Army Educational Outreach Program

Undergraduate Research Apprentice Program

2016 Annual Program Evaluation Report

ARMY EDUCATIONAL OUTREACH PROGRAM

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ARMY EDUCATIONAL OUTREACH PROGRAM

Contents

Executive Summary

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

Apprentices receive an educational stipend equivalent to $10 per hour and are allowed to work up to 300 hours total. The apprentices contribute to the research of the laboratory while learning research techniques in the process. This "hands-on" experience gives students a broader view of their fields of interest and shows students what kind of work awaits them in their future career. At the end of the program, the apprentices prepare abstracts for submission to the US Army Research Office Youth Science programs office.

This report, prepared by the consortium evaluation team with based in part on data from the U.S. Army Research Office, documents the administration of 2016 URAP. The intent is to provide key data points from 2015 URAP as well as a contextualized understanding of administration decisions and program achievements.

In 2016, there were 52 URAP apprentices and 46 mentors who participated at 39 Army-sponsored university/college laboratory sites, an increase in all categories from 2015. This report documents the evaluation of the 2016 URAP program. The evaluation addressed questions related to program strengths and challenges, benefits to participants, and overall effectiveness in meeting AEOP and program objectives. The assessment strategy for URAP included: in-person interviews with apprentices and mentors conducted over the telephone post-program.

2016 URAP Fast Facts	
Description	STEM Apprenticeship Program – Summer, in Army-funded labs at colleges/universities nationwide, with college/university S&E mentors
Participant Population	College undergraduate students
No. of Applicants	177
No. of Students (Apprentices)	52
Placement Rate	29%
No. of Adults (Mentors)	46
No. of Army-Funded College/University Laboratories	39
No. of HBCU/MSIs	14
Total Cost	$202,703*

Admin/Overhead Costs	$49,303
Total Stipends	$153,400.
Cost Per Student Participant	$3,898

*Includes matching funds from ARO.

Summary of Findings

The 2016 evaluation of URAP collected data about participants; participants' perceptions of program processes, resources, and activities; and indicators of achievement in outcomes related to AEOP and program objectives. A summary of findings is provided in the following table.

Table 25. 2016 URAP Evaluation Findings	
Participant Profiles	
URAP's number of applications far exceeded available apprenticeship opportunities.	Of the 177 applications for URAP apprenticeships, only 52 students were selected, yielding an acceptance rate of 29%, which is very competitive and reflective of a large unmet need for potential URAP participants.
URAP outreach efforts are reaching more HBCUs and MSIs. However most apprentices do not come from groups typically underrepresented in STEM.	Fourteen of the 39 institutions have Historically Black College and University (HBCU) or Minority-serving Institution (MSI) status, twice the number of HBCU or MSI status institutions from 2015.
	There were 58% male and 42% female URAP apprentices in FY16. Of this group, only 10% reported being Black or African American, 13% Hispanic or Latino, 13% Asian, and 58% reported being White. URAP is providing access for females similar to male students. However, participation from other underrepresented groups is less than desired.
Actionable Program Evaluation	
Participation in URAP was useful in exposing apprentices to other AEOP programs. However, other resources were not as useful.	Mentors reported participation in URAP (64%) was the only resource they utilized to learn about AEOP programs, which more than half of responding mentors rated as "very much" useful. Apprentices indicated the URAP Program administrator or site coordinator was useful for learning about other AEOPs (50%). More than half of respondents reported that they did not see/use the AEOP brochure, It Starts Here! Magazine, AEOP social media, or invited speakers or career events.
	When asked how interested they were in future participation in AEOP programs, a majority of apprentices (75%) indicated being at least somewhat interested in participating in URAP again, as well as some interest in NDSEG (35%), and SMART (50%). Interest in participating in the other programs may be reported as low because the apprentices also reported that they were not aware of specific AEOP programs. URAP participants are ineligible for many of the other available AEOPs based on their level of education.

URAP apprentices are more likely to engage in STEM activities because of their participation in URAP.	95% of apprentices reported being more likely to work on a STEM project or experiment in a university or professional setting, 75% being more likely to participate in a STEM camp, club, or competition, 80% to talk with friends or family about STEM and 75% being more likely to mentor or teach other students about STEM.
URAP engage apprentices who come to the experience with high interest in STEM through hands-on activities that are meaningful.	The majority of respondents indicated communicating with other students about STEM, and interacting with scientists or engineers. About three quarters of the respondents indicated they were learning about new STEM topics (75% most days or everyday), and applying STEM knowledge to real-life situations (90%) on most or every day of the experience during URAP. Half of the apprentices reported learning about different careers that use STEM most days or every day, which is an increase from 2015.
	Ninety percent of responding apprentices indicated practicing hands-on STEM activities on most days or every day; 85% reported using laboratory procedures and tools; 75% noted analyzing data or information; and 80% reported working as part of a team. In addition, apprentices indicated being integrally involved the work of STEM on most days or every day, including drawing conclusions from an investigation (75%), carrying out investigations (65%), designing investigations (55%), coming up with creative explanations or solutions (75%), and identifying questions or problems to investigate (75%).
URAP mentors communicated about STEM careers and marketing of other AEOP opportunities to the apprentices, however they were not explicit about the actual programs.	Most apprentices reported that mentors discussed AEOP with them, but did not discuss any specific program (88%). Of the programs, which were explicitly discussed, the most commonly mentioned were NDSEG (42%; increase from 2015). Mentors reported not sharing the GEMS Near Peer Mentor Program (0%) or SMART programs with their apprentices (0%).
	Apprentices were asked which resources impacted their awareness of the various AEOPs. URAP mentors (70%) and participants in the program (80%) rated the impact of URAP on their awareness of AEOP as "somewhat" or "very much." Beyond these two, most resources were reported to have little or no impact on the majority of responding apprentices' awareness of AEOPs, in part because some participants did not experience these resources
URAP offers meaningful experiences to both apprentices and mentors.	The vast majority of responding apprentices were somewhat or very much satisfied with each of the listed program features. For example, more than three quarters of the responding participants reported being somewhat or very much satisfied with all of the categories of this question including the physical location of URAP activities (95%), instruction or mentorship during program activities (85%), participant stipends (80%), the application or registration process (95%), the availability of interesting program topics or fields (80%), communication with URAP host site organizers (75%), other administrative tasks (90%), and research abstract preparation requirements (80%).

	Three-quarters of responding mentors were somewhat or very much satisfied with communicating with ARO (93%), communicating with URAP organizers (93%) and other administrative tasks (85%). Satisfaction with stipends was reportedly lower than the other categories (57% at least somewhat satisfied).
Outcomes Evaluation	
URAP had a positive impact on apprentices' STEM knowledge and competencies, and 21st Century Skills.	Large or extreme gains were reported by 85% of apprentices in their knowledge of what everyday research work is like in STEM, and by 85% in their knowledge of research conducted in a STEM topic or field. Similarly, most apprentices reported impacts on knowledge of how professionals work on real problems in STEM (85%); knowledge of a STEM topic or field in depth (80%); and knowledge of research processes, ethics, and rules for conduct in STEM (70%). There were only two apprentices who indicated that they had no or little gain in any of the areas on the survey.
	At least half of apprentices indicated large or greater gains in 8 of the 10 competencies, with the exception of defending an argument that conveys how an explanation best describes an observation (45%), and Integrating information from technical or scientific texts and other media to support your explanation of an observation (40%).
	Between 60-90% of responding apprentices reported large or extreme gains for all of these skills. The highest impact of a large or extreme gain was with the skills of learning to work independently (90%), sticking with a task until it is finished (80%), and working well with people from all backgrounds (75%).
URAP helped apprentices' gain confidence in learning and doing STEM as well as developing a STEM identity.	Data strongly suggest that the program has had a positive impact in this area. For example, 75% of responding apprentices reported a large or extreme gain in feeling prepared for more challenging STEM activities and 70% reported gains in confidence to try out new ideas or procedures on my own in a STEM project.
	Substantial proportions of apprentices reported large or extreme gains in their interest in a new STEM topic (60%), sense of accomplishing something in STEM (65%), patience for the slow pace of STEM research (65%), desire to build relationships with mentors in STEM (60%), and connecting a STEM topic or field to their personal values (50%).
URAP and URAP mentors supported apprentices' plans to pursue a STEM education at a higher level, and a career in STEM.	Before participating in URAP, 40% of apprentices indicated that they wanted to either attend or finish college, with no indication of wanting to pursue additional higher education. After participating in URAP, only 15% the students indicated that their highest level of desired education was finishing college, with the remaining 85% wanting to pursue graduate degrees.
	92% of the responding mentors reported asking students about their educational and career interests. Many also indicated providing guidance to students about educational pathways that would prepare them for a STEM career (79%); and discussing STEM career opportunities in private industry or academia (71%). Over half of the mentors reported that they recommend student and professional organizations in STEM to their students (62%)

URAP apprentices and mentors felt that URAP had positive impacts on apprentices' STEM knowledge.	A large majority of responding apprentices (90%) indicated an impact of participation in URAP on confidence in their STEM knowledge, skills, and abilities, with 70% reporting that URAP contributed to this impact and another 20% reporting that URAP was the primary reason for this impact.

Responsiveness to FY15 Evaluation Recommendations

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

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

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

Finding: AEOP objectives include expanding participation of historically underrepresented and underserved populations. URAP has made some progress in this area, as it was noted as an area for improvement in the FY14 evaluation report. Future marketing efforts could focus on the need for a more diverse pool of STEM professionals, and take the opportunity to showcase the diversity of mentors in electronic and printed materials.

URAP FY16 Efforts and Outcomes: As URAP is an ARO and AEOP co-sponsored program; the mentor pool is comprised of professors and undergraduate students at universities, which currently have an active grant with ARO. Ongoing communication to mentors and students, and a new social media campaign throughout the summer, showcased the diversity of STEM professionals. In FY16, 25% of URAP students were underrepresented, 5% over the FY16 target.

Finding: A second area that was noted for improvement in FY14 was the need to focus more on recruiting students from underrepresented populations. Similar to past years, in URAP, recruitment of apprentices is largely accomplished with personal interactions, either by knowing a professor or peer who attended URAP previously, using professional or academic connections, or mechanisms available to the university or college site. As a result, the ability of URAP to recruit underserved or underrepresented populations of students depends upon the diversity of the universities or colleges in which recruitment takes place. Additionally, the Army and ARO may need to consider practical solutions to the challenge posed by URAP locations, as the student population of some universities and colleges is likely to advantage some groups of students more than others, particularly in STEM fields. Thus, the program may want to emphasize recruiting a more diverse pool of mentors and apprentices, perhaps specifically targeting Historically Black Colleges and Universities and other

Minority Serving Institutions. A focused and strategic plan to engage a more diverse pool of mentors could ultimately engage a more diverse pool of apprentices.

URAP FY16 Efforts and Outcomes: 14 of the 39 FY16 URAP host sites (or 36%) were HBCU/MSIs, a notable increase over FY15. ARO will continue to aggressively advertise the URAP opportunity to HBCU/MIs that currently have an active grant with our organization. ARO also plans to more clearly express the importance of diversity to mentors when detailing the student selection process.

Finding: URAP is very effective in giving apprentices authentic opportunities to engage in STEM professional activities, and for mentors to build the next generation of STEM professionals. Given the goal of exposing apprentices to Army/DoD STEM research and careers, the program may want to build in systematic opportunities to provide this information to their apprentices. More than half of apprentices who completed the survey reported that they did not learn about any DoD STEM jobs/careers during URAP. Perhaps more importantly, only a few mentors were aware of specific Army/DoD STEM research and careers and even fewer mentors explicitly discussed this with their apprentices. This was an area noted by the FY14 evaluation report as a need for additional focus that has not improved much in FY15. In an effort to increase and standardize the information provided to apprentices, it would be beneficial to create a resource that profiles Army STEM interests and the education, on-the-job training, and related research activities of Army careers. Such a resource could not only start the conversation about Army STEM careers and motivate further exploration beyond the resource itself, but could be used to train the mentors to learn more about specific Army/DoD STEM research and careers. The application to be a URAP site or a mentor could ask for their plan to explicitly discuss these resources (e.g., Army and directorate STEM career webpages, online magazines, federal application guidelines), thus developing a network of ongoing opportunities for the apprentices.

URAP FY16 Efforts and Outcomes: In FY16, URAP student awareness of DoD STEM careers was 68%, an increase over FY15. The increased awareness of DoD STEM careers was due to weekly communication with apprentices and mentors that included the 2016 Guide to STEM Careers, and the AEOP newsletters. URAP students were also invited to participate in an Army DoD STEM Career Scavenger Hunt. URAP students were also given the ARO program manager contact information to create professional connections.

Finding: Perhaps more importantly, as in FY14 evaluation findings, only a few mentors were aware of specific AEOP programs and even fewer mentors explicitly discussed other AEOP opportunities with their apprentices. This lack of awareness is a barrier in communicating about other AEOP opportunities. In an effort to increase and standardize the information provided to apprentices, it would be beneficial to create a resource that profiles AEOP opportunities and the relationship they have to ongoing education, on-the-job training, and related research activities of Army careers. Such a resource could not only start the conversation about AEOP programs and motivate further exploration beyond the resource itself, but could be used to train the mentors to learn more about specific AEOP opportunities. The application to be a URAP site or a mentor could ask for their plan to explicitly discuss these resources thus expanding the network of ongoing opportunities for the apprentices.

URAP FY16 Efforts and Outcomes: Increased social media, electronic mailings, and postal mailings were utilized to consistently promote awareness of AEOP opportunities and encourage visibility to the AEOP website. Specific programs were highlighted in "exit letters and emails" for consideration as pipeline opportunities.

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

Findings: There were no recommendations for URAP on this AEOP Priority area in FY15.

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

Finding: Efforts should be undertaken to improve participation in evaluation activities, as the low response rates for both the apprentice and mentor questionnaires raise questions about the representativeness of the results. Low response rates were also a concern during the 2013, 2014 and 2015 questionnaire administration. Improved communication with the individual program sites about expectations for the URAP evaluation study may help. In addition, the evaluation instruments may need to be streamlined as the questionnaires are quite lengthy (estimated response time 45 minutes) and response burden can affect participation. It is recommended that program sites provide time on-site for participants to complete the AEOP evaluation survey.

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

Recommendations

Evaluation finding indicate that FY16 was a successful year for the URAP program. URAP had a very competitive 29% acceptance rate of the apprentice applicants, which indicates there is great interest in this program. From the high quality applicants (mentors and apprentices), there were 46 mentors and 52 apprentices selected. URAP has experienced success in recruiting diverse STEM mentors and have had increased numbers of women in FY16. Mentors overwhelmingly reported their satisfaction with the apprentices and apprentices reported their satisfaction with their mentor and with the URAP experience. Mentors indicated they consistently use innovative and research-based strategies to engage apprentices in STEM activities, and the apprentices similarly report increased ability to engage in STEM activities and have STEM habits of mind, due to the URAP experience. Apprentice educational aspirations were reportedly increased due to the URAP experience, most notably in a 45% increase of apprentices wanting to pursue graduate degrees after the URAP experience. Additionally, engaging in more hands-on STEM experiences motivated the apprentices, which was delivered by their URAP experience. The URAP program succeeded in increasing STEM knowledge and confidence in pursuing more STEM-focused activities, increasing mentor and apprentice diversity, and

providing an authentic hands-on experience for apprentices that was a professional development experience for mentors.

While the successes for URAP detailed above are commendable, there are some areas that remain with potential for growth and/or improvement. The evaluation team therefore offers the following recommendations for FY17 and beyond.

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

1. AEOP objectives include expanding participation of historically underrepresented and underserved populations. URAP has made some progress in this area, as it was noted as an area for improvement, particularly in recruiting female mentors, in the FY16 evaluation report. Between 2014 and 2016, URAP has engaged more female mentors, which is a positive trend. Future marketing efforts could focus on the need for a more diverse pool of STEM professionals, and take the opportunity to showcase the diversity of mentors in electronic and printed materials.

2. A second area that was noted for improvement in FY14 and FY15 was the need to focus more on recruiting students from underrepresented populations. Similar to past years in URAP, recruitment of apprentices is largely accomplished with personal interactions, either by knowing a professor, peer who attended URAP previously, using professional or academic connections, or mechanisms available to the university or college site. However, in 2016 there was a slight increase in recruitment through websites, which is promising in encouraging a more diverse apprentice pool. It should be noted that URAP was successful in recruiting more Historically Black Colleges and Universities and other Minority Serving Institutions as research sites. Continued efforts in recruiting mentors from HBCUs and MSIs in addition to maintaining communications through websites could offer more diversity in the future.

