Army Educational Outreach Program

Junior Solar Sprint

2016 Annual Program Evaluation Report

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U.S. Army Contacts

Jeffrey Singleton
Director for Basic Research
Office of the Assistant Secretary of the Army
Acquisition, Logistics, and Technology
(703) 697-0508
jeffrey.d.singleton.civ@mail.mil

Andrea Simmons
Army Educational Outreach Program Director on behalf of the Deputy Assistant Secretary of the Army for Research and Technology DASA(R&T)
(703) 697-0505
andrea.e.simmons.ctr@mail.mil

AEOP Cooperative Agreement Managers

Louie Lopez
AEOP Cooperative Agreement Manager
U.S. Army Research, Development, and Engineering Command (RDECOM)
(410) 278-9858
louie.r.lopez.civ@mail.mil

Battelle Memorial Institute – Lead Organization

David Burns
Project Director, AEOP CA
Director of STEM Innovation Networks
(859) 322-7431
burnsd@battelle.org

Junior Solar Sprint Program Administrators

Sue King
JSS Program Director
Technology Student Association
(703) 860-9000
SKing@tsaweb.org

Rosanne White, Ph.D.
Principal Investigator
Technology Student Association
(703) 860-9000
rwhite@tsaweb.org

PURDUE UNIVERSITY

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Evaluation Team Contacts

Carla C. Johnson, Ed.D.
Evaluation Director, AEOP CA
Purdue University
(765) 494-0019
carlacjohnson@purdue.edu

Toni A. Sondergeld, Ph.D.
Asst. Evaluation Director, AEOP CA
Metriks Amerique
(419) 902-6898
tonisondergeld@metriks.com

Janet B. Walton, Ph.D.
Asst. Evaluation Director, AEOP CA
Purdue University
(765) 494-0019
walton25@purdue.edu

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Executive Summary

Junior Solar Sprint (JSS), managed by the Technology Student Association (TSA), is an Army Educational Outreach Program (AEOP) science, technology, engineering, and mathematics (STEM) education program where 5th-8th grade students apply scientific understanding, creativity, experimentation, and teamwork to design, build, and race solar electric vehicles. JSS activities occur nationwide, in classrooms and schools, through extracurricular clubs and student associations, and as community-based events that are independently hosted and sponsored. The AEOP's JSS programming is designed to support the instruction of STEM in categories such as alternative fuels, engineering design, and aerodynamics. Through JSS, students develop teamwork and problem-solving abilities, investigate environmental issues, gain hands-on engineering skills, and use principles of science and math to create the fastest, most interesting, and best crafted vehicle possible. Students have the opportunity to participate in JSS through TSA chapters and Army-hosted locations across the country.

This report documents the evaluation of the FY16 JSS 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 JSS included questionnaires for students and mentors, two focus groups with students at regional events, one focus group with students at the national event, one interview with a mentor at a regional event, and one focus group with mentors at the national event.

In 2016, students participated in JSS through 26 TSA-affiliated state competitions, two regional Army laboratory-hosted locations, and one national competition in Nashville, TN.

2016 JSS Fast Facts	
Description	STEM competition-Solar car competition regional events at 2 Army laboratories, 25 TSA state events, and one national event hosted in conjunction with the national TSA conference.
Participant Population	5th-8th grade students
No. of Students	609
Placement Rate	N/A (all students who register compete as participants)
No. of Adults (Mentors and Volunteers – incl. Teachers and Army S&Es)	249 (total regional/state level Adult Participants+ TSA adults at national level + army)
No. of Army Research Centers and Laboratories	2
No. of K-12 Schools	*609 (21 did not include school name)
No. of K-12 Schools – Title I	61 (17 did not report)

No. of Other Collaborating Organizations	2 (Army Research Labs – APG and ARDEC)
Total Cost	$129,973
Scholarships/Awards Cost	$32,117
Administrative Cost to TSA	$97,831
Cost Per Student Participant	$222.00

*Number based on reports from Cvent.

Summary of Findings

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

2016 JSS Evaluation Findings	
Participant Profiles	
JSS served relatively small percentages of students from historically underrepresented and underserved populations; there is room for growth in this.	Female participation in JSS remained close to FY15 levels. In FY16 only 26% of JSS student participants were female (a population historically underrepresented and underserved in STEM fields) as compared to 27% in FY15.
	Slightly fewer participants identified themselves as Black or African American or as Hispanic or Latino in FY16 as compared to FY15 (7% versus 6% and 9% versus 6% respectively). This indicates that JSS has had limited success in engaging students from these groups.
	Participant demographic data was readily available in FY16. This is an improvement as compared to previous years, however there are significant discrepancies between Cvent registration data and data reported by state advisors.
JSS participants have little experience with other AEOPs and only limited interest in participating in other AEOPs in the future.	As in previous years, only very small number of students reported having participated in other AEOPs. This may be due to the grade levels that are eligible for JSS – as one of the first AEOP programs that are open to elementary students. The majority of students have not heard of AEOPs that they currently qualify for or that they may qualify for in high school, suggesting that AEOP information may not be reaching students through JSS.
Actionable Program Evaluation	
TSA markets JSS widely to its members, although there is little evidence that students learn	In FY16, TSA continued to market JSS by mailing postcards to TSA chapter advisors, and through print and electronic mailings to TSA state advisors and middle school advisors.

2016 JSS Evaluation Findings	
about AEOPs more generally through JSS or the TSA.	Students and mentors reported high levels of satisfaction with TSA online resources. Although the TSA website was identified by students as a source of information about other AEOPs, most students had not heard of the other programs in the AEOP portfolio.
JSS students reported a variety of motivators for participating in the program.	Students identified having fun, interest in STEM, teacher encouragement, and the desire to learn something new as the primary motivators for participating in JSS.
JSS students reported engaging in meaningful STEM learning through team-based and hands-on activities.	Large proportions of students reported gains in skills related to teamwork such as including others' perspectives when making decisions and communicating effectively with others. Student responses to open-ended questionnaire items also indicated that they place a high value on the teamwork components of JSS.
	The majority of students reported gains in skills related to problem solving such as using knowledge and creativity to suggest testable explanations (hypotheses) for observations and making models of an object or system showing its parts and how they work. Student responses to open-ended questionnaire items also indicated that participants place a high value these aspects of JSS.
	Students reported engaging in a variety of other STEM practices on a frequent basis, including analyzing data or information (59%) and drawing conclusions from an investigation (55%).
	Mentors reported using a variety of strategies to help make learning activities to students relevant, support the needs of diverse learners, develop students' collaboration and interpersonal skills, and engage students in authentic STEM activities.
JSS has an opportunity to improve student and mentor awareness of other AEOPs and DoD STEM careers.	Although 78% of students reported that participating in JSS had some impact on their awareness of other AEOPs, most students reported that they had never heard of the other AEOPs. Although 28% of mentors reported discussing AEOPs in general with their students, the vast majority of mentors (97%-100%) reported that they did not discuss specific programs, and 80% of mentors reported that they did not recommend AEOPs that align with students' goals to participants.
	Mentors (89%) reported that found the TSA website was a useful resource to expose students to DoD STEM careers and, to a lesser extent, that the JSS website was useful for this purpose (68%). This suggests that there is an opportunity for these websites to be used for targeted marketing of programs for which JSS students are or will soon be eligible such as GEMS, JSHS, and SEAP.
	Although student attitudes toward DoD researchers and research were positive, over half of responding students (55%) of students reported that they did not learn about any DoD STEM careers during JSS. Over a third of students (34%) reported that JSS participation did not impact their awareness of Army and DoD STEM careers.

2016 JSS Evaluation Findings	
Students and mentors reported overall satisfaction with the JSS experience.	The majority of students reported satisfaction with program features including mentoring during JSS and the location of JSS activities. The only area in which more than four responding students reported dissatisfaction was the process of applying or registering for the program (12% or respondents were "not at all satisfied" with this aspect of JSS).
	Mentors also reported satisfaction with program features that they had experienced. Mentor satisfaction with the application or registration process was higher than for students (71% of mentors were at least "somewhat satisfied" with this process).
Outcomes Evaluation	
JSS students reported gains in STEM knowledge and competencies.	A majority of students (62-76%) reported medium or large gains in their STEM knowledge, including knowledge of research processes, ethics, and rules for conduct in STEM, Knowledge of how scientists and engineers work on real problems in STEM, and in-depth knowledge of a STEM topic(s).
	Additionally, students (45-76%) reported medium or large gains in most STEM competencies, including using knowledge and creativity to suggest a solution to a problem, identifying the limitations of the methods and tools used for data collection, and carrying out procedures for an experiment and recording data accurately.
JSS participants reported gains in 21st Century Skills.	Most participants (62-87%) also reported medium or large gains in all 21st Century Skills, including sticking with a task until it is finished, making changes when things do not go as planned, and communicating effectively with others.
JSS participants reported gains in their identity in STEM and in their interest in engaging in STEM in the future.	JSS participants (61-79%) reported medium or large gains in all aspects of their STEM identities, including their decisions to pursue a STEM career, thinking creatively about a STEM project or activity, and feeling prepared for more challenging STEM activities.
	Participants reported being more likely to engage in STEM activities outside of school, with a majority indicating that they are more likely to engage in activities such as using a computer to design or program something (59%), take an elective (not required) STEM class (65%), and work on a STEM project or experiment in a university or professional setting (50%).
Students' education aspirations were higher after participating in JSS, and there were shifts in their career aspirations toward STEM careers.	Participants were more likely to aspire to continue their education after college after JSS as compared to before participation (66% after versus 50% before).
	More students aspired to careers as scientists and researchers and as engineers or architects after participating in JSS as compared to before participation. The vast majority of students (97%) reported that they expect to use STEM knowledge, skill, and abilities in their jobs when they are 30.

