Army Educational Outreach Program

Junior Science & Humanities Symposia Program

2016 Annual Program Evaluation Report

ARMY EDUCATIONAL OUTREACH PROGRAM

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Contents

Executive Summary

The Junior Science & Humanities Symposia Program (JSHS), administered by the Academy of Applied Science (AAS) on behalf of the Services, is an AEOP pre-collegiate science, technology, engineering, and mathematics (STEM) research competition for high school students. JSHS is co-sponsored by the Army, Navy and Air Force. JSHS encourages high school students to engage in original research in preparation for future STEM career pathways. In regional (R-JSHS) and national (N-JSHS) symposia, students present their research in a forum of peer researchers and practicing researchers from government (in particular the DoD), industry, and academia.

This report documents the evaluation of the FY16 JSHS 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 JSHS included questionnaires for R-JSHS and N-JSHS participants and mentors; three focus groups with R-JSHS students; four focus groups with N-JSHS students; three R-JSHS focus groups with mentors; and one focus group with N-JSHS mentors; and an annual program report compiled by AAS.

Regional symposia were held in 47 university campus sites nationwide. The top five students in each region received an invitation to participate and compete at NJSHS, an all-expense-paid trip hosted by the Services. Of these five, the top two students were invited to present their research as part of the national competition; the third place student was invited to display a poster of his/her research in a competitive poster session; and the fourth and fifth place students were invited to attend as student delegates with the option to showcase their research in a non-competitive poster session.

2016 JSHS Fast Facts	
Description	STEM Competition - Nationwide (incl. DoDEA schools), research symposium that includes 47 regional events and one national event
Participant Population	9th-12th grade students
No. of Applicants	8,947 students and 970 teachers self-reported by each of the the 47 sites
No. of Students	5,300 Regional Participants (of whom 230 were selected to attend the National JSHS Symposium)
Placement Rate	60%
No. of Adults (Mentors, Regional Directors, Volunteers – incl. Teachers and S&Es)	3,214 + Mentors for students would increase total to > 8,000
No. of Army and DoD S&Es	234

No. of Army/DoD Research Laboratories	56
No. of K-12 Teachers	970
No. of K-12 Schools	1,060
No. of K-12 Schools – Title I	196
No. of College/University Personnel	1,979
No. of College/Universities	120
No. of Other Collaborating Organizations	189
DoDEA Students	45
DoDEA Teachers	30
Total Cost	$1,879,713
National Symposium Cost	$386,240
Regional Symposia Support Cost	$730,790
Scholarship/Award Cost	$403,000
Administrative Cost to AAS	$359,683
Cost Per Student Participant	$355

Summary of Findings

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

2016 JSHS Evaluation Findings	
Participant Profiles	
Participation in JSHS remained similar to FY15, with a 4% decrease in applications and participants. JSHS continued to engage a majority of female participants. However, growing the ethnic/racial diversity of	In FY16, JSHS received slightly fewer applications than in FY15 (4%). The 47 R-JSHS sites received 8,947 applications and were able to accommodate 63% of these (5,620). This represents a 4% decrease in participants from FY15 when 9,347 students applied and 5,829 were selected.
	JSHS continued to be successful in FY16 in attracting a majority of female participants based upon data that were available. In the regions that reported gender data, 57% of participants were female and 43% were male. However, demographic data was available from only 29 of 46 regional symposiums (2,065 participants – less than 50% of total population).

JSHS continues to be an area in need of focus.	JSHS continued to struggle with growing diversity of participants in FY16. JSHS participants remained predominantly White or Asian in FY16, as nearly half (45%) of students identified themselves as White with another 22% identifying themselves as Asian. 21% of students chose not to report their race/ethnicity, 4% identified themselves as Black or African American and 6% as Hispanic or Latino. Native American students comprised .3% of the students reporting their race/ethnicity, while .3% identified as Native Hawaiian or Pacific Islander.
	R-JSHS participants were mostly from public schools (77%) though some students represented DoD schools (3%). The percentage of rural students participating in JSHS declined by 50% down to 14% (compared to over 40% in FY15). The majority of students reported being from suburban schools (59%) and urban locations (27%).
	More than half of participants were oral research presenters (57%). There were 24% poster presenters, and 19% of attendees did not present at JSHS.
JSHS mentor demographics reflected the diversity of participants in FY16.	There were 970 teachers who participated in JSHS in FY16. Demographics reported on the mentor questionnaire (109 participants) indicated that 63% were female, 34% male, and 3% chose not to report gender. Ethnic/racial diversity was similar to the participant group including 75% White, 12% Asian, 3% Native American, 1% Hispanic/Latino, 2% other, and 7% chose not to report. There were 0% Black or African American mentors that completed the questionnaire.
Actionable Program Evaluation	
Marketing of JSHS continues to predominantly be schools and past participants. Students continue to be motivated to participate in JSHS to receive experiences they normally do not receive in school.	JSHS continued to utilize marketing and recruitment strategies focused primarily at the regional level through JSHS directors in FY16, along with AAS driven communications and marketing on websites/social media. Similar to FY15, participants learned about JSHS through three primary means: 20% of participants indicated they learned about JSHS through their school or university, 18% learned about JSHS through a school newsletter or website, and 18% learned about JSHS through a past participant. Other ways that were reported included: friend (9%); AEOP website (8%); family (5%); someone who works with program (4%); community group (4%); Department of Defense (1%); social media (1%) and 5% chose not to report.

	The top motivations for participating in JSHS in FY16 were the same as in FY15 though the percentage agreement decreased considerably and a broader array of reasons received similar agreement. The top two included interest in STEM (10%) and desire to learn something new (8%), though were closely followed by having fun (8%); desire to expand laboratory or research skills (8%); and learning through ways not possible in school (7%).
Participation in STEM activities occurred more frequently on a most to every day basis in JSHS than in school. However, participants reported less frequent use of most STEM practices in JSHS than in school. Mentors increased their use of strategies for diverse learners.	Participants indicated JSHS STEM Activities occurred more frequently than in school STEM activities in nearly all areas. Participants (41%) indicated that they learn about STEM topics that are new to them every day both in school and in JSHS. However, more participants agreed JSHS provides them opportunities every day to apply STEM learning to real-life 32% (18% in school); learn about new discoveries in STEM 34% (14% in school); learn about different careers that use STEM 25% (10% in school); interact with scientists or engineers 30% (10% in school); and communicate with other students about STEM 40% (27% in school).
	As in FY15, participants reported using STEM Practices less frequently during R-JSHS than during school – with the exception of building or making a computer model –, which had 17%, agreement during R-JSHS compared to 10% agreement at school. Findings indicate that R-JSHS students are not as frequently engaged in (less than most days) STEM practices including: using laboratory procedures and tools, hands on STEM activities, working as part of a team, identifying questions or problems to investigate, designing and carrying out investigations, analyzing data and drawing conclusions, and coming up with creative explanations or solutions.
	Mentors reported increased use of strategies for diverse learners in FY16 compared to FY15. 91% of mentors reported using a variety of teaching and/or mentoring activities to meet the needs of students while 85% interacted with students and other personnel the same way regardless of their backgrounds. Nearly al mentors (90%) reported directing students to other individuals or programs for additional support. treating all students the same way, regardless of gender or race/ethnicity. Most of responding mentors also reported using strategies such as identifying different learning styles students may have at the beginning of their JSHS experience (70%) and providing extra readings, activities, or learning support for students who lacked essential background skills (78%).

JSHS succeeded in exposing participants to STEM careers/jobs through program activities and mentor efforts. However, 60% of R-JSHS participants reported not learning about any DoD STEM jobs/careers. N-JSHS participants reported that invited speakers and career events were the key way they learned about DoD STEM careers. The difference in experiences may be attributed to low percentage (35%) of mentors who reported discussing DoD STEM careers with students. Additionally, only 31% of mentors recommended other AEOPs to participants.	R-JSHS participant reported exposure to STEM careers and DoD STEM jobs/careers specifically were areas of decline for FY16. Only 10% of R-JSHS students reported learning about at least one STEM job/career, and 21% reported learning about five or more. Additionally, 22% of R-JSHS participants reported that they did not learn about any STEM jobs/careers during the program. Comparatively, many fewer R-JSHS participants learned about DoD STEM jobs/careers overall. 60% of participants reported that they did not learn about even one DoD STEM job/career. Only 12% learned about one job, 11% two jobs, 8% three jobs, 2% four jobs, and 8% five or more jobs. However, a large majority of N-JSHS (80%) students indicated that invited speakers or career events were a key resource for learning about DoD STEM careers.
	Mentors for both R-JSHS and N-JSHS were asked to report their use of strategies specifically focused on introducing participants to STEM careers and DoD specific STEM jobs/careers in FY16. 73% of mentors reported discussing STEM career opportunities with participants, indicating JSHS participants are learning about STEM careers – as participants have also reported. However, only 35% reported discussing DoD STEM career opportunities with participants. Additionally, only 31% of mentors recommended other AEOPs to participants. These are areas that should be considered for improvement in FY17.

Participant satisfaction with JSHS program components ranged from around 50% to 82% for various aspects in FY16. N-JSHS participants were dissatisfied with feedback received from judges. Mentors continued to report satisfaction with JSHS in FY16.	Participant satisfaction with JSHS program components ranged from around 50% to 82% for various aspects in FY16. Despite this decline, R-JSHS students were somewhat or very much satisfied with the student oral presentations (82%) while over half (56%) were very satisfied with student poster presentations, and invited speaker presentations (64%). Nearly half (47%) were very satisfied with social events while 51% reported being very satisfied with features such as feedback from VIPs and peers, and tours of field trips (47%). Another 53% of students indicated being satisfied with feedback from judges. It should be noted that large proportions of students did not experience features such as panel or round table discussions (48%), team-building activities (55%), and career exhibits (53%). Participant dissatisfaction with the judging process continued to be an area of concern in FY16 (which has declined since FY14). Though 64% of R-JSHS participants were satisfied, the majority of N-JSHS participants (60%) reported dissatisfaction with feedback received from judges at R-JSHS. Respondents reported wanting more diversity in expertise and ethnic/racial/gender backgrounds of judges, more focus actual project content than presentation skills, and written feedback on presentation/poster.
	The research experience overall ranked as the top JSHS resource for participants (89%). The amount of time spent with their mentor was also rated highly (79%). Many participants did not utilize some JSHS resources including the oral presentation tips (42%), sample papers (42%), and JSHS Groundrules (31%). Surprisingly, 47% of R-JSHS respondents to the survey indicated they did not have a JSHS mentor.
	Mentors reported being very satisfied with JSHS program features. Communication with the JSHS site organizers was rated highest (75%) followed by the physical location (67%), application or registration process (62%), support for instruction or mentorship (58%), and research abstract preparation requirements (56%).
Outcomes Evaluation	
Nearly half of R-JSHS participants reported large gains on their STEM knowledge and STEM competencies.	Over 40% of R-JSHS students reported large gains on their in-depth knowledge of a STEM topic or field; knowledge of research, processes, ethics, and rules for conduct in STEM; knowledge of what everyday research work is like in STEM; knowledge of how scientists and engineers work on real problems in STEM; and knowledge of research conducted in a STEM topic or field.

	Slightly over 40% of R-JSHS participants reported large impacts on some of the STEM competencies, or abilities to "do STEM." These areas included: using knowledge and creativity to suggest a solution to a problem; identifying limitations of methods and tools used for data collection; carrying out procedures for an experiment and recording data accurately; organizing data in charts or graphs to find patterns and relationships; supporting an explanation for an observation with data from experiments and STEM knowledge; supporting a solution for a problem with data; identifying the strengths and limitations of explanations in terms of how well they describe or predict observations; communicating about your experiments and explanations in different ways.
R-JSHS participants reported large gains in 21st Century Skills.	Slightly over 40% of responding R-JSHS participants reported large gains in 21st Century Skills. These skills included communicating effectively with others (50% R-JSHS), viewing failure as an opportunity to learn (55% R-JSHS), and setting goals and reflecting on performance (49% R-JSHS).
Participants reported gains in STEM identity and interest in engaging in STEM in the future.	50% of R-JSHS participants reported large gain in the STEM identity areas including: feeling prepared for more challenging STEM activities (51%); confidence to try out new ideas or procedures on my own in a STEM project (51%); and desire to build relationships with mentors who work in STEM (50%).
	Over 60% of R-JSHS participants reported being more likely to engage in out-of-school STEM activities including: work on a STEM project or experiment in a university of professional setting (70%); participate in a STEM camp, club, or competition (64%); talk with friends or family about STEM (63%); help with a community service project related to STEM (63%); mentor or teach other students about STEM (61%); and take an elective STEM class (61%). As in FY15, the impact of JSHS extends and is lasting beyond the actual competition.
JSHS participants aspired to further their education beyond finishing college after JSHS. The type of work they expected to do before and after participation were similar.	After participating in JSHS, students indicated being more likely to go further in their schooling than they would have before JSHS. For R-JSHS students, the proportion of students wanting to graduate high school increased from .50% to 2% and get a Ph.D. grew from 21% to 29% from before JSHS to after JSHS participation. R-JSHS participants wanting to finish college remained similar at about 14% prior to participation and 9% after.
	Participants were asked to indicate what kind of work they expected to be doing at age 30, both before and after JSHS participation. The majority of students aspired to STEM careers both before and after JSHS participation and no significant change was found.

Some R-JSHS participants were more aware of and interested in other AEOPs. N-JSHS students reported learning about the SMART Scholarship but no other AEOPs were mentioned.	Almost half of R-JSHS participants agreed JSHS made them more aware of other AEOPs (49%) and 46% of R-JSHS participants indicated interest in participating in other AEOPs. The program of most interest was JSHS (59%), followed by SMART College Scholarship (33%), SEAP (31%), REAP (31%), HSAP (29%), URAP (29%), NDSEG Fellowship (29%), CQL (27%), GEMS Near Peer Mentor (25%) and Unite (24%). The N-JSHS questionnaire asked participants to list the AEOP programs they had learned about through JSHS this year. Most participants reported learning about the SMART Scholarship. N-JSHS participants mentioned no other AEOPs.
	R-JSHS participants reported that participation in JSHS was the best resource available to learn about other AEOPs (43%). Most students reported not experiencing the AAS website (89%) or AEOP website (85%) or AEOP social media (91%) at all. Further, the AEOP brochure was not provided to 87% of responding participants in FY16.
	Mentors reported similar experiences with resources that may be utilized to expose participants to other AEOPs. 84% of mentors did not use the AAS website and 87% did not use the AEOP website. 95% did not use any form of AEOP social media and 81% did not experience the AEOP brochure. Interestingly, 62% of mentors indicated the JSHS program administrator or site coordinator were their best sources of information (62%) along with actual participation in JSHS (82%) for learning about other AEOPs. Mentors reported their discussion of individual programs within the AEOP portfolio with student participants. Unite was the most discussed at 23%, followed by SMART College Scholarship (14%), eCybermission (12%), SEAP (11%), URAP (10%), REAP (10%), HSAP (9%), CQL (5%), and NDSEG Fellowship (6%).
Most R-JSHS participants had positive views of Army/DoD research and a subset of the group were interested in pursuing Army/DoD STEM careers.	R-JSHS participants reported being more aware of Army/DoD STEM research and careers (53%) and having greater appreciation of Army/DoD STEM research (56%). More than 60% of R-JSHS students expressed agreement that DoD research is valuable to society, that DoD researchers solve real-world problems, that DoD researchers develop new, cutting edge technologies, and the DoD researchers advance science and engineering fields. Finally, 42% of R-JSHS participants reported being more interested in pursuing a STEM career with the Army or DoD.

Responsiveness to FY14 and 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.

FY15 Finding: Although the applicant placement rate increased from 55% to 62% from FY14 to FY15, it is concerning that there was a 30% decrease in the number of applicants in FY15 as compared to FY14, and overall participation was 21% lower. It is recommended that JSHS track the number of applicants and placement rates at each regional site to insure more consistent placement rates across the portfolio (i.e. Illinois – Chicago had only 20% placement rate compared to 100% at other sites such as South Carolina). One strategy would be for AAS to work with regional sites to support increasing their capacity to accept more participants in the low placement rate regions.

The program failed to meet its goal of a 10% increase in the number of participating high schools and, in fact, there was an 8% decline in the number of schools participating in FY15. Of the 47 regional events held, 18 regions showed a 27% increase over the previous year in the total number of participating high schools. Another 14 regions showed a 37% decrease since FY14. While there are a variety of intervening factors associated with these phenomena, including weather impacts, competing activities, and impacts of school budget cuts on students' ability to travel, program administrators should be mindful of these decreases in participation and particularly the effect they may have on engaging students from underserved and underrepresented populations.

AAS may want to support states to reach out and cast broader nets for recruiting participants – beyond the local area of the competition or host. The program may wish to investigate student recruitment practices from the regions that demonstrated growth in FY15 and identify scalable recruitment and marketing strategies that could be applied across regions. Likewise, the program may wish to investigate strategies from regions with decreasing participation with the aim of identifying longitudinal changes in regional practices that may have affected student participation rates. Some recommended strategies to grow the diversity of student participants to increase the number of underrepresented students include conducting outreach to schools with high populations of underrepresented students to make them

aware of JSHS and reaching out to academically prepare and competitively eligible underrepresented students to encourage actual participation in JSHS.

JSHS FY16 Efforts:

- Invite younger students and those from underrepresented populations to observe and/or participate in specific sessions to encourage future participation, including non-competitive poster sessions, science related visual art presentations, and oral presentations with reflection and feedback discussions. (Alabama, Connecticut, Florida, Intermountain, Missouri, North Carolina, Ohio, South Carolina, Wisconsin-UP of Michigan)
- Provide training and support to students in specific topics concerning how to conduct research, write papers, and present projects through workshops, webinars, and print materials. (Connecticut, Iowa)
- Engage volunteers from underrepresented populations to serve as role models and those to whom underrepresented students can better relate. (Connecticut, Florida, Hawaii, Philadelphia, Southeastern Michigan, Southwest, and Washington)
- Connect undergraduate and graduate students in STEM fields from host institution to teachers in rural schools to serve as mentors in new mentorship initiative that plans to expand in FY17. (Alabama, Ohio)
- Provide direct mentor support to underrepresented students through the US2020 program. (Philadelphia)
- Provide additional funding to reduce or eliminate costs for travel, meals, and accommodations associated with the JSHS regional symposia; use private donations to provide STEM opportunities and research supplies to schools with large under-represented populations. (Alaska, Intermountain, Missouri, New York-Upstate)
- Adjust maximum number of students allowed from a school to participate in JSHS regional symposia, especially if school is from a more financially challenged district. (Missouri)
- Create and use Advisory Board which includes key school district personnel to outreach to Detroit schools and students. (Southeastern Michigan).

JSHS FY16 Outcomes:

- The AEOP has the goal of broadening the talent pool in STEM fields, specifically targeting underrepresented and underserved populations, and therefore increasing the number of participants in programs, including JSHS. In FY15, JSHS experienced a decrease in student and high school participation overall due to several factors which affected regional competitions such as inclement weather, school budget cuts and competing activities. With respect to including underrepresented and underserved populations, the evaluation data indicate that JSHS was able to attract a significant number of female participants (a recognized underrepresented group in STEM) the program had limited success in attracting underserved minority race/ethnicity and low-income groups on a regional and national scale.
- To expand participation in FY16, the AAS identified sustainable recruitment strategies used in Regional Symposia, which saw increases in participation and explored avenues to pursue similar practices in regions struggling to meet participation goals, with specific emphasis placed on practices targeting underrepresented groups. Each of the Regional Symposia reported outreach efforts to heighten awareness of JSHS among high schools, particularly those serving underrepresented populations, or efforts to develop partnerships with STEM enrichment programs serving underrepresented population. However, overall participation in JSHS continued to decline in FY16.

- As a result in FY16, JSHS participation by Title I high school increased as measured by the number of participating Title I schools. The FY16 target of 10% or 110 Title I schools was exceeded with 18% or 196 Title I high schools participating in JSHS Regional Symposia. The number of participating high schools remained steady in FY '16, with 1,060 high schools participating in FY '16 as compared to 1,100 high schools in the previous year.

FY15 Finding: AEOP objectives include expanding participation of populations historically underrepresented in STEM careers. Since no program-wide demographic data was available from FY14, however, it is not possible to determine whether there was any change in participation of these groups from FY14 to FY15. Collecting demographic information on students participating in the R-JSHS through Cvent will enable a more accurate representation of the JSHS participation pool and concerted efforts should be made by program administrators to ensure that demographic data for all JSHS participants is compiled annually. JSHS failed to meet its FY15 goal for attracting Title I schools (associated with low-income status students) to the program. Of the 1,020 schools participating 15% were Title I schools, falling short of its FY15 goal of 20%. The program should continue to collect information and strategies from specific regional symposia as well as other AEOPs that successfully attract underrepresented and underserved students. This information should be disseminated to the larger JSHS community of regional directors. Additionally, the program may with to consider ways to build on previous efforts to strengthen its outreach to schools that serve large proportions of underrepresented groups of students (e.g., urban schools, Title I schools). JSHS might also consider the possibility of engaging with target districts through the AEOP's strategic outreach initiative opportunities, which provide limited financial support to assist in the ability of a target community to engage with the AEOPs.

JSHS FY16 Efforts and Outcomes:

- JSHS encouraged more sites to use Cvent in FY16 – however only a few did. As a result, demographic data outside of the evaluation data was incomplete at best.

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

FY 15 Finding: The frequency with which students expressed dissatisfaction with judging practices and judging feedback during their JSHS experience (including the increased dissatisfaction from FY14 to FY15) suggests that there may be a need to direct additional resources to judge recruitment and training. While participation of DoD STEM personnel was constant from FY14 to FY15, there was a 33% decrease in the participation of college/university personnel from FY14 to FY15. The program may wish to further investigate practices of regions that were successful in attracting larger numbers of and greater diversity of judges with the aim of identifying practices that may be scaled across regions. Additionally, the program may wish to consider whether current judging practices established by the program are adequate to ensure standardization of judging practices nationwide and consider additional methods to standardize judging and reduce students' perception of judging bias. The program may wish to consider, for instance, creating judging rubrics, providing enhanced judging training or orientation, and providing methods for judges to easily provide both oral and written feedback to students. Currently, the feedback at regional level JSHS competitions is varied and is mostly verbal in format.

JSHS FY16 Efforts and Outcomes:

- The AEOP program wide goal to empower educators with unique Army research and technology resources to mentor students and develop the pool of future STEM talent is assessed through multiple experience related questions in the evaluation. JSHS data collected reveals that while participation of DoD STEM personnel was constant from FY14 to FY15. Participation by mentors, regional directors, and volunteers representing academia continued to grow from FY14 (2,500) to FY16 (3,214).
- In FY '16 a total 3,214 mentors, regional directors, and volunteers representing academia contributed to JSHS Regional and National symposia. Among the total 275 adults attending the National JSHS, 275 reported the data on Gender and/or Race/Ethnicity. Reported NRM data on National adult leaders was:
    - Gender: 103 Female; 170 Male ; 2 Choose not to report
    - Race/Ethnicity: 10-Asian; 11-Black or African American; 9-Hispanic or Latino; 1-Native American or Alaskan Native; 1-Native Hawaiian; 6-Other; 13-Choose not to report.
- Recommendation was made to the Academy to investigate practices employed by regions that attract larger numbers and greater diversity of judges for Regional Symposium in order to establish best practices, which can be distributed across all regions. The Academy was also advised to examine judging procedures to ensure standardization across the Regional and National Symposia and to reduce students' perception of judging bias. In response to the evaluation report, the Academy devoted time and facilitated an intentional discussion about the topic of judging at the Annual Meeting of Regional Directors in FY16. The Academy also reinstituted the Regional Directors Advisory Council (RDAC). RDAC, a representative body of JSHS regional symposium directors and others, will advise the Academy of Applied Science in the continuing development and direction of the JSHS program. This group met in August FY16 and has revised the rules of competition and judging policies for FY17. These revisions have been published in the National guidelines and will be distributed to all regional directors through email and website publications.
- In addition to the Academy's immediate responses to the issue of judges and AEOP's goal to empower educators with research and technology resources, particularly those from the DoD, to serve as mentors and volunteers, the Academy will also identify current practices employed by regions to recruit and train judges and further develop and distribute these methods to all Regional Symposia. Practices which can be shared include collaboration with DoD STEM personnel at regional and national symposia and participation practices, engagement by JSHS alumni, engagement by graduate students, volunteer diversity, and use of technology for training judges and volunteers.

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

FY15 Finding: In order to create a robust pipeline of AEOP programs in which students' progress from other AEOPs into JSHS and beyond, the program may want to consider innovative ways to work with other AEOPs to create a more seamless continuum of programs. One finding that is cause for concern is that although many participants expressed interest in other AEOP programs, most students had never heard of AEOP programs outside of JSHS. Large numbers of

students at R-JSHS events reported not having seen the AEOP brochure. This is especially concerning since the FY15 APR indicates that AEOP resources were distributed to all regional symposia. Coupled with this is student reliance on teachers or mentors for information about AEOPs and mentor reports of having little familiarity with AEOPs other than JSHS. The program may wish to consider devising methods to disseminate AEOP information directly to teachers and mentors before the regional events as well as communicating expectations to regional symposia concerning the distribution of AEOP materials at events to ensure that all mentors, teachers, and students have access to structured opportunities that both describe the other AEOPs and provide information to students on how they can apply to them.