3. Perhaps more importantly, as in FY14 and FY15 evaluation findings, only a few mentors were aware of specific AEOP programs and even fewer mentors explicitly discussed other AEOP opportunities with their apprentices. This lack of awareness is a barrier in communicating about other AEOP opportunities. It would be beneficial to create a resource that profiles AEOP opportunities and the relationship they have to ongoing education, on-the-job training, and related research activities of Army careers. Such a resource could not only start the conversation about AEOP programs and motivate further exploration beyond the resource itself, but could be used to train the mentors to learn more about specific AEOP opportunities.

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

1. URAP is very effective in giving apprentices authentic opportunities to engage in STEM professional activities, and for mentors to build the next generation of STEM professionals. Given the goal of exposing apprentices to Army/DoD STEM research and careers, the program may want to build in systematic opportunities to provide

this information to their apprentices. Most of the apprentices who completed the survey reported that they did not learn about any DoD STEM jobs/careers during URAP. In an effort to increase and standardize the information provided to apprentices, it would be beneficial to create a resource that profiles Army STEM interests and the education, on-the-job training, and related research activities of Army careers. Such a resource could not only start the conversation about Army STEM careers and motivate further exploration beyond the resource itself, but could be used to train the mentors to learn more about specific Army/DoD STEM research and careers.

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

1. Efforts should be undertaken to improve participation in evaluation activities, as the low response rates for both the apprentice and mentor questionnaires raise questions about the representativeness of the results. Low response rates were also a concern during the 2013, 2014, 2015 and 2016 questionnaire administration. The evaluation instruments may need to be streamlined as the questionnaires are quite lengthy (estimated response time 45 minutes[1]) and response burden can affect participation. It is recommended that program sites provide time on-site for participants to complete the AEOP evaluation survey.

[1] Berry, S. (2013). How to estimate questionnaire administration time before pretesting: An interactive spreadsheet approach. *Survey Practice, 2*(3). Retrieved from http://www.surveypractice.org/index.php/SurveyPractice/article/view/166. Date accessed: 13 Mar. 2015.

Introduction

The Army Educational Outreach Program (AEOP) vision is to offer a collaborative and cohesive portfolio of Army sponsored science, technology, engineering and mathematics (STEM) programs that effectively engage, inspire, and attract the next generation of STEM talent through K-college programs and expose them to Department of Defense (DoD) STEM careers. The consortium, formed by the Army Educational Outreach Program Cooperative Agreement (AEOP CA), supports the AEOP in this mission by engaging non-profit, industry, and academic partners with aligned interests, as well as 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 across the Army.

This report documents the evaluation of one of the AEOP elements, the Undergraduate Research Apprentice Program (URAP). URAP is managed by the U.S. Army Research Office (ARO) and the Academy of Applied Science (AAS). The evaluation study was performed by Purdue University in cooperation with Battelle, the Lead Organization (LO) in the AEOP CA consortium. Data analyses and reports were prepared using data collected by Purdue University.

Program Overview

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

Apprentices receive an educational stipend equivalent to $10 per hour, and are allowed to work up to 300 hours total. The apprentices contribute to the research of the laboratory while learning research techniques in the process. This "hands-on" experience gives apprentices a broader view of their fields of interest and shows apprentices what kind of work awaits them in their future career. At the end of the program, the apprentices prepare final reports for submission to the U.S. Army Research Office's Youth Science Programs office.

In 2016, URAP was guided by the following priorities:

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

Apprenticeships were completed at 39 Army-funded university and college research laboratories in 24 U.S states, summarized in Table 1; 14 of the 39 institutions have Historically Black College and University (HBCU) or Minority-serving Institution (MSI) status (denoted with an asterisk below), twice the number of HBCU or MSI status institutions from 2015. In 2016, URAP provided outreach to 52 apprentices and their mentors at these 39 universities and college research laboratory sites (herein called URAP sites).

Table 1. 2016 URAP Sites

2016 URAP Site	City	State	No. of Applicants (Participants)
Arizona State University*	Tempe	Arizona (AZ)	38 (2)
Children's Hospital of Philadelphia	Philadelphia	Pennsylvania (PA)	5 (1)
City University of New York*	New York	New York (NY)	5 (2)
Clark Atlanta University*	Atlanta	Georgia (GA)	1 (1)
Clemson University	Clemson	South Carolina (SC)	5 (1)
Colorado School of Mines	Golden	Colorado (CO)	3 (2)
Duke University	Durham	North Carolina (NC)	10 (2)
Emory University	Atlanta	Georgia (GA)	2 (1)
Florida International University*	Miami	Florida (FL)	7 (2)
Georgia Regents University - Augusta	Augusta	Georgia (GA)	3 (2)
Georgia State University*	Atlanta	Georgia (GA)	2 (1)
Georgia Tech	Atlanta	Georgia (GA)	15 (3)
Harvard University	Cambridge	Massachusetts (MA)	3 (1)
Louisiana State University*	Baton Rouge	Louisiana (LA)	1 (1)
Michigan State University	East Lansing	Michigan (MI)	4 (1)

NC A&T*	Greensboro	North Carolina (NC)	3 (1)
New York University	Brooklyn	New York (NY)	2 (1)
North Carolina State University	Raleigh	North Carolina (NC)	3 (1)
Northeastern University	Boston	Massachusetts (MA)	4 (1)
Oklahoma State University	Stillwater	Oklahoma (OK)	3 (2)
Rutgers, State University - New Jersey	Camden	New Jersey (NJ)	4 (1)
Texas A&M University*	College Station	Texas (TX)	5 (1)
Texas State University*	San Marcos	Texas (TX)	9 (1)
University of Alabama	Tuscaloosa	Alabama (AL)	1 (1)
University of Arizona	Tucson	Arizona (AZ)	7 (2)
University of California - Riverside*	Riverside	California (CA)	14 (2)
University of Maryland - College Park*	College Park	Maryland (MD)	28 (2)
University of Massachusetts - Amherst	Amherst	Massachusetts (MA)	3 (1)
University of Minnesota	Minneapolis	Minnesota (MN)	1 (1)
University of New Hampshire	Durham	New Hampshire (NH)	1 (1)
University of North Carolina - Charlotte*	Charlotte	North Carolina (NC)	6 (1)
University of Notre Dame	Notre Dame	Indiana (IN)	3 (2)
University of Pennsylvania	Philadelphia	Pennsylvania (PA)	6 (1)
University of South Florida	Tampa	Florida (FL)	3 (1)
University of Texas - Arlington*	Arlington	Texas (TX)	5 (1)
University of Texas - El Paso*	El Paso	Texas (TX)	2 (1)
University of Texas - Rio Grande Valley*	Rio Grande Valley	Texas (TX)	3 (1)
Washington State University	Pullman	Washington (WA)	2 (1)
Yale University	New Haven	Connecticut (CT)	4 (1)

**HBCU/MI*

-Numbers highlighted in red signify that one of the student's stipends is NOT funded by AEOP/ARO.

The total cost of 2016 URAP was approximately $202,703 including $153,400 for participant stipends. Funding was provided half by AEOP and half by ARO program manager funds. The average cost per 2016 URAP participant taken across all URAP sites was $3,898. Table 3 summarizes these and other 2016 URAP program costs.

Table 2. 2016 URAP Program Costs	
2016 URAP - Cost Per Student Participant	
Total Student Participants (Apprentices)	52 (51 funded by AEOP and ARO)
Total Cost	$202,703*
Total Stipends	$153,400

Cost Per Student Participant	$3,898

*Includes matching funds from ARO

Evidence-Based Program Change

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

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

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

Activities:

- Published apprenticeship opportunities to high schools and universities located near Army labs and universities using direct mail and email campaigns.
- Developed and distributed new flyers & welcoming narrative to attract participants to the AEOP website and AEOP program information, to over 500 high schools, PTAs and after school programs targeting more diverse population, specifically to those close to host universities and DoD laboratories.
- University host directors assisted with distribution of college level program information by posting at universities.

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

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

Activities:

- All directors/mentors, students and lab coordinators received AEOP brochures, AEOP notebooks, flash drives and lab coats to promote all AEOP programs.
- Apprenticeship announcements to over 500 high schools, PTAs and after school programs targeting more diverse population, specifically to those close to host universities and DoD laboratories, also included information about all AEOP programs.

- Directors/mentors, students and lab coordinators received weekly communications addressing the entire AEOP portfolio, program evaluation assistance, abstract tip submissions, AEOP Newsletter, Social Media guidelines and the 2016 Guide to STEM Careers.
- New social media campaign was developed, including an AAS Instagram account and hashtag campaign to engage participants. #AEOPapprentice Executed AEOP's Social Media Guidelines using relevant hashtags, i.e. #edchat, #science, #womeninSTEM, #USAEOP, etc.
- Cross marketing by sharing posts about all AEOP programs.
- Provided photos and newsworthy items to Widmeyer throughout the summer.

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

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

Activities:

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

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

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

Activities:

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

- Conducted email outreach campaign to target AEOP alumni and publicize apprenticeship opportunities.
- ALL AEOP program alumni
  57% students participated in an AEOP in prior years. SEAP: 74 CQL: 182 REAP: 34

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

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

Activities:

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

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

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

Activities:

- The consolidation of marketing efforts for all apprenticeship programs resulted in greater awareness of all AEOP opportunities.
- Centralized supply distribution.
- Created new media release form.
- Centralized application process for all apprenticeship applicants through the use of Cvent.
- Increased mentor recognition with certificates and/or letters of appreciation.
- Worked extensively with lab coordinators to foster better working relationship. Surveyed lab coordinators to improve stipend payment process.
- Announced new AEOP Travel Award to all participants.

FY16 Evaluation At-A-Glance

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

Inputs	Activities	Outputs	Outcomes (Short term)	Impact (Long Term)
• ARO and AEOP co-sponsorship • ARO providing administration of program • Operations conducted by 39 Army-funded university/ college labs • 52 apprentices participating in URAP apprenticeships • 46 university/college S&Es serving as URAP mentors • Apprenticeship funds administered to university/college research labs to support apprentice participation • Centralized branding and comprehensive marketing • Centralized evaluation	• Apprentices engage in authentic STEM research experiences through hands-on summer apprenticeships at Army-funded university/college labs • University/college S&Es supervise and mentor apprentices' research • Program activities that expose students to AEOP programs and/or STEM careers in the Army or DoD	• Number and diversity of apprentice participants engaged in URAP • Number and diversity of university / college S&Es engaged in URAP • Apprentices, university / college S&Es, and ARO 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 URAP programs	• 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 URAP

The URAP evaluation gathered information from multiple participant groups about URAP 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 URAP program objectives.

Key Evaluation Questions

- What aspects of URAP motivate participation?
- What aspects of URAP structure and processes are working well?
- What aspects of URAP could be improved?
- Did participation in URAP:
  - Increase apprentices' STEM competencies?
  - Increase apprentices' interest in future STEM engagement?
  - Increase apprentices' awareness of and interest in other AEOP opportunities?
  - Increase apprentices' awareness of and interest in Army/DoD STEM research and careers?

The assessment strategy for URAP included apprentice and mentor questionnaires as well as 8 individual interviews with apprentices and 6 with mentors. Tables 3-7 outline the information collected in apprentice and mentor questionnaires and interviews.

Table 3. 2015 Apprentice Questionnaires

Category	Description
Profile	**Demographics:** Participant gender, age, grade level, race/ethnicity, and socioeconomic status indicators
	Education Intentions: Degree level, confidence to achieve educational goals, field sought
AEOP Goal 1	**Capturing the Student Experience:** In-school vs. In-program experience
	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 (students respond to a subset)
	Comprehensive Marketing Strategy: 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 4. 2015 Mentor Questionnaires	
Category	**Description**
Profile	**Demographics:** Participant gender, race/ethnicity, occupation, past participation
Satisfaction & Suggestions	Awareness of URAP, satisfaction with and suggestions for improving URAP programs, benefits to participants
AEOP Goal 1	**Capturing the Student Experience:** In-program experience
	STEM Competencies: Gains in Knowledge of STEM, Science & Engineering Practices; contribution of AEOP
	Transferrable Competencies: Gains in 21st Century Skills
	AEOP Opportunities: Past participation, awareness of other AEOP programs; efforts to expose students to AEOPs, impact of AEOP resources on efforts; contribution of AEOP in changing student AEOP metrics
	Army/DoD STEM: attitudes toward Army/DoD STEM research and careers, efforts to expose students to Army/DoD STEM research/careers, impact of AEOP resources on efforts; contribution of AEOP in changing student 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
Satisfaction & Suggestions	Benefits to participants, suggestions for improving programs, overall satisfaction

Table 5. 2015 Apprentice Focus Groups	
Category	**Description**
Profile	Gender, race/ethnicity, grade level, past participation in URAP, past participation in other AEOP programs
Satisfaction & Suggestions	Awareness of URAP, motivating factors for participation, awareness of implications of research topics, satisfaction with and suggestions for improving URAP 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 6. 2015 Mentor Focus Groups	
Category	**Description**
Profile	Gender, race/ethnicity, occupation, organization, role in URAP, past participation in URAP, past participation in other AEOP programs
Satisfaction & Suggestions	Perceived value of URAP, benefits to participants suggestions for improving URAP programs
AEOP Goal 1 and 2 Program Efforts	**Army STEM: AEOP Opportunities –** Efforts to expose apprentices to AEOP opportunities
	Army STEM: Army/DoD STEM Careers – Efforts to expose apprentices to STEM and Army/DoD STEM jobs
	Mentor Capacity: Local Educators – Strategies used to increase diversity/support diversity in URAP

Detailed information about methods and instrumentation, sampling and data collection, and analysis are described in Appendix A, the evaluation plan. The reader is strongly encouraged to review Appendix A to clarify how data are summarized, analyzed, and reported in this document. Findings of statistical and/or practical significance are noted in the report narrative, with tables and footnotes providing results from tests for significance. Questionnaires are provided in Appendix B (apprentice) and Appendix C (mentor). Focus group protocols are provided in Appendices D (apprentice) and E (mentor). Major trends in data and analyses are reported herein.

Study Sample

Table 7 provides an analysis of apprentice and mentor participation in the URAP questionnaires, the response rates, 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 acceptable, indicating that the samples may not be representative of their respective populations. Note that the apprentice response rate is lower than in 2015 (response rate 56%), in 2014 (response rate of 61%), and in 2013 (response rate of 77%). The mentor questionnaire response rate was the same for 2013 but was lower than in 2014 (response rate 52%) and 2015 (response rate 40%).

Eight apprentice interviews were conducted with students who were either undergraduate juniors or seniors. Six mentor interviews were also conducted over the phone with university educators. Interviews were not intended to yield generalizable findings; rather they were intended to provide additional evidence of, explanation for, or illustrations of apprentice questionnaire data. They add to the overall narrative of URAP's efforts and impact, and highlight areas for future exploration in programming and evaluation.

Table 7. 2016 URAP Questionnaire Participation				
Participant Group	**Respondents (Sample)**	**Total Participants (Population)**	**Participation Rate**	**Margin of Error @ 95% Confidence[2]**
Apprentices	18	52	35%	±19%
Mentors	14	46	30%	±23%

Respondent Profiles

Apprentice Demographics

Demographic information collected from URAP questionnaire respondents is summarized in Table 8.[3] More males (61%) than females (39%) completed the questionnaire. More responding apprentices identified with the race/ethnicity category of White (77%) than any other single race/ethnicity category. The majority of URAP apprentices are advanced undergraduate students (3rd year or older), just graduated, or will be entering graduate school in the fall (90%).

One objective of all AEOPs is to involve a larger percentage of students from previously underrepresented and underserved segments of our population, such as women, American Indians, African Americans, and Hispanics, in pursuing science and engineering careers through participation in Army-sponsored programs. The 2015 and 2016 questionnaire data suggests that URAP engaged a smaller proportion of female students—a population that is historically underrepresented in certain STEM fields—than male students. The same data suggest that URAP had limited success providing outreach to students from historically underrepresented and underserved minority race/ethnicity groups as well. It is notable that there were no Black or African American respondents, and only 2 Latino/a or Hispanic respondents in both 2015 and in 2016.

