Army Educational Outreach Program

High School Apprenticeship Program

2016 Annual Program Evaluation Report

ARMY EDUCATIONAL OUTREACH PROGRAM

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ARMY EDUCATIONAL OUTREACH PROGRAM

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Executive Summary

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

Students receive an educational stipend of up to $3,000, and are allowed to work up to 300 hours total. The students 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 students prepare abstracts for submission to the US Army Research Office Youth Science programs office.

In 2016, HSAP provided outreach to 65 apprentices and their 42 mentors at 35 Army-sponsored university/college laboratory sites (herein called HSAP sites). Sixteen of the university/college sites were HBCU/MIs, which is a 129% increase from 2015 (at 7 HBCU/MIs).

This report documents the evaluation of the 2016 HSAP 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 HSAP included post-program questionnaires distributed to all apprentices and mentors, individual interviews with eight apprentices, and interviews with three mentors.

2016 HSAP Fast Facts	
Description	STEM Apprenticeship Program – Summer, in Army-funded laboratories at colleges/universities nationwide, with college/university mentors
Participant Group	11th-12th grade students
No. of Applicants	363
No. of Students (Apprentices)	65
Placement Rate	18%
No. of Adults (Mentors)	42
No. of K-12 Schools	53
No. of Army-Funded College/University Laboratories	35
No. of HBCU/MIs	16

Total Cost	$235,746
Total Stipends	$180,876.00
Cost Per Student Participant	$3,627

*Includes matching funds from ARO.

Summary of Findings

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

2016 HSAP Evaluation Findings	
Participant Profiles	
HSAP continues to be a popular and selective program which serves students of historically underrepresented and underserved populations.	HSAP has been extremely successful in reaching out to more high school students – experiencing a 26% increase in applications received in FY16 (267 vs. 363 applications). The ARO office utilized direct email to targeted schools, which produced a significant increase in applications.
	HSAP experienced continued success in providing outreach to students from historically underrepresented and underserved race/ethnic and low-income groups. The number of HCBU/MIs increased from 2 HBCU/MI sites in 2014, 7 HBCU/MIs in 2015, and 16 HBCU/MIs in 2016.
	More than half of the respondents in the HSAP program were from race/ethnicity categories other than White.
Actionable Program Evaluation	
HSAP recruitment continue to be mainly from personal contacts and from websites.	Many apprentices learned about HSAP from someone who works at the university (29%), school or university newsletter, email, or website (15%), and the AEOP website (15%). Other responses include hearing about HSAP from a family member (11%) and from someone who works in the program (11%).
	Marketing via social media such as Facebook, Twitter or Pinterest were the least frequently used sources for learning about HSAP specifically and AEOP generally.
HSAP apprentices learn STEM skills and knowledge that they do not learn in school settings.	There is a statistically significant difference in student perceptions of STEM Learning and STEM Engagement when comparing these activities in School and HSAP. Apprentices report significantly higher STEM Learning and STEM Engagement in HSAP over school.
Although HSAP apprentices come to the program with an interest in STEM, HSAP offers	More than 90% of apprentices agree or strongly agree that DoD researchers develop new, cutting edge technologies, solve real-world problems, advance science and engineering fields, and that their research is valuable to society.

opportunities for high school students in authentic STEM learning that provides insight into college and beyond.	Mentor access is a key component of HSAP, and apprentices were asked about the availability of their mentor. Apprentices responded that mentors were always available to apprentices in HSAP and 100% of mentors were available for more than half of the time of the project.
	97% of the apprentices interacted with scientists or engineers on most days or every day, 92% applied STEM learning to real-life situations most days or every day, and 97% learned about new STEM topics. Similarly, 76% of apprentices learned about new discoveries in STEM, 85% communicated with other students about STEM, and 75% learned about different careers that use STEM most days or every day.
HSAP mentors used effective research-based strategies to help mentors understand STEM knowledge and skills. They were less aware of other AEOP programs, although a majority of apprentices reported that mentors were helpful in increasing awareness of other AEOP programs.	Mentors were very strong in using all of the research-based strategies, and at least 84% of the mentors reported using all of the strategies listed on the questionnaire. 100% of the mentors reported having their students search for and review technical research, demonstrate lab and/or field techniques, encouraged students to learn collaboratively, and provided their students with constructive feedback.
	Most of the apprentices had not heard of the range of AEOP programs (78% had not hear of UNITE, 86% had not heard of CQL, and 79% had not heard of GEMS Near Peer). Apprentices rated the HSAP program (78%) and their mentors (61%) at somewhat or very much impactful on their awareness of AEOPs. Conversely, the majority of HSAP apprentices reported not experiencing the AEOP brochure and AEOP social media.
HSAP was highly valued by apprentices and mentors alike.	Similar to 2015, apprentices and mentors reported being very satisfied with their HSAP experience, including communications from Army Research Office, and the application/ registration process. Mentors reported in the interview that they felt having high school students in their laboratories was a valuable professional development experience.
Outcomes Evaluation	
HSAP apprentices reported large or extreme gains in their STEM knowledge and skills, and expect to use their STEM knowledge and skills extensively in the future.	Between 67-89% of apprentices reported a large or extreme gain on all aspects of STEM knowledge asked in the questionnaire. Eighty-nine percent of apprentices reported a large or extreme gain in their knowledge of what everyday research is like in STEM and 69% of apprentices reported that their knowledge of research conducted in a STEM topic or field had a large or extreme gain.
	Additionally, 89% of apprentices expect to use their STEM knowledge, skills and abilities at least half of the time, with the remaining 11% using their STEM skills, knowledge, and abilities at least a quarter of the time, indicating a large amount of apprentices who want to pursue a STEM career.
HSAP positively impacted apprentices' 21st Century skills related to STEM	Most responding apprentices reported large or extreme gains on each of these skills, including making changes when things do not go as planned, viewing failure as an opportunity to learn, and communicating effectively with others.

	The majority of apprentices indicated they were more likely or much more likely to engage in many of these activities as a result of HSAP, such as working on solving mathematical or scientific puzzles, talking with a friend or family member about STEM, helping with a community service project that relates to STEM, and mentoring or teaching other students about STEM.
HSAP apprentices come to the program with an interest in STEM, but the program positively influences their aspirations to pursue higher education degrees.	In terms of education, the questionnaire asked apprentices how far they wanted to go in school before and after participating in HSAP. More of the responding apprentices indicated wanting to obtain advanced degrees after participating in HSAP than before HSAP, most notably a 17% increase in the desire to obtain a Ph.D.
HSAP raised some apprentice awareness and appreciation of DoD STEM research but websites and social media outlets did not inform the apprentices about DoD STEM careers.	97% of HSAP apprentices learned about at least one general STEM job/career, and 50% learned about 5 or more STEM jobs/careers. The number of reported careers that were 5 or more has increased from the 2015 reports.
	There was little overall impact of resources on apprentice awareness of DoD STEM careers, and that only 68% of HSAP apprentices felt that their participation in the program impacted their awareness and 64% felt that their mentors impacted their awareness. Apprentices reported not experiencing the AAS website (83%), It Starts Here! Magazine (83%), social media outlets (72%), Invited speakers (61%), and the ARO website (53%).

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. Between 2014 and 2015, HSAP has engaged more apprentices who identify with a typically underrepresented group in STEM, which is a positive trend. Additionally, it is positive that the HBCU/MI sites increased from 2 in 2014 to 7 in 2015. 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.

HSAP FY16 Efforts and Outcomes: As HSAP is a commuter program conducted at university/college locations that vary annually, recruitment of apprentices is focused upon the surrounding area of the community in which the host sites are situated. ARO and AAS identified and targeted nearby high schools and organizations that have traditionally underserved and underrepresented populations in STEM, then directly sent emails advertising the HSAP program to those locations. The number of HBCU/MI sites participating in HSAP increased from 7 to 16 in FY16; 46% of HSAP host sites are HBCU/MIs. More focus was also given to diversity of STEM professionals via electronic mailings and social media.

1. **Finding:** Similar to past years, in HSAP, recruitment of apprentices is largely accomplished with personal interactions, either by knowing a teacher who is familiar with AEOP or a personal friend who has received an email about HSAP. As a result, the ability of HSAP to recruit underserved or underrepresented populations of students depends upon the diversity of the high schools in which recruitment takes place. Thus, HSAP may want to emphasize recruiting a more diverse pool of mentors and apprentices, perhaps specifically targeting more urban schools or schools who receive Title 1 funding. A focused and strategic plan to engage a more diverse pool of apprentices could ultimately improve the diversity of the STEM pipeline, based on the large impact that HSAP has on STEM knowledge, skills, and identity.

   HSAP FY16 Efforts and Outcomes: ARO and AAS identified and specifically marketed HSAP and other AEOP opportunities to schools who receive Title 1 funding in the surrounding area of the FY16 HSAP host site locations, which resulted in 35% of HSAP students represented underserved population, 15% over the FY16 target.

   Finding: HSAP 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. Mentors are particularly skilled in being able to engage high school students into their laboratory by giving them meaningful learning experiences and asking them to report on their work to graduate students and STEM professionals. Although mentors are particularly skilled in their area of expertise, mentors can be more effective in helping students understand the big picture of how STEM can improve community. Only 54% of mentors reported communicating how STEM can improve community. Only 52% of the mentors highlighted the under-representation of women and racial and ethnic minority populations in STEM as well. Mentors can be provided ways to incorporate how STEM topics affect the larger community in a systematic way by the program, so that the bigger picture of how STEM fits into society can be explicitly emphasized.

   HSAP FY16 Efforts and Outcomes: Mentors were required to express how STEM topics affect the larger community in the educational merit description of their proposals to ARO. They were also encouraged to discuss this with their participants. FY17 program plans include a focused attempt for improvement in this area by providing more-detailed training for mentors to empower them in this effort.

2. **Finding:** Similar to recommendation #3, 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 HSAP. 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 lack of awareness is a barrier in communicating about Army/DoD STEM research and careers. 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 HSAP 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.

HSAP FY16 Efforts and Outcomes: In FY16, HSAP 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. Sites, mentors, and students received AEOP print materials and information for access to online resources via Welcome Packets and weekly emails. The weekly communications with apprentices and mentors, which included the 2016 Guide to STEM Careers and the AEOP newsletters were provided online. HSAP students were also invited to participate in an Army DoD STEM Career Scavenger Hunt. Unfortunately, many students did not complete the scavenger hunt. However, enough did to distribute a gold, silver, and bronze winning medal. Also, ARO inquired about the scavenger hunt during local (NC) site visits and we were told by several students that they were very interested but didn't have time to participate. I'm not sure how to compare the increase in awareness as this was the first year we've implemented the scavenger hunt. We also utilized Constant Contacts for the first time this year (for promoting of the scavenger hunt and in general), but it is our intent to use a more personal approach in FY17. [Please see below the intent to use a more personal approach for survey completion as well. HSAP students were also given the ARO program manager contact information to create professional connections.

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

Finding: There were no recommendations in this area for HSAP in FY15.

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

Finding: Apprentices and mentors who participate in HSAP are only aware in a general way that other programs in AEOP exist. When asked, the mentors and apprentices could not name many of the other AEOP programs. Apprentices rated the HSAP program (88%) and their mentors (89%) at somewhat or very much impactful on their awareness of AEOPs. However, the majority of HSAP apprentices reported not experiencing the AEOP brochure and AEOP social media. Social media efforts, in particular, require constant updates and focused attention on messaging to gain attention. Since most HSAP applicants hear about the program through another individual, having a social media presence may increase the likelihood that an apprentice or mentor may hear about the program from another person who learned about it on Facebook, Twitter, or Pinterest. A recommendation for the FY16 years and beyond would be for the HSAP program mentors to provide time for apprentices to complete the survey during their apprenticeship meeting time. This will provide a more accurate measure to gauge how effective HSAP activities and communications are in growing awareness of AEOPs.

HSAP FY16 Efforts and Outcomes: Program evaluation completion is always challenging. In FY16, ARO plans 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 findings indicate that 2016 was a successful year for the HSAP program. HSAP had a 26% increase in the number of apprentice applicants and had a very competitive 18% placement rate of the apprentice applicants, which indicates there is great interest in this program, but potentially some unmet need. From the high quality applicants (mentors and apprentices), there were 42 mentors and 65 apprentices selected. HSAP has experienced some success in recruiting diverse apprentices, as there was an increase from 7 HBCU/MI sites to 16 HBCU/MI sites. Apprentices and mentors overwhelmingly reported satisfaction with HSAP experience. Mentors indicated they use innovative and research-based strategies to engage apprentices in STEM activities, and by engaging the apprentices, graduate students become better educators. Apprentices reported that the mentors were widely available and helpful in improving their STEM knowledge and skills. The apprentices similarly report increased ability to engage in STEM activities due to the HSAP experience. Additionally, engaging in more hands-on STEM experiences motivated the apprentices, which was delivered by their HSAP experience.

While the successes for HSAP 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. Between 2014 and 2016, HSAP has engaged more apprentices who identify with a typically underrepresented group in STEM, which is a positive trend. Additionally, it is positive that the HBCU/MI sites increased from 2 in 2014 to 7 in 2015 to 16 in 2016. HSAP should explore how to accommodate more participants in coming years – as the 18% placement rate indicates a much larger interest and need than is currently being accommodated.

2. Similar to past years in HSAP, recruitment of apprentices is largely accomplished with personal interactions, either by knowing someone at the university or someone who works at HSAP. As a result, the ability of HSAP to recruit underserved or underrepresented populations of students depends upon the diversity of the high schools in which recruitment takes place. Thus, HSAP may want to emphasize recruiting a more diverse pool of mentors and apprentices, perhaps specifically targeting more urban schools or schools who receive Title 1 funding. AAS and ARO should work with AEOP SOI awardees and identify possible overlaps where we can leverage our strategic outreach partners' reach and network A focused and strategic plan to engage a more diverse pool of apprentices could ultimately improve the diversity of the STEM pipeline, based on the large impact that HSAP has on STEM knowledge, skills, and identity.

3. HSAP is very effective in offering apprentices authentic opportunities to engage in STEM professional activities, and for mentors to build the next generation of STEM professionals. Mentors are particularly skilled in being able to engage high school students in their laboratory by giving them meaningful learning experiences and asking them to report on their work to graduate students and STEM professionals. Most of the apprentices had not heard of the range of AEOP programs (78% had not hear of UNITE, 86% had not heard of CQL, and 79% had not heard of GEMS Near Peer). Although mentors are particularly skilled in their area of expertise, mentors should be better prepared by the program to provide information and resources on the array of AEOP opportunities. AAS/ARO should work with the Battelle and the CAM to develop materials and training/onboarding that could be used with mentors each year to target this area of need.

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

1. HSAP mentors were effective in FY16 at informing apprentices about DoD STEM jobs/careers, as 97% of respondents reported hearing about one STEM career and 50% reported hearing about 5 or more, which is increased greatly from 2015. However, there was little overall impact of the program and mentors on apprentice awareness of DoD STEM careers, as only 68% of HSAP apprentices felt that their participation in the program impacted their awareness and 64% felt that their mentors impacted their awareness.

   Apprentices reported not utilizing the AAS website (83%), It Starts Here! Magazine (83%), social media outlets (72%), Invited speakers (61%), and the ARO website (53%). This lack of awareness/utilization is a potential barrier for communicating about Army/DoD STEM research and careers and the AEOP portfolio overall. 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 HSAP 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. Again, some type of onboarding/training for mentors – even virtual – would help to support progress in this area for HSAP.