Evaluation data indicate that nearly half (47%) of R-JSHS students did not hear about any Army or DoD STEM career opportunities during their JSHS experience. Since R-JSHS mentors were reported to be a useful source of information about DoD STEM careers it would be useful for the program to devise ways to familiarize mentors with resources available to expose students to DoD STEM careers. A large majority of N-JSHS (80%) students indicated that invited speakers or career events were a key resource for learning about DoD STEM careers, however over a third (35%) of R-JSHS students reported not having experienced these resources. Because of the potential marked impact of this resource on student awareness of DoD STEM careers, the program may wish to consider innovative ways to connect regional students with DoD STEM professionals, including creating web-based video profiles of DoD STEM professionals, creating virtual lab tours hosted by DoD STEM professionals, and devising strategies to facilitate regional symposia's efforts to engage DoD STEM professionals as speakers at events.

The R-JSHS experience comprises the entirety of the JSHS experience for most students, however consistent differences between R-JSHS and N-JSHS student responses suggest that N-JSHS may have a greater impact on students than R-JSHS. While some of these differences are likely due to initial differences in interest and/or ability between students who are selected to go on to N-JSHS and those who are not, other differences may be related to differences in the availability/quality of mentor support or the availability/quality of activities at each symposium. The program should consider what guidance and support can be provided to regional directors, mentors, and other supporters of R-JSHS to facilitate the identification of mentors (particularly in rural areas and other areas with logistical barriers to accessing university and other professional STEM resources), active engagement in STEM activities, useful feedback from judges, and feelings of success that support a positive STEM identity among students who are not selected for N-JSHS.

JSHS FY16 Efforts and Outcomes:

- The AEOP established a goal to create a robust pipeline of AEOP programs in which students' progress from other AEOPs into JSHS and beyond. The primary objective has been to expand cross-marketing and outreach for JSHS to include other AEOP programs, however, data from the FY15 evaluation confirms that despite marketing efforts, JSHS participants do not know about AEOP or its opportunities outside of JSHS. Survey responses indicate strong participant interest in other AEOP programs but that a majority have little or no awareness of these programs. It is evident that JSHS and the AEOP programs as a whole need to develop a brand identity to connect them to each other and to the larger organization of AEOP. In addition to the lack of awareness of AEOP specifically, the evaluation revealed a significant disconnect between the amount of

Army and DoD STEM experiences highlighted at the Regional and National Symposium and that students who participate in the National competition receive much more exposure to DoD STEM opportunities than those who only participate at the Regional level. In FY15, the Academy mailed AEOP resources to all regional directors for distribution at the Regional Symposia. The Academy continued this practice in FY16, however the supply of materials was more limited and regional requests were not always met in full.

- Recommendation was made to the Academy to consider innovative ways to collaborate with other AEOPs to create a more seamless continuum of programs. The Academy disseminates AEOP materials directly to teachers and mentors to highlight the organization and the multiple opportunities offered. Survey results illustrate that students identify teachers and mentors as a useful source of information about STEM careers in general.
- The Academy continues to support all AEOP programs through cross marketing. In FY16, AAS made pointed efforts to collaborate with the LO and Widmeyer to promote AEOP programs among JSHS participants and alumni. A more robust social media and marketing campaign that included AEOP branding was implemented in FY16 and will continue to grow into FY17 and beyond. In FY16, targeted communication was sent to alumni to recruit volunteers for eCybermission, and newsletters and emails were sent to JSHS and participants in the Apprenticeship Programs to encourage continued engagement in AEOP opportunities. To address the disconnect between the presence of AEOP and awareness of DoD STEM careers between the regional and national symposia, the Academy is considering ways to create and distribute promotional materials such as banners and posters to be displayed at all Regional Symposia to include and highlight AEOP branding. The Academy will also continue to encourage all regions to include language about AEOP and to engage DoD volunteers to establish a stronger Army and DoD presence at events to raise awareness.

FY15 Finding: Participation in the AEOP evaluation continues to be an area of concern. While student and mentor participation rates rose slightly from FY14 to FY15, the continued relatively low rates of participation threaten the generalizability of results. Improved communication with regional JSHS sites about expectations for the evaluation may help. A recommendation was made in the FY14 evaluation report as follows: "Given the large number of participants in the Regional competitions, it may be worth randomly sampling students to respond to the questionnaire, and rechanneling efforts into getting a high response rate from the sample." Although there is no indication that this recommendation was acted upon in FY15, it may be a strategy to consider going forward. It is recommended that JSHS consider requiring regional sites to provide time for participants to complete the AEOP evaluation questionnaire during regional symposia.

JSHS FY16 Efforts and Outcomes:

- JSHS encouraged more sites to complete the evaluation in FY16, including hosting webinars for regional directors. Participation in the FY16 evaluation was still very low despite the efforts.

Recommendations for FY17 Program Improvement/Growth

Evaluation findings indicate that FY16 was a successful year overall for the JSHS program. Notable successes for the year include the continued high participation rate for females, continued participation by other groups traditionally under-

represented in STEM fields, and good levels of mentor and student satisfaction with the programs. In FY16 JSHS mentors increased their use of effective mentoring strategies and most R-JSHS participants indicated strong interest in engaging in out-of-school STEM experiences in the future.

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

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

1. In FY16 JSHS continued to experience a decrease in applications and participation in the program overall – which represents a three-year downward trend. For FY16 there were 8,900 applications and 5,300 participants – compared to 9,347 and 5,829 respectively in FY15. This is an area that is in need of focus for FY17. We suggest as an example a couple of strategies for addressing enrollment concerns: 1) work with regions to expand their recruitment efforts beyond the local area utilizing websites, social media, and other marketing efforts of the consortium, 2) grow capacity for stronger regions to accept more participants. For example, most participants at the Kentucky regional site visit were from the greater Louisville region – with very little to no representation from other central and southeastern parts of the state. We suspect this may be the case for other regional sites. JSHS may also consider utilizing electronic formats to grow participation in JSHS from remote locations – similar to an eCybermission model – for the future. Additionally, it is recommended that JSHS provide the Regional Directors a forum to share best practices in both program administration as well as infusing information about AEOP programs and DoD research and careers into programming.

2. In addition to increasing participation overall – JSHS should also continue and expand efforts to provide outreach to prospective participants from historically underrepresented groups. JSHS participants remained predominantly White or Asian in FY16, as nearly half (45%) of students identified themselves as White with another 22% identifying themselves as Asian. 21% of students chose not to report their race/ethnicity, 4% identified themselves as Black or African American and 6% as Hispanic or Latino. Native American students comprised .3% of the students reporting their race/ethnicity, while .3% identified as Native Hawaiian or Pacific Islander. JSHS should examine housing regional sites within areas that provide great representation of potential diverse JSHS participants and work with regional directors to specifically target schools that have not been well represented in JSHS.

3. R-JSHS participants reported having experience with STEM activities within JSHS. However, most reported that they were able to use STEM practices more frequently in school than in JSHS. This should be an area of focus for JSHS and AAS should consider providing specific suggestions/guidelines/handbook to regional sites on how to include STEM practices within the programming for R-JSHS. Further, almost half (40%) reported large gains in their STEM knowledge, STEM competencies, and 21st Century Skills after participating in JSHS. In FY16 most

participants did not feel that JSHS impacted their abilities to do STEM and associated knowledge. This is another data point that illuminates a need to provide more guidance and structure to the JSHS programming – particularly at the regional level – to ensure that participants are gaining these valuable experiences and abilities during the program.

4. Program provided/collected demographic data on participants was incomplete, as in FY15. It is strongly suggested that JSHS require regional sites to collect full demographic data on all participants – ideally through Cvent in FY17.

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

1. In FY16 JSHS participants continued to report dissatisfaction with judging practices and judging feedback at regional competitions – a finding that has been reported in FY14 and FY15 as well. There were several data points that reinforced this finding, from the R-JSHS survey to N-JSHS focus group sessions and the N-JSHS survey. Participants reported not being satisfied with the quality of and amount of feedback provided from judges – including receiving no written feedback from judges. Further, participants felt that the judges were not content experts and that they were judged primarily for their presentation skills rather than the actual content and focus of their research project. As has been recommended in previous years, JSHS should develop and implement guidelines for judging that include templates for providing feedback (written and oral) to participants. Further, regional sites should make every effort to have judges that reflect the breadth and depth of STEM content that participants may focus on as much as possible. STEM experts as well as Army/DoD STEM experts should be sought to engage in R-JSHS events. Virtual judging processes that may enable more qualified STEM judges to participate may be a potential strategy – along with virtual competitions for those that are regionally unable to participate.

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

1. As in FY15, less than 50% of JSHS participants agreed that JSHS made them more aware of other AEOPs and only 46% were interested in participating in other AEOPs. Additionally, only 15% of JSHS participants had used the AEOP website and fewer had used social media related to AEOP (9%). Further, only 13% of participants had been provided with the AEOP brochure. Most mentors did not discuss AEOPs with participants – as only 23% discussed Unite, 14% SMART, 12% eCybermission, 11% SEAP, 10% URAP, 10% REAP, 9% HSAP, 5% CQL, and 6% NDSEG Fellowship. These findings are concerning, primarily because these are areas that AAS could address through collective and organized marketing efforts for JSHS. In FY17 AAS should develop with or without consortium support materials to be provided to participants (i.e. brochures, handouts) as well as instructional resources for regional sites (mandatory) to go through with all regional site participants during the

overview/orientation session prior to competition or at the conclusion (e.g. slides, speakers). Promotion of the AEOPs should be collective responsibility of each and every program within the consortium.

2. The majority of participants in R-JSHS (78%) in FY16 reported learning about STEM careers during the program and most (68%) learned about more than one career. However, JSHS did a much less effective job of exposing participants to Army/DoD STEM careers – as only 40% learned about at least one Army/DoD STEM career. Conversely, a large majority of N-JSHS (80%) students indicated that invited speakers or career events were a key resource for learning about DoD STEM careers. The difference in growth of learning about STEM careers overall and DoD STEM careers specifically may be attributed to mentor level of discussion of each during the program. Mentors (78%) reported discussing STEM careers with participants. However, only 35% discussed Army/DoD STEM careers. Mentors (78%) reported discussing STEM careers with participants. However, only 35% discussed Army/DoD STEM careers. In FY17 JSHS should address this area through development of a toolkit for regional sites to use (i.e. slideshow, handouts, social media posts) and also an inventory of potential regional Army/DoD STEM career people who could be engaged to participate in person or by video in the programming.

Introduction

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

AEOP Goals

Goal 1: STEM Literate Citizenry.

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

Goal 2: STEM Savvy Educators.

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

Goal 3: Sustainable Infrastructure.

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

This report documents the evaluation of one of the AEOP elements, the Junior Science & Humanities Symposia Program (JSHS). JSHS is administered on behalf of the Army by the Academy of Applied Science (AAS) and is co-sponsored by the Navy and Air Force. The evaluation study was performed by Purdue University in cooperation with Battelle, the Lead Organization (LO) in the AEOP CA consortium.

Program Overview

JSHS is an AEOP pre-collegiate STEM competition. JSHS encourages high school students to engage in original research in preparation for future STEM career pathways. The categories of competition are:

1. Chemistry (including geochemistry, energy-alternative fuels, materials science);
2. Engineering;
3. Environmental sciences;
4. Life sciences (including natural sciences, microbiology, molecular/cellular, biochemistry);
5. Mathematics and computer sciences;
6. Medicine & health (including behavioral sciences, neurobiology, biomedical, physiology); and
7. Physics and astronomy.

In regional (R-JSHS) and national (N-JSHS) symposia, students present their research in a forum of peer researchers and practicing researchers from government (in particular the DoD), industry, and academia. In addition, they receive public recognition and awards for their research achievements while competing for scholarship funds.

Regional symposia were held at 47 university campus sites nationwide in 2016. The top five students in each region received an expense-paid trip to the N-JSHS. Of these five, the top two students were invited to present their research as part of the national competition; the third place student was invited to display a poster of his/her research in a competitive poster session; and the fourth and fifth place students were invited to attend as student delegates with the option to showcase their research in a non-competitive poster session. The AAS has established guidelines and "Ground rules" for the student research paper competition and provides these guidelines to JSHS regional symposia and other cooperating organizations. These resources allows for a general consistency in student experience and outcome, while still allowing sites the flexibility to design the details of their program to meet the unique needs of their students. All JSHS programs are designed to meet the following objectives:

1. Promote research and experimentation in STEM at the high school level;
2. Recognize the significance of research in human affairs and the importance of humane and ethical principles in the application of research results;
3. Search out talented youth and their teachers, recognize their accomplishments at symposia, and encourage their continued interest and participation in the sciences, mathematics, and engineering;
4. Recognize innovative and independent research projects of youth in regional and national symposia;
5. Expose students to academic and career opportunities in STEM and to the skills required for successful pursuit of STEM;
6. Expose students to STEM careers in the Army and/or DoD laboratories; and
7. Increase the future pool of talent capable of contributing to the national's scientific and technological workforce.

The 47 R-JSHS sites received applications from 8,947 students (self-reported by each of the sites), most sites did not use the CVENT system to process applications/registrations) and were able to accommodate 63% of these (5,620). This represents a 4% decrease in student applicants and a 4% decrease in participants from FY15 when 9,347 students applied and 5,829 were selected. Table 1 summarizes interest and final selection by site.

Table 1. 2016 JSHS Site Applicant and Selection Numbers			
2016 JSHS Site	**No. of Student Applicants**	**No. of Selected Students**	**No. of Selected Teachers**
Alabama	170	120	17
Alaska	22	22	3
Arizona	200	160	20
Arkansas	90	60	10
California No. & W. Nevada	200	40	2
California Southern	200	40	2
Connecticut	400	240	33
Europe	132	52	17
Florida	490	240	33
Georgia	140	133	9
Hawaii	240	90	14
Illinois	80	60	10
Illinois-Chicago	120	50	5
Indiana	0	0	0
Intermountain	120	90	10
Iowa	133	133	29
Kansas-Nebraska-Oklahoma	120	80	30
Kentucky	70	36	6
Louisiana	150	80	12
Maryland	100	100	10
Michigan Southeastern	90	40	10
Mississippi	50	20	5
Missouri	200	120	20
New England Northern	110	110	20
New England Southern	100	60	11
New Jersey Monmouth	435	435	30
New Jersey Rutgers	270	112	23
New York Long Island	460	200	74
New York Metro	300	218	48
New York Upstate	484	484	61
North Carolina	160	80	20
North Central	290	234	30
Ohio	310	115	13

Oregon	50	50	10
Pacific	170	50	14
Pennsylvania	120	60	10
Puerto Rico	150	60	17
Philadelphia	260	173	15
South Carolina	300	225	50
Southwest	100	100	14
Tennessee	110	85	25
Texas	200	80	25
Virginia	500	100	20
Washington	120	70	12
Washington D.C.	280	128	22
West Virginia	40	15	2
Wisconsin	90	60	11
Wyoming-Eastern Colorado	60	60	14
Total	**8,946**	**5,390**	**939**
National Symposium		230	34

JSHS engaged approximately 12,300 teachers, faculty, graduate students, and support personnel in conducting the symposia including approximately 234 Army/DoD STEM scientists and engineers (S&Es). Participants by category are listed in Table 2.

Table 2. 2016 JSHS Participation

Participant Group	No. of Participants
High school students (grades 9-12)	5,300
In-service K-12 teachers	970
College/university faculty or other personnel	1,979
Army/DoD Scientists & Engineers	234
Total	**8,483**

Demographic data was available from only 29 of 46 regional symposiums (2,065 participants – less than 50% of total population). In the regions that reported gender data, 57% of participants were female and 43% were male. Nearly half (45%) of students identified themselves as White with another 22% identifying themselves as Asian. While 21% of students chose not to report their race/ethnicity, 4% identified themselves as Black or African American and 6% as Hispanic or Latino. Native American students comprised .3% of the students reporting their race/ethnicity, while .3% were Native Hawaiian or Pacific Islanders.

The total cost of the 2015 JSHS program was $1,879,713, including $403,000 provided in scholarships and awards (Table 3). Undergraduate tuition scholarships to winners at the R-JSHS and N-JSHS events are payable to the students' college of enrollment upon matriculation. The average cost per student participant for 2016 JSHS was $355.

Table 3. 2016 JSHS Program Costs	
2016 JSHS – Summative Cost Breakdown	
Total Cost	$1,879,713
Scholarship/Awards Cost	$403,000
Regional Symposia Support Cost*	$730,790
National Symposium Cost	$386,240
Administrative Cost	$237,667
Cost Per Student Participant	$355

** Note that regional symposia often contribute significant additional funds to support their events. Funding may come from a combination of donors including: colleges/universities, STEM organizations, industry, etc. The average cost per student at R-JSHS varies significantly by site.*

Evidence-Based Program Change

The three key priorities for AEOP programs in FY16 were: (1) increase outreach to populations that are historically underserved and underrepresented in STEM; (2) increase participants' awareness of Army/DoD STEM careers; and (3) increase participants' awareness of other AEOP opportunities. AAS took the following actions in the FY16 administration of the JSHS program in light of programmatic recommendations from the Army and LO, the key AEOP priorities, site visits conducted by AAS and the LO, and the FY15 JSHS evaluation study:

I. **Increase outreach to populations that are historically underserved and underrepresented in STEM:**
   a. Collaborate with HBCU's/MSIs to identify students and to prepare for research competition.
   b. Expanded mentorship opportunities for students developed through regional symposia efforts to identify external funding.
   c. Expanded partnerships with strategic statewide initiatives designed to increase the pool of STEM talent.
   d. Target outreach to urban or rural schools to identify students and prepare for research competition.
   e. Share best practices to reach and engage underrepresented students among Consortium and JSHS Regions.
   f. Engage participation by REAP students and mentors in National JSHS (4 REAP students participated in JSHS).

II. **Increase participants' awareness of other Army/DoD STEM careers:**
   a. Coordinated with tri-service leadership to identify the participation of DoD STEM personnel in regional and national symposia.

b. AAS conducted meetings between Regional Symposium and DoD laboratory personnel (i.e., Mississipi and Maryland).
c. Conducted "Reverse Science Fair" to expose National JSHS participatnes to DoD research and terminology.
d. Expanded use of social media, website, and branded materials to publicize AEOP opportunities/Army STEM careers.

III. Increase participants' awareness of other AEOP opportunities:

a. AEOP materials were distributed to all JSHS Regional Symposia for distribution to Regional participants.
b. Expanded use of social media, website, and branded materials to publicize AEOP opportunities/Army STEM careers.
c. AAS and LO presentations to JSHS Regional Directors at Annual Meeting of Regional Directors; AAS presentations to R-JSHS Advisory Committees; AAS presentations of branded materials to RD's in print and electronic form.
d. REAP students and mentors participated in 2015 N-JSHS.

IV. Other evidence based changes or activities:

a. Expanded outreach to military labs at Regional and National symposia to engage volunteer service.
b. Increased awareness of the volunteers' role in contributing to the AEOP mission to expand the pipeline of future STEM talent. Provided feedback on success throug presentations and distribution of published reports.
c. Ongoing support of "Teacher Award," and AEOP branded participation certificates to recognize volunteer contributions.
d. Regional sympsia administer training to prepare volunteers, and provide recognition for service. As a result, longstanding service of faculty members was reported across regions.
e. Several regional symposia engage younger faculty and pre-service teachers in STEM outreach and JSHS**.**

FY16 Evaluation At-A-Glance

Purdue University, in collaboration with AAS, collected the FY16 evaluation data for the JSHS program. The JSHS logic model below presents a summary of the expected outputs and outcomes for the JSHS program in relation to the AEOP and JSHS-specific priorities. This logic model provided guidance for the overall JSHS evaluation strategy.

Inputs	Activities	Outputs	Outcomes (Short term)	Impact (Long Term)
• Tri-service sponsorship • AAS providing oversight of regional and national programs • Operations conducted by university and DoD partners • Students participating in regional and national programs • STEM professionals and educators serving as research mentors, judges, personnel and volunteers of regional and national programs • Awards for student competitors, and recognition for STEM professionals and educators in support roles • Centralized branding and comprehensive marketing • Centralized evaluation	• Students conduct "authentic" STEM and humanities research, often mentored by STEM professionals and educators • Students present their research in poster or oral presentations at 47 regional symposium • STEM professionals judge presentations and select regional winners • Regional winners advance to N-JSHS (Dayton, OH). • Program activities that expose students to AEOP programs and/or STEM careers in the Army or DoD (including the U.S. Science & Engineering Festival)	• Number and diversity of student participants engaged in programs • Number and diversity of STEM professionals and educators serving as research mentors, judges, personnel and volunteers of regional and national programs • Number and diversity of DoD scientists and engineers and other military personnel engaged in programs • Number and Title 1 status of high schools served through participant engagement • Students, regional directors, national judges, and AAS contributing to evaluation	• Increased participant knowledge, skills and abilities, and confidence in STEM • Increased student interest in future STEM engagement • Increased participant awareness of and interest in other AEOP opportunities • Increased participant awareness of and interest in DoD STEM research and careers • Implementation of evidence-based recommendations to improve JSHS regional and national programs	• Increased student participation in other AEOP and DoD-sponsored 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 DoD STEM careers • Continuous improvement and sustainability of JSHS

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

Key Evaluation Questions

- What aspects of regional and national JSHS programs motivate participation?
- What aspects of regional and national JSHS program structure and processes are working well?
- What aspects of the regional and national JSHS programs could be improved?
- Did participation in JSHS programs:
  - Increase student competencies in STEM?
  - Increase student interest in or motivation for future engagement in STEM?
  - Increase student awareness of and interest in other AEOP opportunities?
  - Increase student awareness of and interest in DoD STEM careers?
- To what extent were there differences in student experiences and benefits between Regional and National JSHS?

The assessment strategy for JSHS included R-JSHS and N-JSHS student questionnaires, mentor questionnaire, three focus groups with R-JSHS students and three focus groups with R-JSHS mentors in Kentucky, Philadelphia and Georgia; four focus groups with N-JSHS participants, one focus group with N-JSHS mentors; and the Annual Program Report (APR) prepared by AAS. Tables 4-9 outlines the information collected in student and instructor questionnaires, focus groups, and interviews, as well as information from the APR that is relevant to this evaluation report.

Table 4. 2016 Student Questionnaires	
Category	**Description**
Profile	**Demographics:** Participant gender, age, grade level, race/ethnicity, and socioeconomic status indicators
	Education Intentions: Degree level, confidence to achieve educational goals, field sought
AEOP Goal 1	**Capturing the Student Experience:** In-school vs. In-program experience; mentored research experience and products (students)
	STEM Competencies: Gains in Knowledge of STEM, Science & Engineering Practices; contribution of AEOP
	Transferrable Competencies: Gains in 21st Century Skills
	STEM Identity: Gains in STEM identity, intentions to participate in STEM, and STEM-oriented education and career aspirations; contribution of AEOP
	Future STEM Engagement: Gains in interest/intent for future STEM engagement (informal activities, education, career)
	AEOP Opportunities: Past participation, awareness of, and interest in participating in other AEOP programs; contribution of AEOP, impact of AEOP resources
	Army/DoD STEM: Exposure to Army/DoD STEM jobs, attitudes toward Army/DoD STEM research and careers, change in interest for STEM and Army/DoD STEM jobs; contribution of AEOP, impact of AEOP resources
AEOP Goal 2 and 3	**Mentor Capacity:** Perceptions of mentor/teaching strategies (students respond to a subset)
	Comprehensive Marketing Strategy: How students learn about AEOP, motivating factors for participation, impact of AEOP resources on awareness of AEOPs and Army/DoD STEM research and careers
	Program Specific Online Resources: Usefulness of online resources for participating in AEOP
Satisfaction & Suggestions	Benefits to participants, suggestions for improving programs, overall satisfaction

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

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

Table 7. 2016 Mentor Focus Group	
Category	**Description**
Profile	Gender, race/ethnicity, occupation, organization, role in JSHS, past participation in JSHS, past participation in other AEOP programs
Satisfaction & Suggestions	Perceived value of JSHS, benefits to participants suggestions for improving JSHS programs
AEOP Goal 1 and 2 Program Efforts	**Army STEM: AEOP Opportunities –** Efforts to expose students to AEOP opportunities
	Army STEM: Army/DoD STEM Careers – Efforts to expose students to STEM and Army/DoD STEM jobs
	Mentor Capacity: Local Educators – Strategies used to increase diversity/support diversity in JSHS

Table 8. 2016 Student and Mentor Rapid Interviews	
Category	**Description**
Profile	Gender, race/ethnicity, role in JSHS
Satisfaction & Suggestions	Perceived value of JSHS, benefits to participants suggestions for improving JSHS programs

Table 9. 2016 Annual Program Report	
Category	**Description**
Program	Description of symposia categories and activities
AEOP Goal 1 and 2 Program Efforts	**Underserved Populations:** mechanisms for marketing to and recruitment of students from underserved populations
	Army STEM: Army/DoD STEM Careers – Exposure to Army STEM research and careers (varies by regional, national event); Participation of Army engineers and/or Army research facilities in event activities (varies by regional, national event)
	Mentor Capacity: Local Educators - University faculty and student involvement, teacher involvement

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

Study Sample

Questionnaire responses were received from students participating in the national competition, students from 33 of the 47 regional competitions, and mentors from 41 of the 47 regional sites. Mentors completed the mentor questionnaire

once for all students they mentored, whether the students advanced to N-JSHS or not, and therefore their responses do not distinguish between R-JSHS and N-JSHS. Table 10 shows the number of student and mentor respondents by site.

