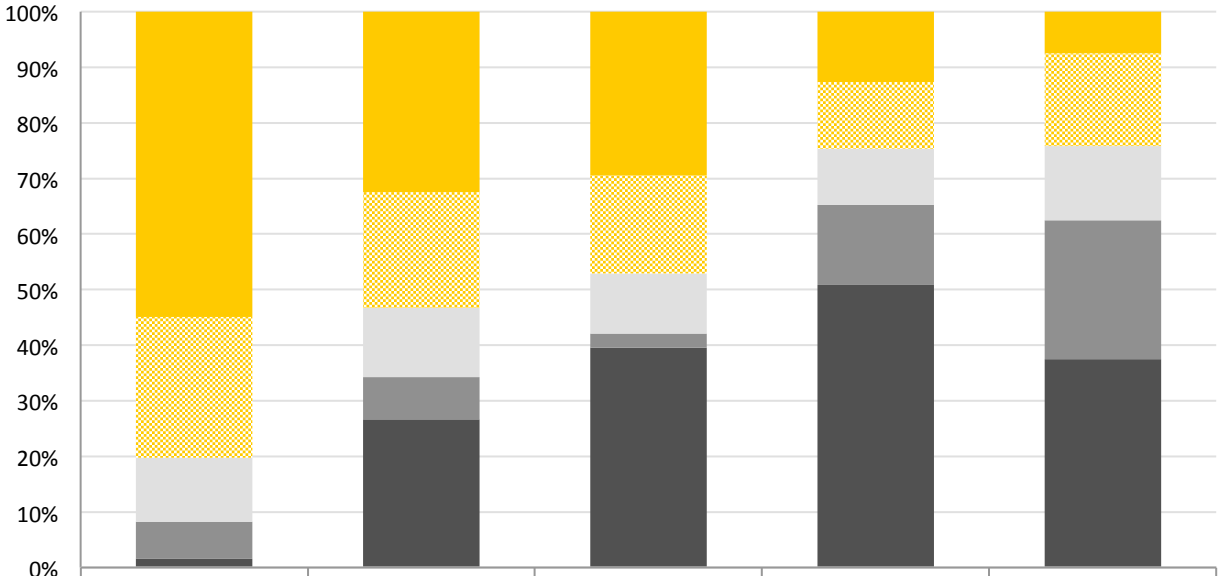


	Work on a STEM project or experiment in a university or professional setting	Talk with friends or family about STEM	Mentor or teach other students about STEM	Take an elective (not required) STEM class	Help with a community service project related to	Use a computer to design or program something	Work on solving mathematical or scientific puzzles	Participate in a STEM camp, club, or competition	Tinker (play) with a mechanical or electrical device	Watch or read non-fiction STEM
More likely	72%	70%	67%	59%	56%	54%	50%	49%	48%	45%
About the same	27%	30%	33%	41%	44%	44%	49%	50%	52%	55%
Less likely	1%	1%	0%	0%	0%	2%	1%	2%	1%	1%

[16] These 10 items had a Cronbach's alpha reliability of 0.895.

Apprentices were also asked how interested they are in participating in future AEOP programs (See Chart 20). A large majority (80%) indicated being "somewhat" or "very much" interested in participating in CQL again and 54% in SMART (see Chart 20). The majority had never heard of or expressed no interest in participating in GEMS Near Peers (76%) and URAP (75%).

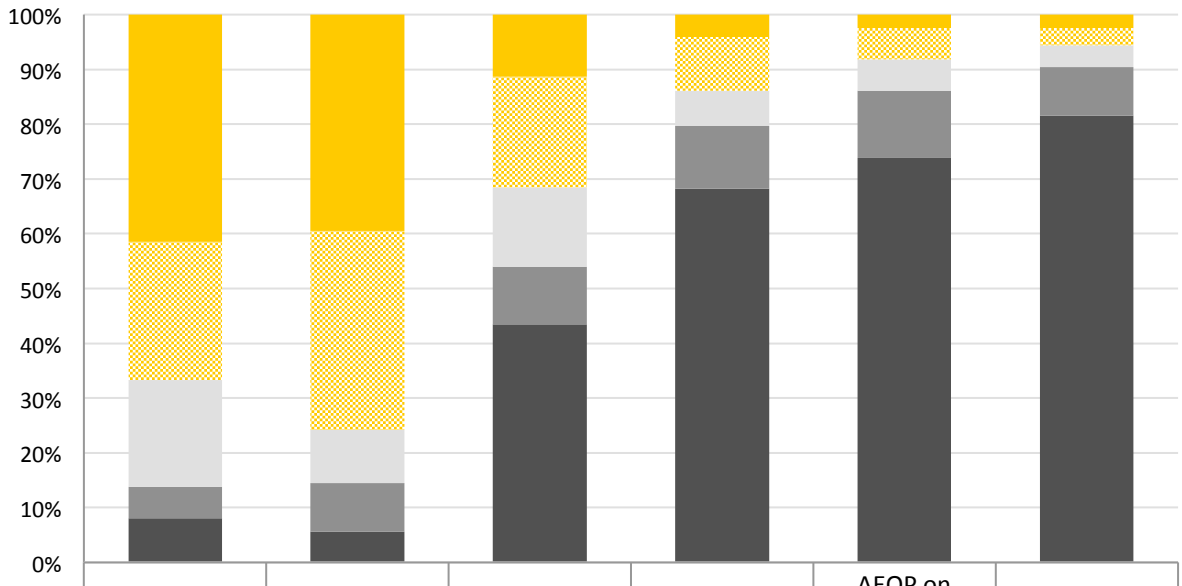
Chart 20: Student Interest in Future AEOP Programs (n = 118-122)



	CQL	SMART College Scholarship	NDSEG Fellowship	URAP	GEMS Near Peer Mentor Program
Very much	55%	33%	29%	13%	8%
Somewhat	25%	21%	18%	12%	17%
A little	12%	13%	11%	10%	13%
Not at all	7%	8%	3%	14%	25%
Never heard of	2%	27%	40%	51%	38%

Apprentices were asked which resources impacted their awareness of the various AEOPs. As can be seen in Chart 21, participating in CQL and the apprentices' mentors impacted apprentices' awareness of AEOPs the most, with 76% and 67% of responding apprentices respectively selecting "somewhat" or "very much." Over half of the responding apprentices had not experienced AEOP resources such as It Starts Here! Magazine (90%), AEOP social media (86%), the AEOP brochure (80%), and invited speakers or career events during CQL (54%).

Chart 21: Impact of Resources on Student Awareness of AEOPs (n = 118-122)



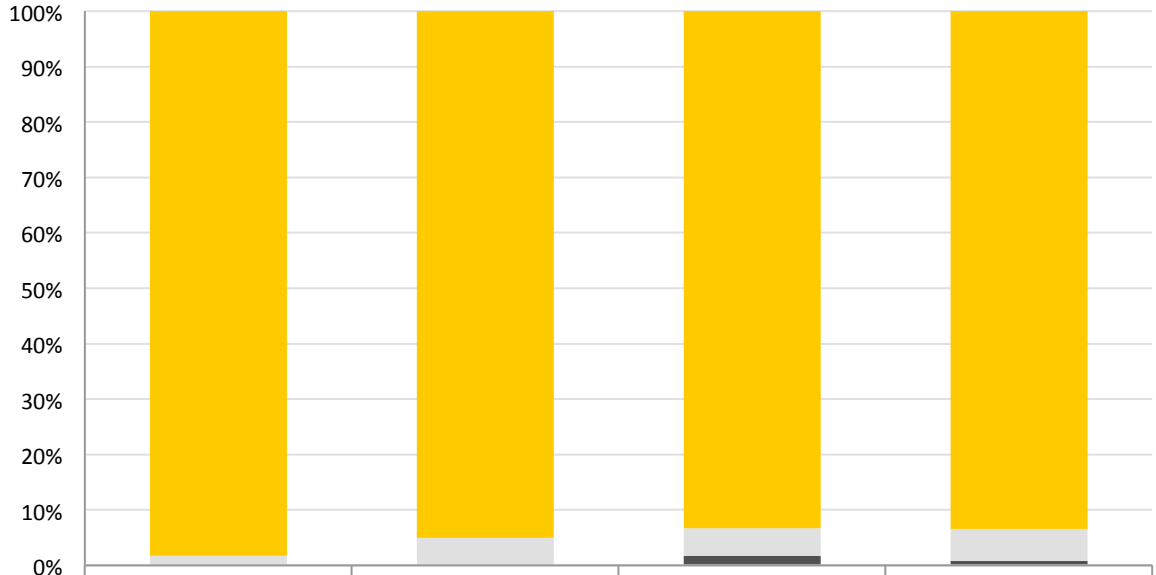
	My CQL mentor(s)	Participation in CQL	Invited speakers or "career" events during CQL	AEOP brochure	AEOP on Facebook, Twitter, Pinterest or other social media	It Starts Here! Magazine
Very Much	42%	40%	11%	4%	3%	2%
Somewhat	25%	36%	20%	10%	6%	3%
A little	20%	10%	15%	7%	6%	4%
Not at all	6%	9%	11%	11%	12%	9%
Did not experience	8%	6%	44%	68%	74%	82%

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. The data indicate that responding apprentices have favorable opinions (see Chart 22). For example, 93% agreed or strongly agreed that DoD researchers solve real-world problems, 95% that DoD researchers advance science and engineering fields, 94% that DoD research is valuable to society, 92% that DoD

researchers develop new, cutting-edge technologies, and 98% that DoD researchers advance science and engineering fields.

Chart 22: Student Opinions about DoD Researchers and Research (n = 121)



	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
Strongly agree or agree	98%	95%	93%	93%
Neither agree nor disagree	2%	5%	5%	6%
Strong disagree or disagree	0%	0%	2%	1%

Education and Career Aspirations

Apprentice education and career aspirations are also another key 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. As can be seen in Table 23, when asked to think back on how far they wanted to go in school before participating in CQL, 95% indicated they wanted an education beyond a Bachelor's degree (i.e., more education after college, a master's degree, or an advanced or professional degree) prior to CQL; that percentage rose to 98% after CQL, primarily as a result of more apprentices wanting to pursue a Ph.D. or a medical-related degree.. While there was a shift towards aspirations for more education it was not statistically significant. [17]

[17] Chi-square test of independence, $\chi^2(2) = 1.88$, $p > 0.05$

Table 23. Apprentice Education Aspirations (n = 122)		
	Before CQL	**After CQL**
Go to a trade or vocational school	0%	0%
Go to college for a little while	0%	0%
Finish college (get a Bachelor's degree)	5%	2%
Get more education after college	23%	9%
Get a master's degree	12%	7%
Get a Ph.D.	28%	38%
Get a medical-related degree (M.D.), veterinary degree (D.V.M), or dental degree (D.D.S)	27%	36%
Get a combined M.D./Ph.D.	5%	4%
Get another professional degree (law, business, etc.)	1%	5%

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 25). The vast majority of responding apprentices expressed interest in STEM-related careers both before and after participating in CQL. For example, 45% indicated aspiring to a career in engineering before CQL, with another 8% interested in computer science. After CQL, 41% of apprentices expressed interest in engineering, and 10% in computer science. There was not a distinct shift in the proportion of apprentices aspiring to a STEM-related career. 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, recent college graduates, or graduate students who were predominately motivated to participate in the program because they were already interested in STEM (see Table 14).

Table 25. Apprentice Career Aspirations (n = 122)		
	Before CQL	**After CQL**
Engineering	45%	41%
Biological science	14%	15%
Computer science	8%	10%
Medicine (doctor, dentist, veterinarian, etc.)	7%	7%
Undecided	5%	3%
Physical science (physics, chemistry, astronomy, materials science)	5%	7%
Technology	4%	6%
Social science (psychologist, sociologist, etc.)	4%	4%
Science (no specific subject)	3%	1%
Environmental science	2%	1%
Health (nursing, pharmacy, technician, etc.)	2%	2%
Earth, atmospheric or oceanic science	1%	1%
Teaching, STEM	1%	3%
Mathematics or statistics	0%	1%
Teaching, non-STEM	0%	0%
Business	0%	0%
Law Military, police, or security	0%	0%
Art (writing, dancing, painting, etc.)	0%	0%
Skilled trade (carpenter)	0%	0%

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 26, almost all apprentices expect to use STEM somewhat in their career. A majority (53%) expect to use STEM 76-100% of the time in their work, 34% expect to use STEM 51-75% of the time, and 8% expect to use STEM 26-50% of the time.