2. Participation in the HSAP evaluation improved for apprentices but less than desirable for mentors. Very few mentors (12%) and apprentices (55%) completed the evaluation survey. The program leadership reported the decrease in participants was greatly due to the use of Constant Contacts for the majority of marketing/promotion, instead of more personal approaches to participation in the evaluation survey. It is recommended that the program use a more personal approach to recruiting participation in the evaluation survey. This strategy worked well for recruiting participants in the evaluation interviews in FY16. A recommendation for the FY17 years and beyond would be for the HSAP program mentors to provide time for apprentices to complete the survey during their apprenticeship meeting time. This will provide a more accurate measure to gauge how effective HSAP activities and communications are in growing awareness of AEOPs.

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 (HSAP). HSAP is managed by the U.S. Army Research Office (ARO). The evaluation study was performed by Purdue University in cooperation with Battelle, the Lead Organization (LO) in the AEOP CA consortium. Data analyses and reports were prepared using data collected by the former LO, Virginia Tech (VT).

Program Overview

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

Apprentices receive an educational stipend equivalent to $10 per hour, and are allowed to work up to 300 hours total. The apprentices contribute to the 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 them what kind of work awaits them in their future career. At the end of the program, the apprentices prepare abstracts for submission to the U.S. Army Research Office's Youth Science Programs office.

In 2015, HSAP was guided by the following priorities:

1. Provide hands-on science and engineering research experience to high school students;
2. Educate students about the Army's interest and investment in science and engineering research and the associated educational opportunities available to students through the AEOP;
3. Provide students with experience in developing and presenting scientific research;
4. Benefit students from the expertise of a scientist or engineer as a mentor; and
5. Develop students' skills and background to prepare them for competitive entry to science and engineering undergraduate programs.

HSAP awards were made at 35 universities or colleges in 18 different U.S. States and funded 65 apprentices (see Table 1). Sixteen of the university/college sites were HBCU/MIs, which is greatly increased from 2015 (at 7 HBCU/MIs; denoted with an asterisk below.)

Table 1. 2016 HSAP Sites

2016 HSAP Site	City	State	No. of Participants
Adams State University*	Alamosa	Colorado (CO)	2
Arizona State University*	Tempe	Arizona (AZ)	4
Children's Hospital of Philadelphia	Philadelphia	Pennsylvania (PA)	1
City University of New York*	New York	New York (NY)	2
Clark Atlanta University*	Atlanta	Georgia (GA)	1
Colorado School of Mines	Golden	Colorado (CO)	2
Duke University	Durham	North Carolina (NC)	1
Florida International University*	Miami	Florida (FL)	3
Georgia State University*	Atlanta	Georgia (GA)	1
Georgia Tech	Atlanta	Georgia (GA)	3
Louisiana State University*	Baton Rouge	Louisiana (LA)	1
Michigan State University	East Lansing	Michigan (MI)	2
NC A&T*	Greensboro	North Carolina (NC)	2
North Carolina State University	Raleigh	North Carolina (NC)	1
Rutgers, State University - New Jersey	Camden	New Jersey (NJ)	1
Savannah State University*	Savannah	Georgia (GA)	4
Stony Brook University of New York	Stony Brook	New York (NY)	2
Texas State University*	San Marcos	Texas (TX)	5
University of Alabama	Tuscaloosa	Alabama (AL)	1
University of Arizona	Tucson	Arizona (AZ)	2
University of California - Riverside*	Riverside	California (CA)	2
University of Central Florida	Orlando	Florida (FL)	2
University of Colorado	Boulder	Colorado (CO)	1

University of Illinois (at Harvard)	Cambridge	Massachusetts (MA)	6
University of Maryland - College Park*	College Park	Maryland (MD)	1
University of Massachusetts - Amherst	Amherst	Massachusetts (MA)	1
University of Miami - Coral Gables*	Coral Gables	Florida (FL)	2
University of New Hampshire	Durham	New Hampshire (NH)	1
University of North Carolina - Charlotte*	Charlotte	North Carolina (NC)	1
University of Texas - Arlington*	Arlington	Texas (TX)	1
University of Texas - Austin	Austin	Texas (TX)	2
University of Texas - El Paso*	El Paso	Texas (TX)	1
University of Texas - Rio Grande Valley*	Rio Grande Valley	Texas (TX)	1
Washington State University	Pullman	Washington (WA)	1
Yale University	New Haven	Connecticut (CT)	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 the 2016 HSAP program was $235,746, including $180,876 in stipends. The average cost per HSAP participant was **$3,627**. Table 2 summarizes these 2016 HSAP program costs. Funding was provided by ARO program managers with matching stipend funds plus additional overhead from AEOP.

Table 2. 2016 HSAP Program Costs	
2016 HSAP - Cost Per Participant	
Total Participants (Apprentices)	65 (62 funded by AEOP and ARO)
Total Cost	$235,746
Total Stipends	$180,876
Cost Per Participant	**$3,627**

Evidence-Based Program Change

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

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

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

Activities:

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

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

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

Activities:

- All directors/mentors, students and lab coordinators received AEOP brochures, AEOP notebooks, flash drives and lab coats to promote all AEOP programs.
- Apprenticeship announcements to over 500 high schools, PTAs and after school programs targeting more diverse population, specifically to those close to host universities and DoD laboratories, also included information about all AEOP programs.
- Directors/mentors, students and lab coordinators received weekly communications addressing the entire AEOP portfolio, program evaluation assistance, abstract tip submissions, AEOP Newsletter, Social Media guidelines and the 2016 Guide to STEM Careers.
- New social media campaign was developed, including an AAS Instagram account and hashtag campaign to engage participants. #AEOPapprentice Executed AEOP's Social Media Guidelines using relevant hashtags, i.e. #edchat, #science, #womeninSTEM, #USAEOP, etc.
- Cross marketing by sharing posts about all AEOP programs.
- Provided photos and newsworthy items to Widmeyer throughout the summer.

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

- *Create opportunities for Army researchers to engage with students, as guest speakers and to visit host university sites, and opportunities for apprentices in university based programs to visit Army sites*

- *Create standardized information on Army STEM career opportunities; distribute to all apprentices*
- *Work with LPCs to obtain success stories and best practices which showcase STEM careers*

Activities:

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

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

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

Activities:

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

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 conducted a comprehensive evaluation of the HSAP program. The HSAP logic model below presents a summary of the expected outputs and outcomes for the HSAP program in relation to the AEOP and HSAP-specific priorities. This logic model provided guidance for the overall HSAP evaluation strategy.

Inputs	Activities	Outputs	Outcomes (Short term)	Impact (Long Term)
• Army and ARO sponsorship • ARO providing oversight of programming • Operations conducted by 28 Army-funded university/college labs (HSAP sites) • Forty-nine students participating in HSAP apprenticeships • Twenty-eight university/college S&Es serve as HSAP mentors • Apprenticeship funds administered to university/college labs to support student participation • Centralized branding and comprehensive marketing • Centralized evaluation	• Students engage in authentic STEM research experiences through hands' on summer apprenticeships at Army-sponsored university/college labs • University/college S&Es supervise and mentor students' research • Program activities that expose students to AEOP programs and/or STEM careers in the Army or DoD	• Number and diversity of student participants engaged in HSAP • Number and diversity of university/college S&Es engaged in HSAP • Number and Title 1 status of high schools served through student engagement • Students, university/college S&Es, and ARO contributing to evaluation	• Increased student STEM competencies (confidence, knowledge, skills, and/or abilities to do STEM) • Increased student interest in future STEM engagement • Increased student awareness of and interest in other AEOP opportunities • Increased student awareness of and interest in STEM research and careers • Increased student awareness of and interest in Army/DoD STEM research and careers • Implementation of evidence-based recommendations to improve HSAP programs	• Increased student participation in other AEOP opportunities and Army/DoD-sponsored scholarship/ fellowship programs • Increased student pursuit of STEM coursework in secondary and post-secondary schooling • Increased student pursuit of STEM degrees • Increased student pursuit of STEM careers • Increased student pursuit of Army/DoD STEM careers • Continuous improvement and sustainability of HSAP

The HSAP evaluation gathered information from apprentice and mentor participants about HSAP 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 HSAP program objectives.

Key Evaluation Questions

- What aspects of HSAP motivate participation?
- What aspects of HSAP structure and processes are working well?
- What aspects of HSAP could be improved?
- Did participation in HSAP:
  - 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 HSAP included post-program apprentice and mentor questionnaires, individual interviews with eight apprentices (via telephone), and an online focus group with three mentors. Tables 3-6 outline the information collected in apprentice and mentor questionnaires, apprentice interviews, and mentor focus group.

Table 3. 2016 Apprentice Questionnaire	
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
Satisfaction & Suggestions	Benefits to participants, suggestions for improving programs, overall satisfaction
AEOP Goal 1	**Capturing the Apprentice Experience:** In-school vs. in-program experience, mentored research experience and products
	STEM Competencies: Gains in Knowledge of STEM, Science & Engineering Practices; contribution of AEOP
	Transferrable Competencies: Gains in 21st Century Skills
	STEM Identity: Gains in STEM identity, intentions to participate in STEM, STEM-oriented education and career aspirations, contribution of AEOP
	AEOP Opportunities: Past participation, awareness of, and interest in participating in other AEOP programs; contribution of AEOP; impact of AEOP resources
	Army/DoD STEM: Exposure to Army/DoD STEM jobs, attitudes toward Army/DoD STEM research and careers, change in interest for STEM and Army/DoD STEM jobs; contribution of AEOP, impact of AEOP resources
AEOP Goal 2 and 3	**Mentor Capacity:** Perceptions of mentor/teaching strategies (apprentices respond to a subset)
	Comprehensive Marketing Strategy: How apprentices learn about AEOP, motivating factors for participation, impact of AEOP resources on awareness of AEOPs and Army/DoD STEM research and careers

Table 4. 2016 Mentor Questionnaire	
Category	**Description**
Profile	**Demographics:** Participant gender, race/ethnicity, occupation, past participation
Satisfaction & Suggestions	Awareness of HSAP, motivating factors for participation, satisfaction with and suggestions for improving the HSAP program, benefits to participants
AEOP Goal 1	**Capturing the Apprentice 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 apprentices to AEOPs, impact of AEOP resources on efforts; contribution of AEOP in changing apprentice AEOP metrics
	Army/DoD STEM: Attitudes toward Army/DoD STEM research and careers, efforts to expose apprentices to Army/DoD STEM research/careers, impact of AEOP resources on efforts; contribution of AEOP in changing apprentice Army/DoD career metrics
AEOP Goal 2 and 3	**Mentor Capacity:** Perceptions of mentor/teaching strategies
	Comprehensive Marketing Strategy: How mentors learn about AEOP, usefulness of AEOP resources on awareness of AEOPs and Army/DoD STEM research and careers

Table 5. 2016 Apprentice Interviews	
Category	**Description**
Profile	Gender, race/ethnicity, grade level, past participation in HSAP, past participation in other AEOP programs
Satisfaction & Suggestions	Awareness of HSAP, motivating factors for participation, involvement in other science programs in addition to HSAP, satisfaction with and suggestions for improving the HSAP program, benefits to participants
AEOP Goal 1 and 2 Program Efforts	**AEOP Opportunities:** Extent to which apprentices were exposed to other AEOP opportunities
	Army/DoD STEM: Extent to which apprentices were exposed to STEM and Army/DoD STEM jobs

Table 6. 2016 Mentor Focus Group	
Category	**Description**
Profile	Gender, race/ethnicity, occupation, organization, role in HSAP, past participation in HSAP, past participation in other AEOP programs
Satisfaction & Suggestions	Perceived value of HSAP, benefits to apprentices, benefits to mentors, suggestions for improving the HSAP program
AEOP Goal 1 and 2 Program Efforts	**AEOP Opportunities:** Efforts to expose apprentices to AEOP opportunities
	Army/DoD STEM Careers: Efforts to expose apprentices to STEM and Army/DoD STEM jobs
	Mentor Capacity: Strategies used to increase diversity/support diversity in HSAP

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. The apprentice interview protocol is provided in Appendix B, the mentor interview protocol is provided in Appendix C, the apprentice questionnaire is provided in Appendix D, and the mentor questionnaire is provided in Appendix E. Major trends in data and analyses are reported herein.

Study Sample

Table 7 provides a display of HSAP apprentice participation by university. There were 65 apprentices placed with 42 different mentors at 35 universities. Sixteen of these universities are identified as historically Black colleges and universities (HBCUs) or minority serving status (MIs).

Table 7. 2016 HSAP Sites

2016 HSAP Site	City	State	No. of Participants
Adams State University	Alamosa	Colorado (CO)	2
Arizona State University	Tempe	Arizona (AZ)	4
Children's Hospital of Philadelphia	Philadelphia	Pennsylvania (PA)	1
City University of New York	New York	New York (NY)	2
Clark Atlanta University	Atlanta	Georgia (GA)	1
Colorado School of Mines	Golden	Colorado (CO)	2
Duke University	Durham	North Carolina (NC)	1
Florida International University	Miami	Florida (FL)	3
Georgia State University	Atlanta	Georgia (GA)	1
Georgia Tech	Atlanta	Georgia (GA)	3
Louisiana State University	Baton Rouge	Louisiana (LA)	1
Michigan State University	East Lansing	Michigan (MI)	2
NC A&T	Greensboro	North Carolina (NC)	2
North Carolina State University	Raleigh	North Carolina (NC)	1
Rutgers, State University - New Jersey	Camden	New Jersey (NJ)	1
Savannah State University	Savannah	Georgia (GA)	4
Stony Brook University of New York	Stony Brook	New York (NY)	2
Texas State University	San Marcos	Texas (TX)	5
University of Alabama	Tuscaloosa	Alabama (AL)	1
University of Arizona	Tucson	Arizona (AZ)	2
University of California - Riverside	Riverside	California (CA)	2
University of Central Florida	Orlando	Florida (FL)	2
University of Colorado	Boulder	Colorado (CO)	1

University of Illinois (at Harvard)	Cambridge	Massachusetts (MA)	6
University of Maryland - College Park	College Park	Maryland (MD)	1
University of Massachusetts - Amherst	Amherst	Massachusetts (MA)	1
University of Miami - Coral Gables	Coral Gables	Florida (FL)	2
University of New Hampshire	Durham	New Hampshire (NH)	1
University of North Carolina - Charlotte	Charlotte	North Carolina (NC)	1
University of Texas - Arlington	Arlington	Texas (TX)	1
University of Texas - Austin	Austin	Texas (TX)	2
University of Texas - El Paso	El Paso	Texas (TX)	1
University of Texas - Rio Grande Valley	Rio Grande Valley	Texas (TX)	1
Washington State University	Pullman	Washington (WA)	1
Yale University	New Haven	Connecticut (CT)	1

The response rate for the post-program apprentice survey decreased from 72% in 2015 to 55% in 2016. The response rate for the mentor survey was slightly lower than 29% in 2014 at 12% in 2016, but much lower than 61% in 2015. These response rates have a large margin of error in terms of being able to generalize from the sample to the HSAP population.

Table 8. 2016 HSAP Questionnaire Participation

Participant Group	Respondents (Sample)	Total Participants (Population)	Participation Rate	Margin of Error @ 95% Confidence[1]
Apprentices	36	65	55%	±10.9%
Mentors	11	95	12%	±27.9%

Individual interviews were conducted with eight apprentices. The ARO office recruits participants for the phone interviews that are conducted as part of the evaluation. Participants ranged from rising 11th graders to rising college freshmen. Three mentor interviews were also conducted. The 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 HSAP's efforts and impact, and highlight areas for future exploration in programming and evaluation.

[1] "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.