Table 10. 2016 JSHS Site Survey Respondent Numbers

2016 JSHS Site	R-JSHS Students		N-JSHS Students		Mentors	
	No. of Participants	No. of Survey Respondents	No. of Participants	No. of Survey Respondents	No. of Participants	No. of Survey Respondents
Alabama	120	0	5	2	17	0
Alaska	22	14	5	1	3	1
Arizona	160	18	5	2	20	0
Arkansas	60	0	5	2	10	0
California—Northern & Western Nevada	40	10	5	1	2	0
California – Southern	100	8	3	1	13	0
Connecticut	240	8	5	1	33	0
DoD Schools-Europe	52	13	5	1	17	0
DoD Schools-Pacific	50	0	5	2	14	0
District of Columbia	128	8	4	1		3
Florida	200	24	5	1	77	6
Georgia	133	14	5	1	9	1
Hawaii	90	0	5	1	14	0
Illinois	60	1	5	2	10	0
Illinois-Chicago	50	1	3	2	5	1
Indiana	0	0	1	0	0	0
Intermountain—C), MT, ID, NV, UT	90	19	5	4	10	4
Iowa	133	0	6	3	29	0
Kansas—Nebraska—Oklahoma	80	33	5	3	30	7
Kentucky	36	8	4	2	6	3
Louisiana	80	0	5	2	12	0
Maryland	100	23	5	1	10	0
Michigan	40	3	3	3	10	2
Mississippi	20	0	5	2	5	0
Missouri	120	29	8	4	20	8
New England – Northern New England	110	6	5	5	20	0
New England – Southern New England	60	9	5	1	11	0
New Jersey--Monmouth	435	0	5	3	30	

New Jersey—Rutgers	112	17	5	3	23	10
New York—Long Island	200	7	5	3	74	5
New York—Metro	218	6	4	2	48	2
New York—Upstate	484	6	5	5	61	1
North Carolina	80	2	5	4	20	0
North Central – Minnesota, North Dakota, South Dakota	234	0	6	4	30	0
Ohio	115	71	5	4	13	13
Oregon	50	2	6	1	10	1
Pennsylvania	60	21	5	2	10	7
Philadelphia	173	5	5	2	15	0
Puerto Rico	60	0	6	4	17	0
South Carolina	225	1	5	3	50	2
Southwest	100	1	4	2	14	0
Tennessee	85	11	5	5	11	5
Texas	80	0	5	1	25	0
Virginia	100	33	5	2	20	5
Washington	70	1	5	2	12	0
West Virginia	15	3	4	4	2	2
Wisconsin – Western Wisconsin & Upper Michigan	60	5	5	2	11	5
Wisconsin	0	1	0	0		0
Wyoming—Eastern Colorado	60	0	6	4	14	0
Total	**5,620**	**442**	**233**	**111**	**939**	**94**

Table 11 provides an analysis of student and mentor participation in the JSHS questionnaires, the response rate, and the margin of error at the 95% confidence level (a measure of how representative the sample is of the population). The margin of error for both the student and mentor surveys is larger than generally acceptable, indicating that the samples may not be representative of their respective populations. As previously stated, AAS should work with regional JSHS sites to provide time within the regional symposium activities (following presentations) for participants to complete the AEOP evaluation survey.

Table 11. 2016 JSHS Questionnaire Participation				
Participant Group	**Respondents (Sample)**	**Total Participants (Population)**	**Participation Rate**	**Margin of Error @ 95% Confidence[1]**
R-JSHS Students	455	5,260	9%	±4.39%
N-JSHS Students	111	233	48%	±6.75%
Mentors	109	939	12%	±8.83%

Focus groups were conducted at Philadelphia, South Carolina and Kentucky R-JSHS. Three student focus groups were also completed at the N-JSHS and one mentor focus group. The six student focus groups included 88 students (41 females, 44 males) in grades 10 to 12. The mentor focus groups included 27 mentors (13 females, 14 males). Focus groups were not intended to yield generalizable findings; rather they were intended to provide additional evidence of, explanation for, or illustrations of questionnaire data. They add to the overall narrative of JSHS's efforts and impact, and highlight areas for future exploration in programming and evaluation.

Respondent Profiles

Student Demographics

Table 12 illustrates demographic information collected from FY16 JSHS questionnaire respondents. In regard to gender, total survey respondents: R-JSHS n = 275 (60% female, 40% male). More females than males completed the questionnaire continuing the trend from FY15 (female 61%; male 38%). Also, similar to FY15, among R-JSHS respondents, more students identified with the race/ethnicity category of White 54% (compared to 54% in FY15) than any other single race/ethnicity category. However, there continued to be substantial representation of Asian (23%) and Hispanic or Latino (10%) populations. There were 31% were rising 12th graders in FY16 (down from 37% in 2015). The percentage of rising college freshman was the second largest R-JSHS group at 33% (up from 27% in FY15). Table 13 shows that a majority of respondents at regionals attended public schools (77%). Finally, more than half of the participants in the survey attended schools in suburban areas (59%). The JSHS program collected demographic data from 36 of the 47 Regional Symposia in FY16. Therefore, it is difficult to make any strong comparisons between the survey respondent group and actual program participation.

Based upon demographic information provided by questionnaire respondents, it appears that JSHS was successful in attracting participation from female students—a population that is historically underrepresented in some STEM fields. However, JSHS continues to struggle with attracting students from historically underserved and underrepresented race/ethnicity and low-income groups. However, JSHS attracted 27% of students from urban school locations in FY16.

[1] "Margin of error @ 95% confidence" means that 95% of the time, the true percentage of the population who would select an answer

Consistent use of Cvent as a centralized registration tool may more accurately capture JSHS's success at serving students from historically underserved and underrepresented populations.

Table 12. 2016 R-JSHS Student Respondent Profile

Demographic Category	R-JSHS Questionnaire Respondents	
Female	275	60%
Male	180	40%
Asian	117	23%
Black or African American	20	5%
Hispanic or Latino	21	10%
Native American or Alaska Native	10	1%
Native Hawaiian or Other Pacific Islander	3	0%
White	267	54%
Other race or ethnicity (specify):[†]	17	2%
9th	24	5%
10th	47	10%
11th	89	21%
12th	140	31%
1st Year College Student	147	33%
Yes	63	14%
No	369	82%
Choose not to report	18	4%

[†] Other = "White-Asian," "Latina-Asian," "Asian (Thailand)," "Middle Eastern," "White and Indian," "Hindu," "Haitian," "Jewish," "Mixed (Asian/White)"

Table 13. 2016 R-JSHS Student Respondent School Information

Demographic Category	R-JSHS Questionnaire Respondents	
Suburban	208	59%
Urban (city)	97	27%
Rural (country)	49	14%
Frontier or tribal school	0	0%
Public school	258	77%
Private school	64	19%
Department of Defense school (DoDDS or DoDEA)	10	3%

The highest level of competition students reported achieving in 2016 is illustrated in Table 14. 14% of responding R-JSHS students participated in non-presenting roles (student delegate/observer), whereas 100% of responding N-JSHS students participated in presenting roles. The diverse participation in student roles at R-JSHS and N-JSHS are aligned with the focus of each level. In particular, student delegate and observer roles are intended to facilitate future participation at the R-JSHS level, and N-JSHS is purposed to support most participants to present.

Table 14. 2016 JSHS Student Respondent Roles

Highest Level of Competition Achieved in 2016	R-JSHS Questionnaire Respondents (n = 453)	N-JSHS Questionnaire Respondents (n = 111)
Oral Presenter	57%	41%
Poster Presenter	24%	59%
Non-presenting Participant	14%	0%
Non-competitive poster presenter	5%	0%

Past Program Participation

R-JSHS participants were asked to report on their past participation in other AEOPs in the participant questionnaire (Table 15). There were 35% of respondents who indicated past participation in JSHS, 4% in eCybermission, 4% in Camp Invention, 3% in GEMS, 1% in SEAP (this is a college program – likely an adult response), 18% in other STEM programs, and 35% reported never participating in any AEOP programs previously. Similarly, N-JSHS participants were also asked to report their past participation. Three had participated in eCybermission and one in Camp Invention (n = 111)

Table 15. R-JSHS Participant Past AEOP Program Participation

	Response Percent	Response Total
Camp Invention	4.00 %	5
eCYBERMISSION	4.00 %	5
Junior Solar Sprint (JSS)	0.80 %	1
Gains in the Education of Mathematics and Science (GEMS)	2.40 %	3
UNITE	0.00 %	0
Junior Science & Humanities Symposium (JSHS)	35.20 %	44
Science & Engineering Apprenticeship Program (SEAP)	0.80 %	1
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	35.20 %	44
Other STEM Program	17.60 %	22

Mentor Demographics

The mentor demographics for FY16 were collected through the mentor questionnaire. Table 16 summarizes the data. In regard to gender and survey participation, JSHS experienced an increase in the percentage of female mentors for FY16 (63%) compared to FY15 (49%). Accordingly, the percentage of male mentors decreased in FY16 to around one-third (34%). Similarly to student reported data, the mentors who completed the survey were predominantly White (75%) with no Black or African American mentor participation and only one Hispanic or Latino mentor. There were 12% Asian mentors in FY16. Most of the mentors identified as teachers (74%) or other (14%). There were only five STEM professionals who served as mentors that completed the survey.

Table 16. 2016 JSHS Mentor Respondent Profile		
Demographic Category	**Questionnaire Respondents**	
Respondent Gender (n = 109)		
Female	69	63%
Male	37	34%
Choose not to report	3	3%
Respondent Race/Ethnicity (n = 108)		
Asian	13	12%
Black or African American	0	0%
Hispanic or Latino	1	1%
Native American or Alaska Native	3	3%
Native Hawaiian or Other Pacific Islander	0	0%
White	81	75%
Other race or ethnicity, (specify):[†]	2	2%
Choose not to report	8	7%
Respondent Occupation (n = 109)		
Teacher	81	74%
Other school staff	6	6%
University educator	2	2%
Scientist, Engineer, or Mathematician in training (undergraduate or graduate student, etc.)	0	0%
Scientist, Engineer, or Mathematics professional	5	5%
Other, (specify):[‡]	15	14%
Respondent Role in JSHS (n = 109)		
Research Mentor	48	44%
Competition advisor	18	17%
Other, (specify)[§]	22	20%
Teacher	71	65%
Invited Speaker	2	2%
Judge	1	1%

[†] No responses provided.

Actionable Program Evaluation

Actionable Program Evaluation is intended to provide assessment and evaluation of program processes, resources, and activities for the purpose of recommending improvements as the program moves forward. This section highlights

information outlined in the Satisfaction & Suggestions sections of Tables 4-9. A focus of the Actionable Program Evaluation is efforts toward the long-term goal of JSHS and all of the AEOP to increase and diversify the future pool of talent capable of contributing to the nation's scientific and technology progress. JSHS regional symposia are engaged in outreach efforts to identify underrepresented populations who are capable of succeeding in JSHS. Thus, it is important to consider how JSHS is marketed and ultimately recruits student participants, the factors that motivate students to participate in JSHS, 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 student and mentor perceptions that pertain to current programmatic efforts and recommend evidence-based improvements to help JSHS achieve outcomes related to AEOP programs and objectives—specifically, to help JSHS continue to expand participation from and support STEM education for students from underrepresented groups.

Marketing and Recruiting Underrepresented Populations

JSHS regional symposia engage in outreach activities specifically targeted to recruiting populations underrepresented in STEM careers. These efforts are largely developed and implemented at a local level. Stratgies that JSHS employed in FY16 included:

- Encouraged regional symposia to establish internal and external partnerships with programs and organizations which mentor underrepresented and underserved students in the pursuit of STEM research.
- Targeted outreach and travel support to various school districts, including urban areas.
- Recruited and engaged diverse role models to contribute at the regional symposia as speakers and judges.
- Leveraged the reach of JSHS Regional Symposia to promote JSHS and expand student participation locally.
- Recruitment via Regional websites, direct outreach to schools and internal/external organizations, partnerships, curriculum support materials.
- Employed strategies to engage expanded student participation in STEM. (Virtual sessions, sub-regionals, posters, Grades 9-10.)

N-JSHS participants were asked how they learned about JSHS (Table 17). Seventy-seven percent (86 students) of participants indicated their school and/or teacher encouraged or required them to participate. The second highest reported means of learning about JSHS was a friend or fellow student (11%) and a family member, the AEOP website, or a local university each had about 5% of participants reporting they learned about JSHS through these means. This is similar to FY15 findings, as the most frequently mentioned source of information about the JSHS program was "someone who works at the school or university I attend" (R-JSHS 30%, N-JSHS 30%).

These findings suggest that disseminating information to teachers and schools continue to be the most effective means of recruiting students.

Table 17. How R-JSHS Participants Learned About JSHS/AEOP (n = 104)

	Response Percent	Response Total
Army Educational Outreach Program (AEOP) Website	8.03 %	11
AEOP on Facebook, Twitter, Instagram, or other social media	1.46 %	2
School or university newsletter, email, or website	18.25 %	25
Past participant of program	18.25 %	25
Friend	9.49 %	13
Family Member	5.11 %	7
Someone who works at the school or university I attend	24.82 %	34
Someone who works with the program	4.38 %	6
Someone who works with the Department of Defense (Army, Navy, Air Force, etc.)	0.73 %	1
Community group or program	4.38 %	6
Choose Not to Report	5.11 %	7

Mentors were also asked how they learned about JSHS (Table 18). The most frequent responses were personal contacts, including a past JSHS participant (67%), a friend (11%), or someone who works at the school or university I am at (11%). In addition, 11% chose not to report.

Table 18. How JSHS Mentors Learned about JSHS/AEOP (n = 9)

	Response Percent	Response Total
Army Educational Outreach Program (AEOP) Website	0.00 %	0
AEOP on Facebook, Twitter, Instagram, or other social media	0.00 %	0
School or university newsletter, email, or website	0.00 %	0
Past participant of program	66.67 %	6
Friend	11.11 %	1
Family Member	0.00 %	0
Someone who works at the school or university I attend	11.11 %	1
Someone who works with the program	0.00 %	0
Someone who works with the Department of Defense (Army, Navy, Air Force, etc.)	0.00 %	0
Community group or program	0.00 %	0
Choose Not to Report	11.11 %	1

Factors Motivating Student Participation

Table 19 conveys the motivating factors for students to participate in R-JSHS. For the R-JSHS responders, the top two motivating factors were interest in STEM (10%) and the desire to learn something new (9%).

Table 19. Factors Motivating Participation in R-JSHS (n = 104)

	Response Percent	Response Total
Teacher or professor encouragement	7.10 %	59
An academic requirement or school grade	1.93 %	16
Desire to learn something new or interesting	8.42 %	70
The mentor(s)	1.81 %	15
Building college application or résumé	5.66 %	47
Networking opportunities	5.66 %	47
Interest in science, technology, engineering, or mathematics (STEM)	9.99 %	83
Interest in STEM careers with the Army	2.17 %	18
Having fun	7.82 %	65
Earning stipends or awards for doing STEM	4.33 %	36
Opportunity to do something with friends	2.77 %	23
Opportunity to use advanced laboratory technology	4.93 %	41
Desire to expand laboratory or research skills	7.70 %	64
Learning in ways that are not possible in school	7.22 %	60
Serving the community or country	3.61 %	30
Exploring a unique work environment	4.93 %	41
Figuring out education or career goals	5.90 %	49
Seeing how school learning applies to real life	4.93 %	41
Recommendations of past participants	2.77 %	23
Choose Not to Report	0.36 %	3

N-JSHS participants indicated very similar reasons for participating in JSHS. A sampling of their responses included:

- I decided to participate because I wanted to take part in this opportunity to present my research.
- I decided to participate more to learn more about science and have a new experience.
- I did it to hone my presentation skills, have fun, make connections, present my research, and learn about other people's research.

- I learned about this event online and decided to participate because I like talking to more judges about my work.
- I decided to get involved because I have a true passion for science and wanted to showcase my research in order to gain exposure and feedback.

The JSHS Experience

R-JSHS students were asked to respond to several questionnaire items asking about the nature of their experiences in JSHS and how that experience compared to their STEM learning opportunities in school. When asked what field their JSHS experience focused on, a large majority of all students selected science (59%;), integrated STEM (more than one content area was the next most frequently chosen focus (26%) followed by engineering (R-JSHS 8%) then technology (4%) and mathematics (3%).

As Table 20 indicates, 41% of Regional students indicated that they designed the entire project on their own. 26% of Regional students indicated that worked with their mentor to design a project. The remaining students reported working with their mentor and research team to design a project (12%) having a choice among various projects suggested by their mentor (8%) or being assigned a project by their mentor (2%). Notably, 12% of respondents were not participants in the actual competition, and about 12% did not have a project.

N-JSHS participants were also asked about the nature of the mentoring support they were provided for JSHS (n = 111). Participants were asked if they had a mentor and if so was their JSHS project part of a class (in school) or did they work after school with a teacher, or did they work with a university or industry mentor. 27% of respondents indicated their project work was part of a class in school and received support from their classroom teacher. Another 27% worked outside of school with a university or industry mentor. 18% worked with a teacher outside of school and the remaining 18% worked alone without a mentor.

Table 20. Participant Input on the Design of Their Project (n = 450)

	Response Percent	Response Total
I did not have a project	11.56 %	52
I was assigned a project by my mentor	2.44 %	11
I worked with my mentor to design a project	25.56 %	115
I had a choice among various projects suggested by my mentor	7.78 %	35
I worked with my mentor and members of a research team to design a project	11.56 %	52
I designed the entire project on my own	41.11 %	185

Table 21 illustrates R-JSHS student participation levels in a research group. Most students worked alone (or alone with their research mentor) on their projects (66%) Very few students (8%) reported working with a group on the same project. Some reported working in a shared laboratory/space with others, but on different projects (15%), or worked alone but met with others regularly to discuss their projects (9%). Finally, again, very few students reported working on a project alone that was closely related to projects of other in their group (3%).

Table 21. Student Participation in a Research Group (n = 439)

	Response Percent	Response Total
I worked alone (or alone with my research mentor)	65.83 %	289
I worked with others in a shared laboratory or other space, but we work on different projects	14.81 %	65
I worked alone on my project and I met with others regularly for general reporting or discussion	8.43 %	37
I worked alone on a project that was closely connected with projects of others in my group	3.19 %	14
I work with a group who all worked on the same project	7.74 %	34

Table 22 provides a reporting of the nature of activities for R-JSHS students in FY16 in school and Table 23 is for in JSHS. Participants were asked about the nature of STEM-related activities they engaged in during their experience. Participants indicated JSHS STEM Activities occurred more frequently than in school STEM activities in nearly all areas. Participants (41%) indicated that they learn about STEM topics that are new to them every day both in school and in JSHS. However, more participants agreed JSHS provides them opportunities every day to apply STEM learning to real-life 32% (18% in school); learn about new discoveries in STEM 34% (14% in school); learn about different careers that use STEM 25% (10% in school); interact with scientists or engineers 30% (10% in school); and communicate with other students about STEM 40% (27% in school).

Although differences between the groups were not statistically tested for each individual activity, a composite score[2] was calculated for the set of activities, titled "Learning about STEM in JSHS."[3] Response categories were converted to a

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

[3] The Cronbach's alpha reliability for these 6 items was 0.934.

scale of 1 = “Not at all” to 5 = “Every day” and the average across all items in the scale was calculated. The composite scores were used to test whether there were differences in student experiences by gender and race/ethnic group (minority vs. non-minority students). Significant differences in Learning about STEM in JSHS by race/ethnic group or gender did not exist.

Table 22. Nature of Student Activities in School for R-JSHS Respondents
(n = 453)

	Not at all	At least once	A few times	Most days	Every day	Response Total
Learn about STEM topics that are new to you	7.1%	6.4%	18.4%	27.1%	41.0%	
	32	29	83	122	185	**451**
Apply STEM learning to real-life situations	8.8%	12.8%	29.2%	31.4%	17.7%	
	40	58	132	142	80	**452**
Learn about new discoveries in STEM	11.8%	14.4%	38.7%	21.3%	13.8%	
	53	65	174	96	62	**450**
Learn about different careers that use STEM	12.2%	18.7%	41.6%	18.0%	9.6%	
	55	84	187	81	43	**450**
Interact with scientists or engineers	25.6%	24.1%	30.0%	10.6%	9.7%	
	116	109	136	48	44	**453**
Communicate with other students about STEM	15.0%	11.7%	22.3%	23.9%	27.0%	
	68	53	101	108	122	**452**

Table 23. Nature of Student Activities in JSHS for R-JSHS Respondents (n = 449)

	Not at all	At least once	A few times	Most days	Every day	Response Total
Learn about STEM topics that are new to you	5.8%	15.0%	20.3%	18.5%	40.4%	
	26	67	91	83	181	**448**
Apply STEM learning to real-life situations	9.4%	15.6%	23.6%	19.4%	32.1%	
	42	70	106	87	144	**449**
Learn about new discoveries in STEM	6.7%	17.7%	23.8%	17.7%	34.1%	
	30	79	106	79	152	**446**
Learn about different careers that use STEM	9.4%	19.5%	28.9%	17.0%	25.3%	
	42	87	129	76	113	**447**
Interact with scientists or engineers	11.8%	16.3%	24.7%	17.1%	30.1%	
	53	73	111	77	135	**449**
Communicate with other students about STEM	8.5%	12.5%	22.5%	16.7%	39.9%	
	38	56	101	75	179	**449**

Table 24 illustrates how students disseminated their research during their JSHS experience. Most R-JSHS participants had presented a talk or poster to other students or faculty (74%). Additionally, 75% of R-JSHS students also reported that they had attended a symposium or conference and 23% reported presenting a talk or poster at a professional symposium or conference. Some reported winning an award or scholarship based on their research (21%). Several reported plans to disseminate their research through research journals (8%), technical paper or patents (5%), and other had already published their work in research journals (13%) and technical papers or patents (11%).

Table 24. Students Engagement with Research Dissemination Activities During R-JSHS (n = 441)

	Response Percent	Response Total
I presented a talk or poster to other students or faculty	73.64 %	324
I presented a talk or poster at a professional symposium or conference	57.73 %	254
I attended a symposium or conference	75.45 %	332
I wrote or co-wrote a paper that was/will be published in a research journal	12.73 %	56
I wrote or co-wrote a technical paper or patent	11.36 %	50
I will present a talk or poster to other students or faculty	27.27 %	120
I will present a talk or poster at a professional symposium or conference	22.50 %	99
I will attend a symposium or conference	27.73 %	122
I will write or co-write a paper that was/will be published in a research journal	7.73 %	34
I will write or co-write a technical paper or patent	5.00 %	22
I won an award or scholarship based on my research	21.36 %	94

Increasing both the number and diversity of students who pursue STEM careers is one goal of the AEOP. Therefore, the R-JSHS student questionnaire asked participants to report how many STEM jobs/careers in general as well as DoD STEM jobs/careers they learned about during their R-JSHS experience. Table 25 illustrates that 10% of Regional students reported learning about at least one STEM job/career, and 21% reported learning about five or more. 22% of R-JSHS participants reported that they did not learn about any STEM jobs/careers during the program. In contrast, many fewer participants learned about DoD STEM jobs/careers overall (Table 26). 60% of participants reported that they did not learn about even one DoD STEM job/career. Only 12% learned about one job, 11% two jobs, 8% three jobs, 2% four jobs, and 8% five or more jobs. This is an area that JSHS should invest more effort into for FY17, as exposure to DoD specific STEM jobs/careers is one of the priority areas for the AEOP overall.

Table 25. Number of STEM Jobs/Careers Students Learned About During R-JSHS (n =441)

Number of STEM Jobs/Careers	Response Percent	Response Total
None	21.77 %	96
One job	9.98 %	44
Two jobs	21.09 %	93
Three jobs	19.05 %	84
Four jobs	7.26 %	32
Five or more	20.86 %	92

Table 26. Number of Department of Defense (DoD) STEM Jobs/Careers Learned About During R-JSHS (n = 441)

Number of DoD STEM Jobs/Careers	Response Percent	Response Total
None	59.86 %	264
One job	11.79 %	52
Two jobs	10.43 %	46
Three jobs	7.71 %	34
Four jobs	1.81 %	8
Five or more	8.39 %	37

N-JSHS participants were asked to describe the Army/DoD careers they learned about in JSHS this year. Most responses were general in characterizing “researchers”, “scientists”, and “engineers” and work at Army labs. Less than ten repsondents mentioned specific labs with responses including “ONR” and “AFRL”. Several mentioned learning about the SMART program – which is a scholarship available within the AEOP portfolio.

Table 27 summarizes the reported impact of resources on student awareness of DoD STEM Careers. The resource that had the most reported impact was actual participation in JSHS (33%). The JSHS mentor (17%) and invited speakers (15%) were also reported as influencing awareness of STEM. AEOP electronic efforts (websites, social media) had the least impact of all resources.