[2] "Margin of error @ 95% confidence" means that 95% of the time, the true percentage of the population who would select an answer lies within the stated margin of error. For example, if 47% of the sample selects a response and the margin of error at 95% confidence is calculated to be 5%, if you had asked the question to the entire population, there is a 95% likelihood that between 42% and 52% would have selected that answer. A 2-5% margin of error is generally acceptable at the 95% confidence level.

[3] In FY15 the AEOP developed and implemented a new application tool through the vendor, Cvent. This centralized tool will facilitate accurate and improved collection of demographic information from participants across the portfolio of AEOP initiatives.

Table 8. 2016 URAP Apprentice Respondent Profile		
Demographic Category	**Questionnaire Respondents**	
Respondent Gender (n = 18)		
Female	7	39%
Male	11	61%
Respondent Race/Ethnicity (n = 18)		
Asian	1	6%
Black or African American	0	0%
Hispanic or Latino	2	11%
Native American or Alaska Native	0	0%
Native Hawaiian or Other Pacific Islander	0	0%
White	14	77%
Other race or ethnicity, (specify):†	0	0%
Choose not to report	1	6%
Respondent Grade Level (n = 20)		
First-Year college student (13)	0	0%
College sophomore (14)	1	5%
College junior (15)	13	65%
College senior (16)	5	25%
Graduate program (17)	0	0%
Choose not to report	1	5%

In addition, apprentices were asked how many times they participated in each of the AEOP programs. As can be seen in Table 9, 94% have not participated in any AEOP programs. A small number of participants indicated participating at Camp Invention, which is also much different form the 2014 data. Prior participation in other AEOPs was also uncommon in 2013, and 2015. 17% of respondents participated in other STEM programs.

Table 9. Student Participation in AEOP Programs (n=18)

	Response Percent	Response Total
Camp Invention	0.00 %	0
eCYBERMISSION	0.00 %	0
Junior Solar Sprint (JSS)	0.00 %	0
Gains in the Education of Mathematics and Science (GEMS)	0.00 %	0
UNITE	0.00 %	0
Junior Science & Humanities Symposium (JSHS)	0.00 %	0
Science & Engineering Apprenticeship Program (SEAP)	0.00 %	0
Research & Engineering Apprenticeship Program (REAP)	0.00 %	0
High School Apprenticeship Program (HSAP)	0.00 %	0

College Qualified Leaders (CQL)	0.00 %	0
Undergraduate Research Apprenticeship Program (URAP)	0.00 %	0
Science Mathematics & Research for Transformation (SMART) College Scholarship	0.00 %	0
I've never participated in any AEOP programs	94.44 %	17
Other STEM Program	16.67 %	3

Mentor Demographics

The 2015 Mentor Questionnaire collected extensive demographic information on the mentors, which is summarized in Table 10. More responding mentors were female than male (73% vs. 27%). In contrast to responding apprentices, 27% of the responding mentors identified themselves as Asian. There were more reported Hispanic or Latino/a mentors in 2015 than in 2014, but that decreased in 2016. However, a larger percent of mentors chose not to answer this question (18%), which may contribute to this trend. Mentors primarily identified as university educators for their occupation (64%). In the URAP program, the large majority of responding mentors served as research mentors (86%).

Table 10. 2016 URAP Mentor Respondent Profile

Demographic Category	Questionnaire Respondents	
Respondent Gender (n = 11)		
Female	3	27%
Male	8	73%
Respondent Race/Ethnicity (n = 11)		
Asian	3	27%
Black or African American	0	0%
Hispanic or Latino	0	0%
Native American or Alaska Native	0	0%
Native Hawaiian or Other Pacific Islander	0	0%
White	5	46%
Other	1	9%
No Response	2	18%
Respondent Occupation (n = 14)		
University educator	9	64%
Scientist, Engineer, or Mathematician in training (undergraduate or graduate apprentice, etc.)	2	14%
Scientist, Engineer, or Mathematics professional	3	22%
Other, (specify):	0	0%
Respondent Role in URAP (n = 14)		
Research Mentor	12	86%
Research Team Member but not a Principal Investigator	1	7%
Other, (specify)	1	7%

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 3-6.

A focus of the Actionable Program Evaluation is efforts toward the long-term goal of URAP and all of the AEOP to increase and diversify the future pool of talent capable of contributing to the nation's scientific and technology progress. URAP sites are primarily responsible for local marketing of the program—including any outreach that is done with the specific intention of recruiting apprentices from traditionally underrepresented and underserved populations. Thus, it is important to consider how URAP is marketed and ultimately recruits apprentice participants, the factors that motivate apprentices to participate in URAP, 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 URAP achieve outcomes related to AEOP programs and objectives. Specifically, this information is intended to help URAP continue to expand participation from and support STEM education for students from underrepresented and underserved groups.

Marketing and Recruiting Underrepresented and Underserved Populations

In URAP, recruitment of apprentices is largely personal recruitment, a phenomenon that occurs at the site-level using connections or mechanisms available to the university or college site. As a result, the ability of URAP to recruit underserved or under-represented populations of students depends upon the diversity of the universities or colleges in which recruitment takes place. The data shows that URAP is consistently increasing programs to be held at HBCUs and MSIs since 2013. ARO, the URAP manager, identified and targeted schools that had traditionally underserved and under-represented populations in STEM and directly sent emails advertising the URAP program. Additionally, all 177 apprentice applicants were given information about the AEOP website to inform them of other programs for which they may be eligible. URAP apprentices who successfully completed the program received an "exit letter" stating pathways to other programs in the AEOP portfolio that were relevant.

ARO requested that all PIs familiarize themselves with the AEOP website in the beginning of the student application process. Also, ARO provided each PI a small number of AEOP brochures and distributed all student participant marketing materials through the PIs (this included an AEOP brochure, lab coat, notebook, and pencil for each student). And lastly, ARO additionally referenced the AEOP website and pipeline opportunities in its final wrap-up email thanking the PIs for their participation. ARO also installed a web-cam on the administrator's computer, with hopes to eventually host webinars that could be useful in working with sites to address this issue.

The evaluation posed questions on the program registration/application to all apprentices related to which recruitment methods were most effective. Table 11 summarizes the responses of apprentices when asked how they learned about

URAP. The most frequently mentioned source of information was someone who works at the school or university I attend (46%). Other sources mentioned relatively frequently were a school or university newsletter, email, or website (29%), and someone who works with the program (13%).

Table 11. How Apprentices Learned about URAP (n=18)

	Response Percent	Response Total
Army Educational Outreach Program (AEOP) Website	0.00 %	0
AEOP on Facebook, Twitter, Instagram, or other social media	4.17 %	1
School or university newsletter, email, or website	29.17 %	7
Past participant of program	0.00 %	0
Friend	0.00 %	0
Family Member	0.00 %	0
Someone who works at the school or university I attend	45.83 %	11
Someone who works with the program	12.50 %	3
Someone who works with the Department of Defense (Army, Navy, Air Force, etc.)	0.00 %	0
Community group or program	4.17 %	1
Choose Not to Report	4.17 %	1

A post-program questionnaire was given to mentors that asked how they learned about URAP and typically Chart 3 is included in this report to detail their responses. However, there were no responses to this item from the mentors.

Factors Motivating Apprentice Participation

Apprentices were asked during registration and application to URAP about their motivation to participate. They were given the choices detailed in Table 11 and could choose multiple sources of motivation. As can be seen in Table 12, three quarters or more of the students indicated that an interest in STEM (89%), opportunity to use advanced laboratory techniques (89%), desire to expand laboratory or research skills (89%), desire to learn something new or interesting (83%), and figuring out educational or career goals (79%) were considered to be very motivating in attending URAP. Almost three quarters of the apprentices reported being motivated to learn in ways that are not possible in school (72%) and networking opportunities (72%). None of the apprentices reported that URAP was a school requirement or grade.

Table 12. Factors that were Motivating for Apprentices to Participate in URAP (n=18)

	Response Percent	Response Total
Teacher or professor encouragement	67%	12

An academic requirement or school grade	0%	0
Desire to learn something new or interesting	83%	15
The mentor(s)	44%	8
Building college application or résumé	50%	9
Networking opportunities	72%	13
Interest in science, technology, engineering, or mathematics (STEM)	89%	16
Interest in STEM careers with the Army	39%	7
Having fun	44%	8
Earning stipends or awards for doing STEM	44%	8
Opportunity to do something with friends	0%	0
Opportunity to use advanced laboratory technology	89%	16
Desire to expand laboratory or research skills	89%	16
Learning in ways that are not possible in school	72%	13
Serving the community or country	44%	8
Exploring a unique work environment	67%	12
Figuring out education or career goals	78%	14
Seeing how school learning applies to real life	72%	13
Recommendations of past participants	0%	0
Choose Not to Report	0%	0

Interviews were conducted to gather more detailed information about motivations of the apprentices to participate in URAP. During these interviews, URAP participants expressed that they were seeking authentic experiences in STEM. Below are the quotes of two of the URAP apprentices regarding their motivations for attending the program.

> *During the spring, almost all of my dorm mates were all applying. I originally did not know about URAP until my friend, who is a premed student, she recommended URAP to me. She said that a lot of the experiences were engineering geared. You would get a lot of the hands on skills needed. For example, with software and with hardware.* (URAP Apprentice)

> *I am really interested in research and gaining experience in research, because I'm thinking about going for a PhD. I knew that I needed to get some exposure to hands on research and exposure some professors and researcher and PhD students to see what the life is like, to decide for sure whether I want to go through a PhD.* (URAP Apprentice)

The URAP Experience

In addition to gathering data about demographics and motivation in the application and registration forms, a post-program questionnaire was distributed to all apprentices. Of the 52 apprentices, 20 apprentices completed the questionnaire. The apprentice questionnaire included several items asking about the nature of apprentices' experience in URAP, and how that experience compared to their STEM learning opportunities in school (Table 13). When asked what input they had on the design of the project, 30% reported they were assigned a project by a mentor, 25% reported working with the mentor and members of a research team to design the project, 20% reported working with their mentor to design a project, and 20% reported they had a choice among various projects. None of the apprentices designed the project entirely on their own.

Table 13. Apprentice Input on Design of Their Project (n=20)

	Response Percent	Response Total
I did not have a project	5.00 %	1
I was assigned a project by my mentor	30.00 %	6
I worked with my mentor to design a project	20.00 %	4
I had a choice among various projects suggested by my mentor	20.00 %	4
I worked with my mentor and members of a research team to design a project	25.00 %	5
I designed the entire project on my own	0.00 %	0

Roughly equal numbers of responding apprentices reported that they worked in a shared laboratory space with others on different projects (25%), that they worked alone but met with a group (25%), that they worked in a group (25%), or they worked alone that was closely connected with other projects (20%) as indicated in Table 14. Only one apprentice reported working alone.

Table 14. Apprentice Participation in a Research Group (n=20)

	Response Percent	Response Total
I worked alone (or alone with my research mentor)	5.00 %	1
I worked with others in a shared laboratory or other space, but we work on different projects	25.00 %	5
I worked alone on my project and I met with others regularly for general reporting or discussion	25.00 %	5
I worked alone on a project that was closely connected with projects of others in my group	20.00 %	4
I work with a group who all worked on the same project	25.00 %	5

Apprentices were asked to share the types of activities they engaged in during their experience. Table 15 below explains their responses. The majority of respondents indicated communicating with other students about STEM, and interacting with scientists or engineers. About three quarters of the respondents indicated they were learning about new STEM

topics (75% most days or everyday), and applying STEM knowledge to real-life situations (90%) on most or every day of the experience during URAP. Half of the apprentices reported learning about different careers that use STEM most days or every day, which is an increase from 2015. The mentors responded in a similar way to the apprentices, indicating that the experiences were consistent from each perspective of URAP participants.[4]

Table 15. Nature of Apprentice Activities in URAP (n=20)

	Not at all	At least once	A few times	Most days	Every day	Response Total
Learn about science, technology, engineering, or mathematics (STEM) topics that are new to you	5.0%	0.0%	0.0%	65.0%	30.0%	
	1	0	0	13	6	20
Apply STEM learning to real-life situations	5.0%	0.0%	5.0%	40.0%	50.0%	
	1	0	1	8	10	20
Learn about new discoveries in STEM	5.0%	0.0%	20.0%	45.0%	30.0%	
	1	0	4	9	6	20
Learn about different careers that use STEM	10.0%	0.0%	40.0%	30.0%	20.0%	
	2	0	8	6	4	20
Interact with scientists or engineers	10.0%	0.0%	0.0%	10.0%	80.0%	
	2	0	0	2	16	20
Communicate with other students about STEM	5.0%	0.0%	5.0%	35.0%	55.0%	
	1	0	1	7	11	20

The questionnaire given to the apprentices post-program asked how many jobs/careers in STEM in general, since URAP and AEOP are interested in increasing the number and diversity of apprentices who pursue STEM careers is one goal of the URAP program. Additionally, the URAP post-program questionnaire asked the apprentices about STEM jobs/careers in the DoD more specifically, and the ways that apprentices learned about during these careers during their experience. As can be seen in Table 16 (general STEM Careers), 95% of the apprentices learned about at least one STEM job/career. However, Table 17 (DoD STEM careers) shows that 40% of apprentices reported that they had not learned about any

[4] 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. In addition, as mentors typically worked with multiple students, it is not clear which students' mentors were considering when responding to these items.

DoD STEM jobs/careers during the program, although 25% indicated that they learned about 5 or more DoD STEM jobs/careers during URAP. These data are similar to the data reported in 2014 and in 2015.

Table 16. Number of STEM Jobs/Careers Learned about During URAP (n=20)

	Response Percent	Response Total
None	5.00 %	1
1	15.00 %	3
2	20.00 %	4
3	15.00 %	3
4	10.00 %	2
5 or more	35.00 %	7

Table 17. Number of DoD STEM Jobs/Careers Learned about During URAP (n=20)

	Response Percent	Response Total
None	40.00 %	8
1	10.00 %	2
2	25.00 %	5
3	0.00 %	0
4	0.00 %	0
5 or more	25.00 %	5

In the post-program questionnaire, apprentices were asked which resources assisted their awareness of DoD STEM careers. Apprentices reported participation in URAP (55%) and their mentors (55%) as being somewhat or very much responsible for impacting their awareness of DoD STEM careers (see Table 18). However, more than half of apprentices indicated that they did not learn about any DoD STEM careers from the AAS website (70%), social media (75%), It Stars Here! Magazine (85%) and guest speakers (80%). Data from the mentor questionnaire are generally aligned with data from the apprentice questionnaire with regard to AEOP resources.

Table 18. Impact of Resources on Apprentice Awareness of DoD STEM Careers (n=20)

	Did not experience	Not at all	A little	Somewhat	Very much	Response Total
Army Research Office (ARO) website	35.0%	15.0%	25.0%	20.0%	5.0%	
	7	3	5	4	1	**20**

Army Educational Outreach Program (AEOP) website	15.0%	10.0%	55.0%	5.0%	15.0%	
	3	2	11	1	3	**20**
Academy of Applied Science (AAS) website	55.0%	15.0%	25.0%	5.0%	0.0%	
	11	3	5	1	0	**20**
AEOP on Facebook, Twitter, Pinterest or other social media	55.0%	20.0%	15.0%	5.0%	5.0%	
	11	4	3	1	1	**20**
AEOP brochure	40.0%	10.0%	15.0%	30.0%	5.0%	
	8	2	3	6	1	**20**
It Starts Here! Magazine	65.0%	20.0%	5.0%	10.0%	0.0%	
	13	4	1	2	0	**20**
My URAP mentor(s)	0.0%	15.0%	30.0%	30.0%	25.0%	
	0	3	6	6	5	**20**
Invited speakers or "career" events during URAP	60.0%	20.0%	10.0%	5.0%	5.0%	
	12	4	2	1	1	**20**
Participation in URAP	0.0%	10.0%	35.0%	20.0%	35.0%	
	0	2	7	4	7	**20**

Apprentices were asked on the questionnaire how often they engaged in various STEM practices during URAP. They reported that they were very actively engaged in doing STEM activities during the program (see Table 19). For example, 90% of responding apprentices indicated practicing hands-on STEM activities on most days or every day; 85% reported using laboratory procedures and tools; 75% noted analyzing data or information; and 80% reported working as part of a team. In addition, apprentices indicated being integrally involved the work of STEM on most days or every day, including drawing conclusions from an investigation (75%), carrying out investigations (65%), designing investigations (55%), coming up with creative explanations or solutions (75%), and identifying questions or problems to investigate (75%). Fewer apprentices indicated that they build or make a computer model on most days or every day (30%). Data from the URAP mentor questionnaire generally aligned with data from the apprentice questionnaire.