Respondent Profiles

Apprentice Demographics

Demographic information collected from HSAP apprentice questionnaire respondents is summarized in Table 9.[2] Approximately equal numbers of males and females completed the questionnaire. More responding apprentices identified with the race/ethnicity category of White (33%) than any other single race/ethnicity category, but this percentage was down from 54% in 2015. The next largest demographic was Asian (28%). The percentage of respondents identifying as Black or African American more than doubled from 2015 (8%) to 2016 (20%). Respondents ranged from rising 11th graders to rising college freshmen.

Findings revealed HSAP experienced success in attracting participation from female students—a population that is historically underrepresented in many STEM fields. HSAP also had success in providing outreach to students from historically underrepresented and underserved race/ethnicity and low-income groups, as more than half of the respondents reported being in a race/ethnicity category other than White.

[2] 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 9. 2016 HSAP Apprentice Respondent Profile		
Demographic Category	**Questionnaire Respondents**	
Respondent Gender (n = 36)		
Female	17	47%
Male	19	53%
No Response	0	0%
Respondent Race/Ethnicity (n = 36)		
Asian	10	28%
Black or African American	7	19%
Hispanic or Latino	4	11%
Native American or Alaska Native	1	3%
Native Hawaiian or Other Pacific Islander	0	0%
White	12	33%
Other race or ethnicity, (specify):[†]	1	3%
Choose not to report	1	3%
Respondent Grade Level (n = 25)		
10th	0	0%
11th	2	6%
12th	29	81%
College freshman	5	13%
Choose not to report	0	0%

Demographic information collected from HSAP mentor questionnaire respondents is summarized in Table 10. In 2014 only 2 mentors responded to the questionnaire and in 2015 41 mentors responded to the questionnaire, so it is difficult to make comparisons from year to year. It is notable that the response rate for the 2016 questionnaire had decreased from 2015. The 2015 demographic information indicated roughly 60% of the mentors were from race/ethnicity White. Having a diverse group of mentors is necessary for providing role models for apprentices who come from typically underrepresented groups in STEM.

Table 10. 2016 HSAP Mentor Respondent Profile		
Demographic Category	**Questionnaire Respondents**	
Respondent Gender (n = 11)		
Female	1	9%
Male	10	91%
No Response	0	0%
Respondent Race/Ethnicity (n = 11)		
Asian	16	39%
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	7	64%
No Response	1	9%
Respondent Occupation (n = 11 some indicated more than one occupation)		
University educator	10	77%
Scientist, Engineer, or Mathematician in training (undergraduate or graduate apprentice, etc.)	1	8%
Scientist, Engineer, or Mathematics professional	2	15%
Other, (specify):	0	0%

In order to determine the effectiveness of the AEOP pipeline, apprentices were asked about their participation in other programs in AEOP. Table 11 displays their responses. Only two of the respondents indicated that they participated in other AEOP programs, one in GEMS and one in UNITE. About a third of the respondents reported participating in other STEM programs that were not part of the AEOP portfolio.

Table 11. Apprentice Participation in Previous AEOP Programs

Choice	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)	2.56 %	1
UNITE	2.56 %	1
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	66.67 %	26
Other STEM Program	28.21 %	11

Actionable Program Evaluation

The Actionable Program Evaluation provides information about tangible changes that can be made to improve programs. 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.

Efforts toward the long-term goal of HSAP to increase and diversify the future pool of talent capable of contributing to the nation's scientific and technology progress is realized in the Actionable Program Evaluation. HSAP sites reach out to students of traditionally underrepresented and underserved populations. Thus, it is important to consider how HSAP is marketed and ultimately recruits student participants, the factors that motivate students to participate in HSAP, 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 HSAP achieve outcomes related to AEOP programs and objectives.

Marketing and Recruiting Underrepresented and Underserved Populations

The solicitation of host sites and students was a focus in the marketing and recruiting of underrepresented and underserved populations. According to the annual program report submitted by AAS, a number of strategies were used to disseminate information about the HSAP program to a diverse audience:

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

ARO, the manager of HSAP as well as the Undergraduate Research Apprenticeship Program (URAP), invited ARO-funded principal investigators at university and college laboratories nationwide to apply for the opportunity to host HSAP and/or URAP apprentices. Once the host labs were selected, HSAP apprenticeships were marketed to students in the following ways: together with the AEOP portfolio of opportunities on the AEOP website, print materials, and social media; targeted marketing through email to high school in proximity to HSAP opportunities; and through targeted distribution of marketing materials at regional STEM events, including the Junior Science & Humanities Symposium (JSHS). It is unclear how these marketing and recruiting efforts targeted underrepresented and underserved student and mentor populations.

HSAP applicants were asked to identify all of the different ways they heard about HSAP in order to understand which recruitment methods are most effective. Table 12 shows that someone who works at the university (29%), school or university newsletter, email, or website (15%), and the AEOP website (15%) were the most frequently mentioned sources of information about HSAP. Other responses include hearing about HSAP from a family member (11%) and from someone who works in the program (11%).

Table 12. How Apprentices Learned About HSAP (n=33)

Choice	Response Percent	Response Total
Army Educational Outreach Program (AEOP) Website	14.55 %	8
AEOP on Facebook, Twitter, Instagram, or other social media	1.82 %	1
School or university newsletter, email, or website	14.55 %	8
Past participant of program	3.64 %	2
Friend	5.45 %	3
Family Member	10.91 %	6
Someone who works at the school or university I attend	29.09 %	16
Someone who works with the program	10.91 %	6
Someone who works with the Department of Defense (Army, Navy, Air Force, etc.)	5.45 %	3
Community group or program	3.64 %	2
Choose Not to Report	0.00 %	0

Mentors were asked how they learned about HSAP on their submitted proposals. Table 13 displays their responses, which indicate that the ARO (39%) was the most prominent source of information about HSAP. The other frequent responses include the AEOP website (15%), someone who works for the DoD (23%) and a colleague (15%). Conferences, workplace communications, students, and social media were not sources of information for the mentors about HSAP.

Table 13. How Mentors Learned About HSAP (n=13)

Choice	Response Percent	Response Total
Army Research Office (ARO) website	38.46 %	5
Academy of Applied Science (AAS)	0.00 %	0
Army Educational Outreach Program (AEOP) website	15.38 %	2
AEOP on Facebook, Twitter, Pinterest, or other social media	0.00 %	0
A STEM conference or STEM education conference	0.00 %	0
An email or newsletter from school, university, or a professional organization	0.00 %	0

Past HSAP participant	0.00 %	0
A student	0.00 %	0
A colleague	15.38 %	2
My supervisor or superior	7.69 %	1
A HSAP site host or director	0.00 %	0
Workplace communications	0.00 %	0
Someone who works with the Department of Defense (Army, Navy, Air Force)	23.08 %	3
Other, (specify):	7.69 %	1

Factors Motivating Apprentice Participation

In order to understand the students who apply to be HSAP apprentices, the HSAP application asked what motivated apprentices to decide to participate in the program. Apprentices were able to choose more than one factor, and about half of the respondents chose most of the options, resulting in a small, but consistent response percent across most factors. Table 14 shows that all the most frequent motivation was a desire to learn something new or interesting (9%), an interest in STEM (9%), and a desire to expand laboratory or research skills (9%), which were similar to the 2015 responses. It appears that the HSAP apprentices are self-motivated because there was a low or zero frequency of responses such as being motivated by an academic requirement or school grade.

Table 14. Factors Motivating Apprentice Participation in HSAP (n=33)

Choice	Response Percent	Response Total
Teacher or professor encouragement	3.79 %	13
An academic requirement or school grade	0.29 %	1
Desire to learn something new or interesting	9.04 %	31
The mentor(s)	3.21 %	11
Building college application or résumé	6.41 %	22
Networking opportunities	6.12 %	21
Interest in science, technology, engineering, or mathematics (STEM)	9.04 %	31
Interest in STEM careers with the Army	4.08 %	14
Having fun	5.54 %	19
Earning stipends or awards for doing STEM	4.08 %	14
Opportunity to do something with friends	1.46 %	5
Opportunity to use advanced laboratory technology	8.16 %	28

Desire to expand laboratory or research skills	8.75 %	30
Learning in ways that are not possible in school	7.58 %	26
Serving the community or country	4.37 %	15
Exploring a unique work environment	7.58 %	26
Figuring out education or career goals	4.96 %	17
Seeing how school learning applies to real life	5.54 %	19
Recommendations of past participants	0.00 %	0
Choose Not to Report	0.00 %	0

Similar data appeared in the interviews with the apprentices. The following three apprentices spoke about their interest in STEM topics and how HSAP helped them expand on their interests. In the words of three apprentices:

> *One of the projects we did was in the field of genomics. We had to write a program. What the program was, was that we were supposed to be given some sequences of DNA, and the program would go identify relationships, properly align sequences because sequences are not necessarily the same length and then create the evolutionary history of those sequences of DNA. I previously didn't know how to program before. I learned how to program through this program. (HSAP Apprentice)*

> *What I got out of the program was definitely how your research things and tackle topics, as well as when it comes to broader issues, how to figure out what you have access to, and what can you use for STEM. (HSAP Apprentice)*

> [The biggest benefit was] *collaborating with the people and working on things like programming which I honestly, usually assume are one person jobs. Working with other people on projects like these has definitely been enlightening. (HSAP Apprentice)*

The HSAP Experience

The intent of HSAP is to provide high school students with STEM experiences they wouldn't normally obtain in schools and many of the evaluation survey items focused on the HSAP experience specifically. For instance, the apprentice questionnaire included several items asking about the nature of apprentices' input on their project. The most frequent response was that the apprentice was assigned a project by their mentor (61%), followed by working with a mentor and members of a research team (22%). Only 8% of apprentices had a choice among various projects suggested by their mentors.

Table 15. Apprentice Input on Design of Their Project (n=36)

Choice	Response Percent	Response Total
I did not have a project	3.57 %	1
I was assigned a project by my mentor	61.11 %	22
I worked with my mentor to design a project	7.14 %	2
I had a choice among various projects suggested by my mentor	8.33 %	3
I worked with my mentor and members of a research team to design a project	22.22 %	8
I designed the entire project on my own	0.00 %	0

Twenty-five percent of responding apprentices reported working with others in a shared laboratory space but on separate projects, 22% worked alone on a project that was connected with a group, and 17% reported that they worked alone but met with a group reporting on projects. The remaining 8% worked alone (see Table 16).

Table 16. Apprentice Participation in a Research Group (n=36)

Choice	Response Percent	Response Total
I worked alone (or alone with my research mentor)	8.33 %	3
I worked with others in a shared laboratory or other space, but we work on different projects	25.00 %	9
I worked alone on my project and I met with others regularly for general reporting or discussion	16.67 %	6
I worked alone on a project that was closely connected with projects of others in my group	22.22 %	8
I work with a group who all worked on the same project	27.78 %	10

In order to get a better understanding of the activities apprentices experienced in HSAP, apprentices were asked a series of questions about what their HSAP experience focused on. Table 17 shows that 97% of the apprentices interacted with scientists or engineers on most days or every day, 92% applied STEM learning to real-life situations most days or every day, and 97% learned about new STEM topics. Similarly, 76% of apprentices learned about new discoveries in STEM, 85% communicated with other students about STEM, and 75% learned about different careers that use STEM most days or every day.

Table 17. Nature of Apprentice Activities in HSAP (n=36)

	Not at all	At least once	A few times	Most days	Every day	Response Total
Learn about science, technology, engineering, or	0.0%	0.0%	2.8%	30.6%	66.7%	**36**

mathematics (STEM) topics that are new to you	0	0	1	11	24	
Apply STEM learning to real-life situations	0.0%	2.8%	5.6%	19.4%	72.2%	**36**
	0	1	2	7	26	
Learn about new discoveries in STEM	0.0%	5.6%	16.7%	36.1%	41.7%	**36**
	0	2	6	13	15	
Learn about different careers that use STEM	0.0%	0.0%	25.0%	44.4%	30.6%	**36**
	0	0	9	16	11	
Interact with scientists or engineers	0.0%	0.0%	2.8%	11.1%	86.1%	**36**
	0	0	1	4	31	
Communicate with other students about STEM	5.6%	2.8%	5.6%	27.8%	58.3%	**36**
	2	1	2	10	21	**36**

One goal of the HSAP program is to increase the number and diversity of students who purse STEM careers. Therefore, questions on the apprentice questionnaire asked about the number of jobs/careers in STEM in general and specifically STEM jobs/careers in the DoD that apprentices learned about during their experience. Table 18 shows that 97% HSAP apprentices learned about at least one general STEM job/career, and 50% learned about 5 or more STEM jobs/careers. The number of reported careers that were 5 or more has increased from the 2015 reports.

Table 18. Number of STEM Jobs/Careers Apprentices Learned about During HSAP (n=36)

Choice	Response Percent	Response Total
None	2.78 %	1
1	8.33 %	3
2	16.67 %	6
3	19.44 %	7
4	2.78 %	1
5 or more	50.00 %	18

To better understand the channel of communication about DoD STEM careers, apprentices were asked which resources impacted their awareness of DoD STEM careers. Table 19 shows that there was little overall impact of resources on apprentice awareness of DoD STEM careers, and that only 68% of HSAP apprentices felt that their participation in the program impacted their awareness and 64% felt that their mentors impacted their awareness. Apprentices reported not

experiencing the AAS website (83%), It Starts Here! Magazine (83%), social media outlets (72%), Invited speakers (61%), and the ARO website (53%).

Table 19. Impact of Resources on Apprentice Awareness of DoD STEM Careers (n=36)

	Did not experience	Not at all	A little	Somewhat	Very much	Response Total
Army Research Office (ARO) website	52.8%	2.8%	11.1%	22.2%	11.1%	
	19	1	4	8	4	36
Army Educational Outreach Program (AEOP) website	41.7%	5.6%	11.1%	30.6%	11.1%	
	15	2	4	11	4	36
AEOP on Facebook, Twitter, Pinterest or other social media	72.2%	8.3%	13.9%	5.6%	0.0%	
	26	3	5	2	0	36
AEOP brochure	50.0%	11.1%	11.1%	13.9%	13.9%	
	18	4	4	5	5	36
It Starts Here! Magazine	83.3%	5.6%	8.3%	2.8%	0.0%	
	30	2	3	1	0	36
My HSAP mentor(s)	16.7%	2.8%	16.7%	27.8%	36.1%	
	6	1	6	10	13	36
Invited speakers or "career" events during HSAP	61.1%	0.0%	8.3%	8.3%	22.2%	
	22	0	3	3	8	36
Participation in HSAP	11.8%	0.0%	20.6%	14.7%	52.9%	
	4	0	7	5	18	34
Academy of Applied Science (AAS) website	82.9%	2.9%	2.9%	8.6%	2.9%	
	29	1	1	3	1	35

Apprentices were asked how often they engaged in various STEM practices during HSAP. Results in Table 20 indicate that apprentices were very actively engaged in doing STEM during the HSAP program. The entire STEM practices were experienced by the HSAP apprentices the majority of most days or every day. The most frequently experienced STEM practice was working as part of a team (82%), analyzing data from an investigation (81%) and participating in hands-on STEM activities (83%). Building or creating a model was the least experienced practice (39%).