Table 27. Impact of Resources on R-JSHS Participant Awareness of STEM (n =446)

	Did not experience	Not at all	A little	Somewhat	Very much	Response Total
AAS website	88.7%	2.7%	3.8%	2.5%	2.3%	
	392	12	17	11	10	**442**
AEOP website	86.9%	3.6%	4.5%	2.9%	2.0%	
	384	16	20	13	9	**442**
AEOP on Facebook, Twitter, Pinterest or other social media	89.6%	3.4%	3.4%	2.3%	1.4%	
	396	15	15	10	6	**442**
AEOP brochure	86.9%	3.8%	5.0%	2.9%	1.4%	
	384	17	22	13	6	**442**
It Starts Here! Magazine	91.6%	3.2%	2.7%	1.4%	1.1%	
	403	14	12	6	5	**440**
My JSHS mentor(s)	50.3%	15.4%	17.7%	7.7%	8.8%	
	222	68	78	34	39	**441**
Invited speakers or "career" events	61.1%	9.0%	14.3%	6.3%	9.3%	
	270	40	63	28	41	**442**
Participation in JSHS	30.6%	13.1%	24.1%	15.5%	16.7%	
	136	58	107	69	74	**444**

To further explore students' exposure to STEM career opportunities in the DoD, student participants in the focus groups were asked whether they had learned about these opportunities during JSHS. Both Philadelphia and Kentucky R-JSHS students responded that that they had not learned about STEM jobs/careers with the DoD in JSHS. In contrast, N-JSHS students responded that they had heard about these careers in part through lunch, dinners, reverse science fair, keynote speakers, and exhibits. For instance:

- Having the talks at dinner and lunch are the ways that we learn about the DOD and the Army
- I really liked the reverse science fair, I thought that was interesting to actually get to talk to people during the research and actually have a conversation with them so it's more directed to your interests
- I really enjoyed the reverse science fair because it was a variety of research there…That was the most helpful because I have considered majoring in a biology-type field to be able to contribute to the Air Force in any way. I didn't know that they contributed to research, to regular civilian research as well. It was just really interesting to know.
- Before everybody gave their presentations, I didn't know to the extent that the DOD research is in the science and STEM field. I learned a lot about different opportunities with the DOD.
- The reverse science fair actually teaches you a lot about different opportunities, and that you don't actually have to be in the military to do research with the military. It was really cool learning about bio-medical engineering and aerospace engineering, and you work for the military but you don't have to go through basic training. You're not an active duty soldier. That was pretty cool.
- I feel like the guest speakers and the reverse science fair have given me a better understanding of the military. It's not all about building better weapons and things like that. There's other options and other paths to go down if you're going to go that way.

R-JSHS students were asked how often they engaged in various STEM practices during JSHS – compared to their typical activities within school (Table 28 and 29). R-JSHS participants reported engaging in STEM practices in all but one area more often in school than during R-JSHS. Participants reported more agreement with building or making a computer model during R-JSHS (17%) than in school (10%). The highest rated activity during R-JSHS was analyzing data or information at 46% agreement and this was lower agreement than in school (55%). There was less reported agreement with the use of teamwork during R-JSHS (32%) than in school (60%).

Table 28. Participant Engagement in STEM Practices in School (n = 451)

	Not at all	At least once	A few times	Most days	Every day	Response Total
Use laboratory procedures and tools	6.7%	7.3%	40.9%	36.0%	9.1%	
	30	33	184	162	41	**450**
Participate in hands-on STEM activities	6.9%	10.0%	36.7%	34.5%	11.8%	
	31	45	165	155	53	**449**
Work as part of a team	6.2%	6.7%	27.3%	42.0%	17.8%	
	28	30	123	189	80	**450**
Identify questions or problems to investigate	6.0%	7.1%	29.0%	39.0%	18.9%	
	27	32	130	175	85	**449**
Design an investigation	8.9%	18.6%	42.6%	22.8%	7.1%	
	40	84	192	103	32	**451**
Carry out an investigation	6.9%	16.6%	38.1%	30.6%	7.8%	
	31	75	172	138	35	**451**
Analyze data or information	3.8%	9.3%	31.9%	40.6%	14.4%	
	17	42	144	183	65	**451**
Draw conclusions from an investigation	5.3%	10.2%	35.8%	35.8%	12.9%	
	24	46	161	161	58	**450**
Come up with creative explanations or solutions	5.8%	14.3%	37.6%	29.8%	12.5%	
	26	64	168	133	56	**447**
Build or make a computer model	47.0%	22.2%	21.3%	6.9%	2.7%	
	212	100	96	31	12	**451**

Table 29. Participant Engagement in STEM Practices in R-JSHS (n = 447)

	Not at all	At least once	A few times	Most days	Every day	Response Total
Use laboratory procedures and tools	38.3%	14.3%	14.3%	19.2%	13.9%	
	171	64	64	86	62	447
Participate in hands-on STEM activities	26.5%	18.6%	20.0%	18.6%	16.4%	
	118	83	89	83	73	446
Work as part of a team	33.3%	16.6%	17.9%	16.3%	15.9%	
	149	74	80	73	71	447
Identify questions or problems to investigate	19.4%	19.0%	21.2%	21.2%	19.2%	
	86	84	94	94	85	443
Design an investigation	30.9%	19.0%	15.2%	20.1%	14.8%	
	138	85	68	90	66	447
Carry out an investigation	30.3%	17.1%	14.6%	21.1%	16.9%	
	135	76	65	94	75	445
Analyze data or information	20.7%	18.9%	14.8%	25.2%	20.4%	
	92	84	66	112	91	445
Draw conclusions from an investigation	20.9%	18.6%	17.5%	21.1%	22.0%	
	93	83	78	94	98	446
Come up with creative explanations or solutions	19.7%	20.4%	18.8%	20.4%	20.8%	
	88	91	84	91	93	447
Build or make a computer model	59.1%	15.3%	8.8%	7.9%	9.0%	
	263	68	39	35	40	445

A composite score was calculated for this set of items, titled "Engaging in STEM Practices in JSHS."[4] Response categories were converted to a scale of 1 = "Not at all" to 5 = "Every day" and the average across all items in the scale was calculated. The composite score was used to test whether there were differences in student experiences by Regional or National JSHS participation, gender, and race/ethnicity group (minority vs. non-minority students). No significant group differences found in terms of Engaging with STEM Practices in JSHS.

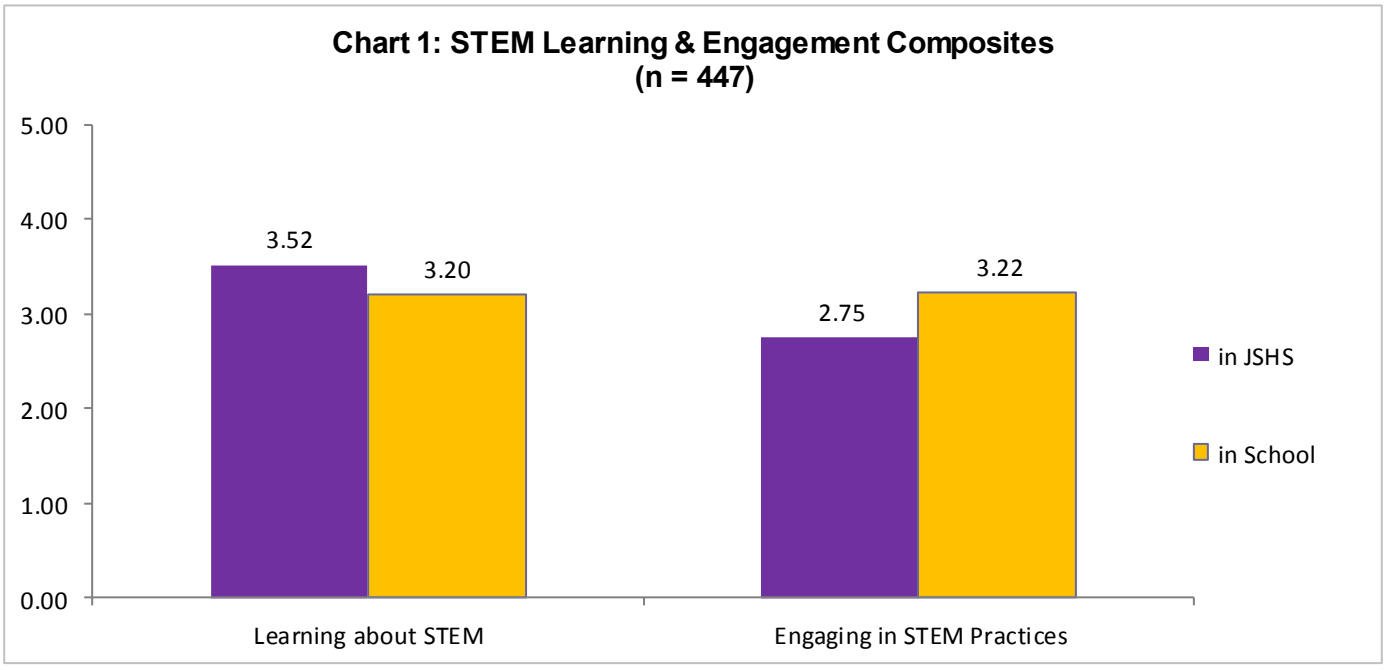
To examine how the JSHS experience compares to their typical school experience, students were asked how often they engaged in the same activities in school. The responses were combined into composites[5] that are parallel to the ones asking about JSHS. Students reported greater "Learning about STEM" in JSHS than in school[6] (medium effect of d = 0.589 standard deviations). Opposite results were found for the "Engaging in STEM Practices" composite; the "in school" scores were higher[7] (large effect of d = 0.821 standard deviations) (see Chart 1). These data indicate that JSHS provides students with more intensive STEM learning experiences, but suggest that JSHS students engage in STEM practices frequently in school.

[4] The Cronbach's alpha reliability for these 10 items was 0.953.

[5] "Learning about STEM in School" had a Cronbach's alpha reliability of 0.903. "Engaging in STEM Practices in School" had a Cronbach's alpha reliability of 0.932.

[6] Two-tailed dependent samples t-test: $t(447) = 6.36$, $p < 0.001$.

[7] Two-tailed dependent samples t-test:, $t(447) = 8.67$, $p < 0.001$.



Mentors were asked to respond to parallel items about their students' activities in JSHS. Mentor responses were generally similar to student responses, although mentors tended to report more frequent engagement in some activities and their responses were overall more similar to N-JSHS students' responses than R-JSHS students'. For example, 60% of mentors reported that students participated in hands-on STEM activities, 63% that students used laboratory procedures and tools, and 56% that students designed investigations on most days or every day of their JSHS experience.

The Role of Mentors

Mentors play a critical role in the JSHS program. Mentors provide one-on-one support to students, chaperone students, advise students on educational and career paths, may provide opportunities for students to use laboratory space and/or equipment, and generally serve as STEM role models for JSHS students. Over 50% of mentors responding to the mentor questionnaire reported working with 5 or fewer students, with a range of 0 to 10 students. Mentors were asked whether or not they used a number of strategies when working with students. These strategies comprised five main areas of effective mentoring: [8]

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

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

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

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

Table 30 indicates that a majority of responding mentors used multiple strategies to establish relevance of learning activities to students. For example, the vast majority tried to learn about the students and their interests at the beginning of the program (90%) and encouraged students to suggest new reading, activities, or projects (88%). Many also helped students become aware of the roles STEM plays in their everyday lives (81%); helped students see how STEM can affect them or their communities (82%); asked students to relate outside events or activities to topics covered in the program (85%), gave students real-life problems to investigate or solve (82%); or selected readings or activities related to students' backgrounds (75%). FY16 data indicate that JSHS mentors increased the use of all of these strategies from the previous year FY15.

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

Table 30. Mentor Strategies to Establish the Relevance of Learning Activities (n = 106)

	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 JSHS experience	89.6%	10.4%	
	95	11	106
Giving students real-life problems to investigate or solve	81.9%	18.1%	
	86	19	105
Selecting readings or activities that relate to students' backgrounds	74.5%	25.5%	
	79	27	106
Encouraging students to suggest new readings, activities, or projects	87.7%	12.3%	
	93	13	106
Helping students become aware of the role(s) that STEM plays in their everyday lives	81.1%	18.9%	
	86	20	106
Helping students understand how STEM can help them improve their own community	82.1%	17.9%	
	87	19	106
Asking students to relate real-life events or activities to topics covered in JSHS	84.8%	15.2%	
	89	16	105

Mentors reported increased use of strategies for diverse learners in FY16 compared to FY15. As can be seen in Table 31, 91% of mentors reported using a variety of teaching and/or mentoring activities to meet the needs of students while 85% interacted with students and other personnel the same way regardless of their backgrounds. Nearly al mentors (90%) reported directing students to other individuals or programs for additional support. treating all students the same way, regardless of gender or race/ethnicity. Most of responding mentors also reported using strategies such as identifying different learning styles students may have at the beginning of their JSHS experience (70%) and providing extra readings, activities, or learning support for students who lacked essential background skills (78%).

Table 31. Mentor Strategies to Support the Diverse Needs of Learners (n = 106)

	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 JSHS experience	69.2%	30.8%	
	72	32	104
Interact with students and other personnel the same way regardless of their background	84.9%	15.1%	
	90	16	106
Use a variety of teaching and/or mentoring activities to meet the needs of all students	91.4%	8.6%	
	96	9	105
Integrating ideas from education literature to teach/mentor students from groups underrepresented in STEM	67.6%	32.4%	
	71	34	105
Providing extra readings, activities, or learning support for students who lack essential background knowledge or skills	78.1%	21.9%	
	82	23	105
Directing students to other individuals or programs for additional support as needed	89.5%	10.5%	
	94	11	105
Highlighting under-representation of women and racial and ethnic minority populations in STEM and/or their contributions in STEM	58.7%	41.3%	
	61	43	104

Mentor use of strategies to support students' development of collaboration and interpersonal skills also increased in FY16 (see Table 32). For example, 91% of respondents had students give and receive constructive feedback with others while over three-quarters of responding mentors also had students listen to the ideas of others with an open mind (92%) and explain difficult ideas to others (90%).

Table 32. Mentor Strategies to Support Participant Development of Collaboration and Interpersonal Skills (n = 104)

	Yes - I used this strategy	No - I did not use this strategy	Response Total
Having participant(s) tell other people about their backgrounds and interests	79.8%	20.2%	
	83	21	104
Having participant(s) explain difficult ideas to others	90.3%	9.7%	
	93	10	103
Having participant(s) listen to the ideas of others with an open mind	92.2%	7.8%	
	95	8	103
Having participant(s) exchange ideas with others whose backgrounds or viewpoints are different from their own	83.5%	16.5%	
	86	17	103
Having participant(s) give and receive constructive feedback with others	91.3%	8.7%	
	95	9	104

Mentor use of strategies to support student engagement in authentic STEM activities also increased in FY16 (Table 33). Nearly all respondents indicated that they allowed students to work independently to improve their self-management skills (98%), provided students with constructive feedback to improve their STEM competencies (92%), and had students search for and review technical research to support their work (91%). Similarly, 85% of mentors indicated that they supervised students while they practiced STEM research skills and that they demonstrated laboratory/field techniques, procedures, and tools for students. The majority of mentors (75%) also reported teaching (or assigning readings) about specific STEM subject matter.

Table 33. Mentor Strategies to Support Participant Engagement in Authentic STEM Activities (n = 105)

	Yes - I used this strategy	No - I did not use this strategy	Response Total
Teaching (or assigning readings) about specific STEM subject matter	75.0%	25.0%	
	78	26	**104**
Having participant(s) search for and review technical research to support their work	91.3%	8.7%	
	95	9	**104**
Demonstrating laboratory/field techniques, procedures, and tools for my student(s)	83.7%	16.3%	
	87	17	**104**
Supervising participant(s) while they practice STEM research skills	85.4%	14.6%	
	88	15	**103**
Providing participant(s) with constructive feedback to improve their STEM competencies	92.3%	7.7%	
	96	8	**104**
Allowing participant(s) to work independently to improve their self-management abilities	98.1%	1.9%	
	103	2	**105**

Finally, mentors were asked to report on the mentoring strategies they used to support students' STEM educational and career pathways (see Table 34).[9] The majority of responding mentors reported using strategies such as asking students about their educational and career interests (93%), providing guidance to students about educational pathways that would prepare them for a STEM career (85%), recommending extracurricular programs that align with their educational goals (67%), and helping students with their resume, application, personal statement, and/or interview preparations (78%).

There were also some disappointing findings in this area as well. For a second year in a row, few mentors reported discussing STEM career opportunities with the DoD or other government agencies (46%). Likewise, although an AEOP

[9] The student questionnaire included subset of these items. The student data are similar to the mentor data, and can be found in Appendix B.

goal is to increase participants' awareness of AEOP opportunities, only 31% of mentors reported recommending other AEOPs that align with student goals. These areas have decreased slightly from FY15.

Table 34. Mentor Strategies to Support Participant STEM Educational and Career Pathways (n = 105)

	Yes - I used this strategy	No - I did not use this strategy	Response Total
Asking participant(s) about their educational and/or career goals	93.2%	6.8%	
	96	7	**103**
Recommending extracurricular programs that align with participants' goals	79.6%	20.4%	
	82	21	**103**
Recommending Army Educational Outreach Programs that align with participants' goals	31.4%	68.6%	
	32	70	**102**
Providing guidance about educational pathways that will prepare participant(s) for a STEM career	85.3%	14.7%	
	87	15	**102**
Discussing STEM career opportunities within the DoD or other government agencies	35.0%	65.0%	
	36	67	**103**
Discussing STEM career opportunities in private industry or academia	72.8%	27.2%	
	75	28	**103**
Discussing the economic, political, ethical, and/or social context of a STEM career	67.0%	33.0%	
	69	34	**103**
Recommending student and professional organizations in STEM to my student(s)	67.3%	32.7%	
	70	34	**104**
Helping participant(s) build a professional network in a STEM field	71.2%	28.8%	
	74	30	**104**
Helping participant(s) with their resume, application, personal statement, and/or interview preparations	77.9%	22.1%	
	81	23	**104**

Another item on the questionnaire asked mentors which of the AEOP programs they explicitly discussed with their students during JSHS (see Table 29). Not surprisingly, the most frequently discussed program was JSHS (79%). Few responding mentors indicated discussing other specific AEOPs with students. The few that did discuss other programs included: UNITE (23%), SEAP (11%), REAP (10%), HSAP (9%), CQL (5%), URAP (10%), SMART Scholarship (14%), NDSEG Fellowship (6%). Some reported discussing AEOP overall but no specific programs (18%).

In an effort to understand what resources are most valuable to JSHS participants, mentors were asked to respond to a questionnaire item asking them how useful various resources were in their efforts to expose students to other AEOPs. In FY16, as in other years, most of the print and electronic AEOP resources go virtually unused. These include the AAS and AEOP websites, social media formats (95% did not use), the AEOP brochure (82% did not use), and It Stars Here! Magazine (which seems to have been discontinued). Table 36 illustrates that participation in JSHS (82%) the JSHS program administrator or site coordinator (62%) continue to be the best resources that mentors use in exposing students to AEOP.

Table 35. Mentors Discussing Other AEOPs with Participants (n = 105)

	Yes - I discussed this program with my student(s)	No - I did not discuss this program with my student(s)	Response Total
UNITE	22.8%	77.2%	
	23	78	101
JSHS	79.6%	20.4%	
	82	21	103
SEAP	10.8%	89.2%	
	11	91	102
REAP	9.9%	90.1%	
	10	91	101
HSAP	8.9%	91.1%	
	9	92	101
CQL	5.0%	95.0%	
	5	96	101
GEMS Near Peer Mentor Program	3.9%	96.1%	
	4	98	102
URAP	9.9%	90.1%	
	10	91	101
SMART College Scholarship	13.7%	86.3%	
	14	88	102
NDSEG Fellowship	5.9%	94.1%	
	6	96	102
I discussed AEOP with participant(s) but did not discuss any specific program	18.4%	81.6%	
	19	84	103
eCybermission	11.8%	88.2%	
	12	90	102

Table 36. Usefulness of Resources for Exposing Students to AEOPs (n = 104)

	Did not experience	Not at all	A little	Somewhat	Very much	Response Total
Academy of Applied Science (AAS) website	83.7%	0.0%	1.9%	8.7%	5.8%	
	87	0	2	9	6	104
AEOP website	86.4%	1.0%	2.9%	3.9%	5.8%	
	89	1	3	4	6	103
AEOP on Facebook, Twitter, Pinterest or other social media	95.2%	1.0%	1.0%	1.0%	1.9%	
	99	1	1	1	2	104
AEOP brochure	81.7%	1.0%	4.8%	6.7%	5.8%	
	85	1	5	7	6	104
It Starts Here! Magazine	93.1%	0.0%	2.9%	2.0%	2.0%	
	95	0	3	2	2	102
JSHS Program administrator or site coordinator	16.3%	1.9%	5.8%	14.4%	61.5%	
	17	2	6	15	64	104
Invited speakers or "career" events	43.3%	1.9%	5.8%	19.2%	29.8%	
	45	2	6	20	31	104
Participation in JSHS	3.8%	1.0%	1.9%	11.5%	81.7%	
	4	1	2	12	85	104

Most N-JSHS participants reported that participation in the R-JSHS competition helped to prepare them for the N-JSHS. However, some shared that they received little formative feedback to help them learn how to improve their work in the future.

Mentors reported that AEOP print and electronic resources were not useful in exposing students to DoD careers in FY16. Table 37 reflects that program participation and program administrators continue to be the best resources for mentors. AEOP print and electronic resources do not seem to be achieving their intended outcomes within JSHS.

Table 37. Usefulness of Resources for Exposing Students to DoD STEM Careers (n = 104)

	Did not experience	Not at all	A little	Somewhat	Very much	Response Total
Academy of Applied Science (AAS) website	81.7%	1.9%	2.9%	3.8%	9.6%	
	85	2	3	4	10	104
AEOP website	83.7%	1.0%	5.8%	2.9%	6.7%	
	87	1	6	3	7	104
AEOP on Facebook, Twitter, Pinterest or other social media	90.3%	2.9%	1.0%	1.0%	4.9%	
	93	3	1	1	5	103
AEOP brochure	82.7%	2.9%	5.8%	1.0%	7.7%	
	86	3	6	1	8	104
It Starts Here! Magazine	90.3%	1.9%	2.9%	1.0%	3.9%	
	93	2	3	1	4	103
JSHS Program administrator or site coordinator	21.2%	6.7%	5.8%	11.5%	54.8%	
	22	7	6	12	57	104
Invited speakers or "career" events	44.7%	3.9%	6.8%	15.5%	29.1%	
	46	4	7	16	30	103
Participation in JSHS	13.5%	4.8%	3.8%	11.5%	66.3%	
	14	5	4	12	69	104

Satisfaction with JSHS

Both students and mentors were asked how satisfied they were with a number of features of the JSHS program. Table 38 displays Regional students' responses to this question. Over half of responding Regional students were somewhat or very much satisfied with the student oral presentations (82%) while over half (56%) were very satisfied with student poster presentations, and invited speaker presentations (64%). Nearly half (47%) were very satisfied with social events while 51% reported being very satisfied with features such as feedback from VIPs and peers, tours of field trips (47%), and the judging process (64%). Another 53% of students indicated being satisfied with feedback from judges. It should be noted that large proportions of students did not experience features such as panel or round table discussions (48%), team-building activities (55%), and career exhibits (53%).

N-JSHS students were also asked about their satisfaction with features of the judging process at regional competitions. Most were dissatisfied with the level of feedback that they received (60%). A sampling of responses to the open-ended item "what are your overall impressions of the regional judging process" is listed below.

- I think there could be a more diverse group of judges.
- It was good, but heavily based on presentation skills.
- The regional judging process was a little odd. I thought that areas that the judges did not know as much in did not get questioned the same and had an easier route to nationals. To improve this I would recommend a wider range of variety in the judging panel.
- I would have appreciated receiving a score sheet from the judges at regionals. Additionally, most judges were not adept in my area of research.
- Overall it was good, I think giving back feedback would be helpful for students. Often times I leave a science fair without knowing what I can improve to be better next time.
- The regional judging question period was much shorter and should be extended to prepare for the National judging process.
- Too easy, allow bad projects to go to Nationals in order to represent under served demographic
- Maybe receive some feedback from the regional judges so that you can change it for nationals.
- My regional judges were not experts in many fields; therefore, there were evident bias in the winning projects.

Table 38. Satisfaction with R-JSHS Program Features (n = 452)

	Did not experience	Not at all	A little	Somewhat	Very much	Response Total
Student Oral Presentations	6.7%	1.6%	10.0%	26.8%	55.0%	
	30	7	45	121	248	**451**
Student Poster Presentations	31.0%	3.3%	9.5%	22.8%	33.3%	
	140	15	43	103	150	**451**
Judging Process	12.0%	6.9%	17.4%	33.0%	30.7%	
	54	31	78	148	138	**449**
Feedback from Judges	21.5%	10.0%	14.6%	21.5%	32.4%	
	97	45	66	97	146	**451**
Feedback from VIPs and Peers	29.3%	5.3%	14.2%	25.3%	25.9%	
	132	24	64	114	117	**451**
Invited Speaker Presentations	21.1%	5.1%	9.1%	22.4%	42.2%	
	95	23	41	101	190	**450**
Panel or Roundtable Discussions	47.9%	2.4%	10.9%	17.7%	21.1%	
	216	11	49	80	95	**451**
Career Exhibits	52.9%	2.4%	10.0%	16.2%	18.4%	
	238	11	45	73	83	**450**
Tours or Field Trips	35.1%	4.2%	13.1%	19.3%	28.2%	
	158	19	59	87	127	**450**
Team Building Activities	54.5%	5.8%	8.4%	12.9%	18.4%	
	246	26	38	58	83	**451**
Social Events	34.7%	3.6%	14.9%	19.8%	27.1%	
	156	16	67	89	122	**450**

R-JSHS students were asked their opinions on the usefulness of JSHS resources available to them (Table 39). The most beneficial resource that was reported was the deadlines (64%) and Groundrules for Student Presentations (53%). The least useful resource (50% agreement) was the selected articles - conducting research.