Table 19. Apprentice Engagement in STEM Practices in URAP (n=20)

	Not at all	At least once	A few times	Most days	Every day	Response Total
Use laboratory procedures and tools	0.0%	0.0%	15.0%	30.0%	55.0%	

	0	0	3	6	11	**20**
Participate in hands-on STEM activities	5.0%	0.0%	5.0%	25.0%	65.0%	
	1	0	1	5	13	**20**
Work as part of a team	5.0%	5.0%	10.0%	35.0%	45.0%	
	1	1	2	7	9	**20**
Identify questions or problems to investigate	5.0%	5.0%	15.0%	30.0%	45.0%	
	1	1	3	6	9	**20**
Design an investigation	5.0%	20.0%	20.0%	20.0%	35.0%	
	1	4	4	4	7	**20**
Carry out an investigation	5.0%	10.0%	20.0%	25.0%	40.0%	
	1	2	4	5	8	**20**
Analyze data or information	5.0%	5.0%	15.0%	20.0%	55.0%	
	1	1	3	4	11	**20**
Draw conclusions from an investigation	5.0%	15.0%	5.0%	35.0%	40.0%	
	1	3	1	7	8	**20**
Come up with creative explanations or solutions	5.0%	5.0%	15.0%	35.0%	40.0%	
	1	1	3	7	8	**20**
Build or make a computer model	30.0%	15.0%	25.0%	25.0%	5.0%	
	6	3	5	5	1	**20**

A composite score[5] was calculated for each of these two sets of items, the first titled "Learning about STEM in URAP,"[6] and the second "Engaging in STEM Practices in URAP."[7] Response categories were converted to a scale of 1 = "Not at all" to 5 = "Every day" and the average across all items in the scale was calculated. The composite scores were used to

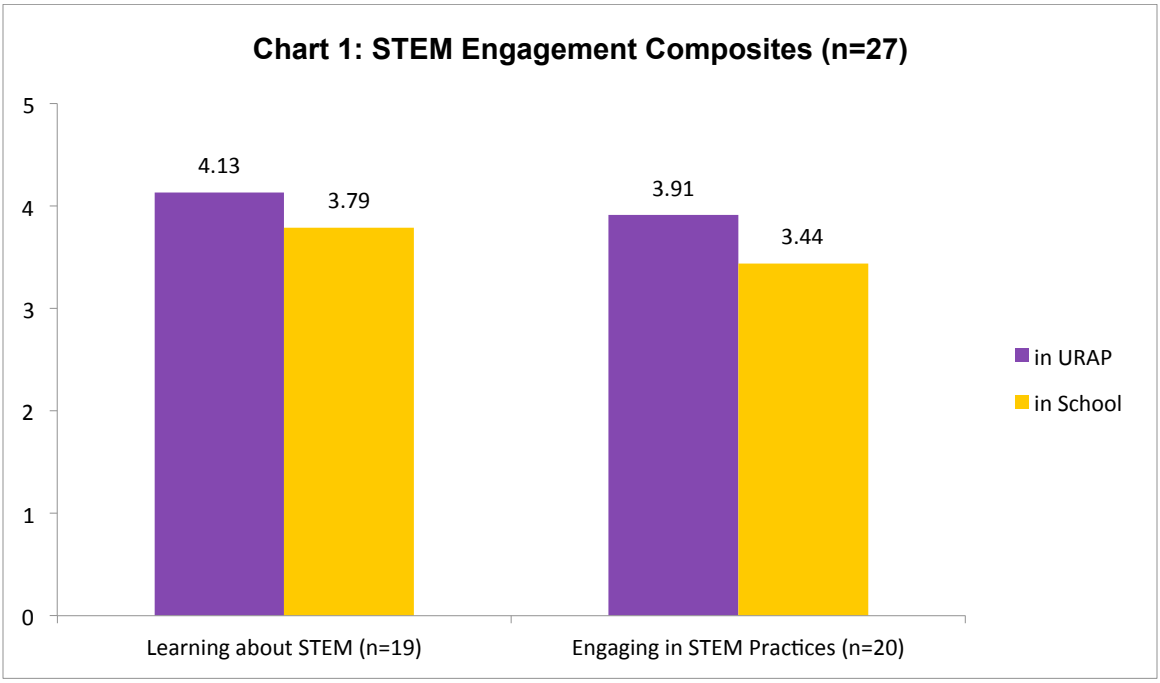
[5] Using multiple statistical tests on related outcomes requires the use of a Type I error rate adjustment to reduce the likelihood of false positives (i.e., detecting a difference when one does not truly exist). However, Type I error rate adjustments lead to a reduction in statistical power (i.e.,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

[6] The Cronbach's alpha reliability for these 6 items was 0.943.

[7] The Cronbach's alpha reliability for these 10 items was 0.941.

determine whether there were differences in apprentice experiences by gender and race/ethnic group (minority vs. non-minority apprentices). There were no significant differences by gender or race/ethnicity.

It is important to understand how the URAP experience is the same or different than their typical school experience. In order to collect data in this area, apprentices were asked how often they engaged in the same activities in school. The responses were combined into two composite variables: "Learning about STEM in School,"[8] and "Engaging in STEM Practices in School"[9] that are parallel to the ones asking about URAP. As can be seen in Chart 1, there is a statistically significant difference in student perceptions of STEM Learning and STEM Engagement when comparing these activities in School and URAP. Students reported significantly higher STEM Learning and STEM Engagement in URAP over school (Learning effect size is large with d = 1.24; Engagement effect size is large with d = 1.46)[10].



The Role of Mentors

Mentors contribute a great deal to the URAP experience. The mentoring provided during URAP defines the experience and is a critical factor in maximizing apprentice participation in these opportunities. Mentoring also plays a key role in

[8] The Cronbach's alpha reliability for these 6 items was 0.930.

[9] The Cronbach's alpha reliability for these 10 items was 0.946.

[10] Dependent Samples t-test for STEM Learning: t(18)=2.64, p=.017; Dependent Samples t-test for STEM Engagement: t(19)=3.19, p<.005.

inspiring and sustaining apprentice interest in future STEM work. Both the apprentice questionnaire and the mentor questionnaire ask about activities of the mentor and the effectiveness of the mentor-apprentice relationship.

Mentors were asked whether or not they used a number of strategies when working with apprentices.[11] These strategies comprised five main areas of effective mentoring: [12]

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

Mentors reported that they used effective strategies to engage apprentices on several different levels (see Table 20). Almost all of the mentors reported that they became familiar with students' backgrounds and interests (93%) and gave students problems that relate to their background (93%). More than three-quarters of mentors reported they gave students real-life problems (79%), encouraged students to suggest new readings, activities, or projects (86%), and helped students become aware of the role(s) that STEM plays in their everyday lives (85%). The least frequently used strategies of mentors relevant to learning activities were helping students understand how STEM can improve their own community (54%).

Table 20. Mentors Using Strategies to Establish Relevance of Learning Activities (n=14)

	Yes - I used this strategy	No - I did not use this strategy	Response Total
Become familiar with my student(s) background and interests at the beginning of the URAP experience	92.9%	7.1%	
	13	1	**14**
Giving students real-life problems to investigate or solve	78.6%	21.4%	
	11	3	**14**

[11] The mentor questionnaire used the term "students"; consequently, the data in this section are reported using that term as well.

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

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

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

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

Selecting readings or activities that relate to students' backgrounds	92.9%	7.1%	
	13	1	**14**
Encouraging students to suggest new readings, activities, or projects	85.7%	14.3%	
	12	2	**14**
Helping students become aware of the role(s) that STEM plays in their everyday lives	84.6%	15.4%	
	11	2	**13**
Helping students understand how STEM can help them improve their own community	53.8%	46.2%	
	7	6	**13**
Asking students to relate real-life events or activities to topics covered in URAP	71.4%	28.6%	
	10	4	**14**

Mentors were asked about the types of strategies that have been found to be effective in to support the diverse needs of students as learners. Table 21 shows the results of the number of mentors that used the strategies and the majority of mentors used most of the strategies. 79% of mentors reported that they provided extra reading or activities to support students who lack essential background knowledge or skills, 77% directed students to other individuals or programs as needed, 71% also used a variety of teaching and/or mentoring activities, 71% reported they interacted with students and other personnel the same way regardless of background, and 92% identified the different learning styles of the students. Few mentors highlighted underrepresentation of women and racial and ethnic minority population in STEM (46%; increased from 38% in 2015).

Table 21. Mentors Using Strategies to Support Diverse Needs of Students as Learners (n=14)

	Yes - I used this strategy	No - I did not use this strategy	Response Total
Identify the different learning styles that my student (s) may have at the beginning of the URAP experience	92.3%	7.7%	
	12	1	**13**
Interact with students and other personnel the same way regardless of their background	71.4%	28.6%	
	10	4	**14**
Use a variety of teaching and/or mentoring activities to meet the needs of all students	71.4%	28.6%	
	10	4	**14**
Integrating ideas from education literature to teach/mentor students from groups underrepresented in STEM	50.0%	50.0%	
	7	7	**14**

Providing extra readings, activities, or learning support for students who lack essential background knowledge or skills	78.6%	21.4%	
	11	3	**14**
Directing students to other individuals or programs for additional support as needed	76.9%	23.1%	
	10	3	**13**
Highlighting under-representation of women and racial and ethnic minority populations in STEM and/or their contributions in STEM	46.2%	53.8%	
	6	7	**13**

During URAP, apprentices need to develop collaboration and interpersonal skills. The questionnaire asked mentors to report the strategies to support apprentices' development of collaboration and interpersonal skills (see Table 22) and the mentors reported that they used a variety of strategies. The majority of mentors also had students explain difficult ideas to others (92%), exchange ideas with others whose backgrounds or viewpoints are different from their own (93%), tell other people about their backgrounds and interests (85%), give and receive constructive feedback with others (86%), and work on collaborative activities or projects as a member of a team (86%). About three quarters of the mentors had their students resolve conflicts and reach agreement within their team (77%).

Table 22. Mentors Using Strategies to Support Student Development of Collaboration and Interpersonal Skills (n=14)

	Yes - I used this strategy	No - I did not use this strategy	Response Total
Having my student(s) tell other people about their backgrounds and interests	84.6%	15.4%	
	11	2	**13**
Having my student(s) explain difficult ideas to others	92.3%	7.7%	
	12	1	**13**
Having my student(s) listen to the ideas of others with an open mind	85.7%	14.3%	
	12	2	**14**
Having my student(s) exchange ideas with others whose backgrounds or viewpoints are different from their own	92.9%	7.1%	
	13	1	**14**
Having my student(s) give and receive constructive feedback with others	85.7%	14.3%	
	12	2	**14**
Having students work on collaborative activities or projects as a member of a team	85.7%	14.3%	
	12	2	**14**
Allowing my student(s) to resolve conflicts and reach agreement within their	76.9%	23.1%	

team	10	3	**13**

Table 23 shows the percentages of mentors who used strategies used to support apprentice engagement in authentic STEM activities, and the majority of URAP mentors noted using of each of these approaches. In the survey, 100% of the responding mentors reported providing student(s) with constructive feedback to improve their STEM competencies, allowing students to work independently to improve their self-management abilities, having students seek support from other teammates, and encouraging students to learn collaboratively. 93% of mentors reported teaching (or assigning readings) about specific STEM subject matter, supervising my student(s) while they practice STEM research skills. At least 85% of mentors used all of the strategies listed.

Table 23. Mentors Using Strategies to Support Student Engagement in "Authentic" STEM Activities (n=14)

	Yes - I used this strategy	No - I did not use this strategy	Response Total
Teaching (or assigning readings) about specific STEM subject matter	92.9%	7.1%	
	13	1	**14**
Having my student(s) search for and review technical research to support their work	85.7%	14.3%	
	12	2	**14**
Demonstrating laboratory/field techniques, procedures, and tools for my student(s)	100.0%	0.0%	
	14	0	**14**
Supervising my student(s) while they practice STEM research skills	92.9%	7.1%	
	13	1	**14**
Providing my student(s) with constructive feedback to improve their STEM competencies	100.0%	0.0%	
	14	0	**14**
Allowing students to work independently to improve their self-management abilities	100.0%	0.0%	
	14	0	**14**
Encouraging students to learn collaboratively (team projects, team meetings, journal clubs, etc.)	100.0%	0.0%	
	13	0	**13**
Encouraging students to seek support from other team members	100.0%	0.0%	
	13	0	**13**

Additionally, mentors were asked about their support for apprentice future STEM educational and career pathways. These data are listed in Table 17. 92% of the responding mentors reported asking students about their educational and career interests. Many also indicated providing guidance to students about educational pathways that would prepare them for a STEM career (79%); and discussing STEM career opportunities in private industry or academia (71%). Over half of the mentors reported that they recommend student and professional organizations in STEM to their students (62%).

It is somewhat surprising that only 57% of the responding mentors reported discussing STEM careers within the DOD or government with apprentices, or helping apprentices build effective STEM networks (58%) since that is a crucial part of developing STEM careers. Additionally, given the interest in having apprentices graduate into other AEOP opportunities, it is also surprising that only 39% of mentors recommended other AEOP programs to apprentices. The amount of mentors recommending the AEOP programs is lower than in 2014 and 2015.

Table 24. Mentors Using Strategies to Support Student STEM Educational and Career Pathways (n=14)

	Yes - I used this strategy	No - I did not use this strategy	Response Total
Asking my student(s) about their educational and/or career goals	92.9%	7.1%	
	13	1	**14**
Recommending extracurricular programs that align with students' goals	53.8%	46.2%	
	7	6	**13**
Recommending Army Educational Outreach Programs that align with students' goals	38.5%	61.5%	
	5	8	**13**
Providing guidance about educational pathways that will prepare my student(s) for a STEM career	78.6%	21.4%	
	11	3	**14**
Discussing STEM career opportunities within the DoD or other government agencies	57.1%	42.9%	
	8	6	**14**
Discussing STEM career opportunities in private industry or academia	71.4%	28.6%	
	10	4	**14**
Discussing the economic, political, ethical, and/or social context of a STEM career	33.3%	66.7%	
	4	8	**12**
Recommending student and professional organizations in STEM to my student(s)	61.5%	38.5%	
	8	5	**13**

Helping students build a professional network in a STEM field	58.3%	41.7%	
	7	5	**12**
Helping my student(s) with their resume, application, personal statement, and/or interview preparations	53.8%	46.2%	
	7	6	**13**

During the phone interviews, mentors were asked about the value that URAP added to both their experiences and their apprentices' experiences. Mentors responded:

> *Personally speaking, for me, I got a pretty capable undergraduate that could help with my research. You also get a lot of benefit, and you learn a lot from research. Basically, I think it's a mutually beneficial for both of us.* (URAP mentor)

> *What comes to me, comes to mind, is basically an opportunity to interact with students and help them get excited about doing research, especially STEM research*. (URAP mentor)

> *I am, right now, mentoring an undergraduate student. If I talk about myself, it helps me a lot to see what kind of approach I should have to help an undergraduate student, because it was long time ago for me. It's helping me to figure out how a good adviser should be or what a good adviser should do. The level's already set. They are, the undergraduate students right now studying, they are not experts. If you are already in the field that you are studying. I'm trying to find a way to explain the concepts or the techniques that we are using in a better way*. (URAP mentor)

Mentors were further asked which of the AEOP programs they explicitly discussed with their apprentices during URAP. Surprisingly, the most frequent response was that the mentors discussed AEOP with the apprentices, but did not discuss any specific program (88%), as can be seen in Table 25. Of the programs, which were explicitly discussed, the most commonly mentioned were NDSEG (42%; increase from 2015). Mentors did not mention GEMS Near Peer Mentor Program (0%) nor did they mention SMART programs to their apprentices (0%).