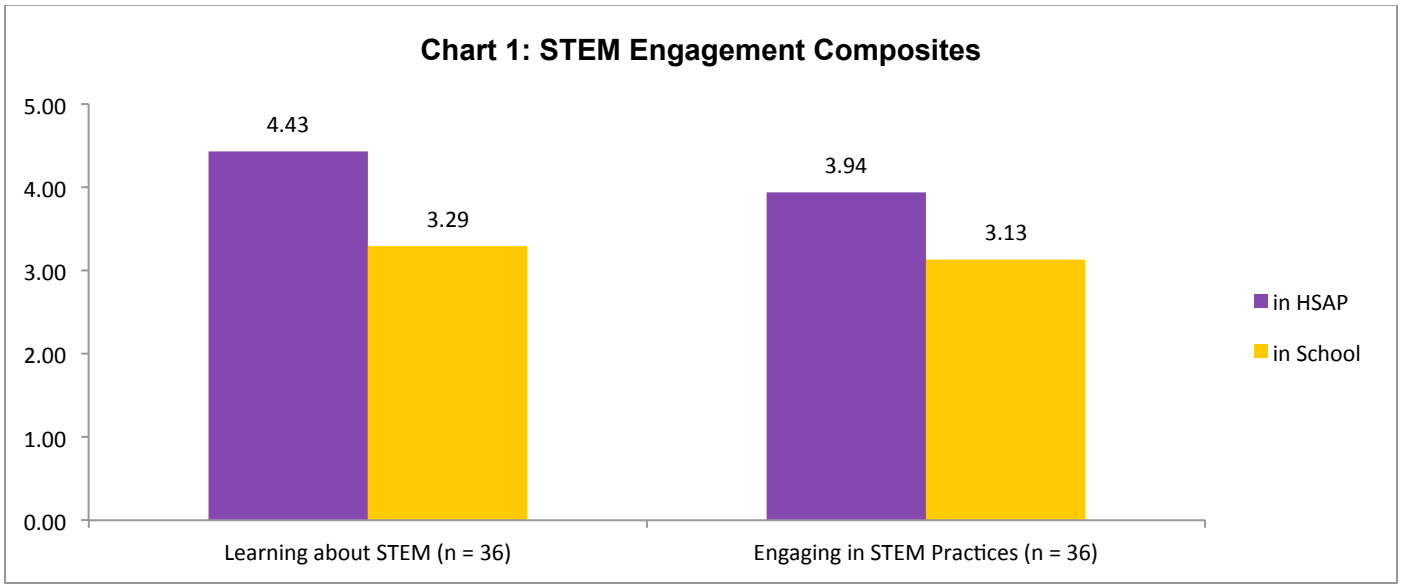
Table 20. Apprentice Engagement in STEM Practices in HSAP (n=36)

	Not at all	At least once	A few times	Most days	Every day	Response Total
Use laboratory procedures and tools	5.6%	8.3%	13.9%	30.6%	41.7%	
	2	3	5	11	15	**36**
Participate in hands-on STEM activities	5.6%	2.8%	8.3%	27.8%	55.6%	
	2	1	3	10	20	**36**
Work as part of a team	2.8%	2.8%	11.1%	19.4%	63.9%	
	1	1	4	7	23	**36**
Identify questions or problems to investigate	0.0%	0.0%	19.4%	30.6%	50.0%	
	0	0	7	11	18	**36**
Design an investigation	13.9%	5.6%	25.0%	27.8%	27.8%	
	5	2	9	10	10	**36**
Carry out an investigation	8.3%	0.0%	16.7%	33.3%	41.7%	
	3	0	6	12	15	**36**
Analyze data or information	2.8%	0.0%	16.7%	30.6%	50.0%	
	1	0	6	11	18	**36**
Draw conclusions from an investigation	2.8%	2.8%	16.7%	36.1%	41.7%	
	1	1	6	13	15	**36**
Come up with creative explanations or solutions	2.8%	2.8%	25.0%	38.9%	30.6%	
	1	1	9	14	11	**36**
Build or make a computer model	38.9%	2.8%	19.4%	22.2%	16.7%	
	14	1	7	8	6	**36**

A composite score[3] was calculated for each of these two sets of items, the first titled "Learning about STEM in HSAP,"[4] and the second "Engaging in STEM Practices in HSAP."[5] Response categories were converted to a scale of 1 = "Not at all"

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

to 5 = "Every day" and the average across all items in the scale was calculated. The composite scores were used to test whether there were differences in apprentice experiences by gender and race/ethnic group (minority vs. non-minority apprentices)[6]. There were no significant differences by gender or race/ethnicity on any of the 4 composites. 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 HSAP. Apprentices report significantly higher STEM Learning and STEM Engagement in HSAP over school (Learning effect size is large with d = 2.62; Engagement effect size is large with d = 2.04).



The Role of Mentors

Mentors were asked about the strategies they used to establish relevance of learning activities during the HSAP experience. Table 22 shows that most of the strategies listed on the questionnaire were reportedly used by 58% or more of the mentors and in the case of becoming familiar with apprentices' backgrounds, 100% of mentors performed this strategy. Only 58% of the mentors used the strategies of understanding how STEM can help them improve their own community and connecting STEM to real-life events.

these problems by reducing the total number of statistical tests used. In addition, composite scores are typically more reliable than individual questionnaire items.

[4] The Cronbach's alpha reliability for these 6 items was 0.783.

[5] The Cronbach's alpha reliability for these 10 items was 0.861.

[6] Dependent Samples t-test for STEM Learning: $t(35)=7.74$, $p<.001$; Dependent Samples t-test for STEM Engagement: $t(35)=6.02$, $p<.001$.

Table 22. Mentors Using Strategies to Establish Relevance of Learning Activities (n=13)

	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 HSAP experience	100.0%	0.0%	
	13	0	13
Giving students real-life problems to investigate or solve	84.6%	15.4%	
	11	2	13
Selecting readings or activities that relate to students' backgrounds	91.7%	8.3%	
	11	1	12
Encouraging students to suggest new readings, activities, or projects	61.5%	38.5%	
	8	5	13
Helping students become aware of the role(s) that STEM plays in their everyday lives	76.9%	23.1%	
	10	3	13
Helping students understand how STEM can help them improve their own community	58.3%	41.7%	
	7	5	12
Asking students to relate real-life events or activities to topics covered in HSAP	58.3%	41.7%	
	7	5	12

One of the goals of HSAP is to encourage typically underrepresented students to participate in STEM activities. Therefore, mentors were asked which strategies they used to support the diverse needs of students as learners. As Table 23 shows, more than 75% of the mentors used 4 of the 7 strategies listed on the questionnaire, and 100% of the mentors used a variety of teaching and/or mentoring activities to meet the needs of all students. Only 41% of the mentors highlighted the integration of ideas from education literature and the under-representation of woman and only 54% highlighted racial and ethnic minority populations in STEM.

Table 23. Mentors Using Strategies to Support the Diverse needs of Students as Learners (n=13)

	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 HSAP experience	58.3%	41.7%	
	7	5	12
Interact with students and other personnel the same way regardless of their	84.6%	15.4%	

background	11	2	**13**
Use a variety of teaching and/or mentoring activities to meet the needs of all students	100.0%	0.0%	
	13	0	**13**
Integrating ideas from education literature to teach/mentor students from groups underrepresented in STEM	41.7%	58.3%	
	5	7	**12**
Providing extra readings, activities, or learning support for students who lack essential background knowledge or skills	76.9%	23.1%	
	10	3	**13**
Directing students to other individuals or programs for additional support as needed	83.3%	16.7%	
	10	2	**12**
Highlighting under-representation of women and racial and ethnic minority populations in STEM and/or their contributions in STEM	53.8%	46.2%	
	7	6	**13**

In a laboratory environment, it is important to be able to work with a variety of people. Mentors were asked which strategies they used to support student development of collaboration and interpersonal skills. At least 80% of the mentors engaged in all of the strategies mentioned on the survey, and 100% of the mentors reported having their students tell other people about their backgrounds and interests, and work on collaborative activities, as seen in Table 24.

Table 24. Mentors Using Strategies to Support Student Development of Collaboration and Interpersonal Skills (n=12)

	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	100.0%	0.0%	
	12	0	**12**
Having my student(s) explain difficult ideas to others	91.7%	8.3%	
	11	1	**12**
Having my student(s) listen to the ideas of others with an open mind	91.7%	8.3%	
	11	1	**12**
Having my student(s) exchange ideas with others whose backgrounds or viewpoints are different from their own	90.9%	9.1%	
	10	1	**11**
Having my student(s) give and receive constructive feedback with others	91.7%	8.3%	

	11	1	**12**
Having students work on collaborative activities or projects as a member of a team	100.0%	0.0%	
	12	0	**12**
Allowing my student(s) to resolve conflicts and reach agreement within their team	81.8%	18.2%	
	9	2	**11**

The qualitative information obtained from mentor interviews confirms the mentor's use of strategies to help apprentices collaborate and work as a member of a team. As explained by two mentors below, collaborating does not only offer apprentices expanded STEM knowledge, but also helps them understand the application of STEM in real-life problems.

> *I think the HSAP program, at least the way we've tried to run it in our group, helps the high school students see what I would call real world problems, real world research problems, and the little steps that people or experts take in attacking them. One of the things it does is add value, a little bit, to their entire learning experience so that they are not just stop with whatever they've learned in the four walls of their classrooms in high schools. They get to see that, "OK, those little concepts actually do play a role in attacking or addressing much larger problems. (HSAP mentor)*

> *This program is really good, because I never had something like this when I was in high school or undergrad. It's a really good platform for showing students what research is all about, letting them get to know what type they are interested in research, if they have it in them to conduct research. It's a good time to introduce students to research. Overall, it's a really beneficial program for the students. Probably it's going to be really good for their future, if they can figure out if they really want to be a scientist, or if they really want to go into research. That way, I think it's a really good program. (HSAP mentor)*

Table 25 shows results from mentors reporting which strategies they used to support student engagement in authentic STEM activities. Mentors were very strong in using all of the strategies, and at least 84% of the mentors reported using all of the strategies listed on the questionnaire. 100% of the mentors reported having their students search for and review technical research, demonstrate lab and/or field techniques, encouraged students to learn collaboratively, and provided their students with constructive feedback.

Table 25. Mentors Using Strategies to Support Student Engagement in "Authentic" STEM Activities (n=13)

	Yes - I used this strategy	No - I did not use this strategy	Response Total
Teaching (or assigning readings) about specific STEM subject matter	92.3%	7.7%	
	12	1	**13**

Having my student(s) search for and review technical research to support their work	100.0%	0.0%	
	13	0	**13**
Demonstrating laboratory/field techniques, procedures, and tools for my student(s)	100.0%	0.0%	
	13	0	**13**
Supervising my student(s) while they practice STEM research skills	84.6%	15.4%	
	11	2	**13**
Providing my student(s) with constructive feedback to improve their STEM competencies	100.0%	0.0%	
	13	0	**13**
Allowing students to work independently to improve their self-management abilities	92.3%	7.7%	
	12	1	**13**
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	84.6%	15.4%	
	11	2	**13**

Mentors were asked which strategies they used to support student STEM educational and career pathways in order to determine the effectiveness of the HSAP program in demonstrating to students their choices in the STEM pipeline (Table 26). At least half of the mentors used all of the strategies to support STEM educational and career pathways. Notably, 100% of the mentors asked their students about their educational and/or career goals, but only 50% of the mentors recommended AEOP programs that aligned with student goals.

Table 26. Mentors Using Strategies to Support Student STEM Educational and Career Pathways (n=13)

	Yes - I used this strategy	No - I did not use this strategy	Response Total
Asking my student(s) about their educational and/or career goals	100.0%	0.0%	
	13	0	**13**
Recommending extracurricular programs that align with students' goals	50.0%	50.0%	
	6	6	**12**
Recommending Army Educational Outreach Programs that align with students' goals	46.2%	53.8%	
	6	7	**13**
Providing guidance about educational pathways that will prepare my	69.2%	30.8%	

student(s) for a STEM career	9	4	**13**
Discussing STEM career opportunities within the DoD or other government agencies	53.8%	46.2%	
	7	6	**13**
Discussing STEM career opportunities in private industry or academia	61.5%	38.5%	
	8	5	**13**
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)	54.5%	45.5%	
	6	5	**11**
Helping students build a professional network in a STEM field	72.7%	27.3%	
	8	3	**11**
Helping my student(s) with their resume, application, personal statement, and/or interview preparations	63.6%	36.4%	
	7	4	**11**

Because a goal of the AEOP is to generate interest in other AEOP programs, mentors were asked which program they explicitly discussed with apprentices. Compared to the mentor response regarding STEM skills, mentors reported lower frequencies across all responses, as displayed in Table 27. Similar to 2015 reports, the most frequently discussed programs were HSAP (60%) and URAP (73%). Almost a third (30%) of the mentors reported that they only discussed AEOP in a general way, and did not discuss any program.

Table 27. Mentors Explicitly Discussing AEOPs with Apprentices (n=12)

	Yes - I discussed this program with my student(s)	No - I did not discuss this program with my student(s)	Response Total
Gains in the Education of Mathematics and Science (GEMS)	0.0%	100.0%	
	0	10	**10**
UNITE	0.0%	100.0%	
	0	10	**10**
Junior Science & Humanities Symposium (JSHS)	0.0%	100.0%	
	0	10	**10**
Science & Engineering Apprenticeship Program (SEAP)	9.1%	90.9%	
	1	10	**11**

Research & Engineering Apprenticeship Program (REAP)	18.2%	81.8%	
	2	9	**11**
High School Apprenticeship Program (HSAP)	60.0%	40.0%	
	6	4	**10**
College Qualified Leaders (CQL)	0.0%	100.0%	
	0	10	**10**
GEMS Near Peer Mentor Program	9.1%	90.9%	
	1	10	**11**
Undergraduate Research Apprenticeship Program (URAP)	72.7%	27.3%	
	8	3	**11**
Science Mathematics, and Research for Transformation (SMART) College Scholarship	27.3%	72.7%	
	3	8	**11**
National Defense Science & Engineering Graduate (NDSEG) Fellowship	18.2%	81.8%	
	2	9	**11**
I discussed AEOP with my student(s) but did not discuss any specific program	30.0%	70.0%	
	3	7	**10**

To better understand the sources of information about AEOP awareness, mentors were asked which resources were helpful in exposing apprentices to AEOPs. As Table 28 shows, by far, participation in HSAP was the most useful with 94% of the mentors reporting it was somewhat or very much useful, followed by the AEOP website (77%). AEOP instructional supplies were also reported to be somewhat or very much useful (58%). Other sources were reported by roughly half of the mentors as being somewhat or very much useful. Social media and invited speakers were reported to be the least useful or not experienced.

Table 28. Useful Resources for Exposing Apprentices to AEOPs (n=13)

	Did not experience	Not at all	A little	Somewhat	Very much	Response Total
Army Research Office (ARO) website	30.8%	0.0%	7.7%	30.8%	30.8%	
	4	0	1	4	4	**13**
Army Educational Outreach Program (AEOP) website	23.1%	0.0%	0.0%	23.1%	53.8%	
	3	0	0	3	7	**13**
AEOP on Facebook, Twitter, Pinterest or	69.2%	0.0%	0.0%	15.4%	15.4%	

other social media	9	0	0	2	2	13
AEOP brochure	30.8%	0.0%	0.0%	38.5%	30.8%	
	4	0	0	5	4	13
It Starts Here! Magazine	61.5%	0.0%	0.0%	23.1%	15.4%	
	8	0	0	3	2	13
HSAP Program administrator or site coordinator	15.4%	0.0%	7.7%	30.8%	46.2%	
	2	0	1	4	6	13
Invited speakers or "career" events	76.9%	0.0%	0.0%	15.4%	7.7%	
	10	0	0	2	1	13
Participation in HSAP	7.7%	0.0%	0.0%	15.4%	76.9%	
	1	0	0	2	10	13

Mentors were asked to share which resources were useful for exposing apprentices to DoD STEM careers. The results in Table 29 show that participation in HSAP was somewhat or very much useful to 85% of the mentors. Likewise, the ARO website was found to be useful by 62% of the mentors, and the AEOP website was found to be somewhat or very much useful by 87% of the mentors. Other resources were found to be less useful or not experienced, such as invited speakers and social media.