Table 39. Usefulness of R-JSHS Resources for Participants (n = 450)

	I did not use this resource	Not at all	A little	Somewhat	Very much	Response Total
JSHS Groundrules for Student Presentations	30.7%	2.4%	14.9%	19.6%	32.4%	
	138	11	67	88	146	**450**
Paper Submissions and Competition Deadlines	23.8%	1.3%	10.9%	24.4%	39.6%	
	107	6	49	110	178	**450**
Sample Papers	41.6%	3.3%	15.8%	14.7%	24.7%	
	187	15	71	66	111	**450**
Oral Presentation Tips	41.9%	3.6%	14.0%	16.0%	24.5%	
	188	16	63	72	110	**449**
Selected Articles – Conducting Research	49.8%	4.2%	12.9%	14.1%	19.0%	
	223	19	58	63	85	**448**

Table 40 reports on students' satisfaction with access to their mentor. Less than half (43%) of responding Regional students indicated their mentor was always available – indicating there may be some access issues for participants. However, only 3% reported that their mentor was never available indicating participants did have some, if limited access to mentors during the program.

Table 40. R-JSHS Participant Reports of Availability of Mentors (n = 452)

Choice	Response Percent	Response Total
I did not have a mentor.	14.16 %	64
The mentor was never available.	2.88 %	13
The mentor was available less than half of the time.	8.19 %	37
The mentor was available about half of the time of my project.	7.74 %	35
The mentor was available more than half of the time.	24.12 %	109
The mentor was always available.	42.92 %	194

Table 41 reports student responses to questionnaire items asking them about their satisfaction with various features of their JSHS experience. The research experience overall ranked as the top JSHS resource for FY16 participants (89%). The amount of time spent with their mentor was also rated highly (79%).

Table 41. R-JSHS Participant Satisfaction with Their Experience

	Did not experience	Not satisfied	Somewhat satisfied	Very satisfied	Response Total
My working relationship with my mentor	15.1%	2.0%	14.4%	68.5%	
	68	9	65	309	451
The amount of time I spent doing meaningful research	9.6%	4.2%	22.2%	64.0%	
	43	19	100	288	450
The amount of time I spent with my research mentor	16.4%	3.8%	22.7%	57.1%	
	74	17	102	257	450
The research experience overall	8.9%	2.0%	19.6%	69.5%	
	40	9	88	312	449

JSHS experience satisfaction items were combined into a composite variable[10] to assess for differences between groups of students. No statistical differences were found by gender or race/ethnicity in terms of student satisfaction with their JSHS experience.

An open-ended item on the questionnaire asked student about their overall satisfaction with their JSHS experience. Of the 120 regional student responses sampled (a 33% sample was taken of the 364 responses available), three-quarters commented only on positive aspects of the program. Many of these responses were simple affirmations of the student's experience in the program such as "Overall, I was very satisfied with my experience. The whole process taught me a lot, and I learned about a lot more than I expected to." Other students were more specific about what they enjoyed about the program including the opportunity to present their work and learning about others' research and STEM in general. For example:

> "I am very satisfied, overall. I really enjoyed being able to present my own work and get feedback, but my favorite part was listening to the other presentations. Many of them were very high level and very interesting. I think that the science and humanities symposium is a great way to expose people my age to higher level science and presentations in a more realistic setting." (R-JSHS Student)

> "I was very pleased to attend and present at JSHS. I felt that I learned much more about STEM through this program, and it was truly interesting to listen to other high school students share their ideas and projects. Although I'm not necessarily going to pursue a career in STEM, my interest and appreciation for science has definitely increased after this experience." (R-JSHS Student)

Twenty-two of the regional students responded with positive comments about the program but also offered caveats, while five students offered only negative comments about their R-JSHS experience. The negative comments were most frequently focused on the judging (12 comments), including comments that judges were unfamiliar with students' areas of research, concerns about inconsistent judging, and insufficient or insulting judge feedback and questioning. For example:

> "I did enjoy the expire but I feel as though the judging was lacking a little bit in giving advice and there was no engineering judge." (R-JSHS Student)

[10] The Cronbach's alpha reliability for these 4 items was 0.901.

> "I am satisfied with the JSHS experience. However the judging process for paper presenters is overly opaque and paper presenters receive no feedback from judges." (R-JSHS Student)

> "Overall I had a lot of fun. I learned many new things about science and made a lot of new friends. However, there were judges in the final round of competition that weren't very nice. I felt as though I was being attacked. The benefits did end up outweighing the negatives, I would do JSHS again." (R-JSHS Student)

Other caveats offered (1 or 2 comments each) by R-JSHS included comments on event organization, dissatisfaction with mentored projects being allowed to compete with un-mentored projects, the logistics of poster sessions, food, and logistical issues including hotel power outages and Wi-Fi outages during the event.

Students participating in the national JSHS event were asked to respond to a similar item, reflecting on their overall impressions of the national event. Of the 53 responses received, three-quarters had only positive things to say about the event. These responses ranged from general comments such as "Good" and "Very well run" to specific comments about opportunities for networking, appreciation for the keynote speakers, and the event organization. Students particularly appreciated time to socialize and network with professionals and other students at the event. For example,

> "It was very well organized with plenty of time to get to places. It was incredible being around so many smart people at one time, and it was even more amazing being able to talk to them." (N-JSHS Student)

> "I greatly enjoyed having the opportunity to present my research in a formal setting and learning about the research that other students and professionals are doing." (N-JSHS Student)

Twelve students who presented at the national event had generally positive things to say but offered some caveats, and two students had no positive comments. The most frequently mentioned caveat focused on the speakers (2 students felt there were too many and 2 felt the speakers lacked diversity). Students offering caveats also expressed a desire for more time to socialize with other students (mentioned in 3 comments), felt that there was too much recruitment (2 responses), and (1 response each) that the poster session did not receive enough emphasis, there was too much downtime, that communication could be improved, and that a workshop to help students improve their papers and presentations would be a useful addition to the national JSHS event.

Students were also asked to respond to an open-ended questionnaire item asking how the program could be improved. Eleven of the 119 regional student responses sampled (33% of the 361 available responses were sampled) replied that no improvements were necessary. Most respondents offered at least one suggestion for improvement, however. Like student responses to the overall satisfaction item, judging was an area that many students felt could be improved, with 37 students (31%) commenting on judging. Another 37 students (31%) indicated that event organization and scheduling could be improved. Students particularly indicated that they would like judges that are knowledgeable about students' areas of research, that they would like more feedback from judges, and more judges overall. Students who participated

in regional events also indicated that providing more activities and more opportunities for students to interact was an area for improvement (25 responses or 21%). Another 17 students (14%) felt that providing more lab tours and field trips would improve the R-JSHS experience. About 10% of students felt that better communication, more speakers, and more publicity/greater participation would improve the JSHS experience. Other suggested improvements, mentioned by fewer than 10% of students included:

- Increasing the number of categories available
- Improving the website
- Earlier registration and/or student notification
- Providing better opportunities for students with un-mentored projects to compete (i.e., having separate categories for mentored versus un-mentored projects)
- Allowing student choice of tours
- More free time
- Longer event
- More opportunities to network with professionals
- More specific guidelines and/or sample presentations
- More opportunity to listen to talks in other disciplines and visit poster sessions
- Improving the choices and/or quality of food provided
- More information about the DoD
- More career information

Students presenting at the national event were also asked for their suggestions for improving the JSHS program overall. The 48 N-JSHS students who responded offered a wide variety of improvements, however the most frequently mentioned were more opportunities for social interaction and more freedom during non-scheduled times (23% of responses) and the event location (15%). Students also commented that they felt there were too many speakers during meals and that speakers lacked diversity in their demographics and fields of interest (13%) and commented that the food quality and meal logistics could be improved (13%). Other improvements mentioned by 6 or fewer students included:

- Improving organization and scheduling (in particular, not scheduling the event during AP exams)
- Improving judging
- Providing more or better lab tours
- Compressing the time frame for the event
- Advertising JSHS in order to expand regional participation
- Opening JSHS to teams
- Decreasing the downtime during the national event
- Improving communication practices

- Streamlining the registration process
- Providing activities for poster participants
- Giving awards for poster participants

Concerns and suggestions from participants included:

- Need for more clear judging guidelines.
- Desire for more hands on activities.
- Need to assign judges who are experienced in the field of the presenter's research.
- Need to know the criteria participants are being judged on.
- Make Questions mandatory from each judge especially in finals
- Questioning by the judges should be focused on the student's project, not areas of research outside of his or her project.
- I believe the judges did not use a judging rubric this year. The placings were very bizzar, with students complaining afterwards. Attempts were made to receive an explanation of how judges scored projects but no answer was received.
- More opportunities to learn about DoD STEM careers
- Weekly newsletters with info on programs
- Feedback forms from judges
- Students who compete should receive written constructive feedback from the judges.

"I greatly enjoyed having the opportunity to present my research in a formal setting and learning about the research that other students and professionals are doing." – N-JSHS Student

Table 42 summarizes mentor satisfaction as reported by the mentors with JSHS program features. Most mentors reported being "very much" or "somewhat" satisfied with the program features they experienced.

Table 42. Mentor Satisfaction with JSHS Program Features (n = 109)

	Did not experience	Not at all	A little	Somewhat	Very much	Response Total
Application or registration process	7.3%	4.6%	7.3%	19.3%	61.5%	
	8	5	8	21	67	109
Communicating with Academy of Applied Science (AAS)	59.4%	3.8%	2.8%	7.5%	26.4%	
	63	4	3	8	28	106
Communicating with your JSHS site's organizers	5.5%	0.9%	5.5%	12.8%	75.2%	
	6	1	6	14	82	109
The physical location(s) of JSHS activities	12.1%	2.8%	4.7%	13.1%	67.3%	
	13	3	5	14	72	107
Support for instruction or mentorship during JSHS activities	16.8%	1.9%	4.7%	18.7%	57.9%	
	18	2	5	20	62	107
Research abstract preparation requirements	14.7%	0.9%	5.5%	22.9%	56.0%	
	16	1	6	25	61	109

Like the student questionnaire, the mentor questionnaire included open-ended items asking mentors for their opinions about the program. Mentors were asked to identify the three most important strengths of JSHS. Like students, many mentors (51% of the 100 responses received) recognized the value of student opportunities to develop presenting and communication skills and the value of students meeting and socializing like-minded peers (35% of responses mentioned this). About a quarter of responses focused on the ability for students to learn about others' research (26%), student learning about STEM in general (24%), students having the opportunity to conduct research (23%), and the judging and feedback students receive (19%). Other, less frequently mentioned strengths mentioned by mentors included networking with professionals, providing opportunities for recognition of student research and competition, building student confidence, providing career information, increasing student motivation and interest in STEM, and exposing students to speakers. These themes were echoed in focus groups.

Strengths of JSHS shared by mentors in focus groups included:

- Creating and encouraging STEM awareness
- Increasing presentation skills
- Opportunity to interact with scientists/ researchers
- The opportunity to know other students who are passionate about STEM education.
- Solid student research
- Opportunities for students to have their work recognized and appreciated by others
- Practicing STEM research techniques
- Listening to career professionals
- Analyzing data
- Engagement with DOD researchers at university
- Seeing and being inspired by what others have done

Mentors were also asked to respond to an open-ended item asked them to describe three ways JSHS could be improved for future participants. The 100 responding mentors suggested a wide variety of improvements. The most frequently mentioned improvements focused on judging (28% of responses) with suggestions including providing more judges, more judge feedback, and improving the quality and consistency of judging. Other relatively frequently mentioned improvements included providing more speakers, more or different activities, and more lab visits or field trips (10% of responses for each). Other suggestions (mentioned by 10% or less of mentors) included:

- Increasing opportunities for students to interact with each other
- Increasing outreach and student participation
- Providing more emphasis on and information about DoD research, careers, and program
- Better communication
- Improvements to mentor access and matching
- Allowing more students from each location to go to nationals
- Providing more awards
- Choosing better quality projects and/or a larger variety of projects to go to nationals
- Providing students and mentors with the judging rubric
- Providing examples of student papers and presentations
- Providing more opportunities for students to network with scientists
- Providing more funding for teachers and/or students
- Increasing diversity of participants

Suggestions for improvement of JSHS shared by mentors in focus groups included:

- Judges the student can understand
- Clearer judging rubric presented beforehand
- It would be helpful to have promotional materials available at the beginning of the school year
- More diversity in judge backgrounds
- Provide more feedback on presentations
- Advertising in local school fairs

Mentors were also asked to comment on their overall satisfaction with their JSHS experience. Of the 93 mentors who responded to this question, nearly all (94%) included positive comment about the program. Many focused on the opportunity for students to present their research, network with peers, and receive feedback from professionals. For example:

> "This program is invaluable. It is one of relatively few such opportunities available to high school students. It also provides a unique perspective that the other high-school oriented programs do not provide, by allowing students a view into DOD research and bringing the students together with DOD professionals." (JSHS Mentor)

> "JSHS is the highlight of our year and the event our students look forward to more than any other. It is a high quality experience that has helped me build a strong research program in both middle and high school. We are very satisfied and look forward to continuing to engage in the future." (JSHS Mentor)

> "JSHS is a great opportunity for our students to interact with peers who are conducting similar research, and to present their findings for scientists in order to receive feedback on how to improve their research moving forward. My student had a great experience at JSHS Long Island region this year." (JSHS Mentor)

Seventeen of these respondents provided positive comments but also offered some caveats, while six respondents offered no positive comments. These respondents' caveats most often focused on judging feedback and the diversity of judges, the quality of projects chosen as finalists, and funding decreases for the program.

> "Very pleased with the organization, its objectives, logistical arrangements and the selection of sessions." (JSHS Mentor)

> "This is the best event I've found to introduce students with a passion for STEM to careers in STEM. They come back energized, excited about science and what it looks like beyond the standard high school curriculum. The symposium format has adequate variety for them, while giving an impression of being an adult event, and what could be expected if they consider a career in science." (JSHS Mentor)

"A+ experience for mentors and for students." (JSHS Mentor)

"This year's JSHS exceeded all of my expectations. The staff was warm and inviting, students were encouraged, and my students met and interacted with students from all over our state. Each participant left with lots more information about careers, research, and so much more. As a teacher I enjoyed the times at meals to interact with staff from other schools and to "pick their brains" on how they approach different things at their schools. A truly exceptional experience from beginning to end - Dr. Ferriera at Wayne State did a phenomenal job - both herself and with the staff she assembled." (JSHS Mentor)

Some respondent to the mentor survey shared concerns and suggestions:

"I liked the experience, but honestly, my students left feeling like they weren't as smart as when they came in. They had never done research, and they kept telling me the students might as well had been speaking Chinese when listening to the presentations. Most of the projects presented were given to these students by PhDs - why not make them more student based? That way more students can actually understand and gain from the experience." (JSHS Mentor)

"Field of judges needs a broader background, no engineers among them." (JSHS Mentor)

"Overall I am satisfied. There are a few criticisms however that I can make. 1. I have worked as a judge of student papers and presentations for many years, and I see a number of errors made by students every year that I judge. For example, many students cannot write a paper without making gross grammatical errors or spelling errors. It would be nice to see a paper free of such errors. 2. I have gotten the feeling that a number of students do not put a lot of thought into their project design or their results. (This is true for many students, but not all. There are some students who do put some thought into their work, and these students are to be commended.) However, it would be nice if all students put some serious thought into their problem of investigation, their method of investigation, and what their results mean. This is why judges should have the opportunity to interact with the students BEFORE the evaluation takes place." (JSHS Mentor)

Outcomes Evaluation

The evaluation of JSHS included measurement of several outcomes relating to AEOP and program objectives, including impacts on students' STEM competencies (e.g., knowledge and skills), STEM identity and confidence, interest in and intent for future STEM engagement (e.g., further education, careers), attitudes toward research, and their knowledge of and interest in participating in additional AEOP opportunities.[11] STEM competencies are necessary for a STEM-literate

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

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 JSHS measured students' 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

A majority of responding R-JSHS students reported medium or large gains in their STEM knowledge as a result of the JSHS program as summarized in Table 43. This included a little over 40% who experienced large gains in each area. The majority of participants reported the gain in knowledge of research conducted in a STEM topic or field (79%). Likewise, participants reported growth in all other areas in this construct.

These Impacts on STEM Knowledge student questionnaire items were combined into a composite variable[12] to test for differences between subgroups of students. Significant differences were found by race/ethnicity with minority students reporting significantly greater gains in STEM Knowledge (small effect size, d = 0.318 standard deviations).[13] There no significant gender differences. Table 44 shows the percentage of responding students reporting medium or large gains in STEM competencies - science-related practices. More than 35% of participants reported large gain in most of the areas.

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.

[12] The Cronbach's alpha reliability for these 5 items was 0.929.

[13] Two-tailed independent samples *t*-test, $t(447) = 3.36$, $p < 0.001$.

Table 43. R-JSHS Participant Reports of Impact on STEM Knowledge (n = 449)

	No gain	Small gain	Medium gain	Large gain	Response Total
In depth knowledge of a STEM topic(s)	5.4%	21.7%	32.1%	40.8%	
	24	97	144	183	**448**
Knowledge of research conducted in a STEM topic or field	4.5%	16.5%	33.9%	45.2%	
	20	74	152	203	**449**
Knowledge of research processes, ethics, and rules for conduct in STEM	8.9%	19.2%	31.7%	40.2%	
	40	86	142	180	**448**
Knowledge of how scientists and engineers work on real problems in STEM	7.4%	19.6%	29.5%	43.5%	
	33	88	132	195	**448**
Knowledge of what everyday research work is like in STEM	8.3%	18.5%	29.9%	43.3%	
	37	83	134	194	**448**

Table 44. R-JSHS Participant Gains in their STEM Competencies – Science and Engineering Practices (n =453)

	No gain	Small gain	Medium gain	Large gain	Response Total
Asking a question that can be answered with one or more scientific experiments	7.2%	22.9%	32.5%	37.4%	
	32	102	145	167	**446**
Using knowledge and creativity to suggest a testable explanation (hypothesis) for an observation	7.6%	20.2%	33.5%	38.7%	
	34	90	149	172	**445**
Using knowledge and creativity to suggest a solution to a problem	6.3%	18.9%	30.6%	44.1%	
	28	84	136	196	**444**
Making a model of an object or system showing its parts and how they work	19.3%	23.6%	27.3%	29.8%	
	85	104	120	131	**440**
Designing procedures for an experiment that are appropriate for the question to be answered	9.7%	20.5%	31.8%	37.9%	
	43	91	141	168	**443**
Identifying the limitations of the methods and tools used for data collection	8.5%	17.5%	31.2%	42.7%	
	38	78	139	190	**445**
Carrying out procedures for an experiment and recording data accurately	9.5%	18.3%	26.0%	46.2%	
	42	81	115	204	**442**
Using computer models of objects or systems to test cause and effect relationships	30.5%	23.9%	20.8%	24.8%	
	135	106	92	110	**443**
Organizing data in charts or graphs to find patterns and relationships	10.4%	18.2%	28.6%	42.8%	
	46	81	127	190	**444**
Considering different interpretations of data to decide if a solution to a problem works as intended	9.5%	21.7%	30.2%	38.6%	
	42	96	134	171	**443**
Considering different interpretations of data when deciding how the data answer a question	10.0%	20.6%	30.6%	38.8%	
	44	91	135	171	**441**
Supporting an explanation for an observation with data from experiments	9.9%	17.8%	28.2%	44.0%	
	44	79	125	195	**443**

Supporting an explanation with relevant scientific, mathematical, and/or engineering knowledge	9.3%	19.2%	30.9%	40.6%	
	41	85	137	180	**443**
Supporting a solution for a problem with data	8.8%	17.2%	28.6%	45.4%	
	39	76	126	200	**441**
Identifying the strengths and limitations of explanations in terms of how well they describe or predict observations	9.7%	17.9%	31.4%	41.0%	
	43	79	139	181	**442**
Defending an argument that conveys how an explanation best describes an observation	11.1%	19.9%	29.4%	39.6%	
	49	88	130	175	**442**
Identifying the strengths and limitations of data, interpretations, or arguments presented in technical or scientific texts	10.2%	18.3%	31.4%	40.2%	
	45	81	139	178	**443**
Identifying the strengths and limitations of solutions in terms of how well they meet design criteria	11.1%	21.9%	29.8%	37.2%	
	49	97	132	165	**443**
Integrating information from technical or scientific texts and other media to support your explanation of an observation	11.3%	19.0%	32.6%	37.1%	
	50	84	144	164	**442**
Communicating about your experiments and explanations in different ways (through talking, writing, graphics, or mathematics)	8.6%	16.7%	29.7%	45.0%	
	38	74	132	200	**444**
Integrating information from technical or scientific texts and other media to support your solution to a problem	11.3%	20.0%	30.4%	38.3%	
	50	89	135	170	**444**

For gains in STEM competencies in Science and Engineering composite scores were calculated.[14] These composites were used to assess if the JSHS program had differential impacts depending on student group membership. Significant differences by race/ethnicity were found with minority students reporting greater impacts on both STEM Competency skills (small effect of d = 0.252)[15]. There was no significant difference in STEM Competency skills by gender.

The student questionnaire also asked students about the impact of JSHS on their "21st Century Skills". As can be seen in Table 45, more than 40% of participants reported large gains in this area. A composite variable of these 8 items focusing

[14] The STEM Competencies composite (21 items) has a Cronbach's alpha reliability of 0.981.

[15] Two-tailed independent samples t-test: $t(444) = 2.66$, $p = .008$.

on 21st Century Skills[16] was created to test for differences between student subgroups. Significant differences were found by gender with females reporting significantly greater gains compared to males (small effect size, d = 0.231)[17]. There were no significant differences in 21st Century Skills by race/ethnicity.

Table 45. R-JSHS Participant Reports of Impacts on 21st Century Skills (n = 445)

	No gain	Small gain	Medium gain	Large gain	Response Total
Learning to work independently	11.5%	12.2%	24.5%	51.8%	
	51	54	109	230	**444**
Setting goals and reflecting on performance	9.0%	11.3%	30.6%	49.1%	
	40	50	136	218	**444**
Sticking with a task until it is finished	9.7%	11.2%	26.7%	52.4%	
	43	50	119	233	**445**
Making changes when things do not go as planned	9.0%	11.5%	24.8%	54.6%	
	40	51	110	242	**443**
Working well with people from all backgrounds	17.1%	14.0%	27.5%	41.4%	
	76	62	122	184	**444**
Including others' perspectives when making decisions	14.4%	14.0%	31.3%	40.3%	
	64	62	139	179	**444**
Communicating effectively with others	10.1%	12.8%	26.8%	50.2%	
	45	57	119	223	**444**
Viewing failure as an opportunity to learn	7.9%	12.2%	25.5%	54.5%	
	35	54	113	242	**444**

[16] The 21st Century Skills composite (8 items) had a Cronbach's alpha reliability of .942.

[17] Two-tailed independent samples t-test, $t(443) = 2.43$, $p = .015$.

STEM Identity and Confidence

The student questionnaire included a series of items intended to measure the impact of JSHS on students' STEM identity. Students are unlikely to purse STEM further in their education and/or careers if they do not see themselves as capable of succeeding in STEM[18], so, deepening students' STEM knowledge and skills is important for increasing the likelihood. These data are shown in Table 46, which illustrates the impact of JSHS on participants is strong, with over 35% reporting large gains in their STEM identity.

Table 46. R-JSHS Participant Reports on JSHS Impacts on STEM Identity (n = 444)

	No gain	Small gain	Medium gain	Large gain	Response Total
Interest in a new STEM topic	9.0%	17.6%	26.4%	47.0%	
	40	78	117	208	**443**
Deciding on a path to pursue a STEM career	15.6%	19.0%	27.1%	38.4%	
	69	84	120	170	**443**
Sense of accomplishing something in STEM	8.4%	16.7%	25.6%	49.3%	
	37	74	113	218	**442**
Feeling prepared for more challenging STEM activities	9.3%	14.4%	25.7%	50.6%	
	41	64	114	224	**443**
Confidence to try out new ideas or procedures on my own in a STEM project	8.4%	13.3%	27.1%	51.2%	
	37	59	120	227	**443**
Patience for the slow pace of STEM research	9.7%	18.8%	29.6%	41.9%	
	43	83	131	185	**442**
Desire to build relationships with mentors who work in STEM	7.2%	15.3%	27.1%	50.3%	
	32	68	120	223	**443**
Connecting a STEM topic or field to my personal values	9.5%	14.9%	26.5%	49.1%	
	42	66	117	217	**442**

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

Composite scores were generated for the STEM identity composite[19] to assess whether the JSHS program had differential impacts on subgroups of students. Minority students reported significantly greater increases in STEM Identity in comparison to White students (small effect size, d = 0.239)[20]. There were no significant differences in STEM Identity by gender.