2016 JSS Evaluation Findings	
Although JSS students are largely unaware of AEOP initiatives, students showed some interest in future AEOP opportunities.	Over half of students indicated that JSS contributed to their interest in participating in other AEOPs. Most students were at least somewhat interested in participating in JSS again in the future. While strong interest in participating in other AEOPs was limited (10% or fewer of students were "very much" interested in any particular program), most students reported being at least "a little" interested in participating in future programs.

Responsiveness to FY14 and FY15 Evaluation Recommendations

The TSA has been generally responsive to the recommendations made in FY14 and FY15 evaluation reports, although progress has been limited in all areas. In particular:

- The TSA has responded to recommendations for attracting students from groups historically underrepresented in STEM by sending postcards and emails to Title 1 schools with TSA chapters promoting JSS and the free solar car kit. There is no evidence that specific efforts were made to engage female participants.
- FY14 and FY15 evaluation reports recommended that the TSA work with JSS sites and with other AEOPs to enhance awareness of AEOP initiatives across programs. While the TSA website contains links to the AEOP website and other AEOP information and the program reported providing AEOP brochures for each state TSA conference, questionnaire results indicate that these brochures may not have reached students. Awareness of AEOP materials including the website, print materials, and social media remain at low levels.
- The TSA responded to recommendations to communicate expectations for and the importance of evaluation activities to individual program sites by providing opportunities to complete evaluations at check-in at the national event, sending evaluation links to state and chapter advisors and sending follow-up emails, and sending evaluation links to national competitors. In spite of these efforts, participation in evaluation activities remains low. It should be noted that, because of the transition in evaluation activities from Virginia Tech to Purdue University, the response to the recommendation to streamline the questionnaire has been delayed.

Recommendations for FY17 Program Improvement/Growth

Evaluation findings indicate that FY16 was a success overall for the JSS program. Notable successes for the year include high levels of mentor and student satisfaction with the program, expansion in the number of regional JSS sites, and satisfaction with TSA resources. There is continued evidence of gains in students' STEM knowledge and competencies and gains in students' 21st Century Skills as a result of the JSS experience.

While these successes are commendable, there are some areas that remain with potential for growth and/or improvement. Specifically, in spite of the increase in the number of regional competitions, the JSS program again

experienced a decline in number of participants and overall lack of diversity in participant demographics. The membership model associated with TSA chapters being the main source of recruitment (along with Army lab-based efforts) may be limiting the ability of JSS to grow and reach the desired target populations. In addition, JSS participants continue to report little familiarity of Army and DoD STEM careers and with other programs in the AEOP portfolio, suggesting that AEOP resources are not reaching students and mentors. The evaluation team therefore offers the following recommendations for FY17 and beyond:

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

Although not an explicit goal of JSS, the AEOP objective of broadening, deepening, and diversifying the pool of STEM talent continues to be a challenge for JSS. The available demographic enrollment data for the past three years suggests that little change in the rates of participation of underserved and underrepresented groups of students has occurred. Previous recommendations (made in the 2013, 2014, and 2015 JSS evaluation reports) for the program to consider doing more to recruit students from schools serving historically underrepresented and underserved groups are therefore repeated. In particular, since many students participate in JSS via the TSA, it is important to consider ways of reaching a broader range of schools through both the TSA and through Army-hosted events. One strategy may be to market the program to fifth graders, a group that has been largely unrepresented in JSS to date. JSS has not marketed the program to 5^{th} or 6^{th} grade students housed in elementary schools in the past due to TSA's focus being middle and high school. Therefore, it is recommended that TSA consider reaching out to potential elementary school participants to engage more students from younger age groups in the program.

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

Mentors and students expressed overall satisfaction with the resources available to them through TSA. At the same time, however, both mentors and students reported little familiarity with Army resources such as the AEOP website, the It Starts Here! magazine, and the AEOP brochure. This suggests that participants may not make connections between JSS and Army sponsorship, particularly since participants' primary organizational connection is with the TSA. The fact that Army representatives at one regional TSA event were unaware that JSS is an AEOP initiative and, more importantly, were unfamiliar with the AEOP, suggests that stronger connections between JSS and the AEOP could be made. Although the TSA website makes clear the association of JSS with the AEOP, it may be useful to ensure that AEOP brochures are on hand at all state and regional TSA events, and to educate Army personnel who staff student events about the AEOP and its various initiatives.

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

1. Students continue to report having little knowledge of other programs in the AEOP. Because of the goal of creating a pipeline of programs in which participants progress from JSS into other AEOPs, this is an area of concern. While over half of students indicated that JSS had an impact on their interest in participating in AEOPs in the future, students were largely unaware of programs for which they are or will soon be eligible such as JSHS and GEMS. In spite of this, over half of responding students reported that the TSA website was helpful in learning about JSS and other AEOPs. Likewise, over half of responding students reported that their JSS mentors were helpful in learning about AEOPs. A large majority of mentors reported that found the TSA website was a useful resource to expose students to DoD STEM careers and, to a lesser extent, that the JSS website was useful for this purpose. This suggests that there is an opportunity for these websites to be used for targeted marketing of programs for which JSS students are or will soon be eligible such as GEMS, JSHS, and SEAP. In addition, since mentors are an important source of student information, additional efforts should be made to educate mentors about the AEOP and programs for which their students are eligible. Further, JSS should consider marketing participation in eCM – as it is available to students regardless of location and is a similar competition-based AEOP.

2. The TSA provided support to the JSS objective of creating a national infrastructure to support events and increase participation in JSS. The expansion of the number of regional events is evidence of this work, however it should be noted that JSS participation declined in 2016. As noted above, since many students participate in JSS via the TSA, it is important to consider ways of reaching a broad range of schools through both the TSA and through Army-hosted events. In addition, although demographic data for participants is more widely available than in past years, use of Cvent remains limited and, for some regional competitions, no participation data was available. The TSA should therefore continue to emphasize the importance of collecting enrollment and participation data with state and regional TSA chapters and other groups holding state and regional competitions.

3. The low response rates for student and mentor questionnaires continue to be an area with potential for growth. There were 10 regional sites and one Army Lab that did not participate in the evaluation survey. Although response rates for mentors have displayed an upward trend over the past three years, the student response rate remained constant from FY15 to FY16. The program may want to consider ways to communicate the importance of these evaluations with individual program sites. Streamlining evaluation instruments may also increase response rates by reducing the time commitment of respondents.

Introduction

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

AEOP Goals

Goal 1: STEM Literate Citizenry.

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

Goal 2: STEM Savvy Educators.

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

Goal 3: Sustainable Infrastructure.

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

This report documents the FY16 evaluation of Junior Solar Sprint (JSS). JSS is administered on behalf of the Army by the Technology Student Association (TSA). The evaluation study was performed by Purdue University in cooperation with Battelle, the Lead Organization (LO) in the AEOP CA consortium.

Program Overview

JSS is a STEM education activity where 5th- 8th grade students apply scientific understanding, creativity, experimentation, and teamwork to design, build, and race a model solar car. JSS activities occur nationwide, in classrooms and schools, through extracurricular clubs and student associations, and as community-based events that are independently hosted and sponsored. The AEOP's investment in JSS-based programming is managed by TSA. The AEOP's JSS programming is designed to support the instruction of STEM in categories such as alternative fuels, engineering design, and aerodynamics. Through JSS, students develop teamwork and problem-solving abilities, investigate environmental issues, gain hands-on engineering skills, and use principles of science and math to create the fastest, most interesting, and best crafted vehicle possible.

In 2016, students participated in JSS through 26 TSA-affiliated state competitions, two regional Army laboratory-hosted locations, and one national competition in Nashville, TN. In 2016, the AEOP's contributions to JSS programming were guided by the following priorities:

1. Create a national infrastructure to manage local, regional, and national JSS events and increase participation;
2. Enhance training opportunities and resources for teachers/mentors;
3. Coordinate tracking and evaluation opportunities for student and teacher participation in JSS; and
4. Leverage AEOP through cross-program marketing efforts.

Table 1 summarizes 2016 student participation by site.

Table 2 provides demographic data for student participants in JSS in 2016. The enrollment of 609 students represents an 8% decrease in enrollment from 2015 when 636 students were enrolled in JSS. At the same time, however, the number of TSA-affiliated competitions increased from 17 in FY15 to 26 in FY16. JSS participants continue to be predominantly male (69%) and 54% of students identified themselves as White while 6% identified themselves as Black or African American and 6% as Hispanic/Latino. The most commonly reported grade was 8th (44% of participants) followed by 7th (30%), 6th (17%), and 5th (2%). These demographics are similar to those reported in FY15.