Table 29. Usefulness of Resources for Exposing Apprentices to DoD STEM Careers (n=13)

	Did not experience	Not at all	A little	Somewhat	Very much	Response Total
Army Research Office (ARO) website	30.8%	0.0%	7.7%	46.2%	15.4%	
	4	0	1	6	2	13
Army Educational Outreach Program (AEOP) website	23.1%	0.0%	0.0%	23.1%	53.8%	
	3	0	0	3	7	13
AEOP on Facebook, Twitter, Pinterest or other social media	66.7%	0.0%	8.3%	16.7%	8.3%	
	8	0	1	2	1	12
AEOP brochure	46.2%	0.0%	0.0%	30.8%	23.1%	
	6	0	0	4	3	13
It Starts Here! Magazine	58.3%	0.0%	0.0%	33.3%	8.3%	

	7	0	0	4	1	12
HSAP Program administrator or site coordinator	23.1%	0.0%	0.0%	30.8%	46.2%	
	3	0	0	4	6	13
Invited speakers or "career" events	75.0%	0.0%	0.0%	16.7%	8.3%	
	9	0	0	2	1	12
Participation in HSAP	15.4%	0.0%	0.0%	15.4%	69.2%	
	2	0	0	2	9	13

Satisfaction with HSAP

To better serve the needs of apprentices, questions were included that asked about satisfaction with a number of features of the HSAP program. Table 30 shows that all or nearly all respondents were somewhat or very much satisfied with each of the listed program features. For example, instruction or mentorship during the program activities were found by 97% of the apprentices to be somewhat or very much useful. Apprentices also reported that the physical locations were somewhat or very much satisfactory (97%), 83% found the application process to be satisfactory, 80% found the research abstract requirements, and 94% of apprentices found stipends to be satisfactory.

Table 30. Apprentice Satisfaction with HSAP Program Features (n=35)

	Did not experience	Not at all	A little	Somewhat	Very much	Response Total
Applying or registering for the program	2.9%	2.9%	11.4%	34.3%	48.6%	
	1	1	4	12	17	35
Other administrative tasks (in-processing, network access, etc.)	5.7%	0.0%	20.0%	37.1%	37.1%	
	2	0	7	13	13	35
Communicating with your HSAP host site organizers	2.9%	5.7%	8.6%	25.7%	57.1%	
	1	2	3	9	20	35
The physical location(s) of HSAP activities	2.9%	0.0%	0.0%	14.3%	82.9%	
	1	0	0	5	29	35
The variety of STEM topics available to you in HSAP	2.9%	0.0%	5.7%	28.6%	62.9%	
	1	0	2	10	22	35
Teaching or mentoring provided during HSAP activities	2.9%	0.0%	0.0%	14.3%	82.9%	
	1	0	0	5	29	35

Stipends (payment)	5.7%	0.0%	0.0%	22.9%	71.4%	
	2	0	0	8	25	**35**
Research abstract preparation requirements	2.9%	0.0%	17.1%	17.1%	62.9%	
	1	0	6	6	22	**35**

Mentor access is a key component of HSAP, and apprentices were asked about the availability of their mentor. Table 31 indicates that mentors were always available to apprentices in HSAP and 100% of mentors were available for more than half of the time of the project.

Table 31. Apprentice Reports of Availability of Mentors (n=36)

Choice	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	0.00 %	0
The mentor was available about half of the time of my project	11.11 %	4
The mentor was available more than half of the time	27.78 %	10
The mentor was always available	61.11 %	22

In addition, apprentices were asked about their satisfaction with their mentors and the research experience (see Table 32). The overall responses were very positive. All apprentices experienced satisfaction with all aspects of the program, and zero apprentices reported that they were not at all satisfied with any aspect of the responses. 100% of the apprentices were somewhat or very much satisfied with their research experience if they indeed experienced the activity.

Table 32. Apprentice Satisfaction with Their Experience (n=36)

	Did not experience	Not at all	A little	Somewhat	Very much	Response Total
My working relationship with my mentor	0.0%	0.0%	2.8%	11.1%	86.1%	
	0	0	1	4	31	**36**
My working relationship with the group or team	8.3%	0.0%	5.6%	16.7%	69.4%	
	3	0	2	6	25	**36**
The amount of time I spent doing meaningful research	0.0%	0.0%	8.3%	22.2%	69.4%	
	0	0	3	8	25	**36**

The amount of time I spent with my research mentor	0.0%	0.0%	8.3%	16.7%	75.0%	
	0	0	3	6	27	**36**
The research experience overall	0.0%	0.0%	0.0%	22.2%	77.8%	
	0	0	0	8	28	**36**

An open-ended item on the apprentice questionnaire and interviews with apprentices asked apprentices about their overall satisfaction with their HSAP experience. Apprentice responses were overwhelmingly positive. In the words of three apprentices:

> *I was very satisfied with my experience in this program. I learned a lot about a very specific field, while at the same time learning skills that I will be able to use for a broad spectrum of fields later in life. I also learned a lot about my colleague's cultures, as some of them are foreign-born and there is always time to talk when waiting for measurements and tests to finish. I plan on recommending this program to everyone I know! (HSAP apprentice)*

> *The HSAP experience was very satisfying-- I was able to see how army research and STEM careers work and how computational research is conducted in contrast to on-hands experimental data and how a good research paper is backed by both computational and experimental data. It made me see how much broader the STEM field is and how long research takes, especially how you have to research efficiently and effectively to find a solution that may not be perfect, but the most suitable of all the options. Overall, it was very gratifying and helped me learn more about Mechanical Engineering, the major I hope to pursue, and jobs in the STEM field as well. (HSAP Apprentice)*

> *I really enjoyed my mentor and myself this summer at the University of Alabama. I have learned a ton about materials science in general and now know exactly what I want to major in for my undergrad. My mentor really took time to teach me and I was able to learn a lot from him. I really think highly of the program. (HSAP Apprentice)*

Mentors likewise were asked about their level of satisfaction with HSAP program features. Similar to the apprentice responses, mentors were overwhelmingly satisfied with features of HSAP (Table 33). Mentors were most satisfied with the application process and communicating with the ARO (85% for each category). 94% of mentors reported their satisfaction with the support for instruction or mentorship, and 100% of the mentors were satisfied with the stipend. All of the mentors who experienced the administrative process reported at least a little satisfaction with the process.

Table 33. Mentor Satisfaction with HSAP Program Features (n=13)

	Did not experience	Not at all	A little	Somewhat	Very much	Response Total
Application or registration process	0.0%	0.0%	15.4%	23.1%	61.5%	
	0	0	2	3	8	**13**
Other administrative tasks (in-processing, network access, etc.)	7.7%	0.0%	15.4%	15.4%	61.5%	
	1	0	2	2	8	**13**
Communicating with Army Research Office (ARO)	0.0%	0.0%	15.4%	0.0%	84.6%	
	0	0	2	0	11	**13**
Communicating with HSAP organizers	0.0%	0.0%	15.4%	0.0%	84.6%	
	0	0	2	0	11	**13**
Support for instruction or mentorship during program activities	0.0%	0.0%	7.7%	15.4%	76.9%	
	0	0	1	2	10	**13**
Stipends (payment)	0.0%	0.0%	0.0%	38.5%	61.5%	
	0	0	0	5	8	**13**
Research abstract preparation requirements	0.0%	0.0%	7.7%	15.4%	76.9%	
	0	0	1	2	10	**13**
Communicating with Academy of Applied Science (AAS)	84.6%	0.0%	0.0%	0.0%	15.4%	
	11	0	0	0	2	**13**

The mentor interviews conducted with 3 mentors explored their perspective of the benefits of the program for apprentices. Mentors described how HSAP allows students to experience research and the environments in which research occurs and how being in HSAP builds an awareness of STEM careers. Mentors also described the benefits for their own professional development. In their own words:

> *Much of what we do is solve our research problems, and most of it is supervised. It's been good to take a step back and realize all we do is not all we should be doing. It's not just research, but also teaching and educating, and the HSAP program has helped me fulfill some of those. Yes, that's been good. (HSAP Mentor)*

> *I had fun teaching with the two smart high school students, so it was also benefit for me. (HSAP Mentor)*

> *I have benefited in some ways, because I'm introducing students to research, and mentoring them, being with them in the laboratory, and showing them how it's done. It's a good experience for me, to have someone working with me, and I can show them what's going on and introduce them to research, and all those things. Yeah, in some ways it is benefiting me. (HSAP Mentor)*

To summarize, findings from the Actionable Program Evaluation indicate that the program is having success in actively engaging apprentices in authentic STEM experiences. There was a substantial increase in mentors and apprentices from 2015, and both mentors and apprentices report valuable experiences because of HSAP and overall high satisfaction with the program. Students typically work collaboratively on research projects and get experience reporting on these projects to undergraduates, graduate students, and STEM professionals. The vast majority of apprentices are consistently interacting with STEM professionals, learning about new STEM topics, applying STEM to real life situations, and learning about cutting-edge STEM research. Apprentices are also learning about STEM jobs/careers with apprentices most often crediting participation in HSAP, their mentors, and most are experiencing the AEOP website with impacting their awareness of DoD STEM jobs/careers. The HSAP program actively engages apprentices in learning about STEM and in STEM practices. Apprentices were actively involved in doing STEM during the program, including practicing laboratory/field techniques, procedures, and tools; participating in hands-on activities; and carrying out investigations. Overall, apprentices and mentors were satisfied with the HSAP program.

Outcomes Evaluation

Several outcome variables were measured by the evaluation of HSAP including measurement of relating to AEOP and program objectives, including impacts on apprentices' STEM competencies (e.g., knowledge and skills), STEM identity and confidence, interest in and intent for future STEM engagement (e.g., further education, careers), attitudes towards research, and knowledge of and interest in participating in additional AEOP opportunities.[7] STEM competencies are

[7] 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.

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 HSAP measured apprentices' self-reported gains in STEM competencies and engagement in opportunities intended to develop what is considered to be a critical STEM skill in the 21st century—collaboration and teamwork.

STEM Knowledge and Skills

Apprentices were asked about how the HSAP impacted their STEM knowledge on the questionnaire. Table 34 shows that HSAP had a great deal of influence on apprentice STEM knowledge. Between 67-89% of apprentices reported a large or extreme gain on all aspects of STEM knowledge asked in the questionnaire. Eighty-nine percent of apprentices reported a large or extreme gain in their knowledge of what everyday research is like in STEM and 69% of apprentices reported that their knowledge of research conducted in a STEM topic or field had a large or extreme gain.

The apprentice questionnaire items were combined into a composite variable[8] 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.

> *"Throughout my time being able to work in the lab, I have increased my knowledge by ten-fold. I have been able to gain hands-on experience in a lab setting of which many high school students could only dream of doing."*-- HSAP Apprentice

[8] The Cronbach's alpha reliability for these 5 items was 0.820.

Table 34. Apprentice Report of Impacts on STEM Knowledge (n=36)

	No gain	A little gain	Some gain	Large gain	Extreme gain	Response Total
In depth knowledge of a STEM topic(s)	0.0%	0.0%	30.6%	41.7%	27.8%	
	0	0	11	15	10	36
Knowledge of research conducted in a STEM topic or field	0.0%	0.0%	20.0%	28.6%	51.4%	
	0	0	7	10	18	35
Knowledge of research processes, ethics, and rules for conduct in STEM	2.8%	2.8%	27.8%	36.1%	30.6%	
	1	1	10	13	11	36
Knowledge of how scientists and engineers work on real problems in STEM	0.0%	0.0%	22.2%	38.9%	38.9%	
	0	0	8	14	14	36
Knowledge of what everyday research work is like in STEM	0.0%	0.0%	11.1%	44.4%	44.4%	
	0	0	4	16	16	36

The apprentices were also asked about perceived impacts on STEM skills, i.e., apprentices' abilities to use STEM practices on the questionnaire (Table 35). In general, the majority of responding apprentices indicated large or extreme gains across all science-related or engineering practices. For example, 72% of responding apprentices reported large or extreme gains in integrating information from technical or scientific texts and other media to support your explanation of an observation, and 78% reported large or extreme gains in considering different interpretations of data and supporting an observation with data. The apprentice questionnaire items were combined into a composite variable[9] 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 35. Apprentice Reported Gains in STEM Competencies (n=36)

	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	5.6%	5.6%	36.1%	41.7%	11.1%	
	2	2	13	15	4	36
Using knowledge and creativity to suggest a testable explanation (hypothesis) for an observation	2.8%	5.6%	36.1%	41.7%	13.9%	
	1	2	13	15	5	36
Considering different interpretations of data when	2.8%	2.8%	22.2%	52.8%	19.4%	

[9] The Cronbach's alpha reliability for these 5 items was 0.933.

deciding how the data answer a question	1	1	8	19	7	**36**
Supporting an explanation for an observation with data from experiments	2.8%	0.0%	19.4%	58.3%	19.4%	
	1	0	7	21	7	**36**
Supporting an explanation with relevant scientific, mathematical, and/or engineering knowledge	2.8%	0.0%	19.4%	58.3%	19.4%	
	1	0	7	21	7	**36**
Identifying the strengths and limitations of explanations in terms of how well they describe or predict observations	0.0%	5.6%	19.4%	55.6%	19.4%	
	0	2	7	20	7	**36**
Defending an argument that conveys how an explanation best describes an observation	8.3%	2.8%	30.6%	41.7%	16.7%	
	3	1	11	15	6	**36**
Identifying the strengths and limitations of data, interpretations, or arguments presented in technical or scientific texts	0.0%	8.3%	33.3%	25.0%	33.3%	
	0	3	12	9	12	**36**
Integrating information from technical or scientific texts and other media to support your explanation of an observation	2.8%	11.1%	13.9%	50.0%	22.2%	
	1	4	5	18	8	**36**
Communicating about your experiments and explanations in different ways (through talking, writing, graphics, or mathematics)	0.0%	8.3%	22.2%	38.9%	30.6%	
	0	3	8	14	11	**36**

Twenty-first Century Skills, such as communication and collaboration, are widely used in STEM practices as well as in daily life. Apprentices were asked about the impact of HSAP on their "21st Century Skills." Table 36 shows that most responding apprentices reported large or extreme gains on each of these skills, including making changes when things do not go as planned, viewing failure as an opportunity to learn, and communicating effectively with others.
The apprentice questionnaire items were combined into a composite variable[10] 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 36. Apprentice Report of Impacts on 21st Century Skills (n=36)

	No gain	A little gain	Some gain	Large gain	Extreme gain	Response Total
Learning to work independently	0.0%	0.0%	30.6%	33.3%	36.1%	
	0	0	11	12	13	**36**
Setting goals and reflecting on performance	0.0%	5.6%	38.9%	25.0%	30.6%	

[10] The Cronbach's alpha reliability for these 8 items was 0.838.