Interest and Future Engagement in STEM

The questionnaire asked students to reflect on if the likelihood of their engaging in STEM activities outside of school changed as a result of their experience (Table 47). As a key goal of the AEOP program is to develop a STEM-literate citizenry, students need to be engaged, both in and out of school, with high-quality STEM activities. R-JSHS students reported being more likely to work on a STEM project or experiment in a university or professional setting (70%), watch or read non-fiction STEM (46%), work on solving mathematical or scientific puzzles (51%), talk about STEM with friends or family (63%), mentor or teach other students about STEM (60%), help with a community service project in STEM (62%), participate in a STEM camp, club, or competition (63%), and take an elective STEM class (62%).

[19] The Cronbach's alpha reliability for these 8 items was 0.946.

[20] Two-tailed independent samples t-test, $t(442) = 2.51$, $p = .012$.

Table 47. R-JSHS Impact on Participants' Intent to Engage in STEM Out of School (n = 444)

	Much less likely	Less likely	About the same before and after	More likely	Much more likely	Response Total
Watch or read non-fiction STEM	2.5%	2.7%	49.4%	25.9%	19.5%	
	11	12	218	114	86	**441**
Tinker (play) with a mechanical or electrical device	3.0%	1.6%	50.6%	26.9%	18.0%	
	13	7	222	118	79	**439**
Work on solving mathematical or scientific puzzles	1.4%	2.5%	44.7%	31.1%	20.4%	
	6	11	197	137	90	**441**
Use a computer to design or program something	2.5%	3.6%	49.2%	23.8%	20.9%	
	11	16	217	105	92	**441**
Talk with friends or family about STEM	2.0%	2.7%	31.8%	33.4%	30.0%	
	9	12	140	147	132	**440**
Mentor or teach other students about STEM	2.5%	2.5%	33.6%	31.2%	30.2%	
	11	11	149	138	134	**443**
Help with a community service project related to STEM	1.8%	2.0%	33.0%	32.4%	30.8%	
	8	9	146	143	136	**442**
Participate in a STEM camp, club, or competition	1.8%	1.6%	32.4%	31.3%	32.9%	
	8	7	143	138	145	**441**
Take an elective (not required) STEM class	1.6%	1.8%	34.8%	27.5%	34.3%	
	7	8	154	122	152	**443**
Work on a STEM project or experiment in a university or professional setting	1.8%	0.9%	27.3%	27.1%	42.9%	
	8	4	121	120	190	**443**

These items were used to create a composite score[21] used for comparing subgroups of students. There were significant differences by race/ethnicity in terms of engaging in STEM activities with minority students reporting greater intent than White participants (small effect size, d = 0.241)[22]. There were no significant differences in likelihood of engaging in STEM activities by gender.

The questionnaire also examined R-JSHS student interest level in participating in future AEOP programs. Table 48 summarizes student responses. Very few students expressed that they would be "not at all" interested in future programs. In contrast, many students expressed that they would be "very much" or "somewhat" interested in future programs (6% or less). However, most reported never hearing of other AEOP programs (65-71%).

The N-JSHS questionnaire asked participants to list the AEOP programs they had learned about through JSHS this year. Most participants reported learning about the SMART Scholarship. N-JSHS participants mentioned no other AEOPs.

[21] These 10 items had a Cronbach's alpha reliability of 0.936.

[22] Two-tailed independent samples t-test, $t(442) = 2.53$, $p = .012$.

Table 48. R-JSHS Participant Interest in Future AEOP Programs (n = 446)

	I've never heard of this program	Not at all	Somewhat interested	Very interested	Response Total
GEMS	64.7%	5.4%	18.3%	11.5%	
	286	24	81	51	442
UNITE	70.8%	5.3%	12.3%	11.6%	
	310	23	54	51	438
JSHS	5.2%	5.6%	30.5%	58.7%	
	23	25	135	260	443
SEAP	63.5%	5.5%	14.6%	16.4%	
	278	24	64	72	438
REAP	64.3%	5.4%	15.8%	14.5%	
	284	24	70	64	442
HSAP	65.5%	5.2%	16.1%	13.2%	
	288	23	71	58	440
CQL	68.9%	4.5%	14.3%	12.3%	
	303	20	63	54	440
GEMS Near Peer Mentor Program	70.6%	4.6%	13.9%	10.9%	
	310	20	61	48	439
URAP	66.4%	4.6%	13.7%	15.3%	
	290	20	60	67	437
SMART College Scholarship	64.4%	2.9%	14.5%	18.1%	
	284	13	64	80	441
NDSEG Fellowship	67.7%	3.6%	14.2%	14.4%	
	300	16	63	64	443

Students were asked which resources impacted their awareness of the various AEOPs. Unfortunately, most R-JSHS participants had not experienced any resources outside of JSHS (85-93%). As can be seen in Table 49, some JSHS participants indicated they had not participated in JSHS – indicating it may not be clear to students who are in JSHS which program they are participating in (22%).

Table 49. Impact of Resources on R-JSHS Participant Awareness of AEOPs (n = 447)

	Did not experience	Not at all	A little	Somewhat	Very much	Response Total
Academy of Applied Science (AAS) website	88.9%	1.8%	3.8%	2.9%	2.5%	
	393	8	17	13	11	**442**
Army Educational Outreach Program (AEOP) website	85.3%	2.3%	6.3%	2.9%	3.2%	
	376	10	28	13	14	**441**
AEOP on Facebook, Twitter, Pinterest or other social media	90.7%	3.4%	3.2%	1.8%	0.9%	
	398	15	14	8	4	**439**
AEOP brochure	87.1%	2.3%	4.3%	4.8%	1.6%	
	384	10	19	21	7	**441**
It Starts Here! Magazine	93.2%	2.3%	1.6%	1.4%	1.6%	
	412	10	7	6	7	**442**
My JSHS mentor(s)	47.2%	12.2%	19.2%	8.8%	12.6%	
	209	54	85	39	56	**443**
Invited speakers or "career" events during JSHS	60.2%	9.7%	13.1%	7.5%	9.5%	
	266	43	58	33	42	**442**
Participation in JSHS	21.5%	10.1%	25.7%	18.1%	24.6%	
	96	45	115	81	110	**447**

Attitudes toward Research

R-JSHS participants were asked about their opinions of what DoD researchers do and the value of DoD research more broadly as attitudes about the importance of DoD research are an important prerequisite to continued student interest in the field and potential involvement in the future. The data indicate that most responding students have favorable opinions (see Table 50). A vast majority of students "strongly agree or agree" with each statement, including that DoD researchers solve real-world problems (70%), DoD research is valuable to society (68%); advance fields (68%); and develop new technologies (67%).

Table 50. R-JSHS Participant Opinions about DoD Researchers and Research (n = 442)

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree	Response Total
DoD researchers advance science and engineering fields	1.1%	0.7%	29.9%	37.6%	30.6%	
	5	3	132	166	135	**441**
DoD researchers develop new, cutting edge technologies	1.1%	0.2%	31.6%	35.0%	32.0%	
	5	1	139	154	141	**440**
DoD researchers solve real-world problems	1.4%	0.5%	27.7%	36.4%	34.1%	
	6	2	122	160	150	**440**
DoD research is valuable to society	1.1%	0.9%	29.7%	34.2%	34.0%	
	5	4	131	151	150	**441**

Army/DoD Programs and Careers N-JSHS Participants Learned About

At the N-JSHS event participants were asked (n = 111) to describe the Army/DoD careers that they learned about in JSHS in FY16. All participants were able to articulate statements about learning more in this area. Some responses from participants included:

- I learned about several opportunities in the military such as working for the DoD in a wide range of scientific categories, doing solid research. Ex. Satellite monitoring, looking for suspicious activity, marine science, material work on vests, bullets and planes.
- With my visit to the Research Labs, I learned about the careers in the human performance wing, materials and manufacturing engineering and aerospace engineering.
- I learned about many different careers, some involving military combat, and others involving space and lab work that contribute to the war fighter.
- I learned about a bunch but I'm not naming them all because that's too much.
- SMART scholars pays for your tuition if you work for the DoD!
- I didn't know the DoD emphasized research as much as they do until this program.
- We mostly learned about the Army/DoD science research opportunities.
- Before coming to nationals, I thought all Army/DoD careers were on active duty, however I learned that you can be a civilian and still have a job in the military. I also learned that there are more than just engineers that do valuable research for the Army/DoD.
- STEM, research in the different military branch procedures. AEOP.

Education and Career Aspirations

Students were asked about their education aspirations both before and after JSHS. As can be seen in Table 51, when asked to think back on how far they wanted to go in school after participating in JSHS, only .5% of Regional students indicated graduating from high school. The majority of participants plan to further their education beyond high school after participating in JSHS.

Table 51. Before JSHS - Participant Education Aspirations

Before Aspirations	Response Percent	Response Total
Graduate from high school	2.02 %	9
Go to a trade or vocational school	0.22 %	1
Go to college for a little while	1.12 %	5
Finish college (get a Bachelor's degree)	13.90 %	62
Get more education after college	5.61 %	25
Get a master's degree	20.63 %	92
Get a Ph.D.	23.54 %	105
Get a medical-related degree (M.D.), veterinary degree (D.V.M), or dental degree (D.D.S)	14.80 %	66
Get a combined M.D. / Ph.D.	14.80 %	66
Get another professional degree (law, business, e	3.36 %	15

Table 52. After JSHS - Participant Education Aspirations

After Aspirations	Response Percent	Response Total
Graduate from high school	0.45 %	2
Go to a trade or vocational school	0.22 %	1
Go to college for a little while	0.45 %	2
Finish college (get a Bachelor's degree)	8.74 %	39
Get more education after college	5.83 %	26
Get a master's degree	19.51 %	87
Get a Ph.D.	28.48 %	127
Get a medical-related degree (M.D.), veterinary degree (D.V.M), or dental degree (D.D.S)	14.80 %	66
Get a combined M.D. / Ph.D.	16.82 %	75
Get another professional degree (law, business, etc.)	4.71 %	21

In terms of career aspirations, students were asked what kind of work they expect to be doing at age 30, both reflecting on what their aspiration was before and after JSHS (see Table 53 and 54). Among each group, the most common aspirations before JSHS were also most popular after JSHS.

Table 53. JSHS Participant Career Aspirations Before JSHS (n = 444)

Before Aspirations	Response Percent	Response Total
Other	6.98 %	31
Undecided	9.23 %	41
Science (no specific subject)	5.41 %	24
Physical science (physics, chemistry, astronomy, materials science)	5.18 %	23
Biological science	11.04 %	49
Earth, atmospheric or oceanic science	0.90 %	4
Environmental science	2.70 %	12
Computer science	5.63 %	25
Technology	0.90 %	4
Engineering	14.64 %	65
Mathematics or statistics	1.58 %	7
Medicine (doctor, dentist, veterinarian, etc.)	19.59 %	87
Health (nursing, pharmacy, technician, etc.)	5.41 %	24
Social science (psychologist, sociologist, etc.)	2.93 %	13
Teaching, STEM	0.68 %	3
Teaching, non-STEM	0.68 %	3
Business	1.35 %	6
Law	2.25 %	10
Military, police, or security	0.68 %	3
Art (writing, dancing, painting, etc.)	2.03 %	9
Skilled trade (carpenter	0.23 %	1

† Before, R-JSHS other includes “journalism,” “animal behavior research, “directing,” “biochemistry”, ”biomedical engineering”, “physical activity”, “cinematographer”, & “forensic science.” After, R-JSHS other includes “journalism,” “animal behavior research, “directing,” “biochemistry”, and “psychology”. After, N-JSHS other includes “Management”

Table 54. JSHS Participant Career Aspirations After JSHS (n = 444)

After Aspriations	Response Percent	Response Total
Undecided	9.46 %	42
Science (no specific subject)	6.76 %	30
Physical science (physics, chemistry, astronomy, materials science)	4.73 %	21
Biological science	10.81 %	48
Earth, atmospheric or oceanic science	1.35 %	6
Environmental science	3.15 %	14
Computer science	6.08 %	27
Technology	0.45 %	2
Engineering	13.29 %	59
Mathematics or statistics	1.58 %	7
Medicine (doctor, dentist, veterinarian, etc.)	19.59 %	87
Health (nursing, pharmacy, technician, etc.)	4.50 %	20
Social science (psychologist, sociologist, etc.)	3.15 %	14
Teaching, STEM	0.68 %	3
Teaching, non-STEM	0.68 %	3
Business	1.80 %	8
Law	2.03 %	9
Military, police, or security	0.68 %	3
Art (writing, dancing, painting, etc.)	2.25 %	10
Skilled trade (carpenter, electrician, plumber, etc.)	0.00 %	0

Table 55 shows that nearly all R-JSHS participants expect to use STEM somewhat in their career when they are age 30. Specifically, 50% of Regional students reported expecting to use STEM 76-100% of the time in their work. Only 2% of

Regional students reported not expecting to use STEM in their work at all and no National students reported not expecting to use STEM in their work at all.

Table 55. Percentages of Time Participants that Expect to Use STEM in Their Career When They Are 30 (n = 444)

Choice	Response Percent	Response Total
not at all	2.00 %	9
up to 25% of the time	7.80 %	35
up to 50% of the time	13.14 %	59
up to 75% of the time	27.39 %	123
up to 100% of the time	49.67 %	223

Overall Impact

Finally, students were asked their opinions about the overall impact of participating in JSHS. Students thought the program had substantial impacts on them (see Table 56). Most importantly, R-JSHS students reported being more confident in their STEM knowledge, skills, and abilities (78%). However, over 40% of participants did not feel more aware of other AEOPs and were not interested in participating in other AEOPs. JSHS should focus more effort in promoting and encouraging participation in other AEOPs in the future.

Table 56. Participant Opinion of JSHS Impacts (n = 444)

	Disagree - This did not happen	Disagree - This happened but not because of JSHS	Agree - JSHS contributed	Agree - JSHS was primary reason	Response Total
I am more confident in my STEM knowledge, skills, and abilities	6.1%	15.7%	63.4%	14.8%	
	27	69	279	65	**440**
I am more interested in participating in STEM activities outside of school requirements	7.2%	20.4%	56.3%	16.1%	
	32	90	249	71	**442**
I am more aware of other AEOPs	41.9%	9.4%	33.9%	14.9%	
	183	41	148	65	**437**
I am more interested in participating in other AEOPs	42.6%	11.2%	33.9%	12.4%	
	186	49	148	54	**437**
I am more interested in taking STEM classes in school	8.8%	30.2%	48.1%	12.9%	
	39	133	212	57	**441**
I am more interested in earning a STEM degree	10.6%	27.6%	47.7%	14.0%	
	47	122	211	62	**442**
I am more interested in pursuing a career in STEM	9.3%	26.9%	48.9%	14.9%	
	41	119	216	66	**442**
I am more aware of Army or DoD STEM research and careers	37.0%	9.8%	36.1%	17.1%	
	162	43	158	75	**438**
I have a greater appreciation of Army or DoD STEM research	31.1%	12.9%	35.4%	20.6%	
	137	57	156	91	**441**
I am more interested in pursuing a STEM career with the Army or DoD	44.6%	13.2%	29.2%	13.0%	
	196	58	128	57	**439**

Overall JSHS Impact survey items were combined into a composite variable[23] to assess differences between student subgroups. There were no significant gender differences in terms of Overall JSHS Impact. Minority students did however report having experienced significantly higher overall impact from JSHS compared to White students (small effect of d = 0.202 standard deviations).[24]

An open-ended item on the questionnaire asked students at the regional level to list the three most important ways they benefited from JSHS. Of the 128 responses sampled (a 33% sample was taken of the 389 responses available), regional students overwhelmingly responded that JSHS enhanced their public speaking, presentation, and/or communication skills (52% of responses contained some mention of this). Student responses also focused on exposure to new concepts and research (35% of responses), the opportunity to interact with like-minded peers (33%), the opportunity to learn about STEM in general (29% of responses), career information (21% of responses), laboratory and/or research experience (19% of responses), confidence-building (18% of responses), and increased interest in STEM (17% of responses).

Students presenting at the national event were also asked to reflect on the benefits of participating in JSHS. Half of the 50 respondents cited the importance of interacting with peers. Over a quarter (28%) cited the importance of presenting, while 16% felt that the opportunity to see others' research is a benefit of JSHS. Other less frequently mentioned benefits included networking with professionals, general learning, learning about other AEOPs, and increasing their confidence.

Similar themes emerged from student focus groups. Some examples that were shared included:

> "Just getting feedback, learning how to present in front of people. Public speaking is a big thing in the world now. You're going to have to learn how to do it anyways." (R-JSHS Student)

> "I realized how difficult it is to explain something in writing when someone doesn't understand anything you're saying. I had to make it more...I had to write it so that other people would be able to understand and also still have it be scientific with all of my work." (R-JSHS Student)

> "I value research a lot more just after going through this whole process, because beginning my senior year I didn't even know if I wanted to go into research at all. It seemed intimidating. (N-JSHS Student)

> "It also helps with your public speaking skills, and you meet a bunch of people who are not just from your area, but also are concerned about the things you're concerned about. You get to see all the different kinds of concerns in your area, and it's really cool." (N-JSHS Student)

[23] The Cronbach's alpha reliability for these 11 items was 0.967.

[24] Two-tailed independent samples t-test, $t(444) = 2.13$, $p = 0.034$.

"I made a lot of good connections. I met a lot of good people. As far as my research goes, I got a lot of good, positive feedback from the judges. That's really helpful. And oral presentation skills, obviously that's always a benefit." (N-JSHS Student)

Summary of Findings

The FY16 evaluation of JSHS collected data about participants, their perceptions of program processes, resources, and activities, and indicators of achievement related to AEOP's and JSHS's objectives and intended outcomes. A summary of findings is provided in Table 57.

Table 57. 2016 JSHS Evaluation Findings	
Participant Profiles	
Participation in JSHS remained similar to FY15, with a 4% decrease in applications and participants. JSHS continued to engage a majority of female participants. However, growing the ethnic/racial diversity of JSHS continues to be an area in need of focus.	In FY16, JSHS received slightly fewer applications than in FY15 (4%). The 47 R-JSHS sites received 8,947 applications and were able to accommodate 63% of these (5,620). This represents a 4% decrease in participants from FY15 when 9,347 students applied and 5,829 were selected.
	JSHS continued to be successful in FY16 in attracting a majority of female participants based upon data that were available. In the regions that reported gender data, 57% of participants were female and 43% were male. However, demographic data was available from only 29 of 46 regional symposiums (2,065 participants – less than 50% of total population).
	JSHS continued to struggle with growing diversity of participants in FY16. JSHS participants remained predominantly White or Asian in FY16, as nearly half (45%) of students identified themselves as White with another 22% identifying themselves as Asian. 21% of students chose not to report their race/ethnicity, 4% identified themselves as Black or African American and 6% as Hispanic or Latino. Native American students comprised .3% of the students reporting their race/ethnicity, while .3% identified as Native Hawaiian or Pacific Islander.
	R-JSHS participants were mostly from public schools (77%) though some students represented DoD schools (3%). The percentage of rural students participating in JSHS declined by 50% down to 14% (compared to over 40% in FY15). The majority of students reported being from suburban schools (59%) and urban locations (27%).
	More than half of participants were oral research presenters (57%). There were 24% poster presenters, and 19% of attendees did not present at JSHS.

JSHS mentor demographics reflected the diversity of participants in FY16.	There were 939 teachers who participated in JSHS in FY16. Demographics reported on the mentor questionnaire (109 participants) indicated that 63% were female, 34% male, and 3% chose not to report gender. Ethnic/racial diversity was similar to the participant group including 75% White, 12% Asian, 3% Native American, 1% Hispanic/Latino, 2% other, and 7% chose not to report. There were 0% Black or African American mentors that completed the questionnaire.
Actionable Program Evaluation	
Marketing of JSHS continues to predominantly be schools and past participants. Students continue to be motivated to participate in JSHS to receive experiences they normally do not receive in school.	JSHS continued to utilize marketing and recruitment strategies focused primarily at the regional level through JSHS directors in FY16, along with AAS driven communications and marketing on websites/social media. Similar to FY15, participants learned about JSHS through three primary means: 20% of participants indicated they learned about JSHS through their school or university, 18% learned about JSHS through a school newsletter or website, and 18% learned about JSHS through a past participant. Other ways that were reported included: friend (9%); AEOP website (8%); family (5%); someone who works with program (4%); community group (4%); Department of Defense (1%); social media (1%) and 5% chose not to report.
	The top motivations for participating in JSHS in FY16 were the same as in FY15 though the percentage agreement decreased considerably and a broader array of reasons received similar agreement. The top two included interest in STEM (10%) and desire to learn something new (8%), though were closely followed by having fun (8%); desire to expand laboratory or research skills (8%); and learning through ways not possible in school (7%).
Participation in STEM activities occurred more frequently on a most to every day basis in JSHS than in school. However, participants reported less frequent use of most STEM practices in JSHS than in	Participants indicated JSHS STEM Activities occurred more frequently than in school STEM activities in nearly all areas. Participants (41%) indicated that they learn about STEM topics that are new to them every day both in school and in JSHS. However, more participants agreed JSHS provides them opportunities every day to apply STEM learning to real-life 32% (18% in school); learn about new discoveries in STEM 34% (14% in school); learn about different careers that use STEM 25% (10% in school); interact with scientists or engineers 30% (10% in school); and communicate with other students about STEM 40% (27% in school).

school. Mentors increased their use of strategies for diverse learners.	As in FY15, participants reported using STEM Practices less frequently during R-JSHS than during school – with the exception of building or making a computer model –, which had 17%, agreement during R-JSHS compared to 10% agreement at school. Findings indicate that R-JSHS students are not as frequently engaged in (less than most days) STEM practices including: using laboratory procedures and tools, hands on STEM activities, working as part of a team, identifying questions or problems to investigate, designing and carrying out investigations, analyzing data and drawing conclusions, and coming up with creative explanations or solutions.
	Mentors reported increased use of strategies for diverse learners in FY16 compared to FY15. 91% of mentors reported using a variety of teaching and/or mentoring activities to meet the needs of students while 85% interacted with students and other personnel the same way regardless of their backgrounds. Nearly al mentors (90%) reported directing students to other individuals or programs for additional support. treating all students the same way, regardless of gender or race/ethnicity. Most of responding mentors also reported using strategies such as identifying different learning styles students may have at the beginning of their JSHS experience (70%) and providing extra readings, activities, or learning support for students who lacked essential background skills (78%).
JSHS succeeded in exposing participants to STEM careers/jobs through program activities and mentor efforts. However, 60% of R-JSHS participants reported not learning about any DoD STEM jobs/careers. N-JSHS participants reported that invited speakers and career events were the key way they learned about DoD STEM careers. The difference in experiences may be	R-JSHS participant reported exposure to STEM careers and DoD STEM jobs/careers specifically were areas of decline for FY16. Only 10% of R-JSHS students reported learning about at least one STEM job/career, and 21% reported learning about five or more. Additionally, 22% of R-JSHS participants reported that they did not learn about any STEM jobs/careers during the program. Comparatively, many fewer R-JSHS participants learned about DoD STEM jobs/careers overall. 60% of participants reported that they did not learn about even one DoD STEM job/career. Only 12% learned about one job, 11% two jobs, 8% three jobs, 2% four jobs, and 8% five or more jobs. However, a large majority of N-JSHS (80%) students indicated that invited speakers or career events were a key resource for learning about DoD STEM careers. This is an area that JSHS should invest more effort into for FY17, as exposure to DoD specific STEM jobs/careers is one of the priority areas for the AEOP overall.

attributed to low percentage (35%) of mentors who reported discussing DoD STEM careers with students. Additionally, only 31% of mentors recommended other AEOPs to participants	Mentors for both R-JSHS and N-JSHS were asked to report their use of strategies specifically focused on introducing participants to STEM careers and DoD specific STEM jobs/careers in FY16. 73% of mentors reported discussing STEM career opportunities with participants, indicating JSHS participants are learning about STEM careers – as participants have also reported. However, only 35% reported discussing DoD STEM career opportunities with participants. Additionally, only 31% of mentors recommended other AEOPs to participants. These are areas that should be considered for improvement in FY17.
Participant satisfaction with JSHS program aspects ranged from around 50% to 82% for various aspects in FY16. N-JSHS participants were dissatisfied with feedback received from judges. Mentors continued to report satisfaction with JSHS in FY16.	Participant satisfaction with JSHS program components ranged from around 50% to 82% for various aspects in FY16. Despite this decline, R-JSHS students were somewhat or very much satisfied with the student oral presentations (82%) while over half (56%) were very satisfied with student poster presentations, and invited speaker presentations (64%). Nearly half (47%) were very satisfied with social events while 51% reported being very satisfied with features such as feedback from VIPs and peers, and tours of field trips (47%). Another 53% of students indicated being satisfied with feedback from judges. It should be noted that large proportions of students did not experience features such as panel or round table discussions (48%), team-building activities (55%), and career exhibits (53%). Participant dissatisfaction with the judging process continued to be an area of concern in FY16 (which has declined since FY14). Though 64% of R-JSHS participants were satisfied, the majority of N-JSHS participants (60%) reported dissatisfaction with feedback received from judges at R-JSHS. Respondents reported wanting more diversity in expertise and ethnic/racial/gender backgrounds of judges, more focus actual project content than presentation skills, and written feedback on presentation/poster.
	The research experience overall ranked as the top JSHS resource for participants (89%). The amount of time spent with their mentor was also rated highly (79%). Many participants did not utilize some JSHS resources including the oral presentation tips (42%), sample papers (42%), and JSHS Groundrules (31%). Surprisingly, 47% of R-JSHS respondents to the survey indicated they did not have a JSHS mentor.
	Mentors reported being very satisfied with JSHS program features. Communication with the JSHS site organizers was rated highest (75%) followed by the physical location (67%), application or registration process (62%), support for instruction or mentorship (58%), and research abstract preparation requirements (56%).