Table 3 provides demographic data for adult participants in JSS in 2016. A total of 249 adults participated in JSS program activities in FY16, an 11% decrease from FY15 when 281 adults participated. In FY16 this included teachers, chaperones, and Army Scientists and Engineers (S&Es). These adults supported students as they prepared for or participated in a JSS event and played important roles as mentors to JSS students.

Table 1. 2016 JSS Site Participation Numbers [t]		
2016 JSS Site	**No. Of Enrolled Students Per CVENT**	**No. Of Enrolled Students Per State Advisor**
National TSA Conference (Nashville, TN)-June 28th-July 2nd, 2016	192	N/A
Aberdeen Proving Ground, MD	52	NA
Alabama TSA state competition-Birmingham	6	No data
Colorado TSA state competition-Denver	21	37
Delaware TSA state competition-Harrington	21	No data
Florida TSA state competition-Orlando	13	80
Georgia TSA state competition-Athens	30	28
Idaho TSA state competition-Twin Falls	No data in Cvent	6
Iowa TSA state competition-Altoona	No data in Cvent	18
Kansas TSA state competition-Salina	No data in Cvent	21
Kentucky TSA state competition-Louisville	5	No data
Montana TSA state competition-Billings	No data in Cvent	10
Mississippi TSA state competition-Jackson	6	24
Missouri TSA state competition-Rolla	6	7
New Hampshire TSA state competition-Bartlett	No data in Cvent	42
New Jersey TSA state competition-Ewing	15	38
New Mexico TSA state competition-Los Lunas	No data in Cvent	No data
New York TSA state competition-Oswego	7	18
North Carolina TSA state competition-Greensboro	23	48
Oklahoma TSA state competition-Midwest City	29	3
Pennsylvania TSA state competition-Champion	45	126
Picatinny Arsenal, NJ	93	NA
South Carolina TSA state competition-Myrtle Beach	No data in Cvent	No data
Tennessee TSA state competition-Chattanooga	8	No participants
Texas TSA state competition	14	No data
Virginia TSA state competition	23	No data
Total Student Participants	609	507

[t] data was provided from JSS program administrator and collected from both Cvent and from state advisors that reported their state conference JSS event numbers.

Table 2. 2016 JSS Student Participant Profile		
Demographic Category		
Respondent Gender (n = 609)		
Female	162	27%
Male	419	69%
Not Reported	28	5%
Respondent Race/Ethnicity (n = 609)		
Asian	65	11%
Black or African American	40	7%
Hispanic or Latino	33	65
Native American or Alaska Native	13	2%
White	329	54%
Other race or ethnicity	21	3%
Choose not to report	108	18%
Respondent Grade Level[‡] (n = 609)		
5th	11	2%
6th	99	16%
7th	190	31%
8th	261	43%
Not Reported	48	8%

[‡] Other = biracial – black and white; Afrasian (African–Asian); mixed

Table 3. 2016 Adult JSS Participation	
Participant Group	**Teachers/Adults**
Total Regional/State-level Adult Participants	175
Adults at TSA state-level competitions	149
Adults at Army regional competitions	26
Total National-level Adult Participants	48
TSA Adults at National-level Competition	43
Army regional Adults at National-level Competition	5
Grand Total of Adult Participants (includes Army S&Es)	**249**

The total cost of the 2016 JSS program was $174,752. The average cost per student participant was $223. Table 4 summarizes these and other 2016 JSS program costs.

Table 4. 2016 JSS Program Costs	
2016 JSS - Cost Per Student Participant	
Total Participants	609 (based on enrollment in Cvent)
Total Cost	$174,752
Cost Per Student Participant	**$223**
2016 JSS - Cost Breakdown	
Administrative Cost to TSA	$162,35
Total Scholarships/Awards Cost	$12,401
Total Cost	**$174,752**

Evidence-Based Program Change

The AEOP tasks its programs with achieving three broad priorities: (1) STEM Literate Citizenry – Broaden, deepen, and diversify the pool of STEM talent in support of our defense industry base; (2) STEM Savvy Educators – Support and empower educators with unique Army research and technology resources; and (3) Sustainable Infrastructure – Develop and implement a cohesive, coordinated, and sustainable STEM education outreach infrastructure across the Army. Based on recommendations from the FY13 and FY14 summative evaluation reports, the AEOP identified three key objectives for the portfolio in FY16:

1. Increase outreach to populations that are historically underserved and under-represented in STEM;
2. Increase participants' awareness of Army/DoD STEM careers; and
3. Increase participants' awareness of other AEOP opportunities.

In support of these priorities and objectives, the TSA established the following objectives for the JSS program in 2016:

1. Create a national infrastructure to manage local, regional, and national JSS events and increase participation;
2. Enhance training opportunities and resources for teachers/mentors;
3. Coordinate tracking and evaluation opportunities for student and teacher participation in JSS; and
4. Leverage AEOP through cross-program marketing efforts.

TSA took the following actions in FY16 in light of these objectives, the FY15 JSS evaluation study, and site visits conducted by TSA, the Army, and Purdue University:

I. Create a national infrastructure to manage local, regional, and national JSS events and increase participation *(supports AEOP Priority 1).*

a) Over 700 personalized postcards were mailed to TSA chapter advisors describing the Junior Solar Sprint program and encouraging participation in JSS.
b) TSA chapters and Army labs were given solar car kits, marketing resources and online educational resources to execute their respective JSS competitions.
c) JSS was promoted through mailings (print and email) to TSA state advisors, TSA middle school advisors (teachers) and on the TSA website.
d) States holding JSS at their TSA state conference were given AEOP promotional materials to distribute to their student participants and adult volunteers.
e) Two teams from Army labs competed in the national JSS competition in Nashville, Tennessee.

II. Strengthen Army connection to JSS regional and national events *(supports AEOP Priority 2).*

a) National TSA coordinated with AEOP representatives to engage them at the national TSA conference as volunteer judges and timers for the national JSS competition.
b) AEOP representatives networked with students, teachers, parents, and other conference attendees during the TSA Meet and Greet and an AEOP special interest session.
c) National TSA coordinated with SAME (Society of American Military Engineers) representatives to engage them at the national TSA conference as volunteer judges and timers for the national JSS competition.
d) A SAME representative held a special interest session for JSS participants titled, "Civil Engineering: A snapshot of Civil Engineering Opportunities".

III. Enhance training opportunities and resources for teachers/mentors *(supports AEOP Priorities 1, 2, and 3).*

a) Provide online resources to include videos, tutorials and lesson plans to teachers and volunteers via the AEOP website.
b) Distribution of free solar car kits from PITSCO to middle school TSA chapters who completed the request for a free kit.
c) Every state holding a JSS competition at their state TSA conference and each Army lab location hosting a JSS race received AEOP brochures, RITR notebooks, pencils and JSS stickers for their participants.

IV. Coordinate tracking and evaluation opportunities for student and teacher participants in JSS *(supports AEOP Priority 3).*

a) Evaluation links sent to state and chapter advisors once link was available. Follow up reminder emails were sent to participating chapters.
b) Students were asked to complete Cvent registration and evaluation during check-in at the national competition via tablets.
c) A link was sent following the national competition to the email addresses collected on Cvent for students who did not complete an onsite evaluation via tablet at the national competition.
d) A link was sent to teachers and adult volunteers and mentors following participation in national JSS competition.

FY16 Evaluation At-A-Glance

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

Inputs	Activities	Outputs	Outcomes (Short term)	Impact (Long Term)
• Army sponsorship • TSA providing —capacity to establish national network of JSS participants —online JSS educational and event resources —national JSS competition • JSS participants, inclusive of local event hosts, educators, and students seeking resources and event information • Awards for student winner(s) of national JSS competition • Centralized branding and comprehensive marketing of AEOP • Centralized evaluation	• Event hosts, educators, and students access and use JSS educational and event resources • Students build, test, and register solar car in state, Army, and national JSS competitions • TSA-selected judges evaluate solar cars at JSS competitions and select winner(s) • Program activities that expose students to AEOP programs and/or STEM careers in the Army or DoD	• Number of event hosts, educators, and students using online JSS educational and event resources • Number and diversity of students participating in national JSS competition • Number of and Title 1 status of schools served through event host, educator, or student engagement • Event hosts, educators, students, others, and TSA contributing to evaluation	• Increased student 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 Army/DoD STEM research and careers • Implementation of evidence-based recommendations to improve TSA's JSS offerings	• Increased participant engagement in other AEOP opportunities and Army/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 Army/DoD STEM careers • Continuous improvement and sustainability of JSS

Key Evaluation Questions

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

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

The assessment strategy for JSS included student and mentor questionnaires, two focus groups with students at regional events, one focus group with students at the national event, one interview with a mentor at a regional event, and one focus group with mentors at the national event. Tables 5-8 outline the information collected in student and mentor questionnaires and focus groups and interviews that is relevant to this evaluation report.