	0	2	14	9	11	**36**
Sticking with a task until it is finished	2.8%	5.6%	25.0%	33.3%	33.3%	
	1	2	9	12	12	**36**
Making changes when things do not go as planned	2.8%	2.8%	16.7%	36.1%	41.7%	
	1	1	6	13	15	**36**
Working well with people from all backgrounds	0.0%	11.1%	16.7%	30.6%	41.7%	
	0	4	6	11	15	**36**
Including others' perspectives when making decisions	5.6%	8.3%	25.0%	30.6%	30.6%	
	2	3	9	11	11	**36**
Communicating effectively with others	0.0%	11.1%	22.2%	33.3%	33.3%	
	0	4	8	12	12	**36**
Viewing failure as an opportunity to learn	0.0%	2.8%	22.2%	33.3%	41.7%	
	0	1	8	12	15	**36**

STEM Identity and Confidence

Students who pursue STEM further in their education and/or careers are more positioned for success with deeper backgrounds in STEM knowledge and skills. However, they are unlikely to explore STEM degrees or careers if they do not see themselves as capable of succeeding in STEM.[11] Consequently, the apprentice questionnaire included a series of items intended to measure the impact of HSAP on apprentices' STEM identity. As seen in Table 37, the apprentices suggest that the HSAP program has had a positive impact in this area. For example, the majority of the 36 responding apprentices reported a large or extreme gain in feeling prepared for more challenging STEM activities, confidence to do well in future STEM courses, desire to build relationships with mentors who work in STEM, feeling responsible for a STEM project or activity, and sense of accomplishing something in STEM. Comparing results on the composite created from these items,[12] there were no differences in impact based on gender or on race/ethnicity.

Table 37. Apprentice Report of Impacts on STEM Identity (n=36)

	No gain	A little gain	Some gain	Large gain	Extreme gain	Response Total
Interest in a new STEM topic	2.8%	13.9%	27.8%	33.3%	22.2%	

[11] 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.

[12] The Cronbach's alpha reliability for these 8 items was 0.867.

	1	5	10	12	8	**36**
Deciding on a path to pursue a STEM career	8.3%	19.4%	22.2%	27.8%	22.2%	
	3	7	8	10	8	**36**
Sense of accomplishing something in STEM	0.0%	8.3%	16.7%	30.6%	44.4%	
	0	3	6	11	16	**36**
Feeling prepared for more challenging STEM activities	0.0%	5.6%	11.1%	41.7%	41.7%	
	0	2	4	15	15	**36**
Confidence to try out new ideas or procedures on my own in a STEM project	0.0%	5.6%	16.7%	36.1%	41.7%	
	0	2	6	13	15	**36**
Patience for the slow pace of STEM research	5.6%	2.8%	27.8%	22.2%	41.7%	
	2	1	10	8	15	**36**
Desire to build relationships with mentors who work in STEM	0.0%	5.6%	11.1%	41.7%	41.7%	
	0	2	4	15	15	**36**
Connecting a STEM topic or field to my personal values	2.8%	5.6%	19.4%	36.1%	36.1%	
	1	2	7	13	13	**36**

Interest and Future Engagement in STEM

The HSAP program strives to contribute to the development of a STEM-literate citizenry. School STEM experiences are enhanced and built upon when students engage in out of school with high quality STEM activities. In order to examine the impact of HSAP on apprentices' interest in future engagement in STEM, the questionnaire asked them to reflect on whether the likelihood of their engaging in STEM activities outside of school changed as a result of their experience, as well as their interest level in participating in future AEOP programs. Table 38 demonstrates that the majority of apprentices indicated they were more likely or much more likely to engage in many of these activities as a result of HSAP, such as working on solving mathematical or scientific puzzles, talking with a friend or family member about STEM, helping with a community service project that relates to STEM, and mentoring or teaching other students about STEM. The only exception to this was that 50% of apprentices reported wanting to read or watch non-fiction STEM content after HSAP. In particular, 92% of apprentices reporting wanting to work on a STEM project or experiment in a university or professional setting after participating in HSAP. A composite score was created from these items,[13] and composite scores were compared across subgroups of apprentices. There were no statistically significant differences.

[13] These 10 items had a Cronbach's alpha reliability of 0.851.

Table 38. Change in Likelihood Apprentices Will Engage in STEM Activities Outside of School (n=36)

	Much less likely	Less likely	About the same before and after	More likely	Much more likely	Response Total
Watch or read non-fiction STEM	5.6%	2.8%	41.7%	33.3%	16.7%	
	2	1	15	12	6	**36**
Tinker (play) with a mechanical or electrical device	0.0%	0.0%	22.2%	47.2%	30.6%	
	0	0	8	17	11	**36**
Work on solving mathematical or scientific puzzles	2.8%	0.0%	41.7%	33.3%	22.2%	
	1	0	15	12	8	**36**
Use a computer to design or program something	0.0%	2.8%	36.1%	22.2%	38.9%	
	0	1	13	8	14	**36**
Talk with friends or family about STEM	0.0%	0.0%	19.4%	41.7%	38.9%	
	0	0	7	15	14	**36**
Mentor or teach other students about STEM	2.8%	0.0%	22.2%	36.1%	38.9%	
	1	0	8	13	14	**36**
Help with a community service project related to STEM	2.8%	0.0%	27.8%	36.1%	33.3%	
	1	0	10	13	12	**36**
Participate in a STEM camp, club, or competition	2.8%	0.0%	30.6%	30.6%	36.1%	
	1	0	11	11	13	**36**
Take an elective (not required) STEM class	2.8%	0.0%	33.3%	30.6%	33.3%	
	1	0	12	11	12	**36**
Work on a STEM project or experiment in a university or professional setting	0.0%	2.8%	5.6%	33.3%	58.3%	
	0	1	2	12	21	**36**

When asked how interested they are in participating in future AEOP programs, most of the apprentices had not heard of the range of AEOP programs (69% had not hear of UNITE, 75% had not heard of CQL, and 67% had not heard of GEMS Near Peer). However, some apprentices report an interest in SEAP (44%), REAP (54%), and URAP (50%) (see Table 39).

Table 39. Apprentice Interest in Future AEOP Programs (n=36)

	I've never heard of this program	Not at all	A little	Somewhat	Very much	Response Total
UNITE	68.6%	5.7%	8.6%	8.6%	8.6%	
	24	2	3	3	3	**35**
Junior Science & Humanities Symposium (JSHS)	64.7%	2.9%	5.9%	8.8%	17.6%	
	22	1	2	3	6	**34**
Science & Engineering Apprenticeship Program (SEAP)	38.9%	2.8%	13.9%	11.1%	33.3%	
	14	1	5	4	12	**36**
Research & Engineering Apprenticeship Program (REAP)	28.6%	2.9%	14.3%	17.1%	37.1%	
	10	1	5	6	13	**35**
College Qualified Leaders (CQL)	75.0%	2.8%	2.8%	5.6%	13.9%	
	27	1	1	2	5	**36**
GEMS Near Peer Mentor Program	66.7%	8.3%	2.8%	11.1%	11.1%	
	24	3	1	4	4	**36**
Undergraduate Research Apprenticeship Program (URAP)	33.3%	2.8%	13.9%	13.9%	36.1%	
	12	1	5	5	13	**36**
Science Mathematics, and Research for Transformation (SMART) College Scholarship	50.0%	2.8%	5.6%	13.9%	27.8%	
	18	1	2	5	10	**36**
National Defense Science & Engineering Graduate (NDSEG) Fellowship	58.3%	2.8%	8.3%	11.1%	19.4%	
	21	1	3	4	7	**36**

To build on the at-hand resources of HSAP apprentices for other AEOP opportunities, apprentices were asked which resources impacted their awareness of the various AEOPs. Table 40 shows that apprentices rated the HSAP program (78%) and their mentors (61%) at somewhat or very much impactful on their awareness of AEOPs. Conversely, the majority of HSAP apprentices reported not experiencing the AEOP brochure, the It Starts Here! Magazine, and AEOP social media.

Table 40. Impact of Resources on Apprentice Awareness of AEOPs (n=36)

	Did not experience	Not at all	A little	Somewhat	Very much	Response Total
Army Research Office (ARO) website	47.2%	2.8%	25.0%	19.4%	5.6%	
	17	1	9	7	2	36
Army Educational Outreach Program (AEOP) website	22.2%	2.8%	27.8%	22.2%	25.0%	
	8	1	10	8	9	36
Academy of Applied Science (AAS) website	88.9%	2.8%	2.8%	2.8%	2.8%	
	32	1	1	1	1	36
AEOP on Facebook, Twitter, Pinterest or other social media	77.8%	2.8%	8.3%	5.6%	5.6%	
	28	1	3	2	2	36
AEOP brochure	44.4%	2.8%	30.6%	13.9%	8.3%	
	16	1	11	5	3	36
It Starts Here! Magazine	86.1%	2.8%	8.3%	2.8%	0.0%	
	31	1	3	1	0	36
My HSAP mentor(s)	22.2%	0.0%	16.7%	27.8%	33.3%	
	8	0	6	10	12	36
Invited speakers or "career" events during HSAP	72.2%	2.8%	8.3%	11.1%	5.6%	
	26	1	3	4	2	36
Participation in HSAP	11.1%	5.6%	5.6%	25.0%	52.8%	
	4	2	2	9	19	36

Attitudes toward DoD Research

Students' 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 gauge apprentices' attitudes in this area, the apprentice questionnaire asked about 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 41). More than 90% of apprentices agree or strongly agree that DoD researchers develop new, cutting edge technologies, solve real-world problems, advance science and engineering fields, and that their research is valuable to society.

Table 41. Apprentice Opinions of DoD Researchers and Research (n=36)

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree	Response Total
DoD researchers advance science and engineering fields	0.0%	0.0%	0.0%	58.3%	41.7%	
	0	0	0	21	15	**36**
DoD researchers develop new, cutting edge technologies	0.0%	0.0%	2.8%	55.6%	41.7%	
	0	0	1	20	15	**36**
DoD researchers solve real-world problems	0.0%	2.8%	5.6%	47.2%	44.4%	
	0	1	2	17	16	**36**
DoD research is valuable to society	0.0%	2.8%	5.6%	47.2%	44.4%	
	0	1	2	17	16	**36**

Education and Career Aspirations

To determine the impact of HSAP on apprentice aspirations for future educational opportunities, the evaluation asked apprentices about the program's impact on their education and career aspirations. In terms of education, the questionnaire asked apprentices how far they wanted to go in school before and after participating in HSAP. As seen in Tables 42 and 43, more of the responding apprentices indicated wanting to obtain advanced degrees after participating in HSAP than before HSAP, most notably a 17% increase in the desire to obtain a Ph.D.

Table 42. Apprentice Education Aspirations Before HSAP (n=36)

Choice	Response Percent	Response Total
Graduate from high school	0.00 %	0
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)	19.44 %	7
Get more education after college	2.78 %	1
Get a master's degree	41.67 %	15
Get a Ph.D.	33.33 %	12
Get a medical-related degree (M.D.), veterinary degree (D.V.M), or dental degree (D.D.S)	0.00 %	0
Get a combined M.D. / Ph.D.	0.00 %	0
Get another professional degree (law, business, etc.)	2.78 %	1

Table 43. Apprentice Education Aspirations After HSAP (n=36)

Choice	Response Percent	Response Total
Graduate from high school	0.00 %	0
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)	5.56 %	2
Get more education after college	0.00 %	0
Get a master's degree	33.33 %	12
Get a Ph.D.	50.00 %	18
Get a medical-related degree (M.D.), veterinary degree (D.V.M), or dental degree (D.D.S)	2.78 %	1
Get a combined M.D. / Ph.D.	5.56 %	2
Get another professional degree (law, business, etc.)	2.78 %	1

In terms of career aspirations, apprentices were asked what kind of work they expect to be doing at age 30, reflecting on what their aspiration was before participating in HSAP and after HSAP (see Table 44 and Table 45). Most responding apprentices expressed interest in STEM-related careers both before and after participating in HSAP, and reported roughly the same proportions of career aspirations before and after HSAP.

Table 44. Apprentice Career Aspirations Before HSAP (n=36)

Choice	Response Percent	Response Total
Other, (specify):	8.33 %	3
Undecided	0.00 %	0
Science (no specific subject)	2.78 %	1
Physical science (physics, chemistry, astronomy, materials science)	16.67 %	6
Biological science	0.00 %	0
Earth, atmospheric or oceanic science	0.00 %	0
Environmental science	2.78 %	1
Computer science	11.11 %	4
Technology	0.00 %	0
Engineering	47.22 %	17
Mathematics or statistics	0.00 %	0
Medicine (doctor, dentist, veterinarian, etc.)	0.00 %	0
Health (nursing, pharmacy, technician, etc.)	5.56 %	2
Social science (psychologist, sociologist, etc.)	0.00 %	0
Teaching, STEM	0.00 %	0
Teaching, non-STEM	0.00 %	0
Business	2.78 %	1

Law	2.78 %	1
Military, police, or security	0.00 %	0
Art (writing, dancing, painting, etc.)	0.00 %	0
Skilled trade (carpenter	0.00 %	0

Table 45. Apprentice Career Aspirations After HSAP (n=36)

Choice	Response Percent	Response Total
Undecided	2.86 %	1
Science (no specific subject)	2.86 %	1
Physical science (physics, chemistry, astronomy, materials science)	11.43 %	4
Biological science	2.86 %	1
Earth, atmospheric or oceanic science	0.00 %	0
Environmental science	2.86 %	1
Computer science	14.29 %	5
Technology	5.71 %	2
Engineering	42.86 %	15
Mathematics or statistics	0.00 %	0
Medicine (doctor, dentist, veterinarian, etc.)	0.00 %	0
Health (nursing, pharmacy, technician, etc.)	2.86 %	1
Social science (psychologist, sociologist, etc.)	0.00 %	0
Teaching, STEM	0.00 %	0
Teaching, non-STEM	0.00 %	0
Business	2.86 %	1
Law	2.86 %	1
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):	5.71 %	2

Apprentices were asked about the extent to which they expect to use their STEM knowledge, skills, and/or abilities in their work when they are age 30. As shown in Table 46, 89% of apprentices expect to use their STEM knowledge, skills and abilities at least half of the time, with the remaining 11% using their STEM skills, knowledge, and abilities at least a quarter of the time, indicating a large amount of apprentices who want to pursue a STEM career.

Table 46. Apprentices Expecting to use STEM in Their Work at Age 30 (n=36)

Choice	Response Percent	Response Total
not at all	0.00 %	0
up to 25% of the time	11.11 %	4
up to 50% of the time	16.67 %	6
up to 75% of the time	25.00 %	9
up to 100% of the time	47.22 %	17

Overall Impact

Finally, apprentices were asked about impacts of participating in HSAP more broadly. From these data, it is clear that apprentices thought the program had substantial impacts on their STEM interests, knowledge and future pursuits (see Table 47). For example, almost all of the apprentices were more confident in their STEM knowledge, and have a greater appreciation of Army or DoD STEM research. However, 17% of apprentices reported that they did not become more aware of other AEOPs nor did they develop an interest in other AEOPs because of their participation in HSAP. These items were combined into a composite variable[14] to test for differences among subgroups of students; no significant differences were found by gender or race/ethnicity.