Table 26. Apprentices Expecting to use STEM in Their Work at Age 30 (n = 121)	
	Questionnaire Respondents
Not at all	1%
Less than 25% of the time	4%
26% to 50% of the time	8%
51% to 75% of the time	34%
75% to 100% of the time	53%

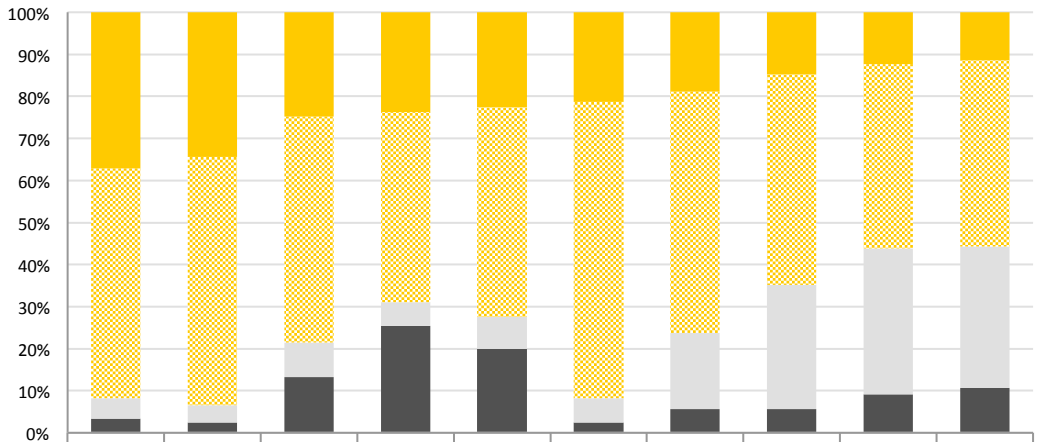
Overall Impact

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 Chart 23). For example, a large majority of responding apprentices indicated an impact of participation in CQL on confidence in their STEM knowledge, skills, and abilities (92%), with 71% reporting that CQL contributed to this impact and another 21% reporting that CQL was the primary reason for this impact. Similarly, many apprentices indicated that participation in CQL had an impact on their awareness of DoD STEM research and careers (54% reporting that CQL contributed, and 25% reporting that CQL was the primary reason), their appreciation of DoD STEM research and careers (55% and 37%), and their interest in pursuing a STEM career with the DoD (54% and 25%). Apprentices also reported an impact on their interest in participating in STEM activities outside of school requirements (57% and 19%), and pursuing a STEM career (50% and 15%). CQL had the least impact on responding apprentices' interest in earning a STEM degree in college (44% and 12%) and taking STEM classes in school (44% and 12%), which is perhaps to be expected given that responding apprentices were primarily college students (undergraduate or graduate), or recent college graduates, who already had an interest in STEM fields. 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.

> *"If I had to do it again, I would do it five times again, five summers in a row…I definitely think this is worthwhile."* -- CQL Apprentice

[18] The Cronbach's alpha reliability for these 10 items was 0.894.

Chart 23: Apprentice Opinions of CQL Impacts (n = 120-122)



	I have a greater appreciation of Army or DoD STEM research	I am more aware of Army or DoD STEM research and careers	I am more interested in pursuing a STEM career with the Army or DoD	I am more aware of other AEOPs	I am more interested in other AEOPs	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 interested in pursuing a career in STEM	I am more interested in earning a STEM degree	I am more interested in taking STEM classes in school
Agree -CQL was primary resason	37%	34%	25%	24%	23%	21%	19%	15%	12%	12%
Agree - CQL contributed	55%	59%	54%	45%	50%	71%	57%	50%	44%	44%
Disagree - happened, but not because of CQL	5%	4%	8%	6%	8%	6%	18%	30%	35%	34%
Disagree - did not happen	3%	3%	13%	25%	20%	3%	6%	6%	9%	11%

An open-ended item on the questionnaire asked apprentices to list the three most important ways they benefited from the program; 106 apprentices provided at least one answer to the question. Apprentices' responses addressed a variety of themes. Nearly half of the responding apprentices (49%) wrote about the value of gaining real-world experience. Over half of responding apprentices (56%) listed gaining knowledge, including knowledge related to STEM content, careers, and research. Other common themes included having opportunities to network and make connections (37%) and having benefits related to future careers or education, such as building a resume; impacting career or education possibilities; and gaining information about, exposure to, or preparation for a career (40%).

Apprentices' comments from interviews expand on some of these impacts. For example:

> *The experience is hands down incredible…they gave me a lot more networking experience. They gave me a lot more insight into how things are run, how decisions are made in the STEM fields…It's a good teaching opportunity for students…you can learn more about how a good workplace functions. (CQL apprentice)*

I gained a lot of knowledge. I've actually gotten out of my comfort zone because if you work here, you really can't be afraid to speak in front of a lot of people. I'm learning how to talk in front of people without getting nervous…I learned more about STEM and how STEM is related to business…and pretty much how STEM is related to everything we do. (CQL apprentice)

I talked to my mentor. We had a pretty long chat about what it's like to work in this lab as a government employee, as well as a contractor. I was more interested after talking to him. (CQL apprentice)

I think [the CQL experience] will definitely set me apart from my peers; I don't think a lot of people get this opportunity. It's just different from the typical research that my university pushes for. (CQL apprentice)

"CQL was a fantastic experience, and I am thankful for the resources and projects that I have been able to work on with my mentors… and I am now interested in pursuing a career in nanorobotics. As an undergraduate…my mentors and my fellow interns have pointed me to several professors who I can work with in the future." -- CQL Apprentice

Summary of Findings

The FY15 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 27.

Table 27. 2015 CQL Evaluation Findings	
Participant Profiles	
CQL had some success at serving students of historically underrepresented and underserved populations.	Overall enrollment for CQL increased in FY15 (394) compared to FY14 (307), despite an 8% decrease in applicants. The applicant placement rate improved 22% in FY15. The number of females participating in CQL increased substantially in FY15. Enrollment data indicate that 40% of all participants were female in FY15, an increase of 15% from FY14 (only 25% female enrollment). Although females continued to participate at a lower rate than males (in FY15 60% of participants were males, 40% were females), this increase in the participation of female students—a population that is historically underrepresented in engineering fields – is a significant gain. The number of participating colleges/universities for the CQL program grew to 120 (from 104 in FY14).
	CQL continued to serve students from historically underrepresented and underserved race/ethnicity groups, however the majority of enrolled apprentices identified themselves as "White" or "Asian." An area of growth for CQL was in the number of apprentices identifying themselves as Black or African American, which tripled from FY14 (9 in 2014 or 6% versus 27 in 2015 or 10%). CQL participants represented a total of 12 historically Black colleges and universities (HBCUs) and other minority serving institutions (MSIs), an increase of 14% over FY14. Conversely, participation of Hispanic or Latino students decreased in FY15, with 3% of apprentices identifying themselves as Hispanic or Latino in FY15 versus 9% in FY14. In sum, only 13% of enrolled participants identified themselves as being from an underrepresented or underserved minority groups, indicating that work remains to be done in devising strategies to recruit apprentices from these groups.

CQL made limited progress in recruiting past AEOP program participants.	Questionnaire data indicate that few responding apprentices had participated in other AEOP programs previously (93% to 98%). About 84% of apprentices noted participation in CQL at least once (although it's not clear whether the one time was including or in addition to current participation), and about 30% had participated more than once. While 32% of students had participated in SEAP at least once, only 13% had participated in GEMS in the past, representing a decline as compared to alumni participation in FY14 when 37% of participants were alumni of SEAP and 18% were alumni of GEMS.
CQL succeeded in reaching and exceeding its targeted number of program applicants.	There were 695 total applicants for CQL in FY15, a 12% increase from FY14. The applicant pool exceeded the target set in FY14 for 650 applicants in 2015, indicating that outreach efforts to grow number or applicants were successful. Likewise, there was an increase of 12% in enrolled participants in FY15 as compared to FY14. In CQL, student participation is dependent upon the number of available mentors. Therefore, the expansion in program participation is also attributable to the corresponding 12% increase in the number of mentor participants from FY14 to FY15. Even with this growth in the number of mentors, however, CQL fell short of meeting its required one-to-one mentor to apprentice ratio (there were 369 mentors and 394 apprentices in FY15, resulting in a mentor to apprentice ratio of .94:1).
Actionable Program Evaluation	
CQL grew their mentor pool in FY15 and pre-existing relationships continue to be a key factor in CQL recruitment.	The number of CQL mentors increased in FY15 (369) from FY14 (288). Mentor questionnaire respondents indicated students were most commonly recruited through colleagues, personal acquaintances, university faculty, and contact from the student.
	Apprentice questionnaire respondents indicated that they most commonly learned about CQL from someone who works at an Army laboratory, teachers or professors, immediate family members, university resources, friends, mentors, or past CQL participants. In addition, apprentice interview data support the notion that pre-existing relationships are instrumental in growing 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, reporting that the strongest motivators were interest in STEM, the desire to expand laboratory and research skills, and the opportunity to learn something new and interesting. Other highly motivating factors included the opportunity to use advanced laboratory technology, figuring out education or career goals, and interest in Stem careers with the Army. Interview data also suggested that apprentices were motivated by the opportunity to gain job and research experience.
CQL engaged apprentices in meaningful STEM learning.	Most apprentices (55-88%) reported learning about STEM topics, applications of STEM to real-life situations, STEM careers, and new discoveries in STEM on most days or every day of their CQL experience.
	Frequent opportunities to engage in a variety of STEM practices were provided to apprentices on most days or every day during their CQL experience. For example, 83% reported participating in hands-on STEM activities; 71% practicing using laboratory procedures, and tools; 71% working as part of a team; 72% carrying out an investigation; and 75% analyzing and interpreting data or information.
	CQL provided more frequent opportunities for apprentices to learn about STEM and be engaged in STEM practices than reported experiences 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, and engage apprentices in authentic STEM activities.
CQL promoted apprentice awareness of DoD STEM research and careers.	Nearly all CQL participants reported learning about at least one STEM career, and 44% reported learning about 4 or more. Similarly, 100% of students reported learning about at least one DoD STEM job, with 60% reporting they learned about 3 or more, an increase over FY14 results. Apprentices reported that mentors and the CQL experience contributed the most to this impact.
Apprentices' awareness of other AEOP scholarship programs increased, but CQL can improve mentor and apprentice awareness of and marketing of other AEOP opportunities.	Most mentor questionnaire respondents reported that participation in CQL or the CQL program administrator or site coordinator were the most useful resources for students to learn about AEOP initiatives. However, mentors overall reported limited awareness of AEOP initiatives. The majority of responding mentors (57%-81%) reported no exposure or experience with AEOP informational resources including the AEOP website, the It Starts Here! Magazine, the AEOP brochure, and AEOP social media. In spite of this, a large majority of responding mentors (95%) reported discussing URAP with apprentices, while 54% discussed NDSEG and 27% discussed SMART. The number of apprentice respondents who had heard of SMART and NSDEG (74% and 61% respectively) increased over FY14 levels and surpassed FY15 goals. Additionally, 49% of apprentices reported having heard of

	URAP.
Apprentices and mentors value the CQL experience, although program administration continues to be an area for improvement.	A large majority of responding apprentices reported satisfaction with their mentors and experiences during the CQL program. For example, over 90% of responding apprentices reported being at least "somewhat" satisfied with their mentor, the time they spent with their mentor, and the research experience overall.
	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 28% of apprentices described some level of dissatisfaction with administrative aspects of the program. In particular, apprentices noted difficulties in communicating with program administrators, problems receiving stipend payments, and delays in getting security clearance and computer access. When asked how the program could be improved, 65% of apprentice respondents cited that improvements could be made in administrative tasks such as stipend payments, communication, security clearance, and computer access.
Outcomes Evaluation	
CQL apprentices reported gains in their STEM knowledge and competencies.	Apprentices reported substantial gains in their STEM knowledge. A majority of respondents reported large or extreme gains in their knowledge of what everyday research work is like in STEM, how professionals work on real problems in STEM, research conducted in a STEM topic or field, in-depth knowledge of a STEM topic, and the research processes, ethics, and rules for conduct in STEM.
	Apprentices also reported gains in their STEM competencies, including the following: carrying out procedures for an investigation and recording data accurately; supporting an explanation with relevant scientific, mathematical, and/or engineering knowledge; identifying the strengths and limitations of data, interpretations, or arguments presented in technical or scientific texts; carrying out procedures for an experiment and recording data accurately, supporting an explanation with relevant scientific, mathematical and/or engineering knowledge; asking a question that can be answered with scientific experiments; considering different interpretations of data; integrating information from technical or scientific texts and other media to support explanations of an observation; communicating about experiments in different ways; and identifying the strengths and limitations of explanations in terms of how well they describe or predict observations.

CQL participants reported gains in apprentices' 21st Century Skills.	A clear majority of apprentices reported large or extreme gains in several critical workplace skills including the ability to make changes when things do not go as planned, learning to work independently, communicating effectively with others, sticking with a task until it is complete, and viewing failure as an opportunity to learn.
CQL participants reported increased confidence and identity in STEM.	Apprentices reported gains in their confidence and STEM identity, including large or extreme gains in feeling prepared for more challenging STEM activities, having a sense of accomplishing something in STEM, having confidence to try out new ideas or procedures, and having a desire to build relationships with mentors in STEM fields.
CQL participants reported increased interest in future STEM engagement.	Apprentices also reported that that they were more likely to engage in additional STEM activities outside of school after participating in CQL. A majority of apprentices indicated that they were more likely to work on a STEM project or experiment in a university or professional setting, talk with friends or family about STEM, mentor or teach other students about STEM, work on a STEM project or experiment in a university or professional setting, and use a computer to design or program something.
CQL influenced apprentices' education aspirations, but did not change their career aspirations.	Apprentices were asked about their education aspirations both before and after their participation in CQL. After CQL, apprentices indicated being more likely to go further in their schooling than they would have before, with the greatest change being in the proportions of apprentices who wanted to get a Ph.D. (28% before CQL, 38% after) and who wanted to get a medical related degree (27% before CQL, 36% after).
	Apprentices were asked to indicate what kind of work they expected to be doing at age 30 both before and after their participation in CQL. Although the vast majority of apprentices indicated interest in a STEM-related career, there was not distinct shift in career aspirations from before CQL to after.

CQL participants reported limited awareness of AEOP initiatives, but apprentices indicated interest in future AEOP opportunities.	Apprentices and mentors reported limited awareness of other AEOP initiatives with the exception of scholarship programs such as SMART and NDSEG. A large majority of apprentices (80%) were at least somewhat interested in participating in CQL in the future. More than half of apprentice respondents (52%) reported being at least somewhat interested in participating in SMART in the future while 47% indicated being at least somewhat interested in NDSEG, and 25% indicated being at least somewhat interested in URAP. Apprentices reported that their CQL participation and their mentors had the most impact on their awareness of AEOPs.
CQL apprentices have positive opinions about DoD researchers and research.	Apprentice perceptions of DoD researchers and research were overwhelmingly positive. A large majority of apprentices reported that they agreed or strongly agreed that DoD researchers solve real-world problems (93%), DoD researchers advance science and engineering fields (98%), DoD research is valuable to society (93%), and DoD researchers develop new, cutting edge technologies (95%).