Outcomes Evaluation	
Nearly half of R-JSHS participants reported large gains on their STEM knowledge and STEM competencies.	Over 40% of R-JSHS students reported large gains on their in-depth knowledge of a STEM topic or field; knowledge of research, processes, ethics, and rules for conduct in STEM; knowledge of what everyday research work is like in STEM; knowledge of how scientists and engineers work on real problems in STEM; and knowledge of research conducted in a STEM topic or field.
	Slightly over 40% of R-JSHS participants reported large impacts on some of the STEM competencies, or abilities to "do STEM." These areas included: using knowledge and creativity to suggest a solution to a problem; identifying limitations of methods and tools used for data collection; carrying out procedures for an experiment and recording data accurately; organizing data in charts or graphs to find patterns and relationships; supporting an explanation for an observation with data from experiments and STEM knowledge; supporting a solution for a problem with data; identifying the strengths and limitations of explanations in terms of how well they describe or predict observations; communicating about your experiments and explanations in different ways.
R-JSHS participants reported large gains in 21st Century Skills.	Slightly over 40% of responding R-JSHS participants reported large gains in 21st Century Skills. These skills included communicating effectively with others (50% R-JSHS), viewing failure as an opportunity to learn (55% R-JSHS), and setting goals and reflecting on performance (49% R-JSHS).
Participants reported gains in STEM identity and interest in engaging in STEM in the future.	50% of R-JSHS participants reported large gain in the STEM identity areas including: feeling prepared for more challenging STEM activities (51%); confidence to try out new ideas or procedures on my own in a STEM project (51%); and desire to build relationships with mentors who work in STEM (50%).
	Over 60% of R-JSHS participants reported being more likely to engage in out-of-school STEM activities including: work on a STEM project or experiment in a university of professional setting (70%); participate in a STEM camp, club, or competition (64%); talk with friends or family about STEM (63%); help with a community service project related to STEM (63%); mentor or teach other students about STEM (61%); and take an elective STEM class (61%). As in FY15, the impact of JSHS extends and is lasting beyond the actual competition.

JSHS participants aspired to further their education beyond finishing college after JSHS. The type of work they expected to do before and after participation were similar.	After participating in JSHS, students indicated being more likely to go further in their schooling than they would have before JSHS. For R-JSHS students, the proportion of students wanting to graduate high school increased from .50% to 2% and get a Ph.D. grew from 21% to 29% from before JSHS to after JSHS participation. R-JSHS participants wanting to finish college remained similar at about 14% prior to participation and 9% after.
	Participants were asked to indicate what kind of work they expected to be doing at age 30, both before and after JSHS participation. The majority of students aspired to STEM careers both before and after JSHS participation and no significant change was found.
Some R-JSHS participants were more aware of and interested in other AEOPs. N-JSHS students reported learning about the SMART Scholarship but no other AEOPs were mentioned.	Almost half of R-JSHS participants agreed JSHS made them more aware of other AEOPs (49%) and 46% of R-JSHS participants indicated interest in participating in other AEOPs. The program of most interest was JSHS (59%), followed by SMART College Scholarship (33%), SEAP (31%), REAP (31%), HSAP (29%), URAP (29%), NDSEG Fellowship (29%), CQL (27%), GEMS Near Peer Mentor (25%) and Unite (24%). The N-JSHS questionnaire asked participants to list the AEOP programs they had learned about through JSHS this year. Most participants reported learning about the SMART Scholarship. N-JSHS participants mentioned no other AEOPs.
	R-JSHS participants reported that participation in JSHS was the best resource available to learn about other AEOPs (43%). Most students reported not experiencing the AAS website (89%) or AEOP website (85%) or AEOP social media (91%) at all. Further, the AEOP brochure was not provided to 87% of responding participants in FY16.
	Mentors reported similar experiences with resources that may be utilized to expose participants to other AEOPs. 84% of mentors did not use the AAS website and 87% did not use the AEOP website. 95% did not use any form of AEOP social media and 81% did not experience the AEOP brochure. Interestingly, 62% of mentors indicated the JSHS program administrator or site coordinator were their best sources of information (62%) along with actual participation in JSHS (82%) for learning about other AEOPs. Mentors reported their discussion of individual programs within the AEOP portfolio with student participants. Unite was the most discussed at 23%, followed by SMART College Scholarship (14%), eCybermission (12%), SEAP (11%), URAP (10%), REAP (10%), HSAP (9%), CQL (5%), and NDSEG Fellowship (6%).

Most R-JSHS participants had positive views of Army/DoD research and a subset of the group were interested in pursuing Army/DoD STEM careers.	R-JSHS participants reported being more aware of Army/DoD STEM research and careers (53%) and having greater appreciation of Army/DoD STEM research (56%). More than 60% of R-JSHS students expressed agreement that DoD research is valuable to society, that DoD researchers solve real-world problems, that DoD researchers develop new, cutting edge technologies, and the DoD researchers advance science and engineering fields. Finally, 42% of R-JSHS participants reported being more interested in pursuing a STEM career with the Army or DoD.

Responsiveness to FY14 and 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.

FY15 Finding: Although the applicant placement rate increased from 55% to 62% from FY14 to FY15, it is concerning that there was a 30% decrease in the number of applicants in FY15 as compared to FY14, and overall participation was 21% lower. It is recommended that JSHS track the number of applicants and placement rates at each regional site to insure more consistent placement rates across the portfolio (i.e. Illinois – Chicago had only 20% placement rate compared to 100% at other sites such as South Carolina). One strategy would be for AAS to work with regional sites to support increasing their capacity to accept more participants in the low placement rate regions.

The program failed to meet its goal of a 10% increase in the number of participating high schools and, in fact, there was an 8% decline in the number of schools participating in FY15. Of the 46 regional events held, 18 regions showed a 27% increase over the previous year in the total number of participating high schools. Another 14 regions showed a 37% decrease since FY14. While there are a variety of intervening factors associated with these phenomena, including weather impacts, competing activities, and impacts of school budget cuts on students' ability to travel, program

administrators should be mindful of these decreases in participation and particularly the effect they may have on engaging students from underserved and underrepresented populations.

AAS may want to support states to reach out and cast broader nets for recruiting participants – beyond the local area of the competition or host. The program may wish to investigate student recruitment practices from the regions that demonstrated growth in FY15 and identify scalable recruitment and marketing strategies that could be applied across regions. Likewise, the program may wish to investigate strategies from regions with decreasing participation with the aim of identifying longitudinal changes in regional practices that may have affected student participation rates. Some recommended strategies to grow the diversity of student participants to increase the number of underrepresented students include conducting outreach to schools with high populations of underrepresented students to make them aware of JSHS and reaching out to academically prepared and competitively eligible underrepresented students to encourage actual participation in JSHS.

JSHS FY16 Efforts:

- Invite younger students and those from underrepresented populations to observe and/or participate in specific sessions to encourage future participation, including non-competitive poster sessions, science related visual art presentations, and oral presentations with reflection and feedback discussions. (Alabama, Connecticut, Florida, Intermountain, Missouri, North Carolina, Ohio, South Carolina, Wisconsin-UP of Michigan)
- Provide training and support to students in specific topics concerning how to conduct research, write papers, and present projects through workshops, webinars, and print materials. (Connecticut, Iowa)
- Engage volunteers from underrepresented populations to serve as role models and those to whom underrepresented students can better relate. (Connecticut, Florida, Hawaii, Philadelphia, Southeastern Michigan, Southwest, and Washington)
- Connect undergraduate and graduate students in STEM fields from host institution to teachers in rural schools to serve as mentors in new mentorship initiative that plans to expand in FY17. (Alabama, Ohio)
- Provide direct mentor support to underrepresented students through the US2020 program. (Philadelphia)
- Provide additional funding to reduce or eliminate costs for travel, meals, and accommodations associated with the JSHS regional symposia; use private donations to provide STEM opportunities and research supplies to schools with large under-represented populations. (Alaska, Intermountain, Missouri, New York-Upstate)
- Adjust maximum number of students allowed from a school to participate in JSHS regional symposia, especially if school is from a more financially challenged district. (Missouri)
- Create and use Advisory Board which includes key school district personnel to outreach to Detroit schools and students. (Southeastern Michigan).

JSHS FY16 Outcomes:

- The AEOP has the goal of broadening the talent pool in STEM fields, specifically targeting underrepresented and underserved populations, and therefore increasing the number of participants in programs, including JSHS. In FY15, JSHS experienced a decrease in student and high school participation overall due to several factors which affected regional competitions such as inclement weather, school budget cuts and competing activities. With

respect to including underrepresented and underserved populations, the evaluation data indicate that JSHS was able to attract a significant number of female participants (a recognized underrepresented group in STEM) the program had limited success in attracting underserved minority race/ethnicity and low-income groups on a regional and national scale.

- To expand participation in FY '16, the AAS identified sustainable recruitment strategies used in Regional Symposia, which saw increases in participation and explored avenues to pursue similar practices in regions struggling to meet participation goals, with specific emphasis placed on practices targeting underrepresented groups. Each of the Regional Symposia reported outreach efforts to heighten awareness of JSHS among high schools, particularly those serving underrepresented populations, or efforts to develop partnerships with STEM enrichment programs serving underrepresented population. However, overall participation in JSHS continued to decline in FY16.
- As a result in FY '16, JSHS participation by Title I high school increased as measured by the number of participating Title I schools. The FY16 target of 10% or 110 Title I schools was exceeded with 18% or 196 Title I high schools participating in JSHS Regional Symposia. The number of participating high schools remained steady in FY '16, with 1,060 high schools participating in FY '16 as compared to 1,100 high schools in the previous year.

FY15 Finding: AEOP objectives include expanding participation of populations historically underrepresented in STEM careers. Since no program-wide demographic data was available from FY14, however, it is not possible to determine whether there was any change in participation of these groups from FY14 to FY15. Collecting demographic information on students participating in the R-JSHS through Cvent will enable a more accurate representation of the JSHS participation pool and concerted efforts should be made by program administrators to ensure that demographic data for all JSHS participants is compiled annually. JSHS failed to meet its FY15 goal for attracting Title I schools (associated with low-income status students) to the program. Of the 1,020 schools participating 15% were Title I schools, falling short of its FY15 goal of 20%. The program should continue to collect information and strategies from specific regional symposia as well as other AEOPs that successfully attract underrepresented and underserved students. This information should be disseminated to the larger JSHS community of regional directors. Additionally, the program may with to consider ways to build on previous efforts to strengthen its outreach to schools that serve large proportions of underrepresented groups of students (e.g., urban schools, Title I schools). JSHS might also consider the possibility of engaging with target districts through the AEOP's strategic outreach initiative opportunities, which provide limited financial support to assist in the ability of a target community to engage with the AEOPs.

JSHS FY16 Efforts and Outcomes:

- JSHS encouraged more sites to use Cvent in FY16 – however only a few did. As a result, demographic data outside of the evaluation data was incomplete at best.

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

FY 15 Finding: The frequency with which students expressed dissatisfaction with judging practices and judging feedback during their JSHS experience (including the increased dissatisfaction from FY14 to FY15) suggests that there may be a

need to direct additional resources to judge recruitment and training. While participation of DoD STEM personnel was constant from FY14 to FY15, there was a 33% decrease in the participation of college/university personnel from FY14 to FY15. The program may wish to further investigate practices of regions that were successful in attracting larger numbers of and greater diversity of judges with the aim of identifying practices that may be scaled across regions. Additionally, the program may wish to consider whether current judging practices established by the program are adequate to ensure standardization of judging practices nationwide and consider additional methods to standardize judging and reduce students' perception of judging bias. The program may wish to consider, for instance, creating judging rubrics, providing enhanced judging training or orientation, and providing methods for judges to easily provide both oral and written feedback to students. Currently, the feedback at regional level JSHS competitions is varied and is mostly verbal in format.

JSHS FY16 Efforts and Outcomes:

- The AEOP program wide goal to empower educators with unique Army research and technology resources to mentor students and develop the pool of future STEM talent is assessed through multiple experience related questions in the evaluation. JSHS data collected reveals that while participation of DoD STEM personnel was constant from FY14 to FY15. Participation by mentors, regional directors, and volunteers representing academia continued to grow from FY14 (2,500) to FY16 (3,214).
- In FY '16 a total 3,214 mentors, regional directors, and volunteers representing academia contributed to JSHS Regional and National symposia. Among the total 275 adults attending the National JSHS, 275 reported the data on Gender and/or Race/Ethnicity. Reported NRM data on National adult leaders was:
    - Gender: 103 Female; 170 Male ; 2 Choose not to report
    - Race/Ethnicity: 10-Asian; 11-Black or African American; 9-Hispanic or Latino; 1-Native American or Alaskan Native; 1-Native Hawaiian; 6-Other; 13-Choose not to report.
- Recommendation was made to the Academy to investigate practices employed by regions that attract larger numbers and greater diversity of judges for Regional Symposium in order to establish best practices, which can be distributed across all regions. The Academy was also advised to examine judging procedures to ensure standardization across the Regional and National Symposia and to reduce students' perception of judging bias. In response to the evaluation report, the Academy devoted time and facilitated an intentional discussion about the topic of judging at the Annual Meeting of Regional Directors in FY16. The Academy also reinstituted the Regional Directors Advisory Council (RDAC). RDAC, a representative body of JSHS regional symposium directors and others, will advise the Academy of Applied Science in the continuing development and direction of the JSHS program. This group met in August FY16 and has revised the rules of competition and judging policies for FY17. These revisions have been published in the National guidelines and will be distributed to all regional directors through email and website publications.
- In addition to the Academy's immediate responses to the issue of judges and AEOP's goal to empower educators with research and technology resources, particularly those from the DoD, to serve as mentors and volunteers, the Academy will also identify current practices employed by regions to recruit and train judges and further develop and distribute these methods to all Regional Symposia. Practices which can be shared include collaboration with DoD STEM personnel at regional and national symposia and

participation practices, engagement by JSHS alumni, engagement by graduate students, volunteer diversity, and use of technology for training judges and volunteers.

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

FY15 Finding: In order to create a robust pipeline of AEOP programs in which students' progress from other AEOPs into JSHS and beyond, the program may want to consider innovative ways to work with other AEOPs to create a more seamless continuum of programs. One finding that is cause for concern is that although many participants expressed interest in other AEOP programs, most students had never heard of AEOP programs outside of JSHS. Large numbers of students at R-JSHS events reported not having seen the AEOP brochure. This is especially concerning since the FY15 APR indicates that AEOP resources were distributed to all regional symposia. Coupled with this is student reliance on teachers or mentors for information about AEOPs and mentor reports of having little familiarity with AEOPs other than JSHS. The program may wish to consider devising methods to disseminate AEOP information directly to teachers and mentors before the regional events as well as communicating expectations to regional symposia concerning the distribution of AEOP materials at events to ensure that all mentors, teachers, and students have access to structured opportunities that both describe the other AEOPs and provide information to students on how they can apply to them.

Evaluation data indicate that nearly half (47%) of R-JSHS students did not hear about any Army or DoD STEM career opportunities during their JSHS experience. Since R-JSHS mentors were reported to be a useful source of information about DoD STEM careers it would be useful for the program to devise ways to familiarize mentors with resources available to expose students to DoD STEM careers. A large majority of N-JSHS (80%) students indicated that invited speakers or career events were a key resource for learning about DoD STEM careers, however over a third (35%) of R-JSHS students reported not having experienced these resources. Because of the potential marked impact of this resource on student awareness of DoD STEM careers, the program may wish to consider innovative ways to connect regional students with DoD STEM professionals, including creating web-based video profiles of DoD STEM professionals, creating virtual lab tours hosted by DoD STEM professionals, and devising strategies to facilitate regional symposia's efforts to engage DoD STEM professionals as speakers at events.

The R-JSHS experience comprises the entirety of the JSHS experience for most students, however consistent differences between R-JSHS and N-JSHS student responses suggest that N-JSHS may have a greater impact on students than R-JSHS. While some of these differences are likely due to initial differences in interest and/or ability between students who are selected to go on to N-JSHS and those who are not, other differences may be related to differences in the availability/quality of mentor support or the availability/quality of activities at each symposium. The program should consider what guidance and support can be provided to regional directors, mentors, and other supporters of R-JSHS to facilitate the identification of mentors (particularly in rural areas and other areas with logistical barriers to accessing

university and other professional STEM resources), active engagement in STEM activities, useful feedback from judges, and feelings of success that support a positive STEM identity among students who are not selected for N-JSHS.

JSHS FY16 Efforts and Outcomes:

- The AEOP established a goal to create a robust pipeline of AEOP programs in which students' progress from other AEOPs into JSHS and beyond. The primary objective has been to expand cross-marketing and outreach for JSHS to include other AEOP programs, however, data from the FY15 evaluation confirms that despite marketing efforts, JSHS participants do not know about AEOP or its opportunities outside of JSHS. Survey responses indicate strong participant interest in other AEOP programs but that a majority have little or no awareness of these programs. It is evident that JSHS and the AEOP programs as a whole need to develop a brand identity to connect them to each other and to the larger organization of AEOP. In addition to the lack of awareness of AEOP specifically, the evaluation revealed a significant disconnect between the amount of Army and DoD STEM experiences highlighted at the Regional and National Symposium and that students who participate in the National competition receive much more exposure to DoD STEM opportunities than those who only participate at the Regional level. In FY15, the Academy mailed AEOP resources to all regional directors for distribution at the Regional Symposia. The Academy continued this practice in FY16, however the supply of materials was more limited and regional requests were not always met in full.
- Recommendation was made to the Academy to consider innovative ways to collaborate with other AEOPs to create a more seamless continuum of programs. The Academy disseminates AEOP materials directly to teachers and mentors to highlight the organization and the multiple opportunities offered. Survey results illustrate that students identify teachers and mentors as a useful source of information about STEM careers in general.
- The Academy continues to support all AEOP programs through cross marketing. In FY16, AAS made pointed efforts to collaborate with the LO and Widmeyer to promote AEOP programs among JSHS participants and alumni. A more robust social media and marketing campaign that included AEOP branding was implemented in FY16 and will continue to grow into FY17 and beyond. In FY16, targeted communication was sent to alumni to recruit volunteers for eCybermission, and newsletters and emails were sent to JSHS and participants in the Apprenticeship Programs to encourage continued engagement in AEOP opportunities. To address the disconnect between the presence of AEOP and awareness of DoD STEM careers between the regional and national symposia, the Academy is considering ways to create and distribute promotional materials such as banners and posters to be displayed at all Regional Symposia to include and highlight AEOP branding. The Academy will also continue to encourage all regions to include language about AEOP and to engage DoD volunteers to establish a stronger Army and DoD presence at events to raise awareness.

FY15 Finding: Participation in the AEOP evaluation continues to be an area of concern. While student and mentor participation rates rose slightly from FY14 to FY15, the continued relatively low rates of participation threaten the generalizability of results. Improved communication with individual program sites about expectations for the evaluation may help. A recommendation was made in the FY14 evaluation report as follows: "Given the large number of participants in the Regional competitions, it may be worth randomly sampling students to respond to the questionnaire, and rechanneling efforts into getting a high response rate from the sample." Although there is no indication that this recommendation was acted upon in FY15, it may be a strategy to consider going forward. It is recommended that JSHS

consider requiring regional sites to provide time for participants to complete the AEOP evaluation questionnaire during regional symposia.

JSHS FY16 Efforts and Outcomes:

- JSHS encouraged more sites to complete the evaluation in FY16, including hosting webinars for regional directors. Participation in the FY16 evaluation was still very low despite the efforts.

Recommendations for FY17 Program Improvement/Growth

Evaluation findings indicate that FY16 was a successful year overall for the JSHS program. Notable successes for the year include the continued high participation rate for females, continued participation by other groups traditionally under-represented in STEM fields, and good levels of mentor and student satisfaction with the programs. In FY16 JSHS mentors increased their use of effective mentoring strategies and most R-JSHS participants indicated strong interest in engaging in out-of-school STEM experiences in the future.

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

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

1. In FY16 JSHS continued to experience a decrease in applications and participation in the program overall – which represents a three-year downward trend. For FY16 there were 8,900 applications and 5,300 participants – compared to 9,347 and 5,829 respectively in FY15. This is an area that is in need of focus for FY17. We suggest as an example a couple of strategies for addressing enrollment concerns: 1) work with regions to expand their recruitment efforts beyond the local area utilizing websites, social media, and other marketing efforts of the consortium, 2) grow capacity for stronger regions to accept more participants. For example, most participants at the Kentucky regional site visit were from the greater Louisville region – with very little to no representation from other central and southeastern parts of the state. We suspect this may be the case for other regional sites. JSHS may also consider utilizing electronic formats to grow participation in JSHS from remote locations – similar to an eCybermission model – for the future. Additionally, it is recommended that JSHS provide the Regional Directors a forum to share best practices in both program administration as well as infusing information about AEOP programs and DoD research and careers into programming.

2. In addition to increasing participation overall – JSHS should also continue and expand efforts to recruit participants from historically underrepresented groups. JSHS participants remained predominantly White or Asian in FY16, as nearly half (45%) of students identified themselves as White with another 22% identifying themselves as Asian. 21% of students chose not to report their race/ethnicity, 4% identified themselves as Black

or African American and 6% as Hispanic or Latino. Native American students comprised .3% of the students reporting their race/ethnicity, while .3% identified as Native Hawaiian or Pacific Islander. JSHS should examine housing regional sites within areas that provide great representation of potential diverse JSHS participants and work with regional directors to specifically target schools that have not been well represented in JSHS.

3. R-JSHS participants reported having experience with STEM activities within JSHS. However, most reported that they were able to use STEM practices more frequently in school than in JSHS. This should be an area of focus for JSHS and AAS should consider providing specific suggestions/guidelines/handbook to regional sites on how to include STEM practices within the programming for R-JSHS. Further, almost half (40%) reported large gains in their STEM knowledge, STEM competencies, and 21st Century Skills after participating in JSHS. In FY16 most participants did not feel that JSHS impacted their abilities to do STEM and associated knowledge. This is another data point that illuminates a need to provide more guidance and structure to the JSHS programming – particularly at the regional level – to ensure that participants are gaining these valuable experiences and abilities during the program.
4. Program provided/collected demographic data on participants was incomplete, as in FY15. It is strongly suggested that JSHS require regional sites to collect full demographic data on all participants – ideally through Cvent in FY17.

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

1. In FY16 JSHS participants continued to report dissatisfaction with judging practices and judging feedback at regional competitions – a finding that has been reported in FY14 and FY15 as well. There were several data points that reinforced this finding, from the R-JSHS survey to N-JSHS focus group sessions and the N-JSHS survey. Participants reported not being satisfied with the quality of and amount of feedback provided from judges – including receiving no written feedback from judges. Further, participants felt that the judges were not content experts and that they were judged primarily for their presentation skills rather than the actual content and focus of their research project. As has been recommended in previous years, JSHS should develop and implement guidelines for judging that include templates for providing feedback (written and oral) to participants. Further, regional sites should make every effort to have judges that reflect the breadth and depth of STEM content that participants may focus on as much as possible. STEM experts as well as Army/DoD STEM experts should be sought to engage in R-JSHS events. Virtual judging processes that may enable more qualified STEM judges to participate may be a potential strategy – along with virtual competitions for those that are regionally unable to participate.

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

1. As in FY15, less than 50% of JSHS participants agreed that JSHS made them more aware of other AEOPs and only 46% were interested in participating in other AEOPs. Additionally, only 15% of JSHS participants had used the AEOP website and fewer had used social media related to AEOP (9%). Further, only 13% of participants had been provided with the AEOP brochure. Most mentors did not discuss AEOPs with participants – as only 23% discussed Unite, 14% SMART, 12% eCybermission, 11% SEAP, 10% URAP, 10% REAP, 9% HSAP, 5% CQL, and 6% NDSEG Fellowship. These findings are concerning, primarily because these are areas that AAS could address through collective and organized marketing efforts for JSHS. In FY17 AAS should develop with or without consortium support materials to be provided to participants (i.e. brochures, handouts) as well as instructional resources for regional sites (mandatory) to go through with all regional site participants during the overview/orientation session prior to competition or at the conclusion (e.g. slides, speakers). Promotion of the AEOPs should be collective responsibility of each and every program within the consortium.