Table 5. 2016 Student Questionnaires

Category	Description
Profile	**Demographics:** Participant gender, grade level, race/ethnicity, and socioeconomic status indicators
	Education Intentions: Degree level, confidence to achieve educational goals, field sought
AEOP Goal 1	**Capturing the Student Experience:** In-school vs. in-program experience
	STEM Competencies: Gains in knowledge of STEM, science & engineering practices; contribution of AEOP
	Transferrable Competencies: Gains in 21st Century Skills
	STEM Identity: Gains in STEM identity, intentions to participate in STEM, and STEM-oriented education and career aspirations; contribution of AEOP
	AEOP Opportunities: Past participation, awareness of, and interest in participating in other AEOP programs; contribution of AEOP, impact of AEOP resources
	Army/DoD STEM: Exposure to Army/DoD STEM jobs, attitudes toward Army/DoD STEM research and careers, change in interest for STEM and Army/DoD STEM jobs; contribution of AEOP, impact of AEOP resources
AEOP Goal 2 and 3	**Mentor Capacity:** Perceptions of mentor/teaching strategies (students respond to a subset)
	Comprehensive Marketing Strategy: 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

I liked working with a team to accomplish a challenge. I had rough times while building the car but in the end we learned from our mistakes and accomplished what we wanted to get done together. -- JSS Student

Table 6. 2016 Mentor Questionnaires	
Category	**Description**
Profile	**Demographics:** Participant gender, race/ethnicity, occupation, past participation
Satisfaction & Suggestions	Awareness of JSS, motivating factors for participation, satisfaction with and suggestions for improving JSS programs, benefits to participants
AEOP Priority 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 Priorities 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 7. 2016 Student Focus Groups	
Category	**Description**
Profile	Gender, race/ethnicity, grade level, past participation in JSS, past participation in other AEOP programs
Satisfaction & Suggestions	Awareness of JSS, motivating factors for participation, interest in participating in other STEM programs, satisfaction with and suggestions for improving JSS programs, benefits to participants
AEOP Priorities 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 knew JSS was sponsored by the Army, extent to which students were exposed to STEM and Army/DoD STEM jobs

Table 8. 2016 Mentor Focus Groups	
Category	**Description**
Profile	Gender, race/ethnicity, occupation, organization, role in JSS, past participation in JSS, past participation in other AEOP programs
Satisfaction & Suggestions	Perceived value of JSS, benefits to participants, suggestions for improving JSS programs
AEOP Priorities 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 JSS

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. The student and mentor interview protocols are provided in Appendix B (student) and Appendix C (mentor); and student and mentor questionnaire instruments are located in Appendix D (student) and Appendix E (mentor).

Table 9 provides an analysis of student and mentor participation in the JSS 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. The student response rate is unchanged from 2014 while the mentor response rate is higher than in 2015 when only 8% of mentors responded to the survey. Although there is much room for improvement in questionnaire response rates, the increase indicates an upward trend in questionnaire responses for mentors.

Table 9. 2016 JSS Questionnaire Participation				
Participant Group	**Respondents (Sample)**	**Total Participants (Population)**	**Participation Rate**	**Margin of Error @ 95% Confidence[1]**
Students	83	609	14%	±10.01%
Mentors	39	249	16%	±14.44%

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

Nine students participated in the two regional student focus groups (1 female, 8 males). Sixteen students participated in the national student focus group (9 females, 7 males). An interview was conducted with one mentor at a regional JSS event, and four mentors (2 females, 2 males) participated in the focus group held at the national JSS event. Focus groups and interviews were not intended to yield generalizable findings; rather they were intended to provide additional evidence of, explanation for, or illustrations of student questionnaire data. They add to the overall narrative of JSS' efforts and impact, and highlight areas for future exploration in programming and evaluation.

Respondent Profiles

Student Demographics

Demographic information collected from JSS questionnaire respondents is summarized in Table 10. Of those who reported their gender, more males (62%) than males (38%) completed the questionnaire. More responding students identified with the race/ethnicity category of White (61%) than with any other single race/ethnicity category, and only 4% of respondents identified with the Black or African American category and 3% with Hispanic or Latino. Nearly half (45%) of respondents were 9th graders, while 32% were in the 8th grade, 16% were in the 7th grade, and only 1% was a 6th grader. These data suggest that students responding to the questionnaire are demographically similar to the population of JSS participants for FY16.

Table 10. 2016 JSS Student Respondent Profile		
Demographic Category	**Questionnaire Respondents**	
Respondent Gender (n = 83)		
Female	27	38%
Male	44	62%
Not Reported	0	0%
Respondent Race/Ethnicity (n = 67)		
Asian	7	11%
Black or African American	3	4%
Hispanic or Latino	2	3%
Native American or Alaska Native	5	8%
Native Hawaiian or Other Pacific Islander	0	0%
White	41	61%
Other race or ethnicity[ŧ]	3	4%
Choose not to report	6	9%
Respondent Grade Level[‡] (n = 71)		
6th	1	1%
7th	11	16%
8th	23	32%
9th[‡]	32	45%
Not Reported	4	6%

[ŧ] Other = biracial – black and white; Afrasian (African-Asian); mixed

[‡] Students who indicated being in the 9th grade started their participation in JSS during their 8th grade year.

Table 11. 2016 JSS Student Respondent School Information		
Demographic Category	**Questionnaire Respondents**	
Respondent School Location (n = 64)		
Suburban	31	49%
Urban (city)	10	15%
Rural (country)	22	34%
Frontier or tribal school	1	2%

In addition, students were asked how many times they participated in each of the AEOP programs. Table 12 outlines these responses and demonstrates that only four respondents had participated in AEOP programs other than JSS (GEMS and eCybermission) in the past. Over half of all respondents had participated in JSS at least once in the past, however.

Table 12. Student past participation in AEOPs

	I have not participated in this program	Once	Twice	Three or more times	Response Total
Gains in the Education of Math and Science (GEMS)	96.7%	3.3%	0.0%	0.0%	
	58	2	0	0	**60**
Junior Solar Sprint (JSS)	37.3%	44.8%	10.4%	7.5%	
	25	30	7	5	**67**
eCybermission	96.6%	3.4%	0.0%	0.0%	
	56	2	0	0	**58**
UNITE	100.0%	0.0%	0.0%	0.0%	
	59	0	0	0	**59**
Junior Science and Humanities Symposium (JSHS)	100.0%	0.0%	0.0%	0.0%	
	59	0	0	0	**59**

Mentor Demographics

Mentor demographic data are summarized in Table 13. Slightly more than half of all mentor respondents were females (54%). All but one of the responding mentors were teachers and most (92%) identified their role in JSS as a competition advisor.

> *It's amazing to watch [the students] sit there and go, "Oh, I know what we can try," and then start figuring it out…and watching them persevere.* -- JSS Mentor

Table 13. 2016 JSS Mentor Profile		
Demographic Category	**Questionnaire Respondents**	
Survey Respondent Gender (n = 39)		
Female	21	54%
Male	17	44%
Choose not to report	1	2%
Race/Ethnicity		
Hispanic or Latino	1	3%
Asian	0	0%
Black or African American	3	8%
Native American or Alaskan Native	1	3%
Native Hawaiian or Other Pacific Islander	0	0%
White	30	77%
Other	0	0%
Choose not to report	4	9%
Occupation		
Teacher	38	97%
Other School Staff	1	3%
Role in JSS		
Competition advisor	35	92%
Chaperone	0	0%
Event coordinator or staff	1	2%
Other, (specify)[§]	2	4%

[§] Other = Advisor; Coach

Actionable Program Evaluation

The Actionable Program Evaluation is intended to provide assessment and evaluation of program processes, resources, and activities for the purpose of recommending improvements as the program moves forward. A focus of the Actionable Program Evaluation is efforts toward the long-term goal of JSS and all of the AEOPs to increase and diversify the future pool of talent capable of contributing to the nation's scientific and technology progress. Thus, it is important to consider how JSS is marketed to and ultimately recruits student participants, the factors that motivate students to participate in JSS, participants' perceptions of and satisfaction with activities, what value participants place on program activities, and what recommendations participants have for program improvement. The following sections report perceptions of students and mentors that pertain to current programmatic efforts and recommend evidence-based improvements to help JSS achieve outcomes related to AEOP programs and objectives. While outreach to underrepresented and underserved populations is not a key objective of JSS hosts and educators nationwide, it is an

Army priority across AEOPs and therefore it is important to view these results with a perspective that focuses on how JSS can expand participation from and support STEM education for students from underrepresented and underserved groups.

Evidence-Based Program Change

The AEOP tasks its programs with achieving three broad priorities: (1) STEM Literate Citizenry – Broaden, deepen, and diversify the pool of STEM talent in support of our defense industry base; (2) STEM Savvy Educators – Support and empower educators with unique Army research and technology resources; and (3) Sustainable Infrastructure – Develop and implement a cohesive, coordinated, and sustainable STEM education outreach infrastructure across the Army. Based on recommendations from the FY13 and FY14 summative evaluation reports, the AEOP identified three key objectives for the portfolio in FY16:

1. Increase outreach to populations that are historically underserved and under-represented in STEM;
2. Increase participants' awareness of Army/DoD STEM careers; and
3. Increase participants' awareness of other AEOP opportunities.