Recommendations

Evaluation findings indicate that FY15 was a successful year overall for the CQL program. Most notably, the program experienced a 12% growth in both apprentice and mentor participation, surpassing the goal set in 2014. In addition, the number of apprentices identifying themselves as Black/African American tripled from FY14 to FY15, a significant step toward achieving the AEOP goal of expanding participation among underrepresented groups. The increase in participation of females from 25% to 40% from FY14 to FY15 is also a notable achievement. Efforts to inform students about other AEOPs appear to be improving as well, as the number of participants who had heard of SMART and NSDEG increased to 74% and 61% in FY15 (up from 64% and 54% in FY14). Apprentices and mentors alike continue to report high levels of satisfaction with the program and mentor-apprentice relationships, and both groups report strong apprentice gains in STEM competencies and knowledge as a result of the CQL experience.

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

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

1. In spite of the increase in the number of CQL participants from underrepresented groups, work remains to be done in achieving the CQL program goal of broadening the talent pool in STEM fields. It is noteworthy that in 2015, 27 participants, or 10%, identified themselves as Black or African American, representing a substantial increase from

the 9 participants (6%) in 2014. The program may want to build upon this success by expanding successful strategies such as outreach to HBCUs/MSIs and implementing other new methods to actively recruit students nationwide. Although there was an increase in the number of female CQL participants in 2015, females continue to participate at lower rates than males, and targeting outreach efforts to women's colleges and groups such as Association for Women in Science (AWIS) and Society of Women Engineers (SWE) may increase the participation of females. Since some students noted that their late notice of acceptance created difficulties in securing housing, and several indicated that assistance in locating housing would be beneficial in facilitating the participation of geographically diverse apprentices, the program may wish to consider whether some support in locating housing can be incorporated into the application and acceptance process in order to attract a broader demographic pool of students. Additionally, by more actively recruiting beyond communities with an Army site, the program is likely to receive more applications, including more from groups that are historically underrepresented and underserved in STEM fields.

2. In addition, 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. The IPA may wish to revise recruitment and selection practices by, for example, masking applicants' names during application reviews, establishing a selection panel, and instituting other measures to ensure that applicants are selected on the basis of their qualifications and aptitudes rather than on the basis of their relationships to lab personnel.

3. In order to continue to work toward the AEOP goal of broadening the STEM talent pool, the program should continue its work in phasing out the practice of granting apprenticeships to graduate students. Since these individuals already hold a STEM degree, they are existing members of the STEM talent pool and their participation in CQL does not promote the goal of broadening this pool.

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

1. While efforts to recruit mentors were met with success as indicated by the 12% increase in mentor participation from 2014 to 2015, apprentice participation continues to be limited by the number of available mentors. In order to broaden participation and provide more opportunities to qualified candidates, mentor participation must continue to grow. It is notable that even with the increase in mentor participation, CQL failed to meet its program requirement of a one-to-one mentor to apprentice ratio. In order to broaden participation and provide more opportunities to qualified candidates, mentor participation must continue to grow, and the program should ensure that the one-to-one mentor to apprentice ratio is met in order to ensure that each apprentice receives the high quality mentoring the program strives to provide. In order to grow and retain the pool of mentors, the program

may want to consider what incentives it can provide for mentor participation. Such incentives could 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. Questionnaire responses indicated that mentors would welcome more support, both in terms of support and instruction in mentorship and by receiving targeted feedback from apprentice questionnaires. As a result, it may be productive to 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.

2. In order to create a robust pipeline of AEOP programs in which students progress from other AEOP programs into CQL and beyond, the program may want to consider innovative ways to work with other AEOP programs to create a more seamless continuum of programs. Apprentice questionnaire data indicate that most apprentices had not participated in other AEOPs and, in fact, the proportion of CQL participants who were alumni of GEMS and SEAP declined from FY14 to FY15. In addition, CQL mentors and apprentices reported only limited knowledge of AEOP programs other than CQL. Apprentice responses indicating the importance of mentors in learning about other AEOPs attest to the importance of mentors in conveying information to apprentices and efforts should be made to ensure that mentors are informed about the range of AEOPs. Because of the time constraints these mentors face in working with apprentices, however, the program should also consider ways to educate apprentices about AEOP opportunities that do not rely on mentors. For instance, information about AEOPs could be incorporated into orientation materials, provided during the student symposium, and incorporated into alumni communications. 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. Administrative difficulties were noted in both FY14 and FY15 and, while students were positive overall about their CQL experiences, problems with receiving stipends in a timely fashion, lack of computer access, and security clearance issues colored the experience of over a quarter of all apprentices. There is evidence that these issues, particularly the late stipend payments, could impact program goals negatively as some students indicated that these problems served as a disincentive to future participation in CQL. Likewise, some mentors reported expending considerable time in assisting students with remedying pay issues. As the Academy of Applied Science assumes the administration of CQL, it should be mindful of these issues and leverage its past experience with administering

apprenticeship programs to streamline processes and improve communication with apprentices. Some mentors also suggested measures to streamline the recruiting and selection process. These suggestions focused on automating the selection process and reducing the amount of paperwork involved. Other suggestions included beginning the security clearance and computer access processes earlier so that these are complete before the start of the apprenticeship.

2. The continued low response rates for both the student and mentor questionnaires (32% and 10% in FY15) raise 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, the evaluation instruments may need to be streamlined to reduce the time commitment of respondents.

Appendices

Appendix A

FY15 CQL Evaluation Plan

Questionnaires

Purpose:
As per the approved FY15 AEOP APP, the external evaluation of CQL (data collected by VT and analysis by Purdue University) 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 FY15, 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 (VT provided questionnaires for FY15). 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.

Telephone Interviews

Purpose

In lieu of on-site focus groups, Virginia Tech (VT) conducted telephone interviews with CQL mentors and apprentices.

Interviews provide the evaluation team first-hand opportunities to speak with CQL participants. The contextual information gleaned from these interviews help evaluators understand the nuance of the evaluation data collected from questionnaires, adding depth to evaluative findings. VT's interview assessment efforts focused on program successes and attempt to inform useful program changes so that CQL can improve in the future.

Phone Interviews in lieu of Focus Groups

There were eight (8), one-on-one phone interviews conducted with CQL apprentices (approx. 15-20 min. each).

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

FY15 CQL Apprentice Data Summaries

CQL Apprentice Data Summary

So that we can determine how diverse students respond to participation in AEOP programs, please tell us about yourself and your school. What grade will you start in the fall? (select one) (Avg. = 15.57, SD = 1.14)		
	Freq.	**%**
9th	0	0%
10th	0	0%
11th	0	0%
12th	0	0%
College freshman (13)	15	16%
College sophomore (14)	20	22%
College junior (15)	26	28%
College senior (16)	14	15%
Graduate program (17)	13	14%
Other	4	4%
Choose not to report	0	0%
Total	**92**	**100%**

What is your gender?		
	Freq.	**%**
Male	52	57%
Female	40	43%
Choose not to report	0	0%
Total	**92**	**100%**

What is your race or ethnicity?		
	Freq.	**%**
Hispanic or Latino	4	4%
Asian	18	20%
Black or African American	6	7%
Native American or Alaska Native	1	1%
Native Hawaiian or Other Pacific Islander	0	0%
White	60	65%
Other race or ethnicity, (specify)	0	0%

Choose not to report	3	3%
Total	**92**	**100%**

Where was the CQL program located? (Select ONE)

	Freq.	%			Freq.	%
Army Aviation & Missile Research Development and Engineering Center-Redstone Arsenal (Huntsville, AL)	11	5%		**Army Criminal Investigation Command-Defense Forensic Science Center (Forest Park, GA)**	3	1%
Army Center for Environmental Health Research (Fort Detrick, MD)	7	2%		**Engineer Research & Development Center-Construction Engineering Research Laboratory (Champaign, IL)**	7	5%
Army Medical Research Institute of Chemical Defense (Aberdeen, MD)	3	4%		**Engineer Research & Development Center-Topographic Engineering CenterGeospatial Research Laboratory (Alexandria, VA)**	1	0%
Army Medical Research Institute for Infectious Diseases (Fort Detrick, MD)	10	12%		**Engineer Research & Development Center-Mississippi (Vicksburg, MS)**	0	0%
Army Research Laboratory- Aberdeen Proving Ground (Aberdeen, MD)	26	27%		**Walter Reed Army Institute of Research (Silver Spring, MD)**	7	19%
Army Research Laboratory–Adelphi (Adelphi, MD)	30	26%				
				Total	**107**	**100%**

How did you learn about CQL? (Check all that apply) (n = 137)						
	Freq.	%			Freq.	%
Someone who works with the Department of Defense	29	32%		School or university newsletter, email, or website	13	14%
Friend	29	32%		Friend or co-worker of a family member	15	17%
Someone who works at the school or university I attend	24	26%		Army Educational Outreach Program (AEOP) website	7	8%
Someone who works with program	16	18%		Other	4	4%
Past participant of program	17	19%		Community group or program	1	1%
				Total	**155**	**100%**

How motivating were the following factors in your decision to participate in CQL?							
	1	2	3	4	n	Avg.	SD
Teacher or professor encouragement	54 (39%)	21 (15%)	26 (19%)	36 (26%)	137	**2.32**	1.24
An academic requirement or school grade	103 (75%)	10 (7%)	16 (12%)	8 (6%)	137	**1.48**	0.92
Desire to learn something new or interesting	0 (0%)	4 (3%)	29 (21%)	103 (76%)	136	**3.73**	0.51
The program mentor(s)	16 (12%)	24 (18%)	44 (32%)	52 (38%)	136	**2.97**	1.02
Building college application or résumé	7 (5%)	7 (5%)	23 (17%)	100 (73%)	137	**3.58**	0.81
Networking opportunities	4 (3%)	11 (8%)	38 (28%)	84 (61%)	137	**3.47**	0.77
Interest in science, technology, engineering, or mathematics (STEM)	0 (0%)	3 (2%)	23 (17%)	111 (81%)	137	**3.79**	0.46
Interest in STEM careers with the Army	18 (13%)	22 (16%)	42 (31%)	54 (40%)	136	**2.97**	1.05
Having fun	9 (7%)	34 (25%)	51 (37%)	43 (31%)	137	**2.93**	0.91
Earning stipend or award while doing STEM	4 (3%)	15 (11%)	35 (26%)	83 (61%)	137	**3.44**	0.80
Opportunity to do something with friends	83 (61%)	25 (18%)	10 (7%)	19 (14%)	137	**1.74**	1.08
Opportunity to use advanced laboratory technology	10 (7%)	16 (12%)	30 (22%)	81 (59%)	137	**3.33**	0.95
Desire to expand laboratory or research skills	3 (2%)	3 (2%)	20 (15%)	111 (81%)	137	**3.74**	0.61
Learning in ways that are not possible in school	1 (1%)	4 (3%)	22 (16%)	110 (80%)	137	**3.76**	0.54
Serving the community or country	16 (12%)	23 (17%)	48 (35%)	50 (36%)	137	**2.96**	1.00

Parent encouragement	46 (34%)	33 (24%)	28 (20%)	30 (22%)	137	**2.31**	1.15
Exploring a unique work environment	6 (4%)	13 (9%)	46 (34%)	72 (53%)	137	**3.34**	0.83
Other, (specify) [†]	16 (80%)	0 (0%)	2 (10%)	2 (10%)	20	**1.50**	1.05

Note. Response scale: 1 = "Not at all," 2 = "A little," 3 = "Somewhat," 4 = "Very much". Other = "Matches my professional goals".

[†]Other = Get published

How often did you do each of the following in STEM classes at school?								
	1	**2**	**3**	**4**	**5**	**n**	**Avg.**	**SD**
Learn about science, technology, engineering, or mathematics (STEM) topics that are new to you.	1 (1%)	0 (0%)	12 (10%)	51 (41%)	61 (49%)	125	**4.37**	0.72
Apply STEM learning to real-life situations	2 (1%)	6 (5%)	41 (33%)	53 (42%)	23 (18%)	125	**3.71**	0.88
Learn about new discoveries in STEM	0 (0%)	12 (10%)	48 (38%)	43 (34%)	22 (18%)	125	**3.60**	0.89
Learn about different careers that use STEM	6 (5%)	10 (8%)	58 (47%)	36 (29%)	14 (11%)	124	**3.34**	0.95
Interact with scientists or engineers	2 (2%)	15 (12%)	20 (16%)	45 (36%)	42 (34%)	124	**3.89**	1.06
Communicate with other students about STEM	3 (2%)	5 (4%)	15 (12%)	40 (14%)	62 (50%)	125	**4.22**	0.97

Note. Response scale: 1 = "Not at all," 2 = "At least once," 3 = "A few times," 4 = "Most days," 5 = "Every day".

How often did you do each of the following in CQL this year?								
	1	**2**	**3**	**4**	**5**	**n**	**Avg.**	**SD**
Learn about science, technology, engineering, or mathematics (STEM) topics that are new to you.	0 (0%)	0 (0%)	22 (17%)	48 (39%)	54 (44%)	124	**4.26**	0.74
Apply STEM learning to real-life situations	0 (0%)	0 (0%)	15 (12%)	33 (27%)	76 (26%)	124	**4.49**	0.70
Learn about new discoveries in STEM	0 (0%)	4 (3%)	37 (30%)	49 (40%)	34 (27%)	124	**3.91**	0.84
Learn about different careers that use STEM	2 (2%)	6 (5%)	48 (39%)	40 (14%)	27 (22%)	123	**3.68**	0.93
Interact with scientists or engineers	0 (0%)	0 (0%)	8 (6%)	17 (14%)	98(80%)	123	**4.73**	0.57
Communicate with other students about STEM	1 (2%)	11 (9%)	25 (19%)	32 (26%)	54 (44%)	124	**4.01**	0.98

Note. Response scale: 1 = "Not at all," 2 = "At least once," 3 = "A few times," 4 = "Most days," 5 = "Every day".

How often did you do each of the following in STEM classes at school?								
	1	2	3	4	5	n	Avg.	SD
Use laboratory procedures and tools	6 (5%)	7 (6%)	46 (37%)	47 (38%)	19 (15%)	125	**3.53**	0.98
Participate in hands-on STEM activities	4 (3%)	6 (5%)	48 (38%)	48 (38%)	19 (15%)	125	**3.58**	0.92
Work as part of a team	3 (2%)	5 (4%)	43 (34%)	52 (42%)	22 (18%)	125	**3.68**	0.89
Identify questions or problems to investigate	2 (2%)	8 (6.4%)	42 (34%)	51 (41%)	22 (18%)	125	**3.06**	0.90
Design an investigation	3 (2%)	28 (22%)	62 (50%)	22 (18%)	10 (8%)	125	**3.90**	1.09
Carry out an investigation	3 (2%)	25 (20%)	48 (38%)	37 (30%)	12 (10%)	125	**3.24**	0.96
Analyze data or information	0 (0%)	6 (2%)	38 (31%)	56 (45%)	24 (19%)	124	**3.79**	0.81
Draw conclusions from an investigation	0 (0%)	11 (9%)	51 (41%)	43 (34%)	20 (16%)	125	**3.58**	0.86
Come up with creative explanation or solutions	1 (1%)	7 (6%)	57 (46%)	37 (30%)	21 (17%)	123	**3.57**	0.87
Build or make a computer model	29 (23%)	31 (25%)	37 (30%)	17 (14%)	11 (9%)	125	**2.60**	1.23

Note. Response scale: 1 = "Not at all," 2 = "At least once," 3 = "A few times," 4 = "Most days," 5 = "Every day".

How often did you do each of the following in CQL this year?								
	1	2	3	4	5	n	Avg.	SD
Use laboratory procedures and tools	8 (6%)	8 (7%)	10 (16%)	31 (25%)	57 (45%)	124	**3.98**	1.21
Participate in hands-on STEM activities	1 (1%)	1 (1%)	19 (15%)	33 (27%)	69 (56%)	123	**4.37**	0.83
Work as part of a team	5 (4%)	6 (5%)	24 (20%)	30 (25%)	56 (46%)	121	**4.04**	1.11
Identify questions or problems to investigate	2 (2%)	3 (2%)	29 (23%)	347 (38%)	43 (35%)	124	**4.02**	0.91
Design an investigation	13 (9%)	12 (10%)	28 (23%)	44 (36%)	27 (22%)	124	**3.48**	1.23
Carry out an investigation	4 (4%)	9 (7%)	22(18%)	43 (35%)	46 (37%)	124	**3.95**	1.07
Analyze data or information	2(1%)	7 (5%)	23 (19%)	43 (35%)	49 (40%)	124	**4.05**	0.98
Draw conclusions from an investigation	6 (5%)	9 (7%)	22 (18%)	50 (40%)	37 (30%)	124	**3.83**	1.09
Come up with creative explanation or solutions	4 (3%)	7 (6%)	30 (24%)	46 (37%)	36 (29%)	123	**3.84**	1.02
Build or make a computer model	38 (31%)	18 (15%)	21 (17%)	24 (19%)	23 (19%)	124	**2.81**	1.51

Note. Response scale: 1 = "Not at all," 2 = "At least once," 3 = "A few times," 4 = "Most days," 5 = "Every day".

How much did each of the following resources help you learn about Army Educational Outreach Programs (AEOPs)?								
	1	2	3	4	5	n	Avg.	SD
Army Educational Outreach Program (AEOP) website	50 (40%)	7 (6%)	24 (19%)	31 (25%)	12 (10%)	124	**2.58**	1.51
AEOP on Facebook, Twitter, Pinterest, or other social media	90 (73%)	15 (12%)	7 (6%)	7 (6%)	3 (3%)	122	**1.51**	1.01

AEOP brochure	84 (68%)	14 (11%)	8 (7%)	12 (10%)	5 (4%)	123	**1.67**	0.90
It Starts Here! Magazine	101 (82%)	11 (9%)	5 (4%)	4 (3%)	3 (2%)	124	**1.36**	0.69
My CQL mentor(s)	10 (8%)	7 (6%)	24 (20%)	31(25%)	51 (42%)	123	**3.86**	1.25
Invited speakers or "career" events during CQL	54 (44%)	13 (11%)	18 (15%)	25 (20%)	14 (11%)	124	**2.45**	1.50
Participation in CQL	7 (6%)	11 (9%)	12 (10%)	44 (36%)	49 (40%)	124	**3.95**	1.17

Note. Response scale: 1 = "Did Not Experience," 2 = "Not at all," 3 = "A little," 4 = "Somewhat," 5 = "Very much".

How much did each of the following resources help you learn about STEM careers in the Army or Department of Defense (DoD)?								
	1	**2**	**3**	**4**	**5**	**n**	**Avg.**	**SD**
Army Educational Outreach Program (AEOP) website	49 (39%)	16 (13%)	26 (21%)	24 (19%)	8 (8%)	123	**2.40**	1.35
AEOP on Facebook, Twitter, Pinterest, or other social media	86 (68%)	17 (13%)	11 (10%)	8 (8%)	2 (1%)	124	**1.57**	1.01
AEOP brochure	82 (66%)	20 (17%)	10 (9%)	9 (7%)	2 (1%)	123	**0.00**	0.00
It Starts Here! Magazine	94 (76%)	17 (14%)	5 (5%)	4 (3%)	3 (2%)	123	**1.41**	0.90
My CQL mentor(s)	3 (2%)	3 (2%)	17 (13%)	35 (28%)	66 (53%)	124	**4.27**	0.96
Invited speakers or "career" events during CQL	39 (31%)	15 (12%)	15 (12%)	38 (30%)	17 (15%)	124	**2.83**	1.49
Participation in CQL	4 (3%)	5 (4%)	10 (8%)	46 (37%)	59 (48%)	124	**4.22**	0.98

Note. Response scale: 1 = "Did Not Experience," 2 = "Not at all," 3 = "A little," 4 = "Somewhat," 5 = "Very much".

How SATISFIED were you with each of the following CQL program features?								
	1	**2**	**3**	**4**	**5**	**n**	**Avg.**	**SD**
Applying or registering for the program	3 (2%)	10 (8%)	25 (20%)	48 (39%)	37 (30%)	123	**3.86**	1.02
Other administrative tasks (in-processing, network access, etc.)	2 (1%)	25 (20%)	38 (30%)	32 (26%)	26 (21%)	122	**3.45**	1.09
Communications with your CQL host site organizers	13 (10%)	9 (7%)	17 (13%)	41 (33%)	42 (34%)	123	**3.74**	1.30
The physical location(s) of CQL activities	3 (2%)	1 (0%)	13 (10%)	45 (36%)	61 (49%)	122	**4.30**	0.88
The variety of STEM topics available to you in CQL	2 (1%)	1 (0%)	7 (5%)	36 (29%)	76 (62%)	122	**4.50**	0.78
Teaching or mentoring provided during CQL activities	0 (0%)	1 (0%)	9 (7%)	21 (17%)	91 (74%)	122	**4.66**	0.65
Stipends (payment)	1 (0%)	7 (5%)	17 (13%)	31 (25%)	66 (54%)	122	**4.26**	0.96
Research abstract preparation requirements	4 (3%)	2 (1%)	18 (14%)	50 (40%)	49 (39%)	123	**4.12**	0.95
Research presentation process	14 (11%)	1 (0%)	16 (13%)	49 (39%)	43 (35%)	123	**3.86**	1.23

Note. Response scale: 1 = "Did Not Experience," 2 = "Not at all," 3 = "A little," 4 = "Somewhat," 5 = "Very much".

How much input did you have in selecting your CQL research project?		
	Freq.	**%**
I did not have a project	5	4%
I was assigned a project by my mentor	51	42%
I worked with my mentor to design a project	25	20%
I had a choice among various projects suggested by my mentor	15	12%
I worked with my mentor and members of a research team to design a project	24	20%
I designed the entire project on my own	3	2%
Total	**123**	**100%**

How often was your mentor available to you during CQL?		
	Freq.	**%**
I did not have a mentor	0	0%
The mentor was never available	0	0%
The mentor was available less than half of the time	6	5%
The mentor was available about half of the time of my project	6	5%
The mentor was available more than half of the time	35	29%
The mentor was always available	75	61%
Total	122	100%

To what extent did you work as part of a group or team during CQL?		
	Freq.	**%**
I worked alone (or alone with my research mentor)	15	12%
I worked with others in a shared laboratory or other space, but we work on different projects	40	33%
I worked alone on my project and I met with others regularly for general reporting or discussion	19	15%
I worked alone on a project that was closely connected with projects of others in my group	30	24%
I work with a group who all worked on the same project	19	15%
Total	123	100%

How SATISFIED were you with each of the following?								
	1	2	3	4	5	n	Avg.	SD
My working relationship with my mentor	0 (0%)	2 (1%)	2 (1%)	12 (9%)	108 (87%)	**124**	**4.82**	0.53
My working relationship with the group or team	7 (5%)	2 (1%)	4 (3%)	25 (20%)	86 (69%)	**124**	**4.46**	1.05
The amount of time I spent doing meaningful research	0 (0%)	4 (3%)	12 (9%)	34 (27%)	74 (59%)	**124**	**4.44**	0.80
The amount of time I spent with my research mentor	0 (0%)	4 (3%)	5 (4%)	27 (21%)	88 (71%)	**124**	**4.60**	0.72
The research experience overall	0 (0%)	0 (0%)	5 (4%)	31 (25%)	88 (71%)	**124**	**4.67**	0.55

Note. Response scale: 1 = "Did Not Experience," 2 = "Not at all," 3 = "A little," 4 = "Somewhat," 5 = "Very much".

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:					
		Yes – my mentor used this strategy with me		No – my mentor did not use this strategy with me	
	n	Freq.	%	Freq.	%
Helped me become aware of STEM in my everyday life	123	86	69.9%	37	30.1%
Helped me understand how I can use STEM to improve my community	123	67	54.5%	56	45.5%
Used a variety of strategies to help me learn	123	103	83.7%	20	16.3%
Gave me extra support when I needed it	124	118	95.2%	6	4.8%
Encouraged me to exchange ideas with others who have different backgrounds or viewpoints are different than I do	124	96	77.4%	28	22.6%
Allowed me to work on a team project or activity	124	109	87.9%	15	12.1%
Helped me practice a variety of STEM skills	124	117	94.4%	7	5.6%
Gave me feedback to help me improve in STEM	124	114	91.9%	10	8.1%
Talked to me about the education I need for a STEM career	123	97	78.9%	26	21.1%
Recommended Army Educational Outreach Programs that match my interests	122	51	41.8%	71	58.2%
Discussed STEM career opportunities with DoD or government agencies	123	90	73.2%	33	26.8%

Which of the following statements apply to your research experience? (choose all that apply) (n = 117)						
	Freq.	%			Freq.	%
I presented a talk or poster to other students or faculty	77	66.96%		I will present a talk or poster to other students or faculty	36	31.30%
I presented a talk or poster at a professional symposium or conference	30	26.09%		I will present a talk or poster at a professional symposium or conference	19	16.52%
I attended a symposium or conference	42	36.52%		I will attend a symposium or conference	23	20.00%
I wrote or co-wrote a paper that was/will be published in a research journal	16	13.91%		I will write or co-write a paper that was/will be published in a research journal	29	25.22%
I wrote or co-wrote a technical paper or patent	18	15.65%		I will write or co-write a technical paper or patent	16	13.91%
				I won an award or scholarship based on my research	9	7.83%

AS A RESULT OF YOUR CQL EXPERIENCE, how much did you GAIN in the following areas?								
	1	2	3	4	5	n	Avg.	SD
In-depth knowledge of a STEM topic(s)	0 (0%)	7 (5%)	31 (25%)	51 (41%)	35 (28%)	124	**3.92**	0.87
Knowledge of research conducted in a STEM topic or field	0 (0%)	3 (2%)	23 (18%)	59 (47%)	39 (31%)	124	**4.08**	0.77
Knowledge of research processes, ethics, and rules for conduct in STEM	2 (1%)	9 (7%)	39 (31%)	43 (34%)	31 (25%)	124	**3.74**	0.97
Knowledge of how professionals work on real problems in STEM	1 (0%)	4 (3%)	24 (19%)	51 (41%)	44 (35%)	124	**4.07**	0.87
Knowledge of what everyday research work is like in STEM	1 (0%)	4 (3%)	17 (13%)	49 (39%)	53 (42%)	124	**4.20**	0.86

Note. Response scale: 1 = "No gain," 2 = "A little gain," 3 = "Some gain," 4 = "Large gain," 5 = "Extreme gain".

Which category best describes the focus of your CQL experience?		
	Freq.	%
Science	52	42%
Technology	22	18%
Engineering	49	40%
Mathematics	1	1%
Total	**124**	**100%**

As a result of your CQL experience, how much did you GAIN in your ability to do each of the following?								
	1	2	3	4	5	n	Avg.	SD
Asking a question that can be answered with one or more scientific experiments	3 (5%)	4 (7%)	14 (26%)	23 (44%)	8 (15%)	**52**	**3.45**	1.08
Using knowledge and creativity to suggest a testable explanation (hypothesis) for an observation	4 (7%)	2 (3%)	18 (34%)	18 (34%)	10 (19%)	**52**	**3.45**	1.11
Making a model of an object or system showing its parts and how they work	15 (28%)	5 (9%)	12 (23%)	12 (23%)	8 (15%)	**52**	**2.87**	1.38
Designing procedures for an experiment that are appropriate for the question to be answered	4 (7%)	6 (11%)	12 (23%)	21 (40%)	9 (17%)	**52**	**3.37**	1.22
Identifying the limitations of the methods and tools used for data collection	3 (5%)	4 (7%)	8 (15%)	24 (46%)	13 (25%)	**52**	**3.76**	1.08
Carrying out procedures for an experiment and recording data accurately	3 (5%)	2 (3%)	12 (23%)	17 (33%)	17 (33%)	51	**3.86**	1.11
Using computer models of objects or systems to test cause and effect relationships	22 (42%)	7 (13%)	9 (17%)	6 (11%)	8 (15%)	**52**	**2.55**	1.50
Organizing data in charts or graphs to find patterns and relationships	8 (15%)	7 (13%)	12 (23%)	15 (28%)	10 (19%)	**52**	**3.16**	1.35
Considering different interpretations of data when how the data answer a question	9 (17%)	4 (7%)	8 (15%)	19 (36%)	12 (23%)	**52**	**3.39**	1.42
Supporting an explanation for an observation with data from experiments	2 (3%)	6 (11%)	12 (23%)	18 (34%)	14 (26%)	**52**	**3.42**	1.33
Supporting an explanation with relevant scientific, mathematical, and/or engineering knowledge	6 (11%)	7 (13%)	9 (17%)	19 (36%)	11 (21%)	**52**	**3.71**	1.04
Identifying the strengths and limitations of explanations in terms of how well they describe or predict observations	7 (13%)	8 (15%)	9 (17%)	18 (34%)	10 (19%)	**52**	**3.47**	1.27
Defending an argument that conveys how an explanation best describes an observation	7 (13%)	5 (9%)	6 (11%)	22 (42%)	12 (23%)	**52**	**3.34**	1.38
Identifying the strengths and limitation of data, interpretations, or arguments presented in technical or scientific texts	5 (9%)	6 (11%)	10 (19%)	17 (32%)	14 (26%)	**52**	**3.47**	1.39

Integrating information from technical or scientific texts and other media to support your explanations of phenomena	3 (5%)	5 (9%)	14 (26%)	15 (28%)	15 (28%)	**52**	**3.50**	1.31
Communicating about your experiments and explanations in different ways (through talking, writing, graphics, or mathematics)	3 (5%)	4 (7%)	14 (26%)	23 (44%)	8 (15%)	**52**	**3.45**	1.08

Note. Response scale: 1 = "No gain," 2 = "A little gain," 3 = "Some gain," 4 = "Large gain," 5 = "Extreme gain".

As a result of your CQL EXPERIENCE, how much did you GAIN in your ability to do each of the following?								
	1	**2**	**3**	**4**	**5**	**n**	**Avg.**	**SD**
Defining a problem that can be solved by developing a new or improved object, process, or system	4 (5%)	3 (4%)	21 (29%)	24 (33%)	20 (27%)	72	**3.74**	1.09
Using knowledge and creativity to propose a testable solution for a problem	1 (1%)	7 (9%)	17 (23%)	29 (40%)	17 (23%)	71	**3.76**	0.98
Making a model of an object or system to show its parts and how they work	9 (12%)	15 (20%)	15 (20%)	15 (20%)	18 (25%)	72	**3.25**	1.37
Designing procedures for an experiment that are appropriate for the question to be answered	6 (8%)	11 (15%)	20 (27%)	22 (30%)	13 (18%)	72	**3.35**	1.19
Identifying the limitations of the methods and tools used for data collection	3 (4%)	5 (6%)	18 (25%)	28 (38%)	18 (25%)	72	**3.74**	1.05
Carrying out procedures for an experiment and recording data accurately	6 (8%)	7 (9%)	19 (26%)	22 (30%)	18 (25%)	72	**3.54**	1.21
Using computer models of an object or system to investigate cause and effect relationships	13 (18%)	9 (12%)	14 (19%)	20 (27%)	16 (22%)	72	**3.24**	1.41
Considering different interpretations of the data when deciding if a solution works as intended	5 (6%)	6 (8%)	23 (31%)	24 (33%)	14 (19%)	72	**3.50**	1.11
Organizing data in charts or graphs to find patterns and relationships	7 (9%)	9 (12%)	19 (26%)	19 (26%)	18 (25%)	72	**3.44**	1.27
Supporting a solution for a problem with data from experiments	5 (6%)	8 (11%)	23 (31%)	21 (29%)	15 (20%)	72	**3.46**	1.15

Supporting a solution with relevant scientific, mathematical, and/or engineering knowledge	3 (4%)	7 (9%)	21 (29%)	24 (33%)	17 (23%)	72	**3.63**	1.08
Identifying the strengths and limitations of solutions in terms of how well they meet design criteria	6 (8%)	9 (12%)	23 (31%)	20 (27%)	14 (19%)	72	**3.38**	1.18
Defend an argument that conveys how a solution best meets design criteria	6 (8%)	10 (13%)	23 (31%)	20 (27%)	13 (18%)	72	**3.33**	1.17
Identifying the strengths and limitations of data, interpretations, or arguments presented in technical or scientific texts	7 (9%)	8 (11%)	21 (29%)	22 (30%)	14 (19%)	72	**3.39**	1.21
Integrating information from technical or scientific texts and other media to support your solution to a problem	5 (6%)	7 (9%)	18 (25%)	23 (31%)	19 (26%)	72	**3.61**	1.18
Communicating information about your design experiments and solutions in different formats (through talking, writing, graphics, or math equations)	4 (5%)	3 (4%)	21 (29%)	24 (33%)	20 (27%)	72	**3.78**	1.12

Note. **Response scale:** 1 = **"No gain,"** 2 = **"A little gain,"** 3 = **"Some gain,"** 4 = **"Large gain,"** 5 = **"Extreme gain".**

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

	1	2	3	4	5	n	Avg.	SD
Learning to work independently	4 (3%)	6 (4%)	27 (22%)	46 (37%)	40 (32%)	123	**3.91**	1.02
Setting goals and reflecting on performance	5 (4%)	13 (10%)	31 (25%)	47 (38%)	27 (22%)	123	**3.63**	1.07
Sticking with a task until it is finished	4 (3%)	5 (4%)	28 (23%)	49 (40%)	36 (29%)	122	**3.89**	0.99
Making changes when things do not go as planned	1 (0%)	6 (4%)	22 (17%)	44 (35%)	50 (40%)	123	**4.11**	0.92
Working well with people from all backgrounds	6 (4%)	11 (8%)	28 (22%)	39 (31%)	39 (31%)	123	**3.76**	1.14
Including others' perspectives when making decisions	7 (5%)	8 (6%)	34 (28%)	39 (32%)	32 (26%)	120	**3.68**	1.12
Communicating effectively with others	2 (1%)	5 (4%)	31 (25%)	51 (41%)	34 (27%)	123	**3.89**	0.91
Viewing failure as an opportunity to learn	4 (3%)	5 (4%)	30 (24%)	45 (37%)	37 (30%)	121	**3.88**	1.00

Note. Response scale: 1 = "No gain," 2 = "A little gain," 3 = "Some gain," 4 = "Large gain," 5 = "Extreme gain".

As a result of your CQL experience, how much did you GAIN in the following areas?								
	1	2	3	4	5	n	Avg.	SD
Interest in a new STEM topic	8 (6%)	10 (8%)	31 (25%)	39 (31%)	35 (28%)	123	**3.67**	1.16
Deciding on a path to pursue a STEM career	8 (6%)	9 (7%)	41 (33%)	29 (23%)	36 (29%)	123	**3.62**	1.17
Sense of accomplishing something in STEM	6 (4%)	4 (3%)	26 (21%)	46 (37%)	41 (33%)	123	**3.91**	1.06
Feeling prepared for more challenging STEM activities	4 (3%)	9 (7%)	24 (19%)	43 (35%)	42 (34%)	122	**3.90**	1.06
Confidence to try out new ideas or procedures on my own in a STEM project	6 (4%)	11 (8%)	27 (22%)	41 (33%)	38 (30%)	123	**3.76**	1.13
Patience for the slow pace of STEM research	9 (7%)	8 (6%)	32 (26%)	45 (36%)	29 (23%)	123	**3.63**	1.13
Desire to build relationships with mentors who work in STEM	2 (1%)	6 (4%)	21 (17%)	48 (39%)	46 (37%)	123	**4.06**	0.94
Connecting a STEM topic or field to my personal values	9 (7%)	12 (9%)	33 (26%)	37 (30%)	32 (26%)	123	**3.58**	1.19

Note. Response scale: 1 = "No gain," 2 = "A little gain," 3 = "Some gain," 4 = "Large gain," 5 = "Extreme gain".

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?								
	1	2	3	4	5	n	Avg.	SD
Watch or read non-fiction STEM	0 (0%)	1 (0%)	67 (54%)	40 (32%)	15 (12%)	123	**3.56**	0.71
Tinker (play) with a mechanical or electrical device	0 (0%)	1 (0%)	63 (51%)	41 (33%)	17 (13%)	122	**3.61**	0.73
Work on solving mathematical or scientific puzzles	0 (0%)	1 (0%)	60 (48%)	53 (43%)	9 (7%)	123	**3.57**	0.64
Use a computer to design or program something	0 (0%)	2 (1%)	54 (43%)	41 (33%)	26 (21%)	123	**3.74**	0.81
Talk with friends or family about STEM	0 (0%)	1 (0%)	36 (29%)	60 (49%)	25 (20%)	122	**3.89**	0.73
Mentor or teach other students about STEM	0 (0%)	0 (0%)	41 (33%)	51 (41%)	31 (25%)	123	**3.92**	0.76
Help with a community service project that relates to STEM	0 (0%)	0 (0%)	54 (44%)	47 (38%)	21 (17%)	122	**3.73**	0.74
Participate in a STEM camp, club, or competition	0 (0%)	2 (1%)	61 (49%)	42 (34%)	18 (14%)	123	**3.62**	0.75
Take an elective (not required) STEM class	0 (0%)	0 (0%)	50 (40%)	51 (41%)	22 (17%)	123	**3.77**	0.73
Work on a STEM project or experiment in a university or professional setting	0 (0%)	1 (0%)	33 (27%)	54 (44%)	34 (27%)	122	**3.99**	0.77

Note. Response scale: 1 = "Much less likely," 2 = "Less likely," 3 = "About the same before and after," 4 = "More likely," 5 = "Much more likely".

Before you participated in CQL, how far did you want to go in school?		
	Freq.	**%**
Go to a trade or vocational school	0	0%
Go to college for a little while	6	5%
Finish college (get a Bachelor's degree)	28	23%
Get more education after college	14	11%
Get a master's degree	34	28%
Get a Ph.D.	33	27%
Get a medical-related degree (M.D.), veterinary degree (D.V.M), or dental degree (D.D.S)	6	5%
Get a combined M.D. / Ph.D.	1	1%
Get another professional degree (law, business, etc.)	0	0%
Total	**122**	**100%**

After you participated in CQL, how far do you want to go in school?		
	Freq.	**%**
Go to a trade or vocational school	0	0%
Go to college for a little while	2	2%
Finish college (get a Bachelor's degree)	11	9%
Get more education after college	8	7%
Get a master's degree	46	38%
Get a Ph.D.	44	36%
Get a medical-related degree (M.D.), veterinary degree (D.V.M), or dental degree (D.D.S)	5	4%
Get a combined M.D. / Ph.D.	6	5%
Get another professional degree (law, business, etc.)	0	0%
Total	**122**	**100%**

When you are 30, to what extent do you expect to use your STEM knowledge, skills, and/or abilities in your job?		
	Freq.	**%**
not at all	1	1%
less than 25% of the time	5	4%
26% to 50% of the time	10	8%
51% to 75% of the time	41	34%

76% to 100% of the time	64	53%
Total	**121**	**100%**

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

	Freq.	%		Freq.	%
Undecided	6	5%	**Health (nursing, pharmacy, technician, etc.)**	2	2%
Science (no specific subject)	3	2%	**Social science (psychologist, sociologist, etc.)**	5	4%
Physical science (physics, chemistry, astronomy, materials science, etc.)	6	5%	**Teaching, STEM**	1	1%
Biological science	16	13%	**Teaching, non-STEM**	0	0%
Earth, atmospheric or oceanic science	1	1%	**Business**	2	2%
Environmental science	2	2%	**Law**	0	0%
Computer science	9	7%	**Military, police, or security**	1	1%
Technology	5	4%	**Art (writing, dancing, painting, etc.)**	0	0%
Engineering	53	43%	**Skilled trade (carpenter, electrician, plumber, etc.)**	0	0%
Mathematics or statistics	0	0%	**Other, (specify)** †	3	2%
Medicine (doctor, dentist, veterinarian, etc.)	8	7%	**Total**	**123**	**100%**

†Other = Linguistics, Forensic biochemistry, Entrepreneurship

After you participated in CQL, what kind of work do you want to do when you are 30 (select one)?						
	Freq.	%			Freq.	%
Undecided	3	2.44%		Health (nursing, pharmacy, technician, etc.)	2	1.63%
Science (no specific subject)	1	0.81%		Social science (psychologist, sociologist, etc.)	5	4.07%
Physical science (physics, chemistry, astronomy, materials science, etc.)	8	6.50%		Teaching, STEM	3	2.44%
Biological science	17	13.82%		Teaching, non-STEM	0	0.00%
Earth, atmospheric or oceanic science	1	0.81%		Business	3	2.44%
Environmental science	1	0.81%		Law	0	0.00%
Computer science	11	8.94%		Military, police, or security	1	0.81%
Technology	7	5.69%		Art (writing, dancing, painting, etc.)	0	0.00%
Engineering	48	39.02%		Skilled trade (carpenter, electrician, plumber, etc.)	0	0.00%
Mathematics or statistics	1	0.81%		Other, (specify) †	3	2.44%
Medicine (doctor, dentist, veterinarian, etc.)	8	6.50%		Total	123	100.00%

† Other = Computation, Forensic biochemistry, Entrepreneurship

How interested are you in participating in the following programs in the future?								
	1	2	3	4	5	n	Avg.	SD
College Qualified Leaders (CQL)	2 (1%)	8 (6%)	14 (11%)	31 (25%)	67 (54%)	122	**4.25**	1.01
GEMS Near Peers	45 (37%)	30 (25%)	16 (13%)	20 (16%)	9 (7%)	120	**2.32**	1.33
Undergraduate Research Apprenticeship Program (URAP)	60 (50%)	17 (14%)	12 (10%)	14 (11%)	15 (12%)	118	**2.21**	1.48
Science Mathematics, and Research for Transformation (SMART) College Scholarship	32 (26%)	9 (7%)	15 (12%)	25 (20%)	39 (32%)	120	**3.25**	1.62
National Defense Science & Engineering Graduate (NDSEG) Fellowship	47 (39%)	3 (2%)	13 (10%)	21 (17%)	35 (29%)	119	**2.95**	1.73

Note. Response scale: 1 = "Never heard of program", 2 = "Not at all," 3 = "A little," 4 = "Somewhat," 5 = "Very much".

How many jobs/careers in STEM did you learn about during CQL?		
	Freq.	%
None	3	2%
1	14	11%

2	25	20%
3	21	17%
4	5	4%
5 or more	54	44%
Total	**122**	**100%**

How many Army or Department of Defense (DoD) STEM jobs/careers did you learn about during CQL?		
	Freq.	**%**
None	9	7%
1	15	12%
2	24	20%
3	20	17%
4	8	7%
5 or more	45	37%
Total	**121**	**100%**

How much do you agree or disagree with the following statements about Department of Defense (DoD) researchers and research:								
	1	2	3	4	5	n	Avg.	SD
DoD researchers advance science and engineering fields	0 (0%)	0 (0%)	2 (1%)	59 (48%)	60 (49%)	121	**4.48**	0.53
DoD researchers develop new, cutting edge technologies	0 (0%)	0 (0%)	6 (5%)	55 (45%)	60 (49%)	121	**4.45**	0.59
DoD researchers solve real-world problems	0 (0%)	2 (1%)	6 (5%)	49 (40%)	64 (52%)	121	**4.45**	0.67
DoD research is valuable to society	0 (0%)	1 (0%)	7 (5%)	50 (41%)	63 (52%)	121	**4.45**	0.64

Note. Response scale: 1 = "Strongly Disagree," 2 = "Disagree," 3 = "Neither Agree nor Disagree," 4 = "Agree," 5 = "Strongly Agree".

Which of the following statements describe you after participating in the CQL program?							
	1	2	3	4	n	Avg.	SD
I am more confident in my STEM knowledge, skills, and abilities	3 (2%)	7 (5%)	86 (70%)	26 (21%)	122	**3.11**	0.60
I am more interested in participating in STEM activities outside of school requirements	7 (5%)	22 (18%)	70 (57%)	23 (18%)	122	**2.89**	0.77
I am more aware of other AEOPs	31 (25%)	7 (5%)	55 (45%)	29 (23%)	122	**2.67**	1.10
I am more interested in participating in other AEOPs	24 (20%)	9 (7%)	60 (50%)	27 (22%)	120	**2.75**	1.02
I am more interested in taking STEM classes in school	13 (10%)	41 (33%)	54 (44%)	14 (11%)	122	**2.57**	0.83
I am more interested in earning a STEM degree	11 (9%)	42 (34%)	53 (43%)	15 (12%)	121	**2.60**	0.82
I am more interested in pursuing a career in STEM	7 (5%)	36 (29%)	61 (50%)	18 (14%)	122	**2.74**	0.78
I am more aware of DoD STEM research and careers	3 (2%)	5 (4%)	72 (59%)	42 (34%)	122	**3.25**	0.65
I have a greater appreciation of Army or DoD STEM research	4 (3%)	6 (5%)	66 (54%)	45 (37%)	121	**3.26**	0.70
I am more interested in pursuing a STEM career with the Army or DoD	16 (13%)	10 (8%)	65 (53%)	30 (24%)	121	**2.90**	0.93

Note. Response scale: **1** = "Disagree – This did not happen," **2** = "Disagree – This happened but not because of CQL," **3** = "Agree – CQL contributed," **4** = "Agree – CQL was the primary reason".

Appendix C

FY15 CQL Mentor Data Summaries

CQL Mentor Data Summary

What is your gender?		
	Freq.	**%**
Male	11	29%
Female	27	71%
Choose not to report	0	0%
Total	**38**	**100%**

What is your race or ethnicity?		
	Freq.	**%**
Asian	3	16%
Black or African American	0	0%
Hispanic or Latino	1	5%
Native American or Alaska Native	0	0%
Native Hawaiian or Other Pacific Islander	0	0%
White	14	74%
Other race or ethnicity, (specify)	0	0%
Choose not to report	1	5%
Total	**19**	**100%**

Which of the following BEST describes the organization you work for? (select ONE)		
	Freq.	**%**
No organization	0	0%
School or district (K-12)	0	0%
State educational agency	0	0%
Institution of higher education (vocational school, junior college, college, or university)	0	0%
Industry	0	0%
Department of Defense or other government agency	36	97%
Non-profit	1	3%
Other, (specify)	0	0%
Total	**37**	**100%**

Which of the following BEST describes your current occupation? (select ONE)		
	Freq.	%
Teacher	0	0%
Other school staff	0	0%
University educator	0	0%
Scientist, Engineer, or Mathematician in training (undergraduate or graduate student, etc.)	1	3%
Scientist, Engineer, or Mathematics professional	34	90%
Other, (specify):	3	8%
Total	38	100%

†Other = Outreach Program Coordinator; Animal Model Specialist; NRC Fellow

Which of the following best describes your primary area of research?						
	Freq.	%			Freq.	%
Physical science (physics, chemistry, astronomy, materials science)	1	3%		Technology	1	3%
Biological science	17	45%		Engineering	7	18%
Earth, atmospheric, or oceanic science	0	0%		Mathematics or statistics	1	3%
Agricultural science	0	0%		Medical, health, or behavioral science	3	8%
Environmental science	3	8%		Social science (psychology, sociology, anthropology, etc.)	0	0%
Computer science	3	8%		Other, (specify)	2	5%
				Total	38	100%

†Other = No research; Forensic science

At which of the following CQL sites did you participate? (Select ONE)						
	Freq.	%			Freq.	%
ALABAMA – U.S. Army Aviation & Missile Research, Development & Engineering Center (AMRDEC) – Redstone, AL	7	18%		MARYLAND – U.S. Army Medical Research and Materiel Command - Walter Reed Army Institute of Research (WRAIR) - Silver Spring, MD	11	29%
GEORGIA – U.S. Army Criminal Investigation Command – Defense Forensic Science Center (DFSC) – Forest Park, GA	2	5%		MARYLAND – U.S. Army Research Laboratory (ARL) – Aberdeen Proving Ground, MD	4	11%

ILLINOIS – U.S. Army Engineer Research & Development Center-Construction Engineering Research Laboratory (ERDC-CERL) - Champaign, IL	1	3%		**MARYLAND – U.S. Army Research Laboratory (ARL) – Adelphi, MD**	2	5%
MARYLAND – U.S. Army Medical Research Institute of Chemical Defense (USAMRICD) – Aberdeen Proving Ground/Edgewood, MD	1	3%		**MISSISSIPI - U.S. ARMY Engineer Research & Development Center (ERDC) - Vicksburg, MS**	1	3%
MARYLAND – U.S. Army Medical Research Institute for Environmental Health Research (USACEHR) – Fort Detrick, MD	1	3%		**VIRGINIA – U.S. Army Engineer Research & Development Center – Geospatial Research Laboratory (ERDC-GRL) – Alexandria, VA**	2	5%
MARYLAND – U.S. Army Medical Research Institute of Infectious Diseases (USAMRIID) – Fort Detrick, MD	6	16%				
				Total	**38**	**100%**

Which of the following BEST describes your role during CQL?		
	Freq.	**%**
Research Mentor	34	89%
Research Team Member but not a Principal Investigator (PI)	2	5%
Other, (specify) †	2	5%
Total	**38**	**100%**

†Other = Outreach Program Coordinator; Site Coordinator

How many CQL students did you work with this year?		
# of Students	**Freq.**	**%**
1	22	61%
2	7	19%
3	1	3%
4	1	3%
5	1	3%
6	1	3%
7	1	3%
8	1	3%
9	1	3%
10	0	0%
Total	**36**	**100%**

How did you learn about CQL? (Check all that apply)						
	Freq.	**%**			**Freq.**	**%**
Army Educational Outreach Program (AEOP) website	7	19%		**A colleague**	10	27%
AEOP on Facebook, Twitter, Pinterest, or other social media	0	0%		**My supervisor or superior**	6	16%
A STEM conference or STEM education conference	0	0%		**A CQL site host or director**	1	3%
An email or newsletter from a school, university, or a professional organization	3	8%		**Workplace communications**	12	32%
A news story or other media coverage	8	22%		**Someone who works with the Department of Defense**	6	16%
Past CQL participant	1	3%		**Other, (specify)** †	2	5%
A student	3	8%				
				Total	**37**	**100**

†Other: Dr. Deb Yourick; Past participation in SEAP

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."								
	0	**1**	**2**	**3**	**4**	**n**	**Avg.**	**SD**
Camp Invention	17 (45%)	0 (0%)	0 (0%)	1 (2%)	19 (51%)	37	**3.14**	2.00
eCYBERMISSION	20 (54%)	1 (2%)	2 (5%)	1 (2%)	13 (35%)	37	**2.62**	1.89
Junior Solar Sprint (JSS)	18 (50%)	0 (0%)	0 (0%)	0 (0%)	18 (50%)	36	**3.00**	2.03
West Point Bridge Design Contest (WPBDC)	18 (48%)	0 (0%)	0 (0%)	0 (0%)	19 (51%)	37	**3.05**	2.03
Junior Science & Humanities Symposium (JSHS)	17 (47%)	1 (2%)	1 (2%)	1 (2%)	16 (44%)	36	**2.94**	1.96
Gains in the Education of Mathematics and Science (GEMS)	28 (73%)	0 (0%)	0 (0%)	5 (13%)	5 (13%)	38	**1.92**	1.58
GEMS Near Peers	26 (72%)	2 (5%)	0 (0%)	2 (5%)	6 (16%)	36	**1.89**	1.58
UNITE	20 (54%)	0 (0%)	0 (0%)	0 (0%)	17 (45%)	37	**2.84**	2.02
Science & Engineering Apprenticeship Program (SEAP)	20 (52%)	3 (7%)	1 (2%)	10 (26%)	4 (10%)	37	**2.34**	1.58
Research & Engineering Apprenticeship Program (REAP)	24 (64%)	0 (0%)	0 (0%)	0 (0%)	13 (35%)	37	**2.41**	1.94
High School Apprenticeship Program (HSAP)	21 (56%)	0 (0%)	0 (0%)	1 (2%)	15 (40%)	37	**2.70**	1.98
College Qualified Leaders (CQL)	10 (27%)	10 (27%)	4 (10%)	12 (32%)	1 (2%)	37	**2.57**	1.28
Undergraduate Research Apprenticeship Program (URAP)	21 (56%)	0 (0%)	0 (0%)	0 (0%)	16 (43%)	37	**2.73**	2.01
Science Mathematics, and Research for Transformation (SMART) College Scholarship	21 (56%)	2 (5%)	2 (5%)	3 (8%)	9 (24%)	37	**2.38**	1.75
National Defense Science & Engineering Graduate (NDSEG) Fellowship	22 (61%)	1 (2%)	0 (0%)	0 (0%)	13 (36%)	36	**2.47**	1.93

Note. Response scale: **0** = “Never heard of it,” **1** = “Never,” **2** = “Once,” **3**= “Twice,” **4** = “Three or more times”.

Which of the following were used for the purpose of recruiting your student(s) for apprenticeships? (select ALL that apply)						
	Freq.	**%**			**Freq.**	**%**
Applications from American Society for Engineering Education (ASEE) or the AEOP	5	14%		**Communication(s) generated by a university or faculty (newsletter, email blast, website)**	2	5%
Personal acquaintance(s) (friend, family, neighbor, etc.)	9	24%		**STEM or STEM education conference(s) or event(s)**	1	3%
Colleague(s) in my workplace	15	41%		**Organization(s) serving underserved or underrepresented populations**	1	3%
K-12 school teacher(s) outside of my workplace	2	5%		**The student contacted me (the mentor) about the program**	10	27%
University faculty outside of my workplace	9	24%		**I do not know how student(s) were recruited for CQL**	9	24%
Informational materials sent to K-12 schools or Universities outside of my workplace	1	3%		**Other, Specify**[†]	2	5%
Communication(s) generated by a K-12 school or teacher (newsletter, email blast, website)	0	0%				
				Total	**37**	**100%**

[†] Other = Chief Scientist; I personally recruited this student via a connection at my undergraduate institution.

How SATISFIED were you with each of the following CQL program features?								
	0	**1**	**2**	**3**	**4**	**n**	**Avg.**	**SD**
Application or registration process	13 (35%)	2 (5%)	2 (5%)	7 (18%)	13 (35%)	37	**3.14**	1.77
Other administrative tasks (in-processing, network access, etc.)	10 (27%)	2 (5%)	5 (13%)	9 (24%)	11 (29%)	37	**3.24**	1.61
Communications with American Society for Engineering Education	25 (69%)	0 (0%)	1 (2%)	5 (13%)	5 (13%)	36	**2.03**	1.61
Communications with CQL organizers	8 (21%)	1 (2%)	5 (13%)	11 (29%)	12 (32%)	37	**3.49**	1.52
Support for instruction or mentorship during program activities	10 (27%)	1 (2%)	2 (5%)	11 (29%)	13 (35%)	37	**3.43**	1.64
Stipends (payment)	12 (32%)	3 (8%)	2 (5%)	6 (16%)	14 (37%)	37	**3.19**	1.76
Research abstract preparation requirements	3 (8%)	2 (5%)	2 (5%)	16 (44%)	13 (36%)	36	**3.94**	1.19
Research presentation process	7 (18%)	3 (8%)	4 (10%)	11 (29%)	12 (32%)	37	**3.49**	1.50

Note. Response scale: **0** = "Did Not Experience," **1** = "Not at all," **2** = "A little," **3** = "Somewhat," **4** = "Very much".

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.					
		Yes – I used this strategy		No – I did not use this strategy	
	n	Freq.	%	Freq.	%
Becoming familiar with students' backgrounds and interests at the beginning of the CQL experience	37	32	32 (86%)	5	5 (13%)
Giving students real-life problems to investigate or solve	37	35	35 (94%)	2	2 (5%)
Selecting readings or activities that relate to students' backgrounds	36	24	24 (66%)	12	12 (33%)
Encouraging students to suggest new readings, activities, or projects	37	29	29 (78%)	8	8 (21%)
Helping students become aware of the roles STEM plays in their everyday lives	37	26	26 (70%)	11	11 (29%)
Helping students understand how STEM can help them improve their communities	37	18	18 (48%)	19	19 (51%)
Asking students to relate real-life events or activities to topics covered in CQL	37	23	23 (62%)	14	14 (37%)

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.					
		Yes – I used this strategy		No – I did not use this strategy	
	n	Freq.	%	Freq.	%
Identify the different learning styles that my student(s) may have at the beginning of the CQL experience	37	29	78%	8	22%
Interact with all students and other personnel in the same way regardless of their background	37	32	87%	5	14%
Use a variety of teaching and/or mentoring activities to meet the needs of all students	37	31	84%	6	16%
Integrating ideas from education literature to teach/mentor students from groups underrepresented in STEM	37	16	43%	21	57%
Providing extra readings, activities, or learning support for students who lack essential background knowledge or skills	37	28	76%	9	24%
Directing students to other individuals or programs for additional support as needed	37	28	76%	9	24%
Highlighting under-representation of women and racial and ethnic minority populations in STEM and/or their contributions in STEM	37	16	43%	21	57%

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.

		Yes – I used this strategy		No – I did not use this strategy	
	n	Freq.	%	Freq.	%
Having my student(s) tell other people about their backgrounds and interests	37	30	81%	7	19%
Having my student(s) explain difficult ideas to others	37	31	84%	6	16%
Having my student(s) listen to the ideas of others with an open mind	37	35	95%	2	5%
Having my student(s) exchange ideas with others whose backgrounds or viewpoints are different from their own	37	29	78%	8	22%
Having my student(s) give and receive constructive feedback with others	37	32	87%	5	14%
Having my student(s) work on collaborative activities or projects as a member of a team	37	33	89%	4	11%
Allowing my student(s) to resolve conflicts and reach agreement within their team	37	27	73%	10	27%

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.

		Yes – I used this strategy		No – I did not use this strategy	
	n	Freq.	%	Freq.	%
Teaching (or assigning readings) about specific STEM subject matter	37	24	65%	13	35%
Having my student(s) search and review technical research to support their work	37	31	84%	6	16%
Demonstrating laboratory/field techniques, procedures, and tools for my student(s)	37	35	95%	2	5%
Supervising my student(s) while they practice STEM research skills	37	29	78%	8	22%
Providing my student(s) with constructive feedback to improve their STEM competencies	36	34	94%	2	6%
Allowing students to work independently to improve their self-management abilities	37	34	92%	3	8%
Encouraging students to learn collaboratively (team projects, team meetings, journal clubs, etc.)	37	33	89%	4	11%

Encouraging students to seek support from other team members	37	33	89%	4	11%

The list below 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 the list below, please indicate which strategies you used when working with your student(s) in CQL.

		Yes – I used this strategy		No – I did not use this strategy	
	n	**Freq.**	**%**	**Freq.**	**%**
Asking my student(s) about their educational and/or career interests	37	36	97%	1	3%
Recommending extracurricular programs that align with students' educational goals	37	24	65%	13	35%
Recommending Army Educational Outreach Programs that align with students' goals	37	18	49%	19	51%
Discussing STEM career opportunities with the DoD or other government agencies	37	29	78%	8	22%
Discussing STEM career opportunities in private industry or academia	37	28	76%	9	24%
Discussing the economic, political, ethical, and/or social context of a STEM career	37	23	62%	14	38%
Recommending student and professional organizations in STEM to my student(s)	36	17	46%	20	54%
Helping students build a professional network in a STEM field	36	19	53%	17	47%
Helping my student(s) with their résumé, application, personal statement, or interview preparations	37	29	81%	7	19%

How USEFUL were each of the following in your efforts to expose student(s) to Army Educational Outreach Programs (AEOPs) during CQL?								
	0	**1**	**2**	**3**	**4**	**n**	**Avg.**	**SD**
Army Educational Outreach Program (AEOP) website	21 (56%)	1 (2%)	4 (10%)	5 (13%)	6 (16%)	37	**2.30**	1.63
AEOP on Facebook, Twitter, Pinterest, or other social media	29 (80%)	3 (8%)	0 (0%)	3 (8%)	1 (2%)	36	**1.44**	1.05
AEOP brochure	25 (69%)	3 (8%)	1 (2%)	5 (13%)	2 (5%)	36	**1.78**	1.33
It Starts Here! magazine	30 (83%)	4 (11%)	0 (0%)	1 (2%)	1 (2%)	36	**1.31**	0.86
CQL program administrator or site coordinator	7 (18%)	2 (5%)	6 (16%)	7 (18%)	15 (40%)	37	**3.57**	1.54
Invited speakers or "career" events	23 (65%)	2 (5%)	2 (5%)	3 (8%)	5 (14%)	35	**2.00**	1.55
Participation in CQL	6 (16%)	3 (8%)	1 (2%)	10 (27%)	17 (45%)	37	**3.78**	1.51

Note. Response scale: **0** = "Did Not Experience," **1** = "Not at all," **2** = "A little," **3** = "Somewhat," **4** = "Very much".

How USEFUL were each of the following in your efforts to expose your student(s) to Department of Defense (DoD) STEM careers during CQL?								
	0	**1**	**2**	**3**	**4**	**n**	**Avg.**	**SD**
Army Educational Outreach Program (AEOP) website	23 (62%)	1 (2%)	1 (2%)	6 (16%)	6 (16%)	37	**2.22**	1.67
AEOP on Facebook, Twitter, Pinterest, or other social media	30 (83%)	2 (5%)	0 (0%)	3 (8%)	1 (2%)	36	**1.42**	1.05
AEOP brochure	26 (72%)	3 (8%)	2 (5%)	2 (5%)	3 (8%)	36	**1.69**	1.31
It Starts Here! magazine	29 (82%)	4 (11%)	0 (0%)	2 (5%)	0 (0%)	35	**1.29**	0.75
CQL program administrator or site coordinator	13 (35%)	2 (5%)	4 (10%)	7 (18%)	11 (29%)	37	**3.03**	1.71
Invited speakers or "career" events	21 (56%)	3 (8%)	4 (10%)	2 (5%)	7 (18%)	37	**2.22**	1.62
Participation in CQL	7 (18%)	3 (8%)	1 (2%)	9 (24%)	17 (45%)	37	**3.70**	1.58

Note. Response scale: **0** = "Did Not Experience," **1** = "Not at all," **2** = "A little," **3** = "Somewhat," **4** = "Very much".

Which of the following AEOPs did you EXPLICITLY DISCUSS with your student(s) during CQL?					
		Yes - I discussed this program with my student(s)		No - I did not discuss this program with my student(s)	
	n	Freq.	%	Freq.	%
College Qualified Leaders (CQL)	37	27	73%	10	27%
GEMS Near Peer Mentor Program	36	7	19%	29	81%
Undergraduate Research Apprenticeship Program (URAP)	35	0	0%	35	100%
Science Mathematics, and Research for Transformation (SMART) College Scholarship	36	10	28%	26	72%
National Defense Science & Engineering Graduate (NDSEG) Fellowship	34	2	6%	32	94%
I discussed AEOP with my student(s) but did not discuss any specific program	34	9	27%	25	74%

How much do you agree or disagree with each of the following statements about Department of Defense (DoD) researchers and research?								
	1	2	3	4	5	n	Avg.	SD
DoD researchers advance science and engineering fields	0 (0%)	0 (0%)	2 (5%)	11 (29%)	24 (64%)	37	**4.59**	0.60
DoD researchers develop new, cutting edge technologies	0 (0%)	0 (0%)	4 (10%)	11 (29%)	22 (59%)	37	**4.49**	0.69
DoD researchers solve real-world problems	0 (0%)	0 (0%)	2 (5%)	9 (24%)	26 (70%)	37	**4.65**	0.59
DoD research is valuable to society	0 (0%)	0 (0%)	2 (5%)	5 (13%)	29 (80%)	36	**4.75**	0.55

Note. Response scale: **1** = "Strongly Disagree," **2** = "Disagree," **3** = "Neither Agree nor Disagree," **4** = "Agree," **5** = "Strongly Agree".

How often did YOUR STUDENT(S) have opportunities do each of the following in CQL?								
	1	2	3	4	5	n	Avg.	SD
Learn new science, technology, engineering, or mathematics (STEM) topics	0 (0%)	0 (0%)	9 (25%)	15 (41%)	12 (33%)	36	**4.08**	0.77
Apply STEM knowledge to real life situations	1 (2%)	0 (0%)	6 (16%)	14 (38%)	15 (41%)	36	**4.17**	0.91
Learn about new discoveries in STEM	3 (8%)	4 (11%)	8 (22%)	15 (41%)	6 (16%)	36	**3.47**	1.16
Learn about different careers that use STEM	4 (11%)	3 (8%)	12 (33%)	11 (30%)	6 (16%)	36	**3.33**	1.20
Interact with scientists or engineers	0 (0%)	0 (0%)	5 (13%)	7 (19%)	24 (66%)	36	**4.53**	0.74
Communicate with other students about STEM	2 (5%)	2 (5%)	5 (13%)	10 (27%)	17 (47%)	36	**4.06**	1.17
Use laboratory or field techniques, procedures, and tools	0 (0%)	1 (2%)	1 (2%)	9 (25%)	25 (69%)	36	**4.61**	0.69
Participate in hands-on STEM activities	0 (0%)	1 (2%)	1 (2%)	8 (22%)	26 (72%)	36	**4.64**	0.68
Work as part of a team	0 (0%)	1 (2%)	2 (5%)	7 (19%)	26 (72%)	36	**4.61**	0.73
Identify questions or problems to investigate	0 (0%)	0 (0%)	4 (11%)	13 (36%)	19 (52%)	36	**4.42**	0.69
Design an investigation	2 (5%)	5 (13%)	9 (25%)	7 (19%)	13 (36%)	36	**3.67**	1.26
Carry out an investigation	1 (2%)	3 (8%)	6 (16%)	8 (22%)	18 (50%)	36	**4.08**	1.13
Analyze data or information	1 (2%)	2 (5%)	7 (19%)	8 (22%)	18 (50%)	36	**4.11**	1.09
Draw conclusions from an investigation	1 (2%)	1 (2%)	8 (22%)	11 (30%)	15 (41%)	36	**4.06**	1.01
Come up with creative explanations or solutions	2 (5%)	0 (0%)	7 (19%)	10 (27%)	17 (47%)	36	**4.59**	0.60
Build or make a computer model	16 (44%)	5 (13%)	6 (16%)	3 (8%)	6 (16%)	36	**4.49**	0.69

Note. Response scale: **1** = "Not at all," **2** = "At least once," **3** = "A few times," **4** = "Most days," **5** = "Every day".

AS A RESULT OF THE CQL EXPERIENCE, how much did your student(s) GAIN in the following areas?								
	1	2	3	4	5	n	Avg.	SD
In-depth knowledge of a STEM topic(s)	0 (0%)	0 (0%)	9 (25%)	21 (60%)	5 (14%)	35	**4.65**	0.59
Knowledge of research conducted in a STEM topic or field	1 (2%)	2 (5%)	5 (14%)	18 (51%)	9 (25%)	35	**4.75**	0.55
Knowledge of research processes, ethics, and rules for conduct in STEM	1 (2%)	4 (5%)	6 (14%)	16 (51%)	8 (25%)	35	**4.08**	0.77
Knowledge of how professionals work on real problems in STEM	0 (0%)	0 (0%)	7 (20%)	13 (37%)	15 (42%)	35	**4.17**	0.91
Knowledge of what everyday research work is like in STEM	1 (2%)	1 (2%)	5 (14%)	13 (38%)	14 (41%)	34	**3.47**	1.16

Note. Response scale: **1** = "No gain," **2** = "A little gain," **3** = "Some gain," **4** = "Large gain," **5** = "Extreme gain".

Which category best describes the focus of your student's CQL project?		
	Freq.	**%**
Science	21	58%
Technology	3	8%
Engineering	12	33%
Mathematics	0	0%
Total	**34**	**100%**

AS A RESULT OF THE CQL EXPERIENCE, how much did your student(s) GAIN in their abilities to do the following?								
	1	**2**	**3**	**4**	**5**	**n**	**Avg.**	**SD**
Asking a question that can be answered with one or more scientific experiments	0 (0%)	0 (0%)	5 (25%)	12 (60%)	3 (15%)	20	**4.53**	0.74
Using knowledge and creativity to suggest a testable explanation (hypothesis) for an observation	0 (0%)	0 (0%)	3 (15%)	14 (70%)	3 (15%)	20	**4.06**	1.17
Making a model of an object or system showing its parts and how they work	5 (26%)	3 (15%)	4 (21%)	5 (26%)	2 (10%)	19	**4.61**	0.69
Designing procedures for an experiment that are appropriate for the question to be answered	0 (0%)	2 (10%)	4 (20%)	11 (55%)	3 (15%)	20	**4.64**	0.68
Identifying the limitations of methods and tools used for data collection	0 (0%)	2 (10%)	4 (20%)	11 (55%)	3 (15%)	20	**4.61**	0.73
Carrying out procedures for an experiment and recording data accurately	0 (0%)	0 (0%)	1 (5%)	12 (60%)	7 (35%)	20	**4.42**	0.69
Using computer models of objects or systems to test cause and effect relationships	10 (50%)	3 (15%)	2 (10%)	3 (15%)	2 (10%)	20	**3.67**	1.26
Organizing data in charts or graphs to find patterns and relationships	3 (15%)	1 (5%)	5 (25%)	6 (30%)	5 (25%)	20	**4.08**	1.13
Considering different interpretations of data when deciding how the data answer a question	0 (0%)	1 (5%)	5 (25%)	7 (35%)	7 (35%)	20	**4.11**	1.09
Supporting an explanation for an observation with data from experiments	0 (0%)	1 (5%)	3 (15%)	8 (40%)	8 (40%)	20	**4.06**	1.01
Supporting an explanation with relevant scientific, mathematical, and/or engineering knowledge	1 (5%)	2 (10%)	3 (15%)	8 (40%)	6 (30%)	20	**3.80**	1.15

Identifying the strengths and limitations of explanations in terms of how well they describe or predict observations	1 (5%)	0 (0%)	7 (35%)	8 (40%)	4 (20%)	20	**3.70**	0.98
Defending an argument that conveys how an explanation best describes an observation	0 (0%)	1 (5%)	5 (26%)	11 (57%)	2 (10%)	19	**3.74**	0.73
Identifying the strengths and limitation of data, interpretations, or arguments presented in technical or scientific texts	0 (0%)	1 (5%)	6 (31%)	8 (42%)	4 (21%)	19	**3.79**	0.85
Integrating information from technical or scientific texts and other media to support your explanations of an observation	0 (0%)	2 (10%)	7 (35%)	7 (35%)	4 (20%)	20	**3.65**	0.93
Communicating information about your experiments and explanations in different formats (through talking, writing, graphics, or mathematics)	0 (0%)	1 (5%)	4 (20%)	8 (40%)	7 (35%)	20	**4.05**	0.89

Note. Response scale: **1** = "No gain," **2** = "A little gain," **3** = "Some gain," **4** = "Large gain," **5** = "Extreme gain".

AS A RESULT OF THE CQL EXPERIENCE, how much did your student(s) GAIN in the following areas?								
	1	**2**	**3**	**4**	**5**	**n**	**Avg.**	**SD**
Defining a problem that can be solved by developing a new or improved object, process, or system	0 (0%)	1 (6%)	6 (40%)	6 (40%)	2 (13%)	15	**3.60**	0.83
Using knowledge and creativity to propose a testable solution for a problem	0 (0%)	1 (6%)	4 (26%)	8 (53%)	2 (13%)	15	**3.73**	0.80
Making a model of an object or system to show its parts and how they work	4 (26%)	1 (6%)	4 (26%)	3 (20%)	3 (20%)	15	**3.00**	1.51
Designing procedures for an experiment that are appropriate for the question to be answered	2 (13%)	3 (20%)	4 (26%)	3 (20%)	3 (20%)	15	**3.13**	1.36
Identifying the limitations of the methods and tools used for data collection	1 (6%)	4 (26%)	3 (20%)	5 (33%)	2 (13%)	15	**3.20**	1.21
Carrying out procedures for an experiment and recording data accurately	1 (6%)	3 (20%)	4 (26%)	5 (33%)	2 (13%)	15	**3.27**	1.16
Using computer models of an object or system to investigate cause and effect relationships	2 (13%)	5 (33%)	3 (20%)	2 (13%)	3 (20%)	15	**2.93**	1.39
Considering different interpretations of data when deciding if a solution works as intended	1 (6%)	4 (26%)	2 (13%)	6 (40%)	2 (13%)	15	**3.27**	1.22

Organizing data in charts or graphs to identify patterns and relationships	3 (20%)	1 (6%)	4 (26%)	5 (33%)	2 (13%)	15	**3.13**	1.36
Supporting a solution for a problem)with data from experiments	2 (13%)	1 (6%)	4 (26%)	4 (26%)	4 (26%)	15	**3.47**	1.36
Supporting a solution with relevant scientific, mathematical, and/or engineering knowledge	1 (6%)	1 (6%)	5 (33%)	3 (20%)	5 (33%)	15	**3.67**	1.23
Identifying the strengths and limitations of solutions in terms of how well they meet design criteria	1 (6%)	2 (13%)	6 (40%)	4 (26%)	2 (13%)	15	**3.27**	1.10
Defend an argument that conveys how a solution best meets design criteria	1 (6%)	2 (13%)	4 (26%)	6 (40%)	2 (13%)	15	**3.40**	1.12
Identifying the strengths and limitations of data, interpretations, or arguments presented in technical or scientific texts	1 (6%)	2 (13%)	3 (20%)	6 (40%)	3 (20%)	15	**3.53**	1.19
Integrating information from technical or scientific texts and other media to support your solution to a problem	2 (13%)	1 (6%)	4 (26%)	4 (26%)	4 (26%)	15	**3.47**	1.36
Communicating information about your design experiments and solutions in different ways (through talking, writing, graphics, or math equations)	1 (6%)	2 (13%)	2 (13%)	5 (33%)	5 (33%)	15	**3.73**	1.28

Note. **Response scale:** 1 = **"No gain,"** 2 = **"A little gain,"** 3 = **"Some gain,"** 4 = **"Large gain,"** 5 = **"Extreme gain".**

AS A RESULT OF THE CQL EXPERIENCE, how much did your student(s) GAIN (on average) in the skills/abilities listed below?								
	1	**2**	**3**	**4**	**5**	**n**	**Avg.**	**SD**
Learning to work independently	0 (0%)	2 (5%)	7 (20%)	14 (40%)	12 (34%)	35	**4.03**	0.89
Setting goals and reflecting on performance	0 (0%)	1 (2%)	9 (25%)	13 (37%)	12 (34%)	35	**4.03**	0.86
Sticking with a task until it is completed	0 (0%)	0 (0%)	4 (11%)	15 (42%)	16 (45%)	35	**4.34**	0.68
Making changes when things do not go as planned	0 (0%)	2 (5%)	7 (20%)	14 (41%)	11 (32%)	34	**4.00**	0.89
Including others' perspectives when making decisions	0 (0%)	2 (5%)	6 (17%)	14 (40%)	13 (37%)	35	**4.09**	0.89
Communicating effectively with others	0 (0%)	1 (2%)	6 (17%)	12 (35%)	15 (44%)	34	**4.21**	0.84
Confidence with new ideas or procedures in a STEM project	0 (0%)	0 (0%)	8 (22%)	15 (42%)	12 (34%)	35	**4.11**	0.76
Patience for the slow pace of research	1 (2%)	2 (5%)	8 (23%)	15 (44%)	8 (23%)	34	**3.79**	0.98
Desire to build relationships with professionals in a field	0 (0%)	4 (11%)	5 (14%)	14 (40%)	12 (34%)	35	**3.97**	0.98

Connecting a topic or field and their personal values	1 (2%)	3 (8%)	10 (29%)	11 (32%)	9 (26%)	34	**3.71**	1.06

Note. Response scale: **1** = "No gain," **2** = "A little gain," **3** = "Some gain," **4** = "Large gain," **5** = "Extreme gain".

Which of the following statements describe YOUR STUDENT(S) after participating in the CQL program?							
	1	**2**	**3**	**4**	**n**	**Avg.**	**SD**
More confident in STEM knowledge, skills, and abilities	0 (0%)	2 (5%)	22 (62%)	11 (31%)	35	**3.26**	0.56
More interested in participating in STEM activities outside of school requirements	1 (2%)	2 (5%)	22 (64%)	9 (26%)	34	**3.15**	0.66
More aware of other AEOPs	6 (17%)	5 (14%)	19 (54%)	5 (14%)	35	**2.66**	0.94
More interested in participating in other AEOPs	8 (24%)	6 (18%)	12 (36%)	7 (21%)	33	**2.55**	1.09
More interested in taking STEM classes in school	0 (0%)	4 (11%)	22 (64%)	8 (23%)	34	**3.12**	0.59
More interested in earning a STEM degree	0 (0%)	4 (11%)	22 (64%)	8 (23%)	34	**3.12**	0.59
More interested in pursuing a STEM career	0 (0%)	4 (11%)	21 (61%)	9 (26%)	34	**3.15**	0.61
More aware of Department of Defense (DoD) STEM research and careers	0 (0%)	2 (5%)	21 (60%)	12 (34%)	35	**3.29**	0.57
Greater appreciation of DoD STEM research and careers	2 (5%)	1 (2%)	21 (60%)	11 (31%)	35	**3.17**	0.75
More interested in pursuing a STEM career with the DoD	5 (14%)	2 (5%)	22 (62%)	6 (17%)	35	**2.83**	0.89

Note. Response scale: **1** = "Disagree – This did not happen," **2** = "Disagree – This happened but not because of CQL," **3** = "Agree – CQL contributed," **4** = "Agree – CQL was the primary reason".

Appendix D

FY15 CQL Apprentice Interview Protocol

2015 College Qualified Leaders (CQL) Evaluation Study
Apprentice Focus Group or Phone Interview 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 E

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	(Go to question number 2.)
○	No, I do not wish to participate in this survey	Go to end of chapter

8. How often did you do each of the following in STEM classes at school?

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 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	○	○	○	○	○

10. How often did you do each of the following in STEM classes at school?

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 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	○	○	○	○	○

12. 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	○	○	○	○	○

13. 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	○	○	○	○	○

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*
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	○	○	○	○	○
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	○	○	○	○	○

15. 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

16. 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

17. 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

18. 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	○	○	○	○	○

19. 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	○	○

20. 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

21. 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	○	○	○	○	○

22. Which category best describes the focus of your student(s) CQL activities?		
Select one.		
○	Science	(Go to question number 23.)
○	Technology	(Go to question number 24.)
○	Engineering	(Go to question number 24.)
○	Mathematics	(Go to question number 24.)

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.

If answered, go to question number 25.

	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	○	○	○	○	○
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)	○	○	○	○	○

24. 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	○	○	○	○	○
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 math equations)	○	○	○	○	○

25. 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	○	○	○	○	○

26. 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	○	○	○	○	○

27. 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	○	○	○	○	○

28. 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.)

29. 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.)

30. 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

31. 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)::

32. 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)::

33. 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	○	○	○	○	○

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

Select one.

○	None
○	1
○	2
○	3
○	4
○	5 or more

35. 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

36. 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	○	○	○	○	○

37. 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	○	○	○	○

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

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

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

Appendix F

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

6. Which of the following BEST describes the organization you work for? (select ONE)	
Select one.	
○	No organization
○	School or district (K-12)
○	State educational agency
○	Institution of higher education (vocational school, junior college, college, or university)
○	Private Industry
○	Department of Defense or other government agency
○	Non-profit
○	Other, (specify):

7. Which of the following BEST describes your current occupation (select ONE)		
Select one.		
○	Teacher	(Go to question number 8.)
○	Other school staff	(Go to question number 8.)
○	University educator	(Go to question number 13.)
○	Scientist, Engineer, or Mathematician in training (undergraduate or graduate student, etc.)	(Go to question number 13.)
○	Scientist, Engineer, or Mathematics professional	(Go to question number 13.)
○	Other, (specify)::	(Go to question number 13.)

8. What grade level(s) do you teach (select all that apply)?	
Select all that apply.	
☐	Upper elementary
☐	Middle school
☐	High school

12. Which of the following subjects do you teach? (select ALL that apply)	
Select all that apply.	
If answered, go to question number 14.	
☐	Upper elementary
☐	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)::

13. 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)::

14. 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

15. 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)::

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

17. 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):: _____

18. 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	○	○	○	○	○

19. 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 American Society for Engineering Education (ASEE) 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)::

20. 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 American Society for Engineering Education (ASEE)	○	○	○	○	○
Communicating with CQL organizers	○	○	○	○	○
Support for instruction or mentorship during program activities	○	○	○	○	○
Stipends (payment)	○	○	○	○	○
Research abstract preparation requirements	○	○	○	○	○
Research presentation process	○	○	○	○	○

21. 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	○	○

22. 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	○	○

23. 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	○	○

24. 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	○	○

25. 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	○	○

26. 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	○	○	○	○	○

27. 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	○	○	○	○	○

28. 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	○	○

29. 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	○	○	○	○	○

30. 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	○	○	○	○	○

31. 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	○	○	○	○	○

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

Select one.

○	Science	(Go to question number 33.)
○	Technology	(Go to question number 34.)
○	Engineering	(Go to question number 34.)
○	Mathematics	(Go to question number 34.)

33. 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 35.

	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	○	○	○	○	○

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)	○	○	○	○	○

34. **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					
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)	○	○	○	○	○

35. 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	○	○	○	○	○

36. 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	○	○	○	○

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

38. What are the three ways 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 G

American Society for Engineering Education (ASEE)
FY15 Evaluation Report Response

There was no response provided from ASEE to the FY15 CQL Evaluation Report.