Table 47. Apprentice Opinions of HSAP Impacts (n=36)

	Disagree - This did not happen	Disagree - This happened but not because of HSAP	Agree - HSAP contributed	Agree - HSAP was primary reason	Response Total
I am more confident in my STEM knowledge, skills, and abilities	0.0%	2.8%	75.0%	22.2%	
	0	1	27	8	**36**
I am more interested in participating in STEM activities outside of school requirements	2.8%	22.2%	52.8%	22.2%	
	1	8	19	8	**36**
I am more aware of other AEOPs	16.7%	8.3%	47.2%	27.8%	
	6	3	17	10	**36**
I am more interested in participating in other AEOPs	14.3%	14.3%	37.1%	34.3%	
	5	5	13	12	**35**
I am more interested in taking STEM	2.8%	27.8%	50.0%	19.4%	

[14] The Cronbach's alpha reliability for these 10 items was 0.882.

classes in school	1	10	18	7	**36**
I am more interested in earning a STEM degree	5.7%	28.6%	48.6%	17.1%	
	2	10	17	6	**35**
I am more interested in pursuing a career in STEM	5.6%	33.3%	38.9%	22.2%	
	2	12	14	8	**36**
I am more aware of Army or DoD STEM research and careers	19.4%	5.6%	44.4%	30.6%	
	7	2	16	11	**36**
I have a greater appreciation of Army or DoD STEM research	11.1%	0.0%	58.3%	30.6%	
	4	0	21	11	**36**
I am more interested in pursuing a STEM career with the Army or DoD	27.8%	8.3%	50.0%	13.9%	
	10	3	18	5	**36**

An open-ended item on the apprentice questionnaire asked apprentices to list the three most important ways they benefited from the program; 28 of 30 responding apprentices provided at least one answer to the question. Apprentice responses addressed a variety of themes including collaborating with STEM professionals and other students, learning about/participating in lab work, exposure to STEM careers, and increasing STEM content knowledge.

Comments from the apprentice interviews expand on some of these overall impacts. As two apprentices said:

> *I got an experience of working with other people in collaboration. I was able to talk to them and to figure out how we're going to do our project, and how the research is actually done, the steps that it takes to go from an idea to the actual research, and then to the conclusion. (HSAP apprentice)*

> *In school, you usually do assignments that are not new, not research. Usually it's from a textbook, so it's structured and they give you each step. While in here, we get a lot more creative freedom to explore the different possibilities for what we are doing. (HSAP apprentice)*

Summary of Findings

The FY16 evaluation of HSAP collected data about participants; their perceptions of program processes, resources, and activities; and indicators of achievement in outcomes related to AEOP and program objectives. A summary of findings is provided in Table 48.

Table 48. 2016 HSAP Evaluation Findings	
Participant Profiles	
HSAP continues to be a popular and selective program, which serves students of historically, **underrepresented and underserved populations.**	HSAP has been extremely successful in reaching out to more high school students – experiencing a 26% increase in applications received in FY16 (267 vs. 363 applications). The ARO office utilized direct email to targeted schools, which produced a significant increase in applications.
	HSAP experienced continued success in providing outreach to students from historically underrepresented and underserved race/ethnic and low-income groups. The number of HCBU/MIs increased from 2 HBCU/MI sites in 2014, 7 HBCU/MIs in 2015, and 16 HBCU/MIs in 2016.
	More than half of the respondents in the HSAP program were from race/ethnicity categories other than White.
Actionable Program Evaluation	
HSAP recruitment continue to be mainly from personal contacts and from websites.	Many apprentices learned about HSAP from someone who works at the university (29%), school or university newsletter, email, or website (15%), and the AEOP website (15%). Other responses include hearing about HSAP from a family member (11%) and from someone who works in the program (11%).
	Marketing via social media such as Facebook, Twitter or Pinterest were the least frequently used sources for learning about HSAP specifically and AEOP generally.
HSAP apprentices learn STEM skills and knowledge that they do not learn in school settings.	There is a statistically significant difference in student perceptions of STEM Learning and STEM Engagement when comparing these activities in School and HSAP. Apprentices report significantly higher STEM Learning and STEM Engagement in HSAP over school.
Although HSAP apprentices come to the program with an interest in STEM, HSAP offers opportunities for high school students in authentic STEM learning that provides insight into college and beyond.	More than 90% of apprentices agree or strongly agree that DoD researchers develop new, cutting edge technologies, solve real-world problems, advance science and engineering fields, and that their research is valuable to society.
	Mentor access is a key component of HSAP, and apprentices were asked about the availability of their mentor. Apprentices responded that mentors were always available to apprentices in HSAP and 100% of mentors were available for more than half of the time of the project.

	97% of the apprentices interacted with scientists or engineers on most days or every day, 92% applied STEM learning to real-life situations most days or every day, and 97% learned about new STEM topics. Similarly, 76% of apprentices learned about new discoveries in STEM, 85% communicated with other students about STEM, and 75% learned about different careers that use STEM most days or every day.
HSAP mentors used effective research-based strategies to help mentors understand STEM knowledge and skills. They were less aware of other AEOP programs, although a majority of apprentices reported that mentors were helpful in increasing awareness of other AEOP programs.	Mentors were very strong in using all of the research-based strategies, and at least 84% of the mentors reported using all of the strategies listed on the questionnaire. 100% of the mentors reported having their students search for and review technical research, demonstrate lab and/or field techniques, encouraged students to learn collaboratively, and provided their students with constructive feedback.
	Most of the apprentices had not heard of the range of AEOP programs (78% had not hear of UNITE, 86% had not heard of CQL, and 79% had not heard of GEMS Near Peer). Apprentices rated the HSAP program (78%) and their mentors (61%) at somewhat or very much impactful on their awareness of AEOPs. Conversely, the majority of HSAP apprentices reported not experiencing the AEOP brochure and AEOP social media.
HSAP was highly valued by apprentices and mentors alike.	Similar to 2015, apprentices and mentors reported being very satisfied with their HSAP experience, including communications from Army Research Office, and the application/ registration process. Mentors reported in the interview that they felt having high school students in their laboratories was a valuable professional development experience.
Outcomes Evaluation	
HSAP apprentices reported large or extreme gains in their STEM knowledge and skills, and expect to use their STEM knowledge and skills extensively in the future.	Between 67-89% of apprentices reported a large or extreme gain on all aspects of STEM knowledge asked in the questionnaire. Eighty-nine percent of apprentices reported a large or extreme gain in their knowledge of what everyday research is like in STEM and 69% of apprentices reported that their knowledge of research conducted in a STEM topic or field had a large or extreme gain.
	Additionally, 89% of apprentices expect to use their STEM knowledge, skills and abilities at least half of the time, with the remaining 11% using their STEM skills, knowledge, and abilities at least a quarter of the time, indicating a large amount of apprentices who want to pursue a STEM career.
HSAP positively impacted apprentices' 21st Century skills related to STEM	Most responding apprentices reported large or extreme gains on each of these skills, including making changes when things do not go as planned, viewing failure as an opportunity to learn, and communicating effectively with others.
	The majority of apprentices indicated they were more likely or much more likely to engage in many of these activities as a result of HSAP, such as working on solving mathematical or scientific puzzles, talking with a friend or family member about STEM, helping with a community service project that relates to STEM, and mentoring or teaching other students about STEM.

HSAP apprentices come to the program with an interest in STEM, but the program positively influences their aspirations to pursue higher education degrees.	In terms of education, the questionnaire asked apprentices how far they wanted to go in school before and after participating in HSAP. More of the responding apprentices indicated wanting to obtain advanced degrees after participating in HSAP than before HSAP, most notably a 17% increase in the desire to obtain a Ph.D.
HSAP raised some apprentice awareness and appreciation of DoD STEM research but websites and social media outlets did not inform the apprentices about DoD STEM careers.	97% of HSAP apprentices learned about at least one general STEM job/career, and 50% learned about 5 or more STEM jobs/careers. The number of reported careers that were 5 or more has increased from the 2015 reports.
	There was little overall impact of resources on apprentice awareness of DoD STEM careers, and that only 68% of HSAP apprentices felt that their participation in the program impacted their awareness and 64% felt that their mentors impacted their awareness. Apprentices reported not experiencing the AAS website (83%), It Starts Here! Magazine (83%), social media outlets (72%), Invited speakers (61%), and the ARO website (53%).

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. Between 2014 and 2015, HSAP has engaged more apprentices who identify with a typically underrepresented group in STEM, which is a positive trend. Additionally, it is positive that the HBCU/MI sites increased from 2 in 2014 to 7 in 2015. 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.

HSAP FY16 Efforts and Outcomes: As HSAP is a commuter program conducted at university/college locations that vary annually, recruitment of apprentices is focused upon the surrounding area of the community in which the host sites are situated. ARO and AAS identified and targeted nearby high schools and organizations that have traditionally underserved and underrepresented populations in STEM, then directly sent emails advertising the HSAP program to those locations. The number of HBCU/MI sites participating in HSAP increased from 7 to 16 in FY16; 46% of HSAP host sites are

HBCU/MIs. More focus was also given to diversity of STEM professionals via electronic mailings and social media.

Finding: Similar to past years, in HSAP, recruitment of apprentices is largely accomplished with personal interactions, either by knowing a teacher who is familiar with AEOP or a personal friend who has received an email about HSAP. As a result, the ability of HSAP to recruit underserved or underrepresented populations of students depends upon the diversity of the high schools in which recruitment takes place. Thus, HSAP may want to emphasize recruiting a more diverse pool of mentors and apprentices, perhaps specifically targeting more urban schools or schools who receive Title 1 funding. A focused and strategic plan to engage a more diverse pool of apprentices could ultimately improve the diversity of the STEM pipeline, based on the large impact that HSAP has on STEM knowledge, skills, and identity.

HSAP FY16 Efforts and Outcomes: ARO and AAS identified and specifically marketed HSAP and other AEOP opportunities to schools who receive Title 1 funding in the surrounding area of the FY16 HSAP host site locations, which resulted in 35% of HSAP students represented underserved population, 15% over the FY16 target.

Finding: HSAP 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. Mentors are particularly skilled in being able to engage high school students into their laboratory by giving them meaningful learning experiences and asking them to report on their work to graduate students and STEM professionals. Although mentors are particularly skilled in their area of expertise, mentors can be more effective in helping students understand the big picture of how STEM can improve community. Only 54% of mentors reported communicating how STEM can improve community. Only 52% of the mentors highlighted the under-representation of women and racial and ethnic minority populations in STEM as well. Mentors can be provided ways to incorporate how STEM topics affect the larger community in a systematic way by the program, so that the bigger picture of how STEM fits into society can be explicitly emphasized.

HSAP FY16 Efforts and Outcomes: Mentors were required to express how STEM topics affect the larger community in the educational merit description of their proposals to ARO. They were also encouraged to discuss this with their participants. FY17 program plans include a focused attempt for improvement in this area by providing more-detailed training for mentors to empower them in this effort.

Finding: Similar to recommendation #3, 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 HSAP. 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 lack of awareness is a barrier in communicating about Army/DoD STEM research and careers. 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 HSAP 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.

HSAP FY16 Efforts and Outcomes: In FY16, HSAP 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. Sites, mentors, and students received AEOP print materials and information for access to online resources via Welcome Packets and weekly emails. The weekly communications with apprentices and mentors, which included the 2016 Guide to STEM Careers and the AEOP newsletters, were provided online. HSAP students were also invited to participate in an Army DoD STEM Career Scavenger Hunt. Unfortunately, many students did not complete the scavenger hunt. However, enough did to distribute a gold, silver, and bronze-winning medal. Also, ARO inquired about the scavenger hunt during local (NC) site visits and several students told us that they were very interested but didn't have time to participate. I'm not sure how to compare the increase in awareness, as this was the first year we've implemented the scavenger hunt. We also utilized Constant Contacts for the first time this year (for promoting of the scavenger hunt and in general), but it is our intent to use a more personal approach in FY17. [Please see below the intent to use a more personal approach for survey completion as well. HSAP students were also given the ARO program manager contact information to create professional connections.

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

Finding: There were no recommendations in this area for HSAP in FY15.

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

Finding: Apprentices and mentors who participate in HSAP are only aware in a general way that other programs in AEOP exist. When asked, the mentors and apprentices could not name many of the other AEOP programs. Apprentices rated the HSAP program (88%) and their mentors (89%) at somewhat or very much impactful on their awareness of AEOPs. However, the majority of HSAP apprentices reported not experiencing the AEOP brochure and AEOP social media. Social media efforts, in particular, require constant updates and focused attention on messaging to gain attention. Since most HSAP applicants hear about the program through another individual, having a social media presence may increase the likelihood that an apprentice or mentor may hear about the program from another person who learned about it on Facebook, Twitter, or Pinterest. A recommendation for the FY16 years and beyond would be for the HSAP program mentors to provide time for apprentices to complete the survey during their apprenticeship meeting time. This will provide a more accurate measure to gauge how effective HSAP activities and communications are in growing awareness of AEOPs.

HSAP FY16 Efforts and Outcomes: Program evaluation completion is always challenging. In FY16, ARO plans 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 findings indicate that 2016 was a successful year for the HSAP program. HSAP had a 26% increase in the number of apprentice applicants and had a very competitive 18% placement rate of the apprentice applicants, which indicates there is great interest in this program, but potentially some unmet need. From the high quality applicants (mentors and apprentices), there were 42 mentors and 65 apprentices selected. HSAP has experienced some success in recruiting diverse apprentices, as there was an increase from 7 HBCU/MI sites to 16 HBCU/MI sites. Apprentices and mentors overwhelmingly reported satisfaction with HSAP experience. Mentors indicated they use innovative and research-based strategies to engage apprentices in STEM activities, and by engaging the apprentices, graduate students become better educators. Apprentices reported that the mentors were widely available and helpful in improving their STEM knowledge and skills. The apprentices similarly report increased ability to engage in STEM activities due to the HSAP experience. Additionally, engaging in more hands-on STEM experiences motivated the apprentices, which was delivered by their HSAP experience.

While the successes for HSAP 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. Between 2014 and 2016, HSAP has engaged more apprentices who identify with a typically underrepresented group in STEM, which is a positive trend. Additionally, it is positive that the HBCU/MI sites increased from 2 in 2014 to 7 in 2015 to 16 in 2016. HSAP should explore how to accommodate more participants in coming years – as the 18% placement rate indicates a much larger interest and need than is currently being accommodated.

2. Similar to past years in HSAP, recruitment of apprentices is largely accomplished with personal interactions, either by knowing someone at the university or someone who works at HSAP. As a result, the ability of HSAP to recruit underserved or underrepresented populations of students depends upon the diversity of the high schools in which recruitment takes place. Thus, HSAP may want to emphasize recruiting a more diverse pool of mentors and apprentices, perhaps specifically targeting more urban schools or schools who receive Title 1 funding. AAS and ARO should work with AEOP SOI awardees and identify possible overlaps where we can leverage our strategic outreach partners' reach and network A focused and strategic plan to engage a more diverse pool of apprentices could ultimately improve the diversity of the STEM pipeline, based on the large impact that HSAP has on STEM knowledge, skills, and identity.

3. HSAP is very effective in offering apprentices authentic opportunities to engage in STEM professional activities, and for mentors to build the next generation of STEM professionals. Mentors are particularly skilled in being able to engage high school students in their laboratory by giving them meaningful learning experiences and asking them to report on their work to graduate students and STEM professionals. Most of the apprentices had not heard of the range of AEOP programs (78% had not hear of UNITE, 86% had not heard of CQL, and 79% had not heard of GEMS Near Peer). Although mentors are particularly skilled in their area of expertise, mentors should be better prepared by the program to provide information and resources on the array of AEOP opportunities. AAS/ARO should work with the Battelle and the CAM to develop materials and training/onboarding that could be used with mentors each year to target this area of need.

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

1. HSAP mentors were effective in FY16 at informing apprentices about DoD STEM jobs/careers, as 97% of respondents reported hearing about one STEM career and 50% reported hearing about 5 or more, which is increased greatly from 2015. However, there was little overall impact of the program and mentors on apprentice awareness of DoD STEM careers, as only 68% of HSAP apprentices felt that their participation in the program impacted their awareness and 64% felt that their mentors impacted their awareness.