In support of these priorities and objectives, the TSA established the following objectives for the JSS program in 2016:

1. Create a national infrastructure to manage local, regional, and national JSS events and increase participation;
2. Enhance training opportunities and resources for teachers/mentors;
3. Coordinate tracking and evaluation opportunities for student and teacher participation in JSS; and
4. Leverage AEOP through cross-program marketing efforts.

TSA took the following actions in FY16 in light of these objectives, the FY15 JSS evaluation data brief, and site visits conducted by TSA, the Army, and Purdue University:

II. Create a national infrastructure to manage local, regional, and national JSS events and increase participation *(supports AEOP Priority 1).*

f) Over 700 personalized postcards were mailed to TSA chapter advisors describing the Junior Solar Sprint program and encouraging participation in JSS.
g) TSA chapters and Army labs were given solar car kits, marketing resources and online educational resources to execute their respective JSS competitions.
h) JSS was promoted through mailings (print and email) to TSA state advisors, TSA middle school advisors (teachers) and on the TSA website.
i) States holding JSS at their TSA state conference were given AEOP promotional materials to distribute to their student participants and adult volunteers.
j) Two teams from Army labs competed in the national JSS competition in Nashville, Tennessee.

II. Strengthen Army connection to JSS regional and national events *(supports AEOP Priority 2).*

e) National TSA coordinated with AEOP representatives to engage them at the national TSA conference as volunteer judges and timers for the national JSS competition.

f) AEOP representatives networked with students, teachers, parents, and other conference attendees during the TSA Meet and Greet and an AEOP special interest session.

g) National TSA coordinated with SAME (Society of American Military Engineers) representatives to engage them at the national TSA conference as volunteer judges and timers for the national JSS competition.

h) A SAME representative held a special interest session for JSS participants titled, "Civil Engineering: A snapshot of Civil Engineering Opportunities".

III. Enhance training opportunities and resources for teachers/mentors *(supports AEOP Priorities 1, 2, and 3).*

d) Provide online resources to include videos, tutorials and lesson plans to teachers and volunteers via the AEOP website.

e) Distribution of free solar car kits from PITSCO to middle school TSA chapters who completed the request for a free kit.

f) Every state holding a JSS competition at their state TSA conference and each Army lab location hosting a JSS race received AEOP brochures, RITR notebooks, pencils and JSS stickers for their participants.

IV. Coordinate tracking and evaluation opportunities for student and teacher participants in JSS *(supports AEOP Priority 3).*

e) Evaluation links sent to state and chapter advisors once link was available. Follow up reminder emails were sent to participating chapters.

f) Students were asked to complete Cvent registration and evaluation during check-in at the national competition via tablets.

g) A link was sent following the national competition to the email addresses collected on Cvent for students who did not complete an onsite evaluation via tablet at the national competition.

h) A link was sent to teachers and adult volunteers and mentors following participation in national JSS competition.

Marketing to and Recruiting Underrepresented and Underserved Populations

The JSS program employed multi-pronged efforts to market events to students on a broad scale. Although schools identified as serving large populations of traditionally underrepresented and underserved students were not a particular focus of this effort, JSS marketed its program in a variety of ways to reach a diverse population of students:

- Sent targeted postcards and emails to Title 1 schools with TSA chapters promoting the JSS program and the free solar car kit offer.
- Facilitated distribution of solar car kits to middle school TSA chapters.
- Sent program guidelines to those schools that did identify themselves as Title 1 schools within TSA internal database so as to provide an overview of the program.

Participants were asked in the questionnaire to indicate the ways that they heard about AEOP in order to understand what recruitment methods were most effective (see Table 14). The most frequently mentioned source of information for AEOP was someone who works at the school or university the student attends (30%). Other sources less frequently mentioned were a past participant of the program (16%), a school or university newsletter, email, or website (13%), or a family member (8%).

Table 14. How Student Participants Learned About AEOP (n=55)

	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	12.50 %	8
Past participant of program	15.63 %	10
Friend	9.38 %	6
Family Member	7.81 %	5
Someone who works at the school or university I attend	29.69 %	19
Someone who works with the program	1.56 %	1
Someone who works with the Department of Defense (Army, Navy, Air Force, etc.)	0.00 %	0
Community group or program	9.38 %	6
Choose Not to Report	14.06 %	9

When asked how they learned about AEOP (see Table 15), mentors responded that they had learned about it through past participants of the program (40%) or the AEOP website (20%). Smaller proportions of mentors reported hearing about AOP from sources such as a newsletter, email, or website (9%)or someone who works with the program (6%). Only one mentor reported hearing about AEOP from a personal connection such as a friend, family member, or someone who works in the DoD.

Table 15. How Mentors Learned About AEOP (n= 29)

	Response Percent	Response Total
Army Educational Outreach Program (AEOP) Website	20.00 %	7
AEOP on Facebook, Twitter, Instagram, or other social media	0.00 %	0

School or university newsletter, email, or website	8.57 %	3
Past participant of program	40.00 %	14
Friend	2.86 %	1
Family Member	2.86 %	1
Someone who works at the school or university I attend	2.86 %	1
Someone who works with the program	5.71 %	2
Someone who works with the Department of Defense (Army, Navy, Air Force, etc.)	2.86 %	1
Community group or program	5.71 %	2
Choose Not to Report	8.57 %	3

Factors Motivating Student Participation

Participants were asked in the questionnaire about what motivated them to participate in JSS. Specifically, they were asked how motivating a number of factors were in their decision to participate. As can be seen in Table 16, the top motivators students reported were having fun (65%), interest in STEM careers with the Army (56%), teacher or professor encouragement (53%), and interest in STEM (51%).

Table 16. Factors Motivating Students "Very Much" to Participate in JSS (n = 55)

Item	Questionnaire Respondents
Having fun	65%
Interest in STEM careers with the Army	56%
Teacher or professor encouragement	53%
Interest in science, technology, engineering, or mathematics (STEM)	51%
Desire to learn something new or interesting	42%
Opportunity to use advanced laboratory technology	29%
Building college application or resume	11%
Learning in ways that are not possible in school	9%
Seeing how school learning applies to real life	9%
Recommendations of past participants	7%
Choose Not to Report	7%
Exploring a unique work environment	5%
Figuring out education or career goals	5%
The mentor(s)	5%

An academic requirement or school grade	4%
Serving the community or country	2%
Networking opportunities	2%

Students in the focus groups were also asked about their reasons for participating in JSS. These students also mentioned having fun, the opportunity for new experiences, and interest in solar energy as motivations to participate in JSS. For example:

> *I chose to do JSS because the solar power…it was something I had previously done at camp, and it seemed like a fun thing to do again* (JSS Student).

> *I chose JSS because it looked like a challenging event…Solar power has interested me for a while* (JSS Student).

The JSS Experience

Students were asked to respond to several items asking about their experience in JSS, and how that experience compared to their STEM learning opportunities in school. When asked what field best described the focus of their JSS experience, 49% of students selected integrated STEM while 34% of responding students selected engineering, 13% technology, 3% science, and 1% mathematics. Students were also asked a series a questions about the nature of their JSS experience. Table 17 displays student responses to a question about their activities during JSS. Over half of all respondents indicated that they communicated with other students about STEM (67%), applied STEM learning to real-life situations (53%), and learned about new STEM topics (53%) on most or every day of their JSS experience. About one-third of students reported learning about careers that use STEM most days or every day, however 80% or students reported learning about these careers at least once during their JSS experience. Over a third of students (36%) reported that they did not interact with scientists or engineers during JSS. Mentor responses to a parallel item are generally aligned with the data from the student questionnaire although mentors tended to respond that students engaged in some activities with more frequency. For example, 69% of mentors reported that students applied STEM knowledge to real-life situations most days or every day compared to 53% of students.

Table 17. Nature of Student Learning in JSS (n=67-68)

	Not at all	At least once	A few times	Most days	Every day	Response Total
Learn about STEM topics that are new to you	7.6%	9.1%	30.3%	40.9%	12.1%	
	5	6	20	27	8	**68**
Apply STEM learning to real-life situations	10.6%	16.7%	19.7%	34.8%	18.2%	
	7	11	13	23	12	**68**

Learn about new discoveries in STEM	15.4%	13.8%	26.2%	38.5%	6.2%	
	10	9	17	25	4	**67**
Learn about different careers that use STEM	19.4%	13.4%	34.3%	29.9%	3.0%	
	13	9	23	20	2	**68**
Interact with scientists or engineers	35.8%	22.4%	19.4%	19.4%	3.0%	
	24	15	13	13	2	**68**
Communicate with other students about STEM	10.6%	10.6%	12.1%	40.9%	25.8%	
	7	7	8	27	17	**68**

Students were also asked to report on the frequency with which they engaged in various STEM practices during JSS. Findings indicate that students were very actively engaged in a variety of STEM practices during the program (see Table 18). For example, 78% of responding students indicated working as part of a team on most days or every day, 72% reported participating in hands-on STEM activities on most days or every day, and 56% reported coming up with creative explanations or solutions on most days or every day of their JSS experience. Mentor responses to a parallel item are generally aligned with the data from the student questionnaire although mentors tended to respond that students engaged in some activities with more frequency. For example, 71% of mentors responded that students designed an investigation most days or every day while only 37% of students indicated that they designed investigations with this frequency.