Table 25. Mentors Explicitly Discussing AEOPs with Apprentices (n=14)

	Yes - I discussed this program with my student(s)	No - I did not discuss this program with my student(s)	Response Total
College Qualified Leaders (CQL)	18.2%	81.8%	
	2	9	**11**
GEMS Near Peer Mentor Program	0.0%	100.0%	
	0	11	**11**

Science Mathematics, and Research for Transformation (SMART) College Scholarship	0.0% 0	100.0% 11	**11**
National Defense Science & Engineering Graduate (NDSEG) Fellowship	41.7% 5	58.3% 7	**12**
I discussed AEOP with my student(s) but did not discuss any specific program	85.7% 12	14.3% 2	**14**

Mentors were asked to report about the usefulness of various resources in efforts to expose apprentices to the different AEOPs. Table 26 demonstrates that mentors reported participation in URAP (64%) was the only resource, which more than half of responding mentors rated as "very much" useful. Beyond participation in URAP, respondents indicated the URAP Program administrator or site coordinator was very much useful for exposing apprentices to AEOPs (50%). More than half of respondents reported that they did not experience the AEOP brochure, It Starts Here! Magazine, AEOP social media, or invited speakers or career events.

Table 26. Usefulness of resources for Exposing Apprentices to AEOPs (n=14)

	Did not experience	Not at all	A little	Somewhat	Very much	Response Total
Army Research Office (ARO) website	28.6% 4	0.0% 0	7.1% 1	28.6% 4	35.7% 5	**14**
Army Educational Outreach Program (AEOP) website	7.1% 1	0.0% 0	28.6% 4	21.4% 3	42.9% 6	**14**
AEOP on Facebook, Twitter, Pinterest or other social media	84.6% 11	15.4% 2	0.0% 0	0.0% 0	0.0% 0	**13**
AEOP brochure	35.7% 5	7.1% 1	14.3% 2	21.4% 3	21.4% 3	**14**
It Starts Here! Magazine	76.9% 10	15.4% 2	0.0% 0	7.7% 1	0.0% 0	**13**
URAP Program administrator or site coordinator	14.3% 2	7.1% 1	7.1% 1	21.4% 3	50.0% 7	**14**
Invited speakers or "career" events	69.2% 9	15.4% 2	7.7% 1	7.7% 1	0.0% 0	**13**

Participation in URAP	21.4%	0.0%	0.0%	14.3%	64.3%	
	3	0	0	2	9	**14**

Table 27 explains how useful mentors felt the different resources were for exposing apprentices to specific DoD STEM careers. As with the item previously discussed, mentors were most likely to rate participation in URAP as useful, with 57% selecting "very much." Other resources that were very much useful are the ARO website (43%), and the AEOP website (36%). Again, as with exposing students to AEOPs, less than a quarter of mentors considered social media, the AEOP brochure or It Starts Here! Magazine as "very much" useful.

Table 27. Usefulness of Resources for Exposing Apprentices to DoD STEM Careers (n=14)

	Did not experience	Not at all	A little	Somewhat	Very much	Response Total
Army Research Office (ARO) website	35.7%	0.0%	7.1%	14.3%	42.9%	
	5	0	1	2	6	**14**
Army Educational Outreach Program (AEOP) website	28.6%	0.0%	7.1%	28.6%	35.7%	
	4	0	1	4	5	**14**
AEOP on Facebook, Twitter, Pinterest or other social media	84.6%	15.4%	0.0%	0.0%	0.0%	
	11	2	0	0	0	**13**
AEOP brochure	46.2%	15.4%	15.4%	7.7%	15.4%	
	6	2	2	1	2	**13**
It Starts Here! Magazine	76.9%	15.4%	0.0%	7.7%	0.0%	
	10	2	0	1	0	**13**
URAP Program administrator or site coordinator	42.9%	7.1%	7.1%	14.3%	28.6%	
	6	1	1	2	4	**14**
Invited speakers or "career" events	69.2%	15.4%	7.7%	7.7%	0.0%	
	9	2	1	1	0	**13**
Participation in URAP	28.6%	0.0%	7.1%	7.1%	57.1%	
	4	0	1	1	8	**14**

Satisfaction with URAP

Perceived satisfaction with the URAP program can influence the number and quality of future apprentices and mentors, which is central to the success of the program. To glean insight into satisfaction, apprentices were asked how satisfied they were with a number of features of the URAP program. Table 28 displays the responses of the apprentices, which show the vast majority of responding apprentices were somewhat or very much satisfied with each of the listed program features. For example, more than three quarters of the responding participants reported being somewhat or very much satisfied with all of the categories of this question including the physical location of URAP activities (95%), instruction or mentorship during program activities (85%), participant stipends (80%), the application or registration process (95%), the availability of interesting program topics or fields (80%), communication with URAP host site organizers (75%), other administrative tasks (90%), and research abstract preparation requirements (80%).

Table 28. Apprentice Satisfaction with URAP Program Features (n=20)

	Did not experience	Not at all	A little	Somewhat	Very much	Response Total
Applying or registering for the program	0.0%	0.0%	5.0%	35.0%	60.0%	
	0	0	1	7	12	**20**
Other administrative tasks (in-processing, network access, etc.)	5.0%	0.0%	5.0%	40.0%	50.0%	
	1	0	1	8	10	**20**
Communicating with your URAP host site organizers	20.0%	0.0%	5.0%	30.0%	45.0%	
	4	0	1	6	9	**20**
The physical location(s) of URAP activities	5.0%	0.0%	0.0%	10.0%	85.0%	
	1	0	0	2	17	**20**
The variety of STEM topics available to you in URAP	10.0%	0.0%	10.0%	25.0%	55.0%	
	2	0	2	5	11	**20**
Teaching or mentoring provided during URAP activities	5.0%	0.0%	10.0%	10.0%	75.0%	
	1	0	2	2	15	**20**
Stipends (payment)	0.0%	5.0%	15.0%	30.0%	50.0%	
	0	1	3	6	10	**20**
Research abstract preparation requirements	5.0%	0.0%	15.0%	15.0%	65.0%	
	1	0	3	3	13	**20**

Frequent access to a mentor is crucial in developing an effective mentoring relationship. Since this is an important feature of URAP, apprentices were asked about their satisfaction with access to their mentor on the post-program questionnaire. Table 29 shows that 70% of responding apprentices indicated their mentor were always available, and 20% 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 29. Apprentice Reports of Availability of Mentors (n=20)

	Response Percent	Response Total
I did not have a mentor	0.00 %	0
The mentor was never available	0.00 %	0
The mentor was available less than half of the time	5.00 %	1
The mentor was available about half of the time of my project	5.00 %	1
The mentor was available more than half of the time	20.00 %	4
The mentor was always available	70.00 %	14

In addition to the frequency of availability of a mentor, apprentices were asked to rate their satisfaction with their mentors and the research experience. Table 30 shows that the majority of apprentices indicated being "very much" satisfied with each of the features, with the vast majority being at least somewhat satisfied with each feature. For example, 80% of apprentices selected "very much" when asked about satisfaction with their relationship with their mentor, with another 10% indicating "somewhat." Similarly, 70% were very much satisfied with their relationship with the group or team and 60% with the research experience overall; 70% reported being very much satisfied with the time they spent with their mentor; and 65% with the time spent doing meaningful research.

Table 30. Apprentice Satisfaction with Their Experience (n=20)

	Did not experience	Not at all	A little	Somewhat	Very much	Response Total
My working relationship with my mentor	0.0%	0.0%	10.0%	10.0%	80.0%	
	0	0	2	2	16	**20**
My working relationship with the group or team	5.0%	0.0%	10.0%	15.0%	70.0%	
	1	0	2	3	14	**20**
The amount of time I spent doing meaningful research	0.0%	0.0%	15.0%	20.0%	65.0%	
	0	0	3	4	13	**20**
The amount of time I spent with my	0.0%	0.0%	15.0%	15.0%	70.0%	

research mentor	0	0	3	3	14	**20**
The research experience overall	0.0%	5.0%	0.0%	35.0%	60.0%	
	0	1	0	7	12	**20**

The last few questions on the post-program questionnaire were open ended to allow apprentices to use their own words to explain the program. When asked about their overall experience with the URAP program, the responses were extremely positive. Of the 14 apprentices who answered this question, all but one commented on only positive aspects of the program. The one suggestion for improvement was to have better direct contact with other students in AEOP programs. These responses were sometimes as simple as, "My overall experience was excellent." Other times, apprentices provided more detail about what they enjoyed about the program, as in the following examples:

> *I am extremely satisfied with my URAP experience. I have grown as a student, and i have expanded intellectually as well. This has been a great summer experience, and I can't think of any ways to make it better.* (URAP apprentice)

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

> *I greatly enjoyed the program and am really thankful for the research opportunity it provided me.* (URAP apprentice)

The apprentices were asked in an open-ended question how the URAP program could be improved. Ten apprentices answered and indicated some ideas for improvement of the program. The most common theme in the responses was described by 3 apprentices (30%) related to more frequent communication among apprentices. Other suggestions included increasing the time of the program (20%), do more out of lab activities like sightseeing (10%), and increasing the stipend (10%).

"I feel like, even during this summer, that I've learned about as much as I do during the school year, if not more. Coming into the lab every day, getting really, really great opportunities to do a lot of lab work, and also work with others in the lab, like my advisor and the other undergraduates and graduate students, as far as just talking about concepts and talking about ideas." -- URAP Apprentice

Table 31 shows that 100% of the mentors were at least somewhat satisfied with each of the research abstract preparation requirements, and the application or registration process. Additionally, approximately three-quarters of respondents were somewhat or very much satisfied with communicating with ARO (93%), communicating with URAP organizers (93%) and other administrative tasks (85%). Satisfaction with stipends was reportedly lower than the other categories (57% at least somewhat satisfied).

Table 31. Mentor Satisfaction with URAP Program Features (n=14)

	Did not experience	Not at all	A little	Somewhat	Very much	Response Total
Application or registration process	14.3%	0.0%	0.0%	28.6%	57.1%	
	2	0	0	4	8	**14**
Other administrative tasks (in-processing, network access, etc.)	15.4%	0.0%	0.0%	15.4%	69.2%	
	2	0	0	2	9	**13**
Communicating with Army Research Office (ARO)	7.1%	0.0%	0.0%	14.3%	78.6%	
	1	0	0	2	11	**14**
Communicating with URAP organizers	7.1%	0.0%	0.0%	21.4%	71.4%	
	1	0	0	3	10	**14**
Support for instruction or mentorship during program activities	7.1%	0.0%	7.1%	14.3%	71.4%	
	1	0	1	2	10	**14**
Stipends (payment)	28.6%	0.0%	14.3%	21.4%	35.7%	
	4	0	2	3	5	**14**

Research abstract preparation requirements	0.0% 0	0.0% 0	0.0% 0	42.9% 6	57.1% 8	**14**

The mentor questionnaire included open-ended items asking for opinions about the program, parallel to the apprentice questionnaire. Mentors were asked to identify the three most important strengths of URAP, and 11 of the mentors responded to this question. The most frequently described was providing students the opportunity to engage in cutting-edge hands-on research (9 mentors, or 82%), characterized by responses such as "Exposes the undergraduate students to the cutting edge in research in DoD" and "Ability to provide hands on experiences in a research lab." This sentiment was echoed in the mentor interviews. As one mentor said:

> *Through this program, undergraduate students or high school students can involve with a real project, real research. They can tell what is real research. It's what's going on in the real world. They just learn about that theory, and the method, the mathematics things from a class. They don't have a choice to apply those kind of theories to the real world.* (URAP mentor)

The mentors also independently wrote that strengths of the program included building a professional network (55%); promoting critical thinking skills (32%); and the capacity to work on a team (18%).

The questionnaire asked mentors to note three ways in which URAP should be improved for future participants. Nine mentors responded to this question, and their comments included recommendations that the program support a symposium of URAP students (44%), increasing funding (to include more students and to provide students with greater stipends) (45%), and increasing the length of the program (27%).

Mentors reported on the questionnaire their overall satisfaction with their URAP experience. Nine mentors responded to this question, and the responses were positive. Some mentors noted being "very satisfied" or having "overall good experience" without additional elaboration. Others offered more detail about their experience; one mentor wrote:

> *I am very satisfied with the URAP experience this summer. I am happy to play a role on a student's research experience and introduce her to new fields of STEM. This program helped me improve my mentoring skills and I learned to adopt different techniques to teach or discuss with undergraduate students, who do not yet have the research background. The only thing I was concerned about was the stipend provided to students; our student had to commute for more than one hour for an affordable accommodation option. Overall, I thank the coordinators for this opportunity.* (URAP mentor)

It is clear from the Actionable Program Evaluation portion of the questionnaire that URAP provides a program that actively engages apprentices in authentic STEM experiences and influences apprentice aspirations for STEM education in

the future. Although apprentices obtain hands-on experiences with STEM, and gain authentic experiences in laboratories, DoD STEM jobs/careers have not been emphasized equally across program sites. However, recruitment has been implemented beyond local connections through the AEOP website.

Apprentices and mentors are satisfied or very satisfied with the experiences they obtain with the URAP program, particularly how apprentices actively engage in learning about STEM and in STEM practices. Apprentices indicate that they learn about more STEM knowledge in URAP than they would typically experience in school. In part, the success of URAP is due to large proportions of mentors employing 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 student engagement in authentic STEM activities.

Outcomes Evaluation

The evaluation of URAP included measurement of several outcomes related 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 knowledge of and interest in participating in additional AEOP opportunities.[13] 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 URAP 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.

[13] 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

As a result of the URAP program, the majority of apprentices reported large or extreme gains in their STEM knowledge in each area (see Table 32). For example, large or extreme gains were reported by 85% of apprentices in their knowledge of what everyday research work is like in STEM, and by 85% in their knowledge of research conducted in a STEM topic or field. Similarly, most apprentices reported impacts on knowledge of how professionals work on real problems in STEM (85%); knowledge of a STEM topic or field in depth (80%); and knowledge of research processes, ethics, and rules for conduct in STEM (70%). There was only two apprentices who indicated that they had no or little gain in any of the areas on the survey. These data are similar to 2015 URAP Evaluation Report.

Table 32. Apprentice Report of Impact on STEM Knowledge (n=20)

	No gain	A little gain	Some gain	Large gain	Extreme gain	Response Total
In depth knowledge of a STEM topic(s)	5.0%	5.0%	10.0%	60.0%	20.0%	
	1	1	2	12	4	**20**
Knowledge of research conducted in a STEM topic or field	5.0%	0.0%	10.0%	60.0%	25.0%	
	1	0	2	12	5	**20**
Knowledge of research processes, ethics, and rules for conduct in STEM	5.0%	0.0%	25.0%	45.0%	25.0%	
	1	0	5	9	5	**20**
Knowledge of how scientists and engineers work on real problems in STEM	0.0%	5.0%	10.0%	55.0%	30.0%	
	0	1	2	11	6	**20**
Knowledge of what everyday research work is like in STEM	0.0%	0.0%	15.0%	45.0%	40.0%	
	0	0	3	9	8	**20**

A composite score[14] was calculated for this set of five items[15] Response categories were converted to a scale of 1 = "No gain" to 5 = "Extreme gain" and the average across all items in the scale was calculated. The composite scores were used to determine whether there were differences in apprentice experiences by gender and race/ethnic group (minority vs. non-minority apprentices). There were no significant differences by gender or race/ethnicity.

[14] 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.

[15] The Cronbach's alpha reliability is 0.950 for these 5 items.

Table 33 shows the percentage of responding apprentices reporting large or extreme gains in STEM competencies. At least half of apprentices indicated large or greater gains in 8 of the 10 competencies, with the exception of defending an argument that conveys how an explanation best describes an observation (45%), and Integrating information from technical or scientific texts and other media to support your explanation of an observation (40%). Most apprentices reported large or extreme gains in their ability to ask a question that can be answered with one or more scientific experiments (55%), use knowledge and creativity to suggest a testable explanation (hypothesis) for an observation (60%), consider different interpretations of data when deciding how the data answer a question (80%), support an explanation for an observation with data from experiments (70%), support an explanation with relevant STEM knowledge (50%), identify the strengths and limitations of explanations in terms of how well they describe or predict observations (50%), identify the strengths and limitations of data, interpretations, or arguments presented in technical or scientific texts (69%), and Communicating about experiments and explanations in different ways (70%). The apprentice questionnaire items were combined into a composite variable[16] to test for differential impacts across subgroups of apprentices. There were no significant differences between males and females, or between minority and non-minority apprentices.