   Apprentices reported not utilizing the AAS website (83%), It Starts Here! Magazine (83%), social media outlets (72%), Invited speakers (61%), and the ARO website (53%). This lack of awareness/utilization is a potential barrier for communicating about Army/DoD STEM research and careers and the AEOP portfolio overall. 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 HSAP 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. Again, some type of onboarding/training for mentors – even virtual – would help to support progress in this area for HSAP.

2. Participation in the HSAP evaluation improved for apprentices but less than desirable for mentors. Very few mentors (12%) and apprentices (55%) completed the evaluation survey. The program leadership reported the decrease in participants was greatly due to the use of Constant Contacts for the majority of marketing/promotion, instead of more personal approaches to participation in the evaluation survey. It is recommended that the program use a more personal approach to recruiting participation in the evaluation survey. This strategy worked well for recruiting participants in the evaluation interviews in FY16. A recommendation for the FY17 years and beyond would be for the HSAP program mentors to provide time for apprentices to complete the survey during their apprenticeship meeting time. This will provide a more accurate measure to gauge how effective HSAP activities and communications are in growing awareness of AEOPs.

Appendices

Appendix A

FY16 HSAP Evaluation Plan

2016 HSAP Evaluation Questionnaires

Purpose

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

1. AEOP Youth Questionnaire to be completed by student participants of the HSAP program at all university sites; and
2. AEOP Mentor Questionnaire to be completed by HSAP mentors (typically a University Scientist or Engineer), and/or others who support students as they participate in the HSAP 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 HSAP 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 Mentor questionnaire provided to them by Purdue University. 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' HSAP experience;
- Please encourage youth participants to participate in AEOP evaluation efforts. Before, during, and after the HSAP 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 HSAP students please encourage them to prioritize the completion of AEOP's HSAP evaluation survey. These data are critical to maintain funding for HSAP. Additionally, evaluators will release de-identified data from these assessments to individual HSAP sites to help them focus program improvement efforts;
- The HSAP 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:

Participants – Evaluation Questionnaire Invitation

Dear HSAP participant,

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

Here's how you can help:

1) *Complete the HSAP 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.*
   HSAP Student Survey Link: http://www.cvent.com/d/rfqwlw

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

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

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

Mentor Questionnaire Administration Details

- Distribute the survey near or after the conclusion of the mentors' HSAP experience;
- Encourage all adults serving as HSAP mentors (typically a University Scientist or Engineer), and others who supported students as they participated in HSAP, 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 HSAP evaluation survey. These data are critical to maintain funding for HSAP. Additionally, evaluators will release de-identified data from these assessments to HSAP sites to help them focus program improvement efforts;
- The HSAP 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 High School Apprenticeship Program (HSAP) 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 HSAP in support of students as they participated in the HSAP program (HSAP Mentors – University Scientists or Engineers). More than 100 students and 90 adults participated in the HSAP 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 **HSAP Mentor Survey**. The survey will take about 25-30 minutes.*
   ***HSAP Mentor Survey Link**: http://www.cvent.com/d/mfqwls*

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

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

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

Telephone Interviews

Purpose

Per the FY16 Army Education Outreach Program (AEOP) Annual Program Plan (APP), Purdue University will conduct an evaluation study of HSAP that includes telephone interviews with HSAP mentors and apprentices. The participants will be selected by the ARO office in collaboration with site coordinators.

Interviews provide the evaluation team first-hand opportunities to speak with youth and adult HSAP 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 HSAP can improve in the future.

Evaluation activities during Purdue University's Phone Interview

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

Selecting Interview Participants

Purdue University will purposefully sample from HSAP 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 HSAP. 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 HSAP 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 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:

- Use the recruitment email text below to invite apprentices and mentors to volunteer for interviews.
- Be sure to include the date and time of the interview as well as the location of the telephone that they can use for the interview call (if needed).
- 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
    - **"HSAPParticipantDEMOSURVEY.docx"**
    - **"HSAPMentorDEMOSURVEY.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 High School Apprenticeship Program (HSAP) 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 HSAP 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 HSAP is achieving its objective(s) as a program, the results of which will be used by one of the primary sponsors of HSAP (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 HSAP which helps them illustrate and understanding how the HSAP program affects participants. In the end, Purdue University's findings will demonstrate HSAP's success as a program and to make HSAP better for future participants.

Interview Logistics:

We are working with the evaluation team to organize an interview during your HSAP experience. Interviews are being conducted across the HSAP program with student participants and with mentors (anyone who supervises, guides, or supports HSAP 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 HSAP 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, evaluators would still like to hear from you so they will send you an evaluation questionnaire after HSAP.

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

Appendix B

FY16 HSAP Apprentice Focus Group Protocols

2016 HSAP 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 HSAP. 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 HSAP this year?**
    - How did you hear about HSAP?
    - Who did you hear about it from?

The Army Educational Outreach Program (AEOP) is a primary sponsor of HSAP. 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 HSAP is teaching students about STEM career opportunities in the Army and Department of Defense.**
    - During HSAP, 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 HSAP. You are definitely eligible to participate in some of these programs and we need to know if you learned about them during HSAP**
    - During HSAP, 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 HSAP this year.**
    - What, specifically do you think you got out of participating in HSAP?
    - How do your experiences in HSAP compare to your school experiences in STEM?
    - What would you say was the biggest benefit you gained from participating in HSAP?
5. **Do you have any suggestions for improving HSAP 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 HSAP Mentor Focus Group Protocols

2016 HSAP 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 HSAP. 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 HSAP, what kind of value does this program add**?
    - How do you think students benefit from participating in HSAP?
    - Can you think of a particular student or group of students that benefit the most from HSAP?
    - How have you benefited from participating in HSAP?

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

2. **We need to understand more about how HSAP is helping students know more about STEM career opportunities in the Department of Defense, especially civilian positions.**
    - Have you seen any efforts by HSAP to educate participants about the Army, DoD, or careers in the DoD?
    - What strategies seem to be the most effective for HSAP students?
    - Do you have any suggestions for helping HSAP 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 HSAP 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 HSAP 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 HSAP to help engage underserved or underrepresented groups of adults and youth?
    - What strategies seem to work the best? The worst?
    - Any suggestions for helping HSAP reach new populations of adult and youth participants?
5. **What suggestions do you have for improving HSAP?**
6. **Last Chance - Have we missed anything? Tell us anything you want us to know that we didn't ask about.**

Appendix D

FY16 HSAP Apprentice Questionnaire

2016 High School Apprenticeship Program (HSAP): HSAP Apprentice Survey

Dear HSAP participant,

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

Here's how you can help:

1) *Complete the HSAP 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.*

   HSAP Student Survey Link: http://www.cvent.com/d/rfqwlw

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

About this survey:

- While this survey is not anonymous, your responses are CONFIDENTIAL. When analyzing data and reporting results, your name will not be linked to any item responses or any comments you make.
- Responding to this survey is VOLUNTARY. You are not required to participate, although we hope you do because your responses will provide valuable information for meaningful and continuous improvement.
- If you provide your email address, the AEOP may contact you in the future to ask about your academic and career success.
- The survey takes about 25-30 minutes to complete on average, but it could take less time. In the online survey you can scroll over purple print in the survey to see definitions of words or phrases.

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

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

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 grade will you start in the fall? (select one)	
Select one.	
○	9th
○	10th
○	11th
○	12th
○	College freshman
○	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)::

7. Do you get free or reduced lunches at school?	
Select one.	
○	Yes
○	No
○	Choose not to report

9. 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	○	○	○	○	○

10. How often did you do each of the following in HSAP 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	○	○	○	○	○

11. 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	○	○	○	○	○

12. How often did you do each of the following in HSAP 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	○	○	○	○	○

13. 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 HSAP mentor(s)	○	○	○	○	○
Invited speakers or “career” events during HSAP	○	○	○	○	○
Participation in HSAP	○	○	○	○	○

14. 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	○	○	○	○	○
AEOP on Facebook, Twitter, Pinterest or other social media	○	○	○	○	○
AEOP brochure	○	○	○	○	○
It Starts Here! Magazine	○	○	○	○	○
My HSAP mentor(s)	○	○	○	○	○
Invited speakers or “career” events during HSAP	○	○	○	○	○
Participation in HSAP	○	○	○	○	○
Academy of Applied Science (AAS) website	○	○	○	○	○

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

16. How much input did you have in selecting your HSAP 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

17. How often was your mentor available to you during HSAP?

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

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

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

19. 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	○	○	○	○	○

20. 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 HSAP:

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	○	○

21. Which of the following statements apply to your research experience in HSAP? (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

22. As a result of your HSAP 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	○	○	○	○	○

23. Which category best describes the focus of your student(s) HSAP activities?

Select one.

○	Science
○	Technology
○	Engineering
○	Mathematics

24. As a result of your HSAP 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 26.

	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)	○	○	○	○	○

25. As a result of your HSAP 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)	○	○	○	○	○

26. As a result of your HSAP 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	○	○	○	○	○

27. As a result of your HSAP 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	○	○	○	○	○

28. AS A RESULT OF YOUR HSAP 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	○	○	○	○	○

29. Before you participated in HSAP, how far did you want to go in school?

Select one.

○	Graduate from high school
○	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. After you have participated in HSAP, how far do you want to go in school?

Select one.

○	Graduate from high school
○	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.)

31. 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

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

Select one.

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

33. After you participated in HSAP, 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)::

34. 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*
UNITE	○	○	○	○	○
Junior Science & Humanities Symposium (JSHS)	○	○	○	○	○
Science & Engineering Apprenticeship Program (SEAP)	○	○	○	○	○
Research & Engineering Apprenticeship Program (REAP)	○	○	○	○	○
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	○	○	○	○	○

35. How many jobs/careers in STEM did you learn about during HSAP?

Select one.

○	None
○	1
○	2
○	3
○	4
○	5 or more

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

Select one.

○	None
○	1
○	2
○	3
○	4
○	5 or more

37. 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	○	○	○	○	○

38. Which of the following statements describe you after participating in the HSAP program?

Select one per row.

	Disagree - This did not happen	*Disagree - This happened but not because of HSAP*	*Agree - HSAP contributed*	*Agree - HSAP 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	○	○	○	○

39. What are the three most important ways that HSAP has helped you?

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

40. What are the three ways that HSAP should be improved for future participants?

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

41. Please tell us about your overall satisfaction with your HSAP experience.

Appendix E

FY16 HSAP Mentor Questionnaire

2016 High School Apprenticeship Program (HSAP): HSAP Mentor Survey

Dear Colleague:
You are receiving this email because you participated in the 2016 High School Apprenticeship Program (HSAP) 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 HSAP in support of students as they participated in the HSAP program (HSAP Mentors – University Scientists or Engineers). More than 100 students and 90 adults participated in the HSAP and URAP programs this year and Purdue University wants to hear from you!

About this survey:

- This research protocol has been approved for use with human subjects by the Virginia Tech IRB office.
- Although this questionnaire is not anonymous, it is CONFIDENTIAL. Prior to analysis and reporting responses will be de-identified and no one will be able to connect your responses to you or your apprentice's name.
- Only AEOP evaluation personnel will have access to completed questionnaires and personal information will be stored securely.
- Responding to this survey is VOLUNTARY. You are not required to participate, although we hope you do because your responses will provide valuable information for meaningful and continuous improvement.
- If you provide your email address, the AEOP may contact you in the future to ask about you or your students.

Here's how you can help:

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

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

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

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

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

9. Which best describes the location of your school?

Select one.

○	Frontier or tribal school
○	Rural (country)
○	Suburban
○	Urban (city)

10. At what kind of school did you teach while participating in HSAP?

Select one.

○	Public school
○	Private school
○	Home school
○	Online school
○	Department of Defense school (DoDDS, DoDEA)

11. Do you work at a "Title-I" school?

Select one.

○	Yes
○	No
○	I am not sure

12. Which of the following subjects do you teach? (select ALL that apply)

Select all that apply.

If answered, go to question number 14.

☐	Upper elementary
☐	Physical science (physics, chemistry, astronomy, materials science, etc.)
☐	Biological science
☐	Earth, atmospheric, or oceanic science
☐	Environmental science
☐	Computer science
☐	Technology
☐	Engineering
☐	Mathematics or statistics
☐	Medical, health, or behavioral science
☐	Social Science (psychology, sociology, anthropology)
☐	Other, (specify)::

13. Which of the following best describes your primary area of research?

Select one.

○	Physical science (physics, chemistry, astronomy, materials science, etc.)
○	Biological science
○	Earth, atmospheric, or oceanic science
○	Environmental science
○	Computer science
○	Technology
○	Engineering
○	Mathematics or statistics
○	Medical, health, or behavioral science
○	Social Science (psychology, sociology, anthropology)
○	Other, (specify)::

14. At which of the following HSAP sites did you participate? (Select ONE)

Select one.

○	Adams State University
○	University of Alabama
○	Arizona State University
○	Children's Hospital of Philadelphia
○	City University of New York
○	Clark Atlanta University
○	Colorado School of Mines
○	Duke University
○	Florida International University
○	Georgia Regents University - Augusta
○	Georgia State University
○	Georgia Tech
○	Louisiana State University
○	Michigan State University
○	North Carolina A&T
○	North Carolina State University
○	Oklahoma State University
○	Purdue University
○	Rutgers, the State University of New Jersey (Camden Campus)
○	Savannah State University
○	Stonybrook University of New York
○	Texas State University

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

Select one.

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

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

_____ students.

17. How did you learn about HSAP? (Check all that apply)

Select all that apply.

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

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

Select one per row.

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

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

Select all that apply.

☐	Applications from 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 HSAP
☐	Other, (specify)::

20. How SATISFIED were you with the following HSAP 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 HSAP organizers	○	○	○	○	○
Support for instruction or mentorship during program activities	○	○	○	○	○
Stipends (payment)	○	○	○	○	○
Research abstract preparation requirements	○	○	○	○	○
Communicating with Academy of Applied Science (AAS)	○	○	○	○	○

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 HSAP.

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 HSAP 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 HSAP	○	○

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 HSAP.

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 HSAP 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 HSAP.

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 HSAP.

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 HSAP.

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 HSAP?

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	○	○	○	○	○
HSAP Program administrator or site coordinator	○	○	○	○	○
Invited speakers or “career” events	○	○	○	○	○
Participation in HSAP	○	○	○	○	○

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

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	○	○	○	○	○
HSAP Program administrator or site coordinator	○	○	○	○	○
Invited speakers or “career” events	○	○	○	○	○
Participation in HSAP	○	○	○	○	○

28. Which of the following AEOPs did YOU EXPLICITLY DISCUSS with your student(s) during HSAP? (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)*
Gains in the Education of Mathematics and Science (GEMS)	○	○
UNITE	○	○
Junior Science & Humanities Symposium (JSHS)	○	○
Science & Engineering Apprenticeship Program (SEAP)	○	○
Research & Engineering Apprenticeship Program (REAP)	○	○
High School Apprenticeship Program (HSAP)	○	○
College Qualified Leaders (CQL)	○	○
GEMS Near Peer Mentor Program	○	○
Undergraduate Research Apprenticeship Program (URAP)	○	○
Science Mathematics, and Research for Transformation (SMART) College Scholarship	○	○
National Defense Science & Engineering Graduate (NDSEG) Fellowship	○	○
I discussed AEOP with my student(s) but did not discuss any specific program	○	○

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

Select one per row.

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

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

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 HSAP 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) HSAP 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 HSAP 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 HSAP 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 HSAP 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 HSAP program?

Select one per row.

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

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

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

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

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

Appendix F

Army Research Office (ARO)
FY16 Evaluation Report Response

Feedback was received from the ARO office and was incorporated into the report.