Table 18. Nature of Student Engagement in STEM Activities in JSS (n=66-68)

	Not at all	At least once	A few times	Most days	Every day	Response Total
Use laboratory procedures and tools	7.5%	14.9%	22.4%	40.3%	14.9%	
	5	10	15	27	10	**67**
Participate in hands-on STEM activities	7.4%	11.8%	22.1%	35.3%	23.5%	
	5	8	15	24	16	**68**
Work as part of a team	2.9%	7.4%	11.8%	30.9%	47.1%	
	2	5	8	21	32	**68**
Identify questions or problems to	4.5%	13.4%	29.9%	35.8%	16.4%	

investigate	3	9	20	24	11	**67**
Design an investigation	10.4%	19.4%	32.8%	31.3%	6.0%	
	7	13	22	21	4	**67**
Carry out an investigation	12.1%	16.7%	33.3%	30.3%	7.6%	
	8	11	22	20	5	**66**
Analyze data or information	4.5%	16.4%	34.3%	31.3%	13.4%	
	3	11	23	21	9	**67**
Draw conclusions from an investigation	4.5%	22.7%	33.3%	31.8%	7.6%	
	3	15	22	21	5	**66**
Come up with creative explanations or solutions	6.2%	18.5%	20.0%	44.6%	10.8%	
	4	12	13	29	7	**65**
Build or make a computer model	30.3%	15.2%	24.2%	22.7%	7.6%	
	20	10	16	15	5	**66**

A composite score[2] was calculated for each of these two sets of items, the first titled "Learning about STEM in JSS,"[3] and the second "Engaging in STEM Practices in JSS."[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 scores were used to test whether there were differences in student experiences by gender and race/ethnic group. Because widely varying group sizes threaten the validity of results, these tests were not conducted for FRL status and school location. No significant differences were found, indicating that students, regardless of gender or race/ethnic group, had similar experiences.

Participants were asked questions regarding how often they engaged in the same activities in school. These responses were also combined into two composite variables: "Learning about STEM in School,"[5] and "Engaging in STEM Practices in

[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 0.905.

[4] The Cronbach's alpha reliability for these 10 items was 0.951.

[5] Cronbach's alpha reliability of 0.880.

School"[6] that are parallel to the ones asking about JSS. There were no significant differences between the "in JSS and "in School" versions of these composites. This lack of difference may be attributable to the fact that, unlike many other AEOPs, JSS activities are often completed in a school setting. As a result, these questionnaire items may lack meaning for students.

In keeping with the JSS goal of increasing the number and diversity of students who pursue STEM careers, the student questionnaire also asked how many jobs/careers in STEM in general, and, more specifically, STEM jobs/careers in the DoD students learned about during their experience (see Tables 19 and 20). Table 19 shows that 71% of students reported learning about at least one STEM job/career, with 18% learning about five or more. Responding students were less likely to indicate that they learned about DoD STEM jobs/careers (see Table 20) with only 45% of students reporting learning about at least DoD STEM job/careers.

Table 19. Number of STEM Jobs/Careers Students Learned About During JSS (n = 68)

Choice	Response Percent	Response Total
None	29.41 %	20
1	7.35 %	5
2	19.12 %	13
3	17.65 %	12
4	8.82 %	6
5 or more	17.65 %	12

Table 20. Number of Department of Defense (DoD) STEM Jobs/Careers Learned About During JSS (n = 65)

Choice	Response Percent	Response Total
None	55.38 %	36
1	12.31 %	8
2	13.85 %	9
3	6.15 %	4
4	3.08 %	2
5 or more	9.23 %	6

Students also reported on the impact of resources upon their awareness of DoD STEM careers (see Table 21). The TSA website (42%), Participation in JSS (34%), and students' mentors (28%) were most often reported as being somewhat or very much responsible impacting students' awareness of DoD STEM careers. Several of the resources included were not

[6] Cronbach's alpha reliability of 0.923.

experienced by most students, including the AEOP brochure (75%), invited speakers or "career" events during JSS (71%), AEOP social media (79%), and the It Starts Here! magazine (85%).

Table 21. Impact of Resources on Student Awareness of DoD STEM Careers (n=66-67)

	Did not experience	Not at all	A little	Somewhat	Very much	Response Total
TSA website	23.9%	14.9%	19.4%	14.9%	26.9%	
	16	10	13	10	18	**67**
AEOP website	67.2%	7.5%	14.9%	6.0%	4.5%	
	45	5	10	4	3	**67**
AEOP on Facebook, Twitter, Pinterest or other social media	79.1%	7.5%	7.5%	6.0%	0.0%	
	53	5	5	4	0	**67**
AEOP brochure	74.6%	11.9%	9.0%	4.5%	0.0%	
	50	8	6	3	0	**67**
It Starts Here! Magazine	85.1%	9.0%	3.0%	3.0%	0.0%	
	57	6	2	2	0	**67**
My JSS mentor(s)	37.3%	9.0%	25.4%	19.4%	9.0%	
	25	6	17	13	6	**67**
Invited speakers or "career" events during JSS	71.2%	7.6%	12.1%	7.6%	1.5%	
	47	5	8	5	1	**66**
Participation in JSS	27.3%	9.1%	30.3%	16.7%	16.7%	
	18	6	20	11	11	**66**

The Role of Mentors

JSS mentors, typically teachers (all JSS participants have a teacher who is a member of the TSA chapter), play a critical role in the JSS program by designing and facilitating learning activities, delivering content through instruction, supervising and supporting collaboration and teamwork, providing one-on-one support to students, and chaperoning students at JSS events. On average, mentors responding to the mentor questionnaire reported working with 6 students, with a range of 2 to 32 students.

Mentors were asked to report on their use of mentoring strategies when working with students. These strategies comprised five main areas of effective mentoring that are supported by research.
These five areas of effective mentoring are:

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.

The majority of mentors reported using several strategies to help make learning activities relevant to students (see Table 22). For example, over three-quarters of mentors reported helping students become aware of the role that STEM plays in their everyday lives and becoming familiar with their students' backgrounds and interests at the beginning of the program. Over half of mentors (65%) reported giving students real –life problems to investigate or solve and helping students understand how STEM can help them improve their own community (61%). Fewer mentors reported selecting readings or activities related to students' backgrounds (19%).

Table 22. Mentors Using Strategies to Establish Relevance of Learning Activities (n = 36-37)

	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 JSS experience	77.8%	22.2%	
	28	8	**36**
Giving students real-life problems to investigate or solve	64.9%	35.1%	
	24	13	**37**
Selecting readings or activities that relate to students' backgrounds	19.4%	80.6%	
	7	29	**36**
Encouraging students to suggest new readings, activities, or projects	44.4%	55.6%	
	16	20	**36**
Helping students become aware of the role(s) that STEM plays in their everyday lives	77.8%	22.2%	
	28	8	**36**
Helping students understand how STEM can help them improve their own community	61.1%	38.9%	
	22	14	**36**

Asking students to relate real-life events or activities to topics covered in JSS	50.0%	50.0%	
	18	18	**36**

Mentors also used a variety of strategies to support the diverse needs of students as learners (see Table 23). A large majority of mentors (91%) reported interacting with students the same way regardless of their background, and most (80%) reported that they used a variety of teaching and/or mentoring activities to meet the needs of all students.

Table 23. Mentors Using Strategies to Support the Diverse Needs of Students as Learners (n = 34-35)

	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 JSS experience	57.1%	42.9%	
	20	15	**35**
Interact with students and other personnel the same way regardless of their background	91.2%	8.8%	
	31	3	**34**
Use a variety of teaching and/or mentoring activities to meet the needs of all students	80.0%	20.0%	
	28	7	**35**
Integrating ideas from education literature to teach/mentor students from groups underrepresented in STEM	45.7%	54.3%	
	16	19	**35**
Providing extra readings, activities, or learning support for students who lack essential background knowledge or skills	34.3%	65.7%	
	12	23	**35**
Directing students to other individuals or programs for additional support as needed	60.0%	40.0%	
	21	14	**35**
Highlighting under-representation of women and racial and ethnic minority populations in STEM and/or their contributions in STEM	28.6%	71.4%	
	10	25	**35**

Large proportions of mentors also reported using a number of strategies to support students' development of collaboration and interpersonal skills (see Table 24). For example, 89% allowed students to resolve conflicts and reach

agreement within their team, and 86% of mentors reported having students listen to the ideas of others with an open mind. Similarly, 83% of mentors reported having students work on collaborative activities or projects as a member of a team and 80% reported having students give and receive constructive feedback with others.

Table 24. Mentors Using Strategies to Support Student Development of Collaboration and Interpersonal Skills (n = 35)

	Yes - I used this strategy	No - I did not use this strategy	Response Total
Having my student(s) tell other people about their backgrounds and interests	40.0%	60.0%	
	14	21	**35**
Having my student(s) explain difficult ideas to others	65.7%	34.3%	
	23	12	**35**
Having my student(s) listen to the ideas of others with an open mind	85.7%	14.3%	
	30	5	**35**
Having my student(s) exchange ideas with others whose backgrounds or viewpoints are different from their own	77.1%	22.9%	
	27	8	**35**
Having my student(s) give and receive constructive feedback with others	80.0%	20.0%	
	28	7	**35**
Having students work on collaborative activities or projects as a member of a team	82.9%	17.1%	
	29	6	**35**
Allowing my student(s) to resolve conflicts and reach agreement within their team	88.6%	11.4%	
	31	4	**35**

Mentors supported student engagement in authentic STEM activities in a variety of ways as well. Table 25 indicates that 88% of mentors encouraged students to seek support from other team members while 86% reported providing student(s) with constructive feedback to improve their STEM competencies.

Table 25. Mentors Using Strategies to Support Student Engagement in "Authentic" STEM Activities (n = 35)

	Yes - I used this strategy	No - I did not use this strategy	Response Total
Teaching (or assigning readings) about specific STEM subject matter	54.3%	45.7%	
	19	16	**35**
Having my student(s) search for and review technical research to support their work	62.9%	37.1%	
	22	13	**35**
Demonstrating laboratory/field techniques, procedures, and tools for my student(s)	70.6%	29.4%	
	24	10	**34**
Supervising my student(s) while they practice STEM research skills	80.0%	20.0%	
	28	7	**35**
Providing my student(s) with constructive feedback to improve their STEM competencies	85.7%	14.3%	
	30	5	**35**
Allowing students to work independently to improve their self-management abilities	82.4%	17.6%	
	28	6	**34**
Encouraging students to learn collaboratively (team projects, team meetings, journal clubs, etc.)	82.9%	17.1%	
	29	6	**35**
Encouraging students to seek support from other team members	88.2%	11.8%	
	30	4	**34**

Finally, mentors reported on strategies they used to supporting students' STEM educational and career pathways. As evidenced in Table 26, most mentors reported using strategies such as providing guidance about educational pathways to prepare students for STEM careers (71%), asking students about their educational and career interests (66%), and recommending student and professional organizations in STEM to their students (66%). While 63% of mentors discussed STEM career opportunities in private industry or academia, only 29% reported discussing STEM career opportunities with the DoD or other government agencies. Given the AEOP goal of broadening the talent pool in STEM fields, this is an area of potential growth. Additionally, given the AEOP interest in having students graduate into other AEOP opportunities, it is noteworthy that less than only 20% of mentors recommended other AEOPs to students.

Table 26. Mentors Using Strategies to Support Student STEM Educational and Career Pathways (n = 35)

	Yes - I used this strategy	No - I did not use this strategy	Response Total
Asking my student(s) about their educational and/or career goals	65.7%	34.3%	
	23	12	**35**
Recommending extracurricular programs that align with students' goals	65.7%	34.3%	
	23	12	**35**
Recommending Army Educational Outreach Programs that align with students' goals	20.0%	80.0%	
	7	28	**35**
Providing guidance about educational pathways that will prepare my student(s) for a STEM career	71.4%	28.6%	
	25	10	**35**
Discussing STEM career opportunities within the DoD or other government agencies	28.6%	71.4%	
	10	25	**35**
Discussing STEM career opportunities in private industry or academia	62.9%	37.1%	
	22	13	**35**
Discussing the economic, political, ethical, and/or social context of a STEM career	40.0%	60.0%	
	14	21	**35**
Recommending student and professional organizations in STEM to my student(s)	57.1%	42.9%	
	20	15	**35**
Helping students build a professional network in a STEM field	28.6%	71.4%	
	10	25	**35**
Helping my student(s) with their resume, application, personal statement, and/or interview preparations	34.3%	65.7%	
	12	23	**35**

Mentors were specifically asked which of the AEOP programs mentors they discussed with their students during JSS. Ten mentors (37% of respondents) reported discussing AEOPs with students without reference to a specific program (see Table 27. The vast majority of mentors did not discuss specific AEOPs with students (97%-100%)

Table 27. Mentors Explicitly Discussing AEOPs with Students (n = 36-37)

	Yes - I discussed this program with my student(s)	No - I did not discuss this program with my	Response Total
Gains in the Education of Mathematics and Science (GEMS)	2.7%	97.3%	
	1	36	37
UNITE	0.0%	100.0%	
	0	37	37
Junior Science & Humanities Symposium (JSHS)	2.7%	97.3%	
	1	36	37
Science & Engineering Apprenticeship Program (SEAP)	2.7%	97.3%	
	1	36	37
Research & Engineering Apprenticeship Program (REAP)	2.7%	97.3%	
	1	36	37
High School Apprenticeship Program (HSAP)	2.7%	97.3%	
	1	36	37
College Qualified Leaders (CQL)	2.7%	97.3%	
	1	36	37
GEMS Near Peer Mentor Program	2.7%	97.3%	
	1	36	37
Undergraduate Research Apprenticeship Program (URAP)	2.7%	97.3%	
	1	36	37
Science Mathematics, and Research for Transformation (SMART) College Scholarship	2.7%	97.3%	
	1	36	37
National Defense Science & Engineering Graduate (NDSEG) Fellowship	0.0%	100.0%	
	0	37	37
I discussed AEOP with my student(s) but did not discuss any specific program	27.8%	72.2%	
	10	26	36

Mentors were also asked to rate the usefulness of various resources in their efforts to expose students to the range of AEOPs. Table 28 illustrates these findings and shows that the TSA website (90%), participation in JSS (70%), and the JSS website (68%) were most often rated as "very much" or "somewhat" useful. Large proportions of mentors did not experience resources such as invited speakers or "career" events (92%), the It Starts Here! Magazine (92%), and AEOP on social media (89%). Over three-quarters of respondents (78%) reported never experiencing the AEOP brochure.

Table 28. Usefulness of Resources in Exposing Students to AEOPs (n=37-38)

	Did not experience	Not at all	A little	Somewhat	Very much	Response Total
The Junior Solar Sprint website (jrsolarsprint.org)	15.8%	0.0%	15.8%	42.1%	26.3%	
	6	0	6	16	10	**38**
Technology Student Association (TSA) website	2.7%	0.0%	8.1%	48.6%	40.5%	
	1	0	3	18	15	**37**
AEOP website	45.9%	0.0%	18.9%	27.0%	8.1%	
	17	0	7	10	3	**37**
AEOP on Facebook, Twitter, Pinterest or other social media	89.2%	0.0%	5.4%	2.7%	2.7%	
	33	0	2	1	1	**37**
AEOP brochure	78.4%	0.0%	10.8%	8.1%	2.7%	
	29	0	4	3	1	**37**
It Starts Here! Magazine	91.9%	2.7%	5.4%	0.0%	0.0%	
	34	1	2	0	0	**37**
JSS Program administrator or site coordinator	78.4%	0.0%	10.8%	5.4%	5.4%	
	29	0	4	2	2	**37**
Invited speakers or "career" events	91.9%	0.0%	5.4%	2.7%	0.0%	
	34	0	2	1	0	**37**
Participation in JSS	27.0%	0.0%	2.7%	24.3%	45.9%	
	10	0	1	9	17	**37**

Similarly, mentors were asked how useful these resources were for exposing students to DoD STEM careers (see Table 29). Mentors were most likely to rate the TSA website (75%), participation in JSS (47%), and the JSS website (41%) as "very much" or "somewhat" useful for exposing students to DoD STEM careers. Again, most responding mentors reported not having experienced resources such as invited speakers or "career" events (89%), the It Starts Here! Magazine (92%), AEOP on social media (86%), and the AEOP brochure (80%).

Table 29. Usefulness of Resources in Exposing Students to Department of Defense (DoD) STEM Careers (n=36)

	Did not experience	Not at all	A little	Somewhat	Very much	Response Total
The Junior Solar Sprint website (jrsolarsprint.org)	36.1%	0.0%	22.2%	22.2%	19.4%	
	13	0	8	8	7	**36**
Technology Student Association (TSA) website	11.1%	0.0%	13.9%	33.3%	41.7%	
	4	0	5	12	15	**36**
Army Educational Outreach Program (AEOP) website	65.7%	0.0%	8.6%	20.0%	5.7%	
	23	0	3	7	2	**35**
AEOP on Facebook, Twitter, Pinterest or other social media	86.1%	0.0%	2.8%	8.3%	2.8%	
	31	0	1	3	1	**36**
AEOP brochure	80.6%	0.0%	8.3%	11.1%	0.0%	
	29	0	3	4	0	**36**
It Starts Here! Magazine	91.7%	0.0%	5.6%	2.8%	0.0%	
	33	0	2	1	0	**36**
JSS Program administrator or site coordinator	80.0%	0.0%	8.6%	8.6%	2.9%	
	28	0	3	3	1	**35**
Invited speakers or "career" events	88.9%	0.0%	2.8%	5.6%	2.8%	
	32	0	1	2	1	**36**
Participation in JSS	44.4%	0.0%	8.3%	19.4%	27.8%	
	16	0	3	7	10	**36**

Student Satisfaction with JSS

Students were asked how satisfied they were with a number of features of the JSS program. Large proportions of students were somewhat or very much satisfied with the aspects of the program they had experienced (see Table 30). For example, 52% of students were very much or somewhat satisfied with the teaching or mentoring provided during JSS activities. Interestingly, however, 30% of students reported not having experienced teaching or mentoring. Likewise, 46% were very much or somewhat satisfied with the variety of STEM topics available to them in JSS while 25% reported not experiencing this. Another 31% of students reported not having experienced educational materials such as workbooks and online resources although 40% expressed being at least somewhat satisfied with these resources. The most commonly cited areas of student dissatisfaction were with applying or registering for the program (12%), field trips and career events (6%), invited speakers or "career" events (5%), and communicating with site organizers (5%).

Table 30. Student Satisfaction with JSS Features (n = 65-68)

	Did not experience	Not at all	A little	Somewhat	Very much	Response Total
Applying or registering for the program	16.2%	11.8%	22.1%	32.4%	17.6%	
	11	8	15	22	12	**68**
Communicating with your JSS host site organizers	40.3%	4.5%	17.9%	26.9%	10.4%	
	27	3	12	18	7	**67**
The physical location(s) of JSS's activities	21.2%	1.5%	18.2%	39.4%	19.7%	
	14	1	12	26	13	**66**
The variety of STEM topics available to you in JSS	25.4%	3.0%	25.4%	23.9%	22.4%	
	17	2	17	16	15	**67**
Teaching or mentoring provided during JSS activities	29.9%	3.0%	14.9%	26.9%	25.4%	
	20	2	10	18	17	**67**
Educational materials (e.g., workbooks, online resources, etc.) used during program activities	30.8%	1.5%	27.7%	26.2%	13.8%	
	20	1	18	17	9	**65**
Invited speakers or "career" events	59.1%	4.5%	18.2%	10.6%	7.6%	
	39	3	12	7	5	**66**
Field trips or laboratory tours	60.6%	6.1%	13.6%	13.6%	6.1%	
	40	4	9	9	4	**66**

Another questionnaire item gauged participant opinions regarding the usefulness of various online resources (see Table 31). Most respondents (71%) found the official TSA competition rules very much or somewhat useful. Local competition rules were rated as at least somewhat useful by over half (51%) of respondents. Over half of student respondents reported not having experienced resources such as the course outline (55%), lesson plans (55%), terminology, (55%), and video tutorials (55%).

Table 31. Student Perceptions of Usefulness with JSS Online Supports (n = 66-67)

	Did not use	Not at all	A little	Somewhat	Very much	Response Total
Official Technology Student Association Competition Rules	20.9%	0.0%	9.0%	19.4%	50.7%	
	14	0	6	13	34	**67**
Local Competition Rules	32.8%	1.5%	13.4%	34.3%	17.9%	
	22	1	9	23	12	**67**
Build A Car resources	40.3%	3.0%	14.9%	23.9%	17.9%	
	27	2	10	16	12	**67**
Course Outline	54.5%	1.5%	21.2%	12.1%	10.6%	
	36	1	14	8	7	**66**
STEM Standards	43.3%	1.5%	20.9%	19.4%	14.9%	
	29	1	14	13	10	**67**
Lesson Plans	55.2%	0.0%	14.9%	17.9%	11.9%	
	37	0	10	12	8	**67**
Terminology	54.5%	1.5%	16.7%	16.7%	10.6%	
	36	1	11	11	7	**66**
Video Tutorials	55.2%	3.0%	16.4%	13.4%	11.9%	
	37	2	11	9	8	**67**
JSS Host Guide	60.6%	1.5%	18.2%	10.6%	9.1%	
	40	1	12	7	6	**66**
Calendar of Events	47.8%	6.0%	13.4%	19.4%	13.4%	
	32	4	9	13	9	**67**

Items in Table 31 were combined into a composite variable titled "Satisfaction with Website Resources."[7] The composite was used to test for differential impacts across sub-groups of students in terms of gender and race/ethnicity. No significant differences were found in this variable by gender or race/ethnicity.

An open-ended questionnaire item also asked students about their satisfaction with their JSS experience. The responses were positive overall. Of the 49 students who responded to this question, 44 (90%) commented on only positive aspects of the program. Many of the responses were simple affirmations such as "It was super!," or "It's a cool program." Other students provided more detail about what they enjoyed about the program. For example:

> *It was awesome. I really enjoyed learning about solar technology as well as applications of it.* (JSS Student)
>
> *JSS helped with team building and working with others. It also helped bring out a more creative side in me.* (JSS Student)
>
> *I liked working as a team to accomplish a challenge. We had ups and downs while building the car but in the end we accomplished what we wanted.* (JSS Student)

The remaining five responses also included positive comments, but had some caveats. These caveats included a suggestion for providing set racing times for teams at competitions, improving organization at local competitions, and disappointment that AEOP representatives did not attend the NYS TSA conference.

Students were also asked to note the three most important ways that JSS has helped them. Of the 53 students who provided one or more benefits of the JSS program, the most common themes that emerged were learning, teamwork, and problem solving. In particular, 63 responses focused on learning, with 39 referencing general learning, 15 referencing learning about careers, and 9 referencing learning more about STEM. The opportunity for teamwork (23 responses) and developing problem solving skills (17 responses) were also commonly mentioned benefits of JSS participation.

Another open-ended item asked students to list three ways in which JSS could be improved; 43 students responded to this item. Of the responses that included suggestions for improvements, the most common theme (14 students or 33% of respondents) focused on improvements in materials, including providing more options for solar panels (4 students or 9%), providing different or better motors (4 students or 9%). Students also suggested providing better gears, different wheels, more advanced technology, fewer materials constraints, or eliminating the kit (1 student each). Seven students (16%) suggested providing more or better background information or videos. Six students (14% of respondents) also suggested providing more descriptive or more clear rules and shortening or eliminating the survey. Another five

[7] The Cronbach's alpha reliability for these 10 items was 0.949.

students (12%) suggested improving organization at competitions. Other suggestions (mentioned by four or fewer students) included streamlining registration, ensuring consistency of tracks at competitions, improving communication, providing judge feedback to students, and promoting the program more effectively.

Mentor Satisfaction with JSS

Mentors were also asked to rate their level of satisfaction with features of JSS. Like students, mentors reported being somewhat or very much satisfied with the program components they experienced (see Table 32). For example, 895% of mentors were at least somewhat satisfied with communications with the TSA, 76% with location of JSS activities, and 71% with the application or registration process. The most commonly cited area of dissatisfaction for mentors was support for instruction or mentorship during program activities (5%) and nearly half (46%) indicated that they had not experienced this support.

Table 32. Mentor Satisfaction with JSS Features (n = 37-38)

	Did not experience	Not at all	A little	Somewhat	Very much	Response Total
Application or registration process	2.6%	5.3%	21.1%	50.0%	21.1%	
	1	2	8	19	8	**38**
Communicating with Technology Student Association (TSA)	0.0%	0.0%	10.5%	42.1%	47.4%	
	0	0	4	16	18	**38**
Communicating with JSS site coordinators	36.8%	2.6%	7.9%	39.5%	13.2%	
	14	1	3	15	5	**38**
The physical location(s) of JSS's activities	13.2%	2.6%	7.9%	55.3%	21.1%	
	5	1	3	21	8	**38**
Support for instruction or mentorship during program activities	45.9%	5.4%	13.5%	21.6%	13.5%	
	17	2	5	8	5	**37**
Stipends (payment)	86.5%	2.7%	2.7%	8.1%	0.0%	
	32	1	1	3	0	**37**
Invited speakers or "career" events	81.6%	5.3%	2.6%	10.5%	0.0%	
	31	2	1	4	0	**38**
Field trips or laboratory tours	84.2%	2.6%	2.6%	10.5%	0.0%	
	32	1	1	4	0	**38**

Table 39 summarizes responses to a question asking mentors how satisfied they were with a variety of online supports. Mentors were overwhelmingly likely to find the official TSA competition rules useful, and all 95% of mentors who had experience with the rules rated them as somewhat or very much helpful. Other resources mentors were at least somewhat satisfied with included local competition rules (49%) and Build a Car resources (53%). Only one mentor indicated dissatisfaction with any of the online supports or resources (local competition rules), although half or more of respondents had not experienced resources such as the course outline (50%), video tutorials (57%), and calendar of events (58%).

Table 39. Mentor Satisfaction with JSS Online Supports (n = 38)

	Did not experience	Not at all	A little	Somewhat	Very much	Response Total
Official TSA Competition Rules	2.6%	0.0%	2.6%	31.6%	63.2%	
	1	0	1	12	24	**38**
Local Competition Rules	45.9%	2.7%	2.7%	29.7%	18.9%	
	17	1	1	11	7	**37**
Build A Car resources	