Table 33. Apprentices Reporting Gains in Their STEM Competencies (n=20)

	No gain	A little gain	Some gain	Large gain	Extreme gain	Response Total
Asking a question that can be answered with one or more scientific experiments	5.0%	0.0%	40.0%	35.0%	20.0%	
	1	0	8	7	4	**20**
Using knowledge and creativity to suggest a testable explanation (hypothesis) for an observation	5.0%	0.0%	35.0%	40.0%	20.0%	
	1	0	7	8	4	**20**
Considering different interpretations of data when deciding how the data answer a question	0.0%	5.0%	15.0%	55.0%	25.0%	
	0	1	3	11	5	**20**
Supporting an explanation for an observation with data from experiments	0.0%	15.0%	15.0%	45.0%	25.0%	
	0	3	3	9	5	**20**
Supporting an explanation with relevant scientific, mathematical, and/or engineering knowledge	5.0%	5.0%	35.0%	25.0%	30.0%	
	1	1	7	5	6	**20**
Identifying the strengths and limitations of explanations in terms of how well they describe or predict observations	5.0%	5.0%	40.0%	25.0%	25.0%	
	1	1	8	5	5	**20**

[16] The Cronbach's alpha reliability for these 5 items was .967.

Defending an argument that conveys how an explanation best describes an observation	5.0%	10.0%	40.0%	25.0%	20.0%	
	1	2	8	5	4	**20**
Identifying the strengths and limitations of data, interpretations, or arguments presented in technical or scientific texts	10.5%	5.3%	15.8%	47.4%	21.1%	
	2	1	3	9	4	**19**
Integrating information from technical or scientific texts and other media to support your explanation of an observation	5.0%	10.0%	45.0%	25.0%	15.0%	
	1	2	9	5	3	**20**
Communicating about your experiments and explanations in different ways (through talking, writing, graphics, or mathematics)	5.0%	5.0%	20.0%	50.0%	20.0%	
	1	1	4	10	4	**20**

The apprentice questionnaire also asked participants to share information about the impact of URAP on their "21st Century Skills" that are necessary across a wide variety of fields. As can be seen in Table 34, between 60-90% of responding apprentices reported large or extreme gains for all of these skills. The highest impact of a large or extreme gain was with the skills of learning to work independently (90%), sticking with a task until it is finished (80%), and working well with people from all backgrounds (75%). Apprentices reported similar gains regardless of gender or race/ethnicity[17]. In addition, mentor reports of apprentice gains in this area are generally similar to those of the apprentices.

Table 34. Apprentice Reports of Impacts on 21st Century Skills (n=20)

	No gain	A little gain	Some gain	Large gain	Extreme gain	Response Total
Learning to work independently	5.0%	0.0%	5.0%	50.0%	40.0%	
	1	0	1	10	8	**20**
Setting goals and reflecting on performance	5.0%	0.0%	25.0%	30.0%	40.0%	
	1	0	5	6	8	**20**
Sticking with a task until it is finished	5.0%	0.0%	15.0%	35.0%	45.0%	
	1	0	3	7	9	**20**
Making changes when things do not go as planned	5.0%	0.0%	25.0%	40.0%	30.0%	
	1	0	5	8	6	**20**

[17] The Cronbach's alpha reliability was .967 for these 8 items.

Working well with people from all backgrounds	0.0%	10.0%	15.0%	40.0%	35.0%	
	0	2	3	8	7	**20**
Including others' perspectives when making decisions	5.0%	5.0%	30.0%	20.0%	40.0%	
	1	1	6	4	8	**20**
Communicating effectively with others	5.0%	0.0%	25.0%	40.0%	30.0%	
	1	0	5	8	6	**20**
Viewing failure as an opportunity to learn	5.0%	5.0%	25.0%	35.0%	30.0%	
	1	1	5	7	6	**20**

STEM Identity and Confidence

Deepening apprentices' STEM knowledge and skills is important for increasing the likelihood that they will pursue STEM further in their education and/or careers. However, they are unlikely to do so if they do not see themselves as capable of succeeding in STEM.[18] Consequently, the apprentice questionnaire included a series of items intended to measure the impact of URAP on apprentices' STEM identity. These data are shown in Table 35 and strongly suggest that the program has had a positive impact in this area. For example, 75% of responding apprentices reported a large or extreme gain in feeling prepared for more challenging STEM activities and 70% reported gains in confidence to try out new ideas or procedures on my own in a STEM project. Similarly, substantial proportions of apprentices reported large or extreme gains in their interest in a new STEM topic (60%), sense of accomplishing something in STEM (65%), patience for the slow pace of STEM research (65%), desire to build relationships with mentors in STEM (60%), and connecting a STEM topic or field to their personal values (50%). Comparing results on the composite created from these items,[19] there were no differences in impact based on gender or race/ethnicity.

Table 35. Apprentice Report of Impacts on STEM Identity (n=20)

	No gain	A little gain	Some gain	Large gain	Extreme gain	Response Total
Interest in a new STEM topic	5.0%	10.0%	25.0%	35.0%	25.0%	
	1	2	5	7	5	**20**
Deciding on a path to pursue a STEM	0.0%	20.0%	30.0%	25.0%	25.0%	

[18] 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.

[19] The Cronbach's alpha reliability for these 8 items was 0.958.

career	0	4	6	5	5	**20**
Sense of accomplishing something in STEM	0.0%	15.0%	20.0%	35.0%	30.0%	
	0	3	4	7	6	**20**
Feeling prepared for more challenging STEM activities	0.0%	5.0%	20.0%	35.0%	40.0%	
	0	1	4	7	8	**20**
Confidence to try out new ideas or procedures on my own in a STEM project	0.0%	5.0%	25.0%	40.0%	30.0%	
	0	1	5	8	6	**20**
Patience for the slow pace of STEM research	0.0%	5.0%	30.0%	45.0%	20.0%	
	0	1	6	9	4	**20**
Desire to build relationships with mentors who work in STEM	0.0%	15.0%	25.0%	25.0%	35.0%	
	0	3	5	5	7	**20**
Connecting a STEM topic or field to my personal values	5.0%	15.0%	30.0%	25.0%	25.0%	
	1	3	6	5	5	**20**

Interest and Future Engagement in STEM

A key goal of the AEOP program is to develop a STEM-literate citizenry. To do so, apprentices need to be engaged in and out of school with high quality STEM activities. In order to examine the impact of URAP 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 and their interest level in participating in future AEOP programs changed as a result of their experience. As can be seen in Table 36, apprentices indicated they were more likely to engage in many of these activities as a result of URAP. For example, 95% reported being more likely to work on a STEM project or experiment in a university or professional setting, 75% being more likely to participate in a STEM camp, club, or competition, 80% to talk with friends or family about STEM and 75% being more likely to mentor or teach other students about STEM. Apprentices reported similar gains regardless of gender or race/ethnicity on the composite variable[20].

Table 36. Change in Likelihood Apprentices Will Engage in STEM Activities Outside of School (n=20)

	Much less likely	Less likely	About the same before and after	More likely	Much more likely	Response Total
Watch or read non-fiction STEM	5.0%	0.0%	20.0%	60.0%	15.0%	
	1	0	4	12	3	**20**

[20] The Cronbach's alpha reliability was .904 for these 10 items.

Tinker (play) with a mechanical or electrical device	5.0%	0.0%	30.0%	40.0%	25.0%	
	1	0	6	8	5	**20**
Work on solving mathematical or scientific puzzles	0.0%	5.0%	35.0%	40.0%	20.0%	
	0	1	7	8	4	**20**
Use a computer to design or program something	5.0%	0.0%	35.0%	40.0%	20.0%	
	1	0	7	8	4	**20**
Talk with friends or family about STEM	0.0%	5.0%	15.0%	45.0%	35.0%	
	0	1	3	9	7	**20**
Mentor or teach other students about STEM	0.0%	10.0%	15.0%	45.0%	30.0%	
	0	2	3	9	6	**20**
Help with a community service project related to STEM	0.0%	5.0%	35.0%	35.0%	25.0%	
	0	1	7	7	5	**20**
Participate in a STEM camp, club, or competition	0.0%	0.0%	25.0%	50.0%	25.0%	
	0	0	5	10	5	**20**
Take an elective (not required) STEM class	0.0%	0.0%	40.0%	30.0%	30.0%	
	0	0	8	6	6	**20**
Work on a STEM project or experiment in a university or professional setting	0.0%	0.0%	5.0%	55.0%	40.0%	
	0	0	1	11	8	**20**

When asked how interested they are in participating in future AEOP programs, a majority (75%) indicated being at least somewhat interested in participating in URAP again, in NDSEG (35%), and in SMART (50%) (Table 37). Interest in participating in the other programs may be reported as low because the apprentices also reported that they were not aware of specific AEOP programs. URAP participants are ineligible for many of the other available AEOPs based on their level of education.

Table 37. Apprentice Interest in Future AEOP Programs (n=20)

	I've never heard of this program	Not at all	A little	Somewhat	Very much	Response Total
College Qualified Leaders (CQL)	65.0%	10.0%	0.0%	0.0%	25.0%	
	13	2	0	0	5	**20**
GEMS Near Peer Mentor Program	65.0%	5.0%	5.0%	5.0%	20.0%	

	13	1	1	1	4	**20**
Undergraduate Research Apprenticeship Program (URAP)	5.0%	10.0%	10.0%	40.0%	35.0%	
	1	2	2	8	7	**20**
Science Mathematics, and Research for Transformation (SMART) College Scholarship	45.0%	0.0%	5.0%	15.0%	35.0%	
	9	0	1	3	7	**20**
National Defense Science & Engineering Graduate (NDSEG) Fellowship	55.0%	5.0%	5.0%	5.0%	30.0%	
	11	1	1	1	6	**20**

Apprentices were asked which resources impacted their awareness of the various AEOPs. As can be seen in Table 38, URAP mentors (70%) and participating in the program (80%) were most likely to be rated as impacting their awareness "somewhat" or "very much." Beyond these two, most resources were reported to have little or no impact on the majority of responding apprentices' awareness of AEOPs, in part because some participants did not experience these resources.

Table 38. Impact of Resources on Apprentice Awareness of AEOPs (n=20)

	Did not experience	Not at all	A little	Somewhat	Very much	Response Total
Army Research Office (ARO) website	40.0%	10.0%	25.0%	20.0%	5.0%	
	8	2	5	4	1	**20**
Army Educational Outreach Program (AEOP) website	15.0%	5.0%	35.0%	30.0%	15.0%	
	3	1	7	6	3	**20**
Academy of Applied Science (AAS) website	65.0%	15.0%	15.0%	5.0%	0.0%	
	13	3	3	1	0	**20**
AEOP on Facebook, Twitter, Pinterest or other social media	65.0%	20.0%	5.0%	10.0%	0.0%	
	13	4	1	2	0	**20**
AEOP brochure	45.0%	10.0%	20.0%	20.0%	5.0%	
	9	2	4	4	1	**20**
It Starts Here! Magazine	70.0%	20.0%	10.0%	0.0%	0.0%	
	14	4	2	0	0	**20**
My URAP mentor(s)	5.0%	5.0%	20.0%	30.0%	40.0%	

	1	1	4	6	8	**20**
Invited speakers or "career" events during URAP	70.0%	20.0%	0.0%	5.0%	5.0%	
	14	4	0	1	1	**20**
Participation in URAP	0.0%	15.0%	5.0%	10.0%	70.0%	
	0	3	1	2	14	**20**

Attitudes toward DoD Research

Apprentices' attitudes about the importance of DoD research are an important prerequisite to their continued interest in the field and potential involvement in the future. In order to examine attitudes in this area, the questionnaire also asked apprentices to report their opinions of what DoD researchers do and the value of DoD research more broadly. The data indicate that most responding apprentices have favorable opinions (see Table 39). For example, 90% agreed or strongly agreed that DoD researchers develop cutting-edge technologies, 85% that DoD researchers solve real-world problems, 85% that DoD research is valuable to society and 90% that DoD researchers advance science and engineering fields.

Table 39. Apprentice Opinions about DoD Researchers and Research (n=20)

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree	Response Total
DoD researchers advance science and engineering fields	0.0%	0.0%	10.0%	35.0%	55.0%	
	0	0	2	7	11	**20**
DoD researchers develop new, cutting edge technologies	0.0%	0.0%	10.0%	35.0%	55.0%	
	0	0	2	7	11	**20**
DoD researchers solve real-world problems	0.0%	0.0%	15.0%	20.0%	65.0%	
	0	0	3	4	13	**20**
DoD research is valuable to society	0.0%	0.0%	15.0%	25.0%	60.0%	
	0	0	3	5	12	**20**

Education and Career Aspirations

The evaluation examined the program's impact on apprentices' education and career aspirations. Apprentices were asked to report how far they wanted to go in school before (Table 22a) and after (Table 22b) participating in URAP. As can be seen in Table 40 when asked to think back on how far they wanted to go in school before participating in URAP, 40% indicated that they wanted to either attend or finish college, with no indication of wanting to pursue additional

higher education. After participating in URAP (Table 41), only 15% the students indicated that their highest level of desired education was finishing college, with the remaining 85% wanting to pursue graduate degrees. Overall the apprentices' aspirations for education after high school increased from only an undergraduate degree to a Master's degree or higher.

Table 40. Apprentice Education Aspirations Before URAP (n=20)

Before Aspirations	Response Percent	Response Total
Go to a trade or vocational school	0.00 %	0
Go to college for a little while	5.00 %	1
Finish college (get a Bachelor's degree)	35.00 %	7
Get more education after college	5.00 %	1
Get a master's degree	25.00 %	5
Get a Ph.D.	20.00 %	4
Get a medical-related degree (M.D.), veterinary degree (D.V.M), or dental degree (D.D.S)	5.00 %	1
Get a combined M.D. / Ph.D.	5.00 %	1
Get another professional degree (law, business, etc.)	0.00 %	0

Table 41. Apprentice Education Aspirations After URAP (n=20)

After Aspirations	Response Percent	Response Total
Go to a trade or vocational school	0.00 %	0
Go to college for a little while	0.00 %	0
Finish college (get a Bachelor's degree)	15.00 %	3
Get more education after college	0.00 %	0
Get a master's degree	30.00 %	6
Get a Ph.D.	45.00 %	9
Get a medical-related degree (M.D.), veterinary degree (D.V.M), or dental degree (D.D.S)	5.00 %	1
Get a combined M.D. / Ph.D.	5.00 %	1
Get another professional degree (law, business, etc.)	0.00 %	0

In regards to career aspirations, apprentices were asked what kind of work they expect to be doing at age 30, both reflecting on what their aspiration was before participating in URAP (see Table 42) and after URAP (see Table 43). Most apprentices expressed interest in STEM-related careers both before and after participating in URAP. For example, 45% indicated aspiring to a career in engineering before and after URAP, with 20% interest in physical science both before and after. After URAP, approximately the same outcomes for career aspirations were reported.

Table 42. Apprentice Career Aspirations Before URAP (n=20)

Before Aspirations	Response Percent	Response Total
Undecided	10.00 %	2
Science (no specific subject)	5.00 %	1

Physical science (physics, chemistry, astronomy, materials science)	20.00 %	4
Biological science	0.00 %	0
Earth, atmospheric or oceanic science	0.00 %	0
Environmental science	5.00 %	1
Computer science	0.00 %	0
Technology	0.00 %	0
Engineering	45.00 %	9
Mathematics or statistics	0.00 %	0
Medicine (doctor, dentist, veterinarian, etc.)	0.00 %	0
Health (nursing, pharmacy, technician, etc.)	5.00 %	1
Social science (psychologist, sociologist, etc.)	5.00 %	1
Teaching, STEM	0.00 %	0
Teaching, non-STEM	0.00 %	0
Business	0.00 %	0
Law	0.00 %	0
Military, police, or security	0.00 %	0
Art (writing, dancing, painting, etc.)	0.00 %	0
Skilled trade (carpenter, electrician, plumber, etc.)	0.00 %	0
Other, (specify):	5.00 %	1

Table 43. Apprentice Career Aspirations After URAP (n=20)

After Aspirations	Response Percent	Response Total
Undecided	10.00 %	2
Science (no specific subject)	5.00 %	1
Physical science (physics, chemistry, astronomy, materials science)	20.00 %	4
Biological science	5.00 %	1
Earth, atmospheric or oceanic science	0.00 %	0
Environmental science	0.00 %	0
Computer science	0.00 %	0
Technology	0.00 %	0
Engineering	45.00 %	9
Mathematics or statistics	0.00 %	0
Medicine (doctor, dentist, veterinarian, etc.)	0.00 %	0
Health (nursing, pharmacy, technician, etc.)	5.00 %	1
Social science (psychologist, sociologist, etc.)	5.00 %	1
Teaching, STEM	0.00 %	0
Teaching, non-STEM	0.00 %	0
Business	0.00 %	0
Law	0.00 %	0
Military, police, or security	0.00 %	0

Art (writing, dancing, painting, etc.)	0.00 %	0
Skilled trade (carpenter, electrician, plumber, etc.)	0.00 %	0
Other, (specify):	5.00 %	1

Apprentices reported 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 44, all but one apprentice expected to use STEM somewhat in their career. A majority (90%) expects to use STEM 51-100% of the time in their work.