2. The majority of participants in R-JSHS (78%) in FY16 reported learning about STEM careers during the program and most (68%) learned about more than one career. However, JSHS did a much less effective job of exposing R-JSHS participants to Army/DoD STEM careers – as only 40% of R-JSHS participants learned about at least one Army/DoD STEM career. Conversely, a large majority of N-JSHS (80%) students indicated that invited speakers or career events were a key resource for learning about DoD STEM careers. The difference in growth of learning about STEM careers overall and DoD STEM careers specifically may be attributed to mentor level of discussion of each during the program. Mentors (78%) reported discussing STEM careers with participants. However, only 35% discussed Army/DoD STEM careers. In FY17 JSHS should address this area through development of a toolkit for regional sites to use (i.e. slideshow, handouts, social media posts) and also an inventory of potential regional Army/DoD STEM career people who could be engaged to participate in person or by video in the programming.

Appendices

Appendix A

FY16 JSHS Evaluation Plan

Questionnaires

Purpose:
As per the approved FY16 AEOP APP, the external evaluation of JSHS (conducted by Purdue University) includes three post-program questionnaires:

1. AEOP Youth Regional Questionnaire to be completed by student participants of the JSHS regional events; and
2. AEOP Youth National Questionnaire to be completed by student participants of the JSHS national event; and
3. AEOP Mentor Questionnaire to be completed by research mentors, competition advisors, chaperones, teachers, or others who supported students as they prepared for or participated in JSHS national and regional events.

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.

The questionnaires were aligned 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., inclusive of implementation and outcomes evaluation, and outcomes of STEM-specific competencies, transferrable competencies, attitudes about/identifying with STEM, future engagement in STEM-related activities, and educational/career pathways);
- Best practices and published assessment tools in STEM education, STEM informal/outreach, and the evaluation/research communities;
- AEOP's vision to improve the quality of the data collected, focusing on changes in intended student outcomes and contributions of AEOPs like CQL effecting those changes.

The use of common questionnaires and sets of items that are appropriate across programs will allow for comparisons across AEOP programs and, if administered in successive years, longitudinal studies of students as they advance through pipelines within the AEOP. Because the questionnaires incorporate batteries of items from existing tools that have been validated in published research, external comparisons may also be possible. All AEOPs are expected to administer the student and mentor questionnaires provided for their program.

Site Visits/Onsite Focus Groups

Purpose:
As per the approved FY16 AEOP APP, the external evaluation of JSHS includes site visit/onsite focus groups at three JSHS regional events.

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

Evaluation Activities during JSHS Site Visits:

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

Selecting Focus Group Participants:

Evaluators appreciate event administrators' assistance in helping to assemble a diverse group of focus group participants who can provide information about a range of experiences possible in the JSHS. Ideally, this assistance is in the form of pre-event notifications of the focus groups, including scheduled dates, times, and locations.

Ideally, each student focus group will be inclusive of

- males and females (equal representation if possible),
- range of grade levels of students,
- range of race/ethnicities of students served by the program, and
- range of STEM interests (if known).

We prefer that students volunteer themselves after receiving the invitation to participate in the focus group, but will pursue students nominated by program staff or mentors. Participants may RSVP to evaluators privately or simply show up at the focus group location; however, sign-up sheets should not be used--if they are publically displayed, they breach participant confidentiality.

A number of different adult participants of JSHS--regional directors, national judges, chaperones, and even parents. We encourage any of these groups to participate in the adult focus group and have geared questions to be applicable across groups.

Data Analyses

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

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

Appendix B

FY16 JSHS Student Focus Group Protocol

2016 Army Education Outreach Program Evaluation Study
Student Focus Group Protocol, JSHS

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 JSHS. In case you have not been in a focus group before, I'd like to give the group some ground rules that I like to use in focus groups. They seem to help the group move forward and make everyone a little more comfortable:

- What is shared in the room stays in the room.
- Only one person speaks at a time.
- If you disagree please do so respectfully.
- It is important for us to hear the positive and negative sides of an issue.
- This is voluntary - you may choose not to answer any question, or stop participating at any time.
- We will be audio recording the session for note-taking purposes only. Audio will be destroyed.
- Do you have any questions before we begin?

Key Questions

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

The Army Educational Outreach Program (AEOP) is a primary sponsor of JSHS. We do these focus groups 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 JSHS is teaching students about STEM career opportunities in the Army and Department of Defense.**
    - During JSHS, did you learn about 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 JSHS. You are definitely eligible to participate in some of these programs and we need to know if you learned about them during JSHS.**
    - During JSHS, did you learn about any of the outreach programs that the AEOP sponsors? (REAP, SEAP, CQL, SMART, etc.)
    - How did you learn about them?
    - Do you think that you will try to participate in any of those programs?
4. **Were you happy that you chose to participate in JSHS this year?**
    - What, specifically do you think you got out of participating in JSHS?
    - Were there any other benefits of participating in JSHS?
5. **Do you have any suggestions for improving JSHS 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 JSHS Mentor Focus Group Protocol

2016 Army Education Outreach Program Evaluation Study
Adult/Mentor Focus Group Protocol, JSHS

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 JSHS. 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:

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

Key Questions:

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

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

2. **We need to understand more about how JSHS is helping students know more about STEM career opportunities in the Department of Defense, especially civilian positions.**
    - Have you seen any efforts by JSHS to educate participants about the Army, DoD, or careers in the DoD?
    - What strategies seem to be the most effective for JSHS students?
    - Do you have any suggestions for helping JSHS teach students about careers in the DoD?
3. The AEOP sponsors a wide range of national STEM outreach programs that these students qualify for. **The AEOP needs to know if JSHS is teaching students the other STEM outreach programs that it sponsors.**
    - First, are you aware of the other programs offered by the AEOP? (e.g., REAP, SEAP, CQL, SMART, etc)
    - Have you seen any efforts at JSHS 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 JSHS to help engage underserved or underrepresented groups of adults and youth?
    - What strategies seem to work the best? The worst?
    - Any suggestions for helping JSHS reach new populations of adult and youth participants?
5. **What suggestions do you have for improving JSHS?**
6. **Last Chance - Have we missed anything? Tell us anything you want us to know that we didn't ask about.**

Appendix D

FY16 Regional Event Student Questionnaire

*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

*2. Please enter your first initial, middle initial, last initial (example John Kumar Brown would be JKB) followed by your date of birth with no hyphenation, slashes or dashes (example 06171996). The combined entry will look like: JKB06171996 for example.(*Required)

3. What grade will you start in the fall of 2016? (select one)	
Select one.	
○	9th
○	10th
○	11th
○	12th
○	College freshman
○	Other, (specify)::

*4. What is your gender?(*Required)	
Select one.	
○	Male
○	Female

*5. What is your race or ethnicity?(*Required)	
Select one.	
○	Hispanic or Latino
○	Asian
○	Black or African American
○	Native American or Alaska Native
○	Native Hawaiian or Other Pacific Islander
○	White
○	Other race or ethnicity, (specify)::

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

7. Which best describes the location of your school?	
Select one.	
○	Frontier or tribal school
○	Rural (country)
○	Suburban
○	Urban (city)

8. What kind of school do you attend?	
Select one.	
○	Public school
○	Private school
○	Home school
○	Online school
○	Department of Defense school (DoDDS or DoDEA)
○	I am not sure

9. What was your JSHS regional site? (Select ONE)

Select one.

○	Alabama
○	Alaska
○	Arizona
○	Arkansas
○	California—Northern California & Western Nevada
○	California—Southern California
○	Chicago
○	Connecticut
○	DoD Dependent Schools-Europe
○	DoD Dependent Schools-Pacific
○	District of Columbia – Washington DC
○	Florida
○	Georgia
○	Hawaii
○	Illinois
○	Indiana
○	Intermountain—Colorado, Montana, Idaho, Nevada, Utah
○	Iowa
○	Kansas—Nebraska—Oklahoma
○	Kentucky
○	Louisiana
○	Maryland
○	Michigan
○	Mississippi
○	Missouri
○	New Jersey--Monmouth
○	New Jersey—Rutgers

○	New York—Long Island
○	New York—Metro
○	New York—Upstate
○	North Carolina
○	North Central—Minnesota, North Dakota, South Dakota
○	New England—Northern New England
○	New England—Southern New England
○	Ohio
○	Oregon
○	Pennsylvania
○	Philadelphia
○	Puerto Rico
○	South Carolina
○	Southwest
○	Tennessee
○	Texas
○	Virginia
○	Washington
○	West Virginia
○	Wisconsin-Western Wisconsin & Upper Michigan
○	Wisconsin
○	Wyoming—Eastern Colorado

10. Have you participated in any of the following AEOP programs previously and if so, how many times?

Select one per row.

	I have not participated in this program	*Once*	*Twice*	*Three or more times*
Gains in the Education of Mathematics and Science (GEMS)	○	○	○	○
Junior Solar Sprint (JSS)	○	○	○	○
eCybermission	○	○	○	○
UNITE	○	○	○	○
Junior Science & Humanities Symposium (JSHS)	○	○	○	○
Research & Engineering Apprenticeship Program (REAP)	○	○	○	○
Science & Engineering Apprenticeship Program (SEAP)	○	○	○	○
High School Apprenticeship Program (HSAP)	○	○	○	○
GEMS Near Peer Mentor Program	○	○	○	○
Science Mathematics, and Research for Transformation (SMART) College Scholarship	○	○	○	○
National Defense Science & Engineering Graduate (NDSEG) Fellowship	○	○	○	○

11. Which of the following social media outlets do you use on a regular basis? (Choose ALL that apply)

Select all that apply.

☐	Facebook
☐	Twitter
☐	Instagram
☐	LinkedIn
☐	Snapchat
☐	Vine
☐	Flickr
☐	Tumblr
☐	Other:

12. 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	○	○	○	○	○

13. How often did you do each of the following in JSHS 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	○	○	○	○	○

14. 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	○	○	○	○	○

15. How often did you do each of the following in JSHS 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	○	○	○	○	○

16. 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*
Academy of Applied Science (AAS) website	○	○	○	○	○
Army Educational Outreach Program (AEOP) website	○	○	○	○	○
AEOP on Facebook, Twitter, Pinterest or other social media	○	○	○	○	○
AEOP brochure	○	○	○	○	○
It Starts Here! Magazine	○	○	○	○	○
My JSHS mentor(s)	○	○	○	○	○
Invited speakers or “career” events during JSS	○	○	○	○	○
Participation in JSHS	○	○	○	○	○

17. 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*
Academy of Applied Science (AAS) website	○	○	○	○	○
Army Educational Outreach Program (AEOP) website	○	○	○	○	○
AEOP on Facebook, Twitter, Pinterest or other social media	○	○	○	○	○
AEOP brochure	○	○	○	○	○
It Starts Here! Magazine	○	○	○	○	○
My JSHS mentor(s)	○	○	○	○	○
Invited speakers or “career” events during JSS	○	○	○	○	○
Participation in JSHS	○	○	○	○	○

18. How USEFUL were the following resources from JSHS.org?

Select one per row.

	I did not use this resource	*Not at all*	*A little*	*Somewhat*	*Very much*
JSHS Groundrules for Student Presentations	○	○	○	○	○
Paper Submissions and Competition Deadlines	○	○	○	○	○
Sample Papers	○	○	○	○	○
Oral Presentation Tips	○	○	○	○	○
Selected Articles – Conducting Research	○	○	○	○	○

19. How SATISFIED were you with the following JSHS features?

Select one per row.

	Did not experience	*Not at all*	*A little*	*Somewhat*	*Very much*
Applying or registering for the program	○	○	○	○	○
Communicating with your JSHS host site organizers	○	○	○	○	○
The physical location(s) of JSHS activities	○	○	○	○	○
The variety of STEM topics available to you in JSHS	○	○	○	○	○
Teaching or mentoring provided during JSHS activities	○	○	○	○	○
Research abstract preparation requirements	○	○	○	○	○
Research presentation process	○	○	○	○	○

20. How SATISFIED were you with each of the following JSHS program activities?

Select one per row.

	Did not experience	*Not at all*	*A little*	*Somewhat*	*Very much*
Student Oral Presentations	○	○	○	○	○
Student Poster Presentations	○	○	○	○	○
Judging Process	○	○	○	○	○
Feedback from Judges	○	○	○	○	○
Feedback from VIPs and Peers	○	○	○	○	○
Invited Speaker Presentations	○	○	○	○	○
Panel or Roundtable Discussions	○	○	○	○	○
Career Exhibits	○	○	○	○	○
Tours or Field Trips	○	○	○	○	○
Team Building Activities	○	○	○	○	○
Social Events	○	○	○	○	○

21. What was your role at Regional JSHS? (Select ONE)		
Select one.		
○	I was attending JSHS - I did not present my research	
○	I was a non-competitive poster presenter	(Go to question number 22.)
○	I was a competitive poster presenter	(Go to question number 22.)
○	I presented my research in an oral symposium	(Go to question number 22.)

22. Which of the following best describes your primary research mentor?		
Select one.		
○	I did not have a research mentor	(Go to question number 24.)
○	Teacher	(Go to question number 23.)
○	Coach	(Go to question number 23.)
○	Parent	(Go to question number 23.)
○	Club or activity leader (School club, Boy/Girl Scouts, etc.)	(Go to question number 23.)
○	STEM researcher (industry, university, or DoD/government employee, etc.)	(Go to question number 23.)
○	Other, (specify)::	(Go to question number 23.)

23. 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 JSHS:

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	○	○

24. How much input did you have in selecting your JSHS 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

25. How often was your mentor available to you during JSHS?	
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

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

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

Select one per row.

	Did not experience	*Not satisfied*	*Somewhat satisfied*	*Very satisfied*
My working relationship with my mentor	○	○	○	○
The amount of time I spent doing meaningful research	○	○	○	○
The amount of time I spent with my research mentor	○	○	○	○
The research experience overall	○	○	○	○

28. Which of the following statements apply to your research experience in JSHS? (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

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

Select one per row.

	No gain	*Small gain*	*Medium gain*	*Large 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	○	○	○	○

*30. Which category best describes the focus of your JSHS activities?(*Required)
Select between 1 and 1 choices.

☐	Science
☐	Technology
☐	Engineering
☐	Mathematics
☐	Integrated STEM - more than one STEM area

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

Select one per row.

	No gain	*Small gain*	*Medium gain*	*Large 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	○	○	○	○
Using knowledge and creativity to suggest a solution to a problem	○	○	○	○
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 to decide if a solution to a problem works as intended	○	○	○	○
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	○	○	○	○

Supporting a solution for a problem with data	○	○	○	○
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	○	○	○	○
Identifying the strengths and limitations of solutions in terms of how well they meet design criteria	○	○	○	○
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)	○	○	○	○
Integrating information from technical or scientific texts and other media to support your solution to a problem	○	○	○	○

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

Select one per row.

	No gain	*Small gain*	*Medium gain*	*Large 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	○	○	○	○

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

Select one per row.

	No gain	*Small gain*	*Medium gain*	*Large 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	○	○	○	○

34. AS A RESULT OF YOUR JSHS 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	○	○	○	○	○

35. Before you participated in JSHS, 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.)

36. After you have participated in JSHS, 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.)

37. 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

38. Before you participated in JSHS, 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)::

39. After you participated in JSHS, 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)::

40. 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*	*Somewhat interested*	*Very interested*
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	○	○	○	○

41. How many jobs/careers in STEM did you learn about during JSHS?

Select one.

○	None
○	1
○	2
○	3
○	4
○	5 or more

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

Select one.

○	None
○	1
○	2
○	3
○	4
○	5 or more

43. 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	○	○	○	○	○

44. Which of the following statements describe you after participating in the JSHS program?

Select one per row.

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

45. What are the three most important ways that JSHS has helped you?

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

46. What are the three ways that JSHS should be improved for future participants?

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

47. Please tell us about your overall satisfaction with your JSHS experience.

Appendix E

FY16 JSHS Student National Event Questionnaire

1. What was your level of participation in the national JSHS event?
    a. Poster presenter
    b. Research paper presenter
    c. Other
2. How many times have you participated in JSHS nationals?
    a. Once (this year)
    b. Twice
    c. More than Two Times
3. How did you learn about JSHS and why did you decide to participate?
4. What were your overall impressions of participating in the JSHS National Event?
5. Describe the support you received from your teachers/mentors in JSHS this year. For example – did mentoring occur as part of a class or was it outside of class, etc.
6. What are some suggestions you have for improving the mentoring that participants receive from their teachers/mentors?
7. Do you feel like the regional competition helped to prepare you for the JSHS nationals? Explain why or why not.
8. What are your overall impressions of the regional judging process? How could it be improved?
9. What are your overall impressions of the national judging process? How could it be improved?
10. Describe the Army/DoD careers you learned about in JSHS this year.
11. List/describe the other AEOP programs or Department of Defense (other military) programs you learned about this year.
12. List the other AEOP programs or Department of Defense (other military) programs you have participated in previously.
13. What were the most beneficial aspects of participating in JSHS this year for you?
14. Do you have suggestions for improving the JSHS program overall?

Appendix F

FY16 JSHS Mentor Questionnaire

*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

*2. Please provide your personal information below: (required)(*Required)	
*First Name::	
*Last Name::	

3. Please provide your email address: (optional)

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 11.)
○	Scientist, Engineer, or Mathematician in training (undergraduate or graduate student, etc.)	(Go to question number 11.)
○	Scientist, Engineer, or Mathematics professional	(Go to question number 11.)
○	Other, (specify)::	(Go to question number 11.)

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.	
○	Urban (city)
○	Suburban
○	Rural (country)
○	Frontier or tribal school
○	Home School
○	Online School
○	Department of Defense School (DeDEA or DoDDS) Choose not to report

10. Which of the following subjects do you teach? (select ALL that apply)	
Select all that apply.	
☐	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)::

11. 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)
○	N/A - I am a teacher not STEM researcher
○	Other, (specify)::

12. At which of the following JSHS sites did you participate? (Select ONE)

Select one.

○	Alabama
○	Alaska
○	Arizona
○	Arkansas
○	California—Northern California & Western Nevada
○	California—Southern California
○	Connecticut
○	DoD Dependent Schools-Europe
○	DoD Dependent Schools-Pacific
○	District of Columbia – Washington DC
○	Florida
○	Georgia
○	Hawaii
○	Illinois
○	Illinois - Chicago
○	Indiana
○	Intermountain—Colorado, Montana, Idaho, Nevada, Utah
○	Iowa
○	Kansas—Nebraska—Oklahoma
○	Kentucky
○	Louisiana
○	Maryland
○	Michigan
○	Mississippi
○	Missouri
○	New England—Northern New England
○	New England—Southern New England

○	New Jersey--Monmouth
○	New Jersey—Rutgers
○	New York—Long Island
○	New York—Metro
○	New York—Upstate
○	North Carolina
○	North Central—Minnesota, North Dakota, South Dakota
○	Ohio
○	Oregon
○	Pennsylvania
○	Philadelphia
○	Puerto Rico
○	South Carolina
○	Southwest
○	Tennessee
○	Texas
○	Virginia
○	Washington
○	West Virginia
○	Wisconsin-Western Wisconsin & Upper Michigan
○	Wyoming—Eastern Colorado

13. Which of the following describes your role during JSHS (choose all that apply)?

Select all that apply.

☐	Research Mentor
☐	Competition Advisor
☐	Judge
☐	Invited Speaker
☐	Teacher
☐	Other, (specify)::

14. How many JSHS participants did you work with this year?

_____ students.

15. How did you learn about JSHS? (Check all that apply)	
Select all that apply.	
☐	Academy of Applied Science (AAS) website
☐	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 JSHS participant
☐	A student
☐	A colleague
☐	My supervisor or superior
☐	A JSHS site host or director
☐	Workplace communications
☐	Someone who works with the Department of Defense (Army, Navy, Air Force)
☐	Other, (specify)::

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

Select one per row.

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

17. How SATISFIED were you with the following JSHS features?

Select one per row.

	Did not experience	*Not at all*	*A little*	*Somewhat*	*Very much*
Application or registration process	○	○	○	○	○
Communicating with Academy of Applied Science (AAS)	○	○	○	○	○
Communicating with your JSHS site's organizers	○	○	○	○	○
Support for instruction or mentorship during program activitiesThe physical location(s) of JSHS activities	○	○	○	○	○
Support for instruction or mentorship during JSHS activities	○	○	○	○	○
Research abstract preparation requirements	○	○	○	○	○

18. The following activities were common to many Regional JSHS symposia across the nation. How SATISFIED were you with each of the following Regional JSHS program activities?

Select one per row.

	Did not experience	*Not at all*	*A little*	*Somewhat*	*Very much*
Student Oral Presentation	○	○	○	○	○
Student Poster Presentations	○	○	○	○	○
Judging Process	○	○	○	○	○
Feedback from Judges	○	○	○	○	○
Invited Speaker Presentations	○	○	○	○	○
Panel or Roundtable Discussions	○	○	○	○	○
Career Exhibits	○	○	○	○	○
Tours or Field Trips	○	○	○	○	○
Team Building Activities	○	○	○	○	○

19. 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 JSHS.

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 JSHS 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 JSHS	○	○

20. 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 JSHS.

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 JSHS 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	○	○

21. 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 JSHS.

Select one per row.

	Yes - I used this strategy	*No - I did not use this strategy*
Having participant(s) tell other people about their backgrounds and interests	○	○
Having participant(s) explain difficult ideas to others	○	○
Having participant(s) listen to the ideas of others with an open mind	○	○
Having participant(s) exchange ideas with others whose backgrounds or viewpoints are different from their own	○	○
Having participant(s) give and receive constructive feedback with others	○	○

22. 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 JSHS.

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 participant(s) search for and review technical research to support their work	○	○
Demonstrating laboratory/field techniques, procedures, and tools for my student(s)	○	○
Supervising participant(s) while they practice STEM research skills	○	○
Providing participant(s) with constructive feedback to improve their STEM competencies	○	○
Allowing participant(s) to work independently to improve their self-management abilities	○	○

23. 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 JSHS.

Select one per row.

	Yes - I used this strategy	*No - I did not use this strategy*
Asking participant(s) about their educational and/or career goals	○	○
Recommending extracurricular programs that align with participants' goals	○	○
Recommending Army Educational Outreach Programs that align with participants' goals	○	○
Providing guidance about educational pathways that will prepare participant(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 participant(s) build a professional network in a STEM field	○	○
Helping participant(s) with their resume, application, personal statement, and/or interview preparations	○	○

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

Select one per row.

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

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

Select one per row.

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

26. Which of the following AEOPs did YOU EXPLICITLY DISCUSS with your student(s) during JSHS? (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)*
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 participant(s) but did not discuss any specific program	○	○
eCybermission	○	○

27. 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	○	○	○	○	○

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

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	○	○	○	○	○

29. AS A RESULT OF THEIR JSHS 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	○	○	○	○	○

30. Which category best describes the focus of your student(s) JSHS activities?

Select one.

○	Science
○	Technology
○	Engineering
○	Mathematics
○	Integrated STEM - more than one STEM area

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

Select one per row.

	No gain	*Small gain*	*Medium gain*	*Large 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	○	○	○	○
Using knowledge and creativity to suggest a solution to a problem	○	○	○	○
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 if a solution to a problem works as intended	○	○	○	○
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				
Supporting a solution for a problem with data	○	○	○	○
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)	○	○	○	○
Integrating information from technical or scientific texts and other media to support your solution to a problem	○	○	○	○

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

Select one per row.

	No gain	*Small gain*	*Medium gain*	*Large 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	○	○	○	○

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

Select one per row.

	Disagree - This did not happen	*Disagree - This happened but not because of SEAP*	*Agree - SEAP contributed*	*Agree - SEAP was primary reason*
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	○	○	○	○

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

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

36. Please tell us about your overall satisfaction with your JSHS experience.

Appendix G

Academy of Applied Science (AAS) Response to FY16 Evaluation

Response to Findings, 30 November 2016

The Academy of Applied Science (AAS) has received the FY 2016 Program Evaluation and is providing the following edits or feedback to the report.

1. Note in the Introduction to the Evaluation that "margin of error for both the student and mentor surveys is larger than generally acceptable, indicating that the samples may not be representative of their respective populations." (Ref. p. 33). The AAS agrees with this statement and has and will continue to work with JSHS Regional Symposia sites to implement the AEOP evaluation during the symposium.

2. Correct statement on exposure to Army or DoD STEM career opportunities (2nd paragraph, p. 16). Delete "creating web-based video profiles of DoD STEM professionals, creating virtual lab tours hosted by DoD STEM professionals." The AAS will continue to work with the CAM, LO and Marketing team to obtain available virtual resources and distribute to JSHS regional symposia. The AAS will continue to work with regions to devise strategies to facilitate regional symposia's efforts to engage DoD STEM professionals as speakers at events. **This was our wording from FY15 recommendations – have to keep it the same.**

3. The AAS believes that the survey question which measures STEM skills after participating in JSHS is likely misleading to R-JSHS participants. (Reference - Table 28 and Table 29.)

   JSHS is a student competition where students conduct a STEM investigation in school or in a laboratory setting and present that work at regional and national JSHS. Students design and carry out their investigation in school, not at the regional symposium.

4. Table – Demographics. A 1st year college student is included in the demographics. The college student contributed as a speaker or judge, not as a student participant.

5. The JSHS Experience (p. 43). Correct the 2nd paragraph under this section (P. 43). Table 20 presents data on whether or not the student was assigned a research project or designed the entire project on their own. The AAS believes that it is far more interesting to see that the majority of students reported that the mentor assisted them with the design of the project. The data reported, "41% of Regional students indicated that they designed the entire project on their own," is misleading in the way in which it is presented in the document.