Table 44. Apprentices Expecting to Use STEM in Their Work at Age 30 (n=20)

Choice	Response Percent	Response Total
not at all	5.00 %	1
up to 25% of the time	5.00 %	1
up to 50% of the time	20.00 %	4
up to 75% of the time	15.00 %	3
up to 100% of the time	55.00 %	11

Overall Impact

Finally, apprentices were asked to report impacts of participating in URAP more broadly. From these data, it is clear that apprentices thought the program had substantial impacts on them (see Table 45). For example, a large majority of responding apprentices (90%) indicated an impact of participation in URAP on confidence in their STEM knowledge, skills, and abilities, with 70% reporting that URAP contributed to this impact and another 20% reporting that URAP was the primary reason for this impact. Similarly, apprentices reported that participation in URAP had an impact on their awareness of other AEOPs (30% reporting that URAP contributed, 35% reporting that URAP was primary reason) and on their interest in participating in other AEOPs (50% and 25%). Apprentices also reported an impact on their interest in participating in STEM activities outside of school requirements (70% and 15%), appreciation of DoD STEM research and careers (45% and 45%), and awareness of DoD STEM research and careers (35% and 40%). These items were combined into a composite variable[21] to test for differences among subgroups of students; no significant differences were found by gender or race/ethnicity. Mentors were also asked about impacts on apprentices in these areas; in general, their reports of impacts very similar to those of the apprentices.

Table 45. Apprentice Opinions of URAP Impacts (n=20)

	Disagree - This did not happen	Disagree - This happened but not because of URAP	Agree - URAP contributed	Agree - URAP was primary reason	Response Total

[21] The Cronbach's alpha reliability for these 10 items was 0.832.

I am more confident in my STEM knowledge, skills, and abilities	5.0%	5.0%	70.0%	20.0%	
	1	1	14	4	**20**
I am more interested in participating in STEM activities outside of school requirements	5.0%	10.0%	70.0%	15.0%	
	1	2	14	3	**20**
I am more aware of other AEOPs	35.0%	0.0%	30.0%	35.0%	
	7	0	6	7	**20**
I am more interested in participating in other AEOPs	25.0%	0.0%	50.0%	25.0%	
	5	0	10	5	**20**
I am more interested in taking STEM classes in school	5.0%	35.0%	45.0%	15.0%	
	1	7	9	3	**20**
I am more interested in earning a STEM degree	10.0%	30.0%	50.0%	10.0%	
	2	6	10	2	**20**
I am more interested in pursuing a career in STEM	5.3%	26.3%	52.6%	15.8%	
	1	5	10	3	**19**
I am more aware of Army or DoD STEM research and careers	20.0%	5.0%	35.0%	40.0%	
	4	1	7	8	**20**
I have a greater appreciation of Army or DoD STEM research	5.0%	5.0%	45.0%	45.0%	
	1	1	9	9	**20**
I am more interested in pursuing a STEM career with the Army or DoD	25.0%	0.0%	55.0%	20.0%	
	5	0	11	4	**20**

An open-ended item on the questionnaire asked apprentices to share the three most important ways they benefited from the program; 15 apprentices provided at least one answer to this question. Apprentice responses addressed a variety of themes. More than half of the responding apprentices (60%) wrote about research, either noting that they had gained research skills or experience, or that they had increased their understanding of what it means to do research. Several referred to information, which helped them, clarify their future goals and learn what happens after college (67%). Some respondents (30%) mentioned working with different techniques in the lab. Other benefits, each described by only a small number of apprentices, included leadership, responsibility, and gaining experiences.

Apprentices' comments from the interviews expanded on some of these impacts. As three apprentices said:

I've learned to have more patience for the research process. Although lots of times, you figure out things that are new, probably sometimes nobody else has ever done before. Sometimes you just end up sitting there and thinking, and it really forces you to just evaluate things and not rush into it, because otherwise you may waste resources if you don't properly think through it. (URAP Apprentice)

It's very illuminating to be able to see how all the work that goes into it. I don't really get to see the analysis side of the data, since I'm on the data collection. You read about studies that have been done, or whatever, but you never consider the amount of raw data that's required to make all these conclusions. (URAP Apprentice)

Specifically, the learning experience, which was a great help, which will help me pursue my degree further while I'm still in school. Just the experience of being in the labs, working with professors, all of that. (URAP Apprentice)

Summary of Findings

The 2016 evaluation of URAP collected data about participants; participants' perceptions of program processes, resources, and activities; and indicators of achievement in outcomes related to AEOP and program objectives. A summary of findings is provided in Table 46.

Table 46. 2016 URAP Evaluation Findings

Participant Profiles	
URAP continues to be a popular and selective program	Of the 177 applications for apprenticeships, only 52 students were selected, yielding an acceptance rate of 29%, which is very competitive.
URAP outreach efforts are reaching more HBCUs and MSIs, however most apprentices do not come from groups typically underrepresented in STEM.	Fourteen of the 39 institutions have Historically Black College and University (HBCU) or Minority-serving Institution (MSI) status, twice the number of HBCU or MSI status institutions from 2015.
	More males (61%) than females (39%) completed the questionnaire. More responding apprentices identified with the race/ethnicity category of White (77%) than any other single race/ethnicity category.
URAP has had success in recruiting diverse STEM mentors.	More responding mentors were female than male (73% vs. 27%). In contrast to responding apprentices, 27% of the responding mentors identified themselves as Asian.
Actionable Program Evaluation	
Participation in URAP was useful in exposing apprentices to other AEOP programs. However, other resources were not as useful.	Mentors reported participation in URAP (64%) was the only resource, which more than half of responding mentors rated as "very much" useful. Beyond participation in URAP, respondents indicated the URAP Program administrator or site coordinator was very much useful for exposing apprentices to AEOPs (50%). More than half of respondents reported that they did not experience the AEOP brochure, It Starts Here! Magazine, AEOP social media, or invited speakers or

	career events.
	When asked how interested they are in participating in future AEOP programs, a majority (75%) indicated being at least somewhat interested in participating in URAP again, in NDSEG (35%), and in SMART (50%). Interest in participating in the other programs may be reported as low because the apprentices also reported that they were not aware of specific AEOP programs. URAP participants are ineligible for many of the other available AEOPs based on their level of education.
URAP apprentices are more likely to engage in STEM activities because of their participation in URAP.	95% of apprentices reported being more likely to work on a STEM project or experiment in a university or professional setting, 75% being more likely to participate in a STEM camp, club, or competition, 80% to talk with friends or family about STEM and 75% being more likely to mentor or teach other students about STEM.
URAP engage apprentices who come to the experience with high interest in STEM through hands-on activities that are meaningful.	The majority of respondents indicated communicating with other students about STEM, and interacting with scientists or engineers. About three quarters of the respondents indicated they were learning about new STEM topics (75% most days or everyday), and applying STEM knowledge to real-life situations (90%) on most or every day of the experience during URAP. Half of the apprentices reported learning about different careers that use STEM most days or every day, which is an increase from 2015.
	Ninety percent of responding apprentices indicated practicing hands-on STEM activities on most days or every day; 85% reported using laboratory procedures and tools; 75% noted analyzing data or information; and 80% reported working as part of a team. In addition, apprentices indicated being integrally involved the work of STEM on most days or every day, including drawing conclusions from an investigation (75%), carrying out investigations (65%), designing investigations (55%), coming up with creative explanations or solutions (75%), and identifying questions or problems to investigate (75%).
URAP mentors communicated about STEM careers and marketing of other AEOP opportunities to the apprentices, however they were not explicit about the actual programs.	The most frequent response was that the mentors discussed AEOP with the apprentices, but did not discuss any specific program (88%). Of the programs, which were explicitly discussed, the most commonly mentioned were NDSEG (42%; increase from 2015). Mentors did not mention GEMS Near Peer Mentor Program (0%) nor did they mention SMART programs to their apprentices (0%).
	Apprentices were asked which resources impacted their awareness of the various AEOPs. URAP mentors (70%) and participating in the program (80%) were most likely to be rated as impacting their awareness "somewhat" or "very much." Beyond these two, most resources were reported to have little or no impact on the majority of responding apprentices' awareness of AEOPs, in part because some participants did not experience these resources

URAP offers meaningful experiences to both apprentices and mentors.	The vast majority of responding apprentices were somewhat or very much satisfied with each of the listed program features. For example, more than three quarters of the responding participants reported being somewhat or very much satisfied with all of the categories of this question including the physical location of URAP activities (95%), instruction or mentorship during program activities (85%), participant stipends (80%), the application or registration process (95%), the availability of interesting program topics or fields (80%), communication with URAP host site organizers (75%), other administrative tasks (90%), and research abstract preparation requirements (80%).
	Three-quarters of responding mentors were somewhat or very much satisfied with communicating with ARO (93%), communicating with URAP organizers (93%) and other administrative tasks (85%). Satisfaction with stipends was reportedly lower than the other categories (57% at least somewhat satisfied).
Outcomes Evaluation	
URAP had a positive impact on apprentices' STEM knowledge and competencies, and 21st Century Skills.	Large or extreme gains were reported by 85% of apprentices in their knowledge of what everyday research work is like in STEM, and by 85% in their knowledge of research conducted in a STEM topic or field. Similarly, most apprentices reported impacts on knowledge of how professionals work on real problems in STEM (85%); knowledge of a STEM topic or field in depth (80%); and knowledge of research processes, ethics, and rules for conduct in STEM (70%). There were only two apprentices who indicated that they had no or little gain in any of the areas on the survey.
	At least half of apprentices indicated large or greater gains in 8 of the 10 competencies, with the exception of defending an argument that conveys how an explanation best describes an observation (45%), and Integrating information from technical or scientific texts and other media to support your explanation of an observation (40%).
	Between 60-90% of responding apprentices reported large or extreme gains for all of these skills. The highest impact of a large or extreme gain was with the skills of learning to work independently (90%), sticking with a task until it is finished (80%), and working well with people from all backgrounds (75%).
URAP helped apprentices' gain confidence in learning and doing STEM as well as developing a STEM identity.	Data strongly suggest that the program has had a positive impact in this area. For example, 75% of responding apprentices reported a large or extreme gain in feeling prepared for more challenging STEM activities and 70% reported gains in confidence to try out new ideas or procedures on my own in a STEM project.
	Substantial proportions of apprentices reported large or extreme gains in their interest in a new STEM topic (60%), sense of accomplishing something in STEM (65%), patience for the slow pace of STEM research (65%), desire to build relationships with mentors in STEM (60%), and connecting a STEM topic or field to their personal values (50%).

URAP and URAP mentors supported apprentices' plans to pursue a STEM education at a higher level, and a career in STEM.	Before participating in URAP, 40% of apprentices indicated that they wanted to either attend or finish college, with no indication of wanting to pursue additional higher education. After participating in URAP, only 15% the students indicated that their highest level of desired education was finishing college, with the remaining 85% wanting to pursue graduate degrees.
	92% of the responding mentors reported asking students about their educational and career interests. Many also indicated providing guidance to students about educational pathways that would prepare them for a STEM career (79%); and discussing STEM career opportunities in private industry or academia (71%). Over half of the mentors reported that they recommend student and professional organizations in STEM to their students (62%)
URAP apprentices and mentors felt that URAP had positive impacts on apprentices' STEM knowledge.	A large majority of responding apprentices (90%) indicated an impact of participation in URAP on confidence in their STEM knowledge, skills, and abilities, with 70% reporting that URAP contributed to this impact and another 20% reporting that URAP was the primary reason for this impact.

Recommendations

Evaluation finding indicate that FY16 was a successful year for the URAP program. URAP had a very competitive 29% acceptance rate of the apprentice applicants, which indicates there is great interest in this program. From the high quality applicants (mentors and apprentices), there were 46 mentors and 52 apprentices selected. URAP has experienced success in recruiting diverse STEM mentors and have had increased numbers of women in FY16. Mentors overwhelmingly reported their satisfaction with the apprentices and apprentices reported their satisfaction with their mentor and with the URAP experience. Mentors indicated they consistently use innovative and research-based strategies to engage apprentices in STEM activities, and the apprentices similarly report increased ability to engage in STEM activities and have STEM habits of mind, due to the URAP experience. Apprentice educational aspirations were reportedly increased due to the URAP experience, most notably in a 45% increase of apprentices wanting to pursue graduate degrees after the URAP experience. Additionally, engaging in more hands-on STEM experiences motivated the apprentices, which was delivered by their URAP experience. The URAP program succeeded in increasing STEM knowledge and confidence in pursuing more STEM-focused activities, increasing mentor and apprentice diversity, and providing an authentic hands-on experience for apprentices that was a professional development experience for mentors.

While the successes for URAP detailed above are commendable, there are some areas that remain with potential for growth and/or improvement. The evaluation team therefore offers the following recommendations for FY17 and beyond.

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

1. AEOP objectives include expanding participation of historically underrepresented and underserved populations. URAP has made some progress in this area, as it was noted as an area for improvement, particularly in recruiting female mentors, in the FY16 evaluation report. Between 2014 and 2016, URAP has engaged more female mentors, which is a positive trend. Future marketing efforts could focus on the need for a more diverse pool of STEM professionals, and take the opportunity to showcase the diversity of mentors in electronic and printed materials.

2. A second area that was noted for improvement in FY14 and FY15 was the need to focus more on recruiting students from underrepresented populations. Similar to past years in URAP, recruitment of apprentices is largely accomplished with personal interactions, either by knowing a professor, peer who attended URAP previously, using professional or academic connections, or mechanisms available to the university or college site. However, in 2016 there was a slight increase in recruitment through websites, which is promising in encouraging a more diverse apprentice pool. It should be noted that URAP was successful in recruiting more Historically Black Colleges and Universities and other Minority Serving Institutions as research sites. Continued efforts in recruiting mentors from HBCUs and MSIs in addition to maintaining communications through websites could offer more diversity in the future.

3. URAP is very effective in giving apprentices authentic opportunities to engage in STEM professional activities, and for mentors to build the next generation of STEM professionals. Given the goal of exposing apprentices to Army/DoD STEM research and careers, the program may want to build in systematic opportunities to provide this information to their apprentices. Most of the apprentices who completed the survey reported that they did not learn about any DoD STEM jobs/careers during URAP. In an effort to increase and standardize the information provided to apprentices, it would be beneficial to create a resource that profiles Army STEM interests and the education, on-the-job training, and related research activities of Army careers. Such a resource could not only start the conversation about Army STEM careers and motivate further exploration beyond the resource itself, but could be used to train the mentors to learn more about specific Army/DoD STEM research and careers.

4. Perhaps more importantly, as in FY14 and FY15 evaluation findings, only a few mentors were aware of specific AEOP programs and even fewer mentors explicitly discussed other AEOP opportunities with their apprentices. This lack of awareness is a barrier in communicating about other AEOP opportunities. It would be beneficial to create a resource that profiles AEOP opportunities and the relationship they have to ongoing education, on-the-job training, and related research activities of Army careers. Such a resource could not only start the conversation about AEOP programs and motivate further exploration beyond the resource itself, but could be used to train the mentors to learn more about specific AEOP opportunities.

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

Efforts should be undertaken to improve participation in evaluation activities, as the low response rates for both the apprentice and mentor questionnaires raise questions about the representativeness of the results. Low response rates were also a concern during the 2013, 2014, 2015 and 2016 questionnaire administration. The evaluation instruments may need to be streamlined as the questionnaires are quite lengthy (estimated response time 45 minutes[22]) and response burden can affect participation. It is recommended that program sites provide time on-site for participants to complete the AEOP evaluation survey.

[22] Berry, S. (2013). How to estimate questionnaire administration time before pretesting: An interactive spreadsheet approach. *Survey Practice, 2*(3). Retrieved from http://www.surveypractice.org/index.php/SurveyPractice/article/view/166. Date accessed: 13 Mar. 2015.

Appendices

Appendix A

FY16 URAP Evaluation Plan

2016 URAP Evaluation Questionnaires

Purpose

Per the FY16 Army Education Outreach Program (AEOP) Annual Program Plan (APP), Purdue University will conduct an evaluation study of the Undergraduate Research Apprenticeship Program (URAP) that includes two post-program questionnaires:

1. AEOP Participant Questionnaire to be completed by student participants of the URAP program at all university sites; and
2. AEOP Mentor Questionnaire to be completed by URAP mentors (typically a University Scientist or Engineer), and/or others who support students as they participate in the URAP program.

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 FY15 to FY16, questionnaire assessments have been revised and shorted 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 URAP 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 Participant and a Mentor questionnaire provided to them by VT. AEOP-wide Participant 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.

Participant Questionnaire Administration Details

- Distribute the survey near or after the conclusion of the students' URAP experience;
- Please encourage participant participants to participate in AEOP evaluation efforts. Before, during, and after the URAP program activities please mention that questionnaires are forthcoming. It is also helpful to remind Principal Investigators (PIs) and mentors about questionnaires so they can encourage students to participate as well as a reminder for themselves to participate in the surveys;
- If other, non-AEOP, survey(s) will be administered to URAP students please encourage them to prioritize the completion of AEOP's URAP evaluation survey. These data are critical to maintain funding for URAP. Additionally, evaluators will release de-identified data from these assessments to individual URAP sites to help them focus program improvement efforts;
- The URAP survey will be distributed using the CVENT registration system so please inform students and mentors that their registration with CVENT is crucial for the AEOPs records and to look for further communication from the Army Research Office (ARO) and the AEOP through the CVENT portal:

Participant Participants – Evaluation Questionnaire Invitation

Dear URAP participant,

Evaluators from Purdue University are conducting a study to learn about student experiences in the Undergraduate Research Apprenticeship Program (URAP). We are asking you to fill out this survey because you participated in URAP. Your feedback will be used to help us improve URAP for students in the future. The sponsor of URAP, the Army Educational Outreach Program (AEOP), is paying for this study. In 2016, more than 100 apprentices and 90 mentors will participate in URAP or URAP programs and evaluators from Purdue University want to hear from you and your mentor.

Here's how you can help:

1) *Complete the URAP Student Survey using the hyperlink below. Your parent or guardian has already provided permission for us to ask you to participate in the survey. Now, it is up to you to decide whether you want to participate or not. The survey takes 25-30 minutes to complete on average.*
   URAP Student Survey Link: http://www.cvent.com/d/2fqwld

2) *Pass this email along to the mentor(s) who supported you as you as you participated in URAP. Ask them to complete the* ***URAP Mentor Survey.*** *The survey will take 25-30 minutes.* **URAP Mentor Survey Link:** http://www.cvent.com/d/9fqwl4

If you have any questions about these surveys or your participation in the evaluation study ***please contact the Purdue University evaluation team:*** *Dr. Carla C. Johnson, carlacjohnson@purdue.edu or at (765) 494-0019.*

Thank you so much for your participation in the evaluation of URAP!

Mentor Questionnaire Administration Details

- Distribute the survey near or after the conclusion of the mentors' URAP experience;

- Encourage all adults serving as URAP mentors (typically a University Scientist or Engineer), and others who supported students as they participated in URAP, to complete the survey;
- Encourage mentor participation in the evaluation study before, during, and after program activities;
- If other, non-AEOP, survey(s) will be administered to adults please encourage them to prioritize the completion of AEOP's URAP evaluation survey. These data are critical to maintain funding for URAP. Additionally, evaluators will release de-identified data from these assessments to URAP sites to help them focus program improvement efforts;
- The URAP survey will be distributed using the CVENT registration records so please inform students and mentors that their registration is crucial for the AEOPs records and to look for further communication from ARO and the AEOP through the CVENT portal:

Adult Participants – Evaluation Questionnaire Invitation

Dear Colleague:

You are receiving this email because you participated in the 2016 Undergraduate Research Apprenticeship Program (URAP) program in support of one or more students' learning experience(s).

Evaluators from Purdue University are conducting program evaluation on behalf of the Army Research Office (ARO) and U.S. Army. The purpose of evaluation is to determine how well the Army Educational Outreach Program (AEOP) is achieving its primary mission – promoting student interest and engagement in science, technology, engineering, and mathematics (STEM). Purdue University is surveying adults who participated in URAP in support of students as they participated in the URAP program (URAP Mentors – University Scientists or Engineers). More than 100 students and 90 adults participated in the URAP and URAP programs this year and Purdue University wants to hear from you!

Here's how you can help:

1) *Click on the link below and complete the **URAP Mentor Survey**. The survey will take about 25-30 minutes.*
   URAP Student Survey Link: http://www.cvent.com/d/2fqwld

2) *Pass an email along to those students you supported in URAP and ask them to complete the appropriate survey. Their survey also takes about 25-30 minutes to complete.*
   URAP Mentor Survey Link: http://www.cvent.com/d/9fqwl4

*If you have any questions about the evaluation, these surveys, or your participation in the evaluation, **please contact the Purdue University evaluation team:** Dr. Carla C. Johnson, carlacjohnson@purdue.edu or at (765) 494-0019.*

Thank you so much for your participation in the evaluation of URAP.
Regards,

Telephone Interviews

Purpose

Per the FY16 Army Education Outreach Program (AEOP) Annual Program Plan (APP), Purdue University will conduct an evaluation study of URAP that includes telephone interviews with URAP mentors and apprentices.

Interviews provide the evaluation team first-hand opportunities to speak with participant and adult URAP 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. Purdue University's interview assessment efforts focus on program successes and attempt to inform useful program changes so that URAP can improve in the future.

Evaluation activities during Purdue University's Phone Interview

- 8 – 12 one-on-one phone interviews with URAP apprentices (approx. 15-20 min. each);
- 8 – 12 one-on-one phone interviews with URAP mentors (approx. 15-20 min each);

Selecting Interview Participants

Purdue University will purposefully sample from URAP participants using CVENT enrollment data (site name, apprentice/mentor participant names, gender, & race/ethnicity). The IPA and Purdue University will "invite" selected participants that comprise the desired sample to participate via email through the CVENT portal. Participants will each RSVP prior to the scheduled interview date so that an alternate may be identified if needed.

Purposeful sampling is an attempt to assemble a sample of participants that are likely to provide information about the full range of experiences possible in URAP. The interview sample will be selected using the following information:

- Gender
- Grade level
- Racial/ethnic group
- Socio-economic status indicators (e.g., qualification for free or reduced-price lunches)

Scheduling and Technology:

Purdue University will establish dates and times for each interview that accommodate the program activities for each site. The majority of these dates will occur in mid to late July – the purpose of which is to speak with participants after they have experienced the majority of experiences available in their URAP program. Purdue University will attempt to convene interviews between 10 a.m. and 2 p.m. in each site's time zone to minimize disruption to the program.

A simple telephone will be used to conduct each interview. Evaluators at Purdue University will also use a recording device to record the interview. All recordings are used for note-taking and transcription purposes only. After transcription, audio files will be destroyed.

Obtaining Informed Assent/Consent: Prior to the Interview

Apprentice and mentor participants should be informed of the evaluation interview *before* it is conducted. This ensures that individuals do not feel pressured to participate. It would be ideal if Purdue University, the IPA, and/or site coordinators work together to invite apprentices and mentors to participate and provide them with demographic surveys and evaluation policy forms:

- Attach the Purdue University evaluation policy for JSHS to the email
  - **"AEOP Evaluation Policy(Parents).pdf"**
  - **"AEOP Evaluation Policy(Participants).pdf"**
- Attach the appropriate demographic survey for participants to bring to the focus group
  - **"URAPParticipantDEMOSURVEY.docx"**
  - **"URAPMentorDEMOSURVEY.docx"**
- Purdue University evaluators provide participants with a copy of the evaluation policy and will obtain verbal informed consent from participants just prior to conducting the focus group. *Focus groups will be audio-recorded for transcription later.*

Interview Invitation Email:

Dear [participant],

I would like to inform you that evaluators from Purdue University will be carrying out interviews with Undergraduate Research Apprenticeship Program (URAP) participants on behalf of the Army Research Office (ARO) and the Army Educational Outreach Program (AEOP). Purdue University is very interested in hearing your opinions about URAP and would like to formally invite you to participate in one of the interviews, on the telephone, at a time listed below.

Purpose of the Interview:

Evaluators from Purdue University are conducting the evaluation study to determine if URAP is achieving its objective(s) as a program, the results of which will be used by one of the primary sponsors of URAP (U.S. Army) to ensure funding for the program in the future. Interviews provide evaluators the opportunity to speak with students and mentors about their experiences in URAP which helps them illustrate and understanding how the URAP program affects participants. In the end, Purdue University's findings will demonstrate URAP's success as a program and to make URAP better for future participants.

Interview Logistics:

We are working with the VT evaluation team to organize an interview during your URAP experience. Interviews are being conducted across the URAP program with student participants and with mentors (anyone who supervises, guides, or supports URAP students) Please look at the dates, times, and locations of the interviews and decide which one you are available to attend:

1. ***Student Interview #1: Date, Time, Location of telephone or quiet room***
2. ***Student Interview #2: Date, Time, Location of telephone or quiet room***
3. ***Mentor Interview: Date, Time, Location of telephone or quiet room***

Participating in the Interview:

Interviews will be conducted with students across all URAP sites and evaluators will ask all participants the same series of questions. The interview will take 15 – 20 minutes of your time. If you do not volunteer, Purdue University evaluators would still like to hear from you so they will send you an evaluation questionnaire after URAP.

If you volunteer, please fill out the appropriate forms attached to this message – one for minors (17 yrs. or younger) and one for adults.

If you have questions about the URAP interviews, please contact the Purdue University evaluation team:
Dr. Carla C. Johnson, carlacjohnson@purdue.edu or at (765) 494-0019.

Appendix B

FY16 URAP Apprentice Focus Group Protocol

2016 URAP Evaluation Study
Student Interview or Focus Group Protocol

Facilitator: My name is [evaluator] and I'd like to thank you for meeting with us today! We are really excited to learn more about your experiences in URAP. 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:

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

Key Questions

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

The Army Educational Outreach Program (AEOP) is a primary sponsor of URAP. 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 URAP is teaching students about STEM career opportunities in the Army and Department of Defense.**
    - During URAP, 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 URAP. You are definitely eligible to participate in some of these programs and we need to know if you learned about them during URAP**
    - During URAP, 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. **Tell us about your experiences in URAP this year.**
    - What, specifically do you think you got out of participating in URAP?

- How do your experiences in URAP compare to your school experiences in STEM?
- What would you say was the biggest benefit you gained from participating in URAP?

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

Appendix C

FY16 URAP Mentor Focus Group Protocol

2016 URAP Evaluation Study
Mentor Interview or Focus Group Protocol

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

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

Key Questions:

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

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

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

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

3. **The AEOP needs to know if URAP is teaching students about the other STEM outreach programs that it sponsors.**
    - First, are you aware of the other programs offered by the AEOP? (e.g., REAP, CQL, CQL, SMART, etc)
    - Have you seen any efforts at URAP to educate adults or students about the other AEOP programs?
    - What seems to work the best? The worst?
    - Any suggestions for helping the AEOP educate these students about the other programs?

4. **The AEOP is trying to make sure that its programs become more effective at reaching adult and youth participants from underserved and underrepresented groups (racial/ethnic groups, low SES, etc.).**
    - Have you seen any efforts by URAP to help engage underserved or underrepresented groups of adults and youth?
    - What strategies seem to work the best? The worst?
    - Any suggestions for helping URAP reach new populations of adult and youth participants?

5. **What suggestions do you have for improving URAP?**
6. **Last Chance - Have we missed anything? Tell us anything you want us to know that we didn't ask about.**

Appendix D

FY16 URAP Apprentice Questionnaire

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

4. What is your current grade level in school? (select one)	
Select one.	
○	College freshman
○	College sophomore
○	College junior
○	College senior
○	Graduate program
○	Choose not to report
○	Other, (specify)::

5. What is your gender?

Select one.

○	Male
○	Female
○	Choose not to report

6. What is your race or ethnicity?

Select one.

○	Hispanic or Latino
○	Asian
○	Black or African American
○	Native American or Alaska Native
○	Native Hawaiian or Other Pacific Islander
○	White
○	Choose not to report
○	Other race or ethnicity, (specify)::

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 URAP 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 URAP 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 Research Office (ARO) website	○	○	○	○	○
Army Educational Outreach Program (AEOP) website	○	○	○	○	○
Academy of Applied Science (AAS) website	○	○	○	○	○
AEOP on Facebook, Twitter, Pinterest or other social media	○	○	○	○	○
AEOP brochure	○	○	○	○	○
It Starts Here! Magazine	○	○	○	○	○
My URAP mentor(s)	○	○	○	○	○
Invited speakers or “career” events during URAP	○	○	○	○	○
Participation in URAP	○	○	○	○	○

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 Research Office (ARO) website	○	○	○	○	○
Army Educational Outreach Program (AEOP) website	○	○	○	○	○
Academy of Applied Science (AAS) website	○	○	○	○	○
AEOP on Facebook, Twitter, Pinterest or other social media	○	○	○	○	○
AEOP brochure	○	○	○	○	○
It Starts Here! Magazine	○	○	○	○	○
My URAP mentor(s)	○	○	○	○	○
Invited speakers or “career” events during URAP	○	○	○	○	○
Participation in URAP	○	○	○	○	○

14. How SATISFIED were you with the following URAP 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 URAP host site organizers	○	○	○	○	○
The physical location(s) of URAP activities	○	○	○	○	○
The variety of STEM topics available to you in URAP	○	○	○	○	○
Teaching or mentoring provided during URAP activities	○	○	○	○	○
Stipends (payment)	○	○	○	○	○
Research abstract preparation requirements	○	○	○	○	○

15. How much input did you have in selecting your URAP 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 URAP?

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 URAP?

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 URAP:

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 URAP? (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 URAP 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 URAP activities?

Select one.

○	Science
○	Technology
○	Engineering
○	Mathematics

23. As a result of your URAP 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	○	○	○	○	○
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 URAP 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 URAP 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 URAP 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 URAP 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 URAP, 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 URAP, 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 URAP, 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, electrician, plumber, etc.)
○	Other, (specify)::

32. After you participated in URAP, 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 URAP?

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 URAP?

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 URAP program?

Select one per row.

	Disagree - This did not happen	*Disagree - This happened but not because of URAP*	*Agree - URAP contributed*	*Agree - URAP 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 URAP has helped you?

Benefit #1:	
Benefit #2:	
Benefit #3:	

39. What are the three ways that URAP should be improved for future participants?

Improvement #1:	
Improvement #2:	
Improvement #3:	

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

Appendix E

FY16 URAP Mentor Questionnaire

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

4. What is your gender?
Select one.

○	Male
○	Female
○	Choose not to report

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

6. 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)::

15. Which of the following BEST describes your role during URAP?

Select one.

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

16. How many URAP students did you mentor this year?

_____ students.

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 Army Research Office (ARO) 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 URAP
☐	Other, (specify)::

20. How SATISFIED were you with the following URAP 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 Army Research Office (ARO)	○	○	○	○	○
Communicating with URAP organizers	○	○	○	○	○
Support for instruction or mentorship during program activities	○	○	○	○	○
Stipends (payment)	○	○	○	○	○
Research abstract preparation requirements	○	○	○	○	○

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 URAP.

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 URAP 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 URAP	○	○

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 URAP.

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 URAP 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 URAP.

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 URAP.

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 URAP.

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 URAP?

Select one per row.

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

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

Select one per row.

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

28. Which of the following AEOPs did YOU EXPLICITLY DISCUSS with your student(s) during URAP? (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	○	○
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 URAP?

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 URAP 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) URAP 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 URAP 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 URAP 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 URAP 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 URAP program?

Select one per row.

	Disagree - This did not happen	*Disagree - This happened but not because of URAP*	*Agree - URAP contributed*	*Agree - URAP 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 URAP?

Strength #1:	
Strength #2:	
Strength #3:	

38. What are the three ways URAP should be improved for future participants?

Improvement #1:	
Improvement #2:	
Improvement #3:	

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

Appendix F
Army Research Office (ARO)
FY16 Evaluation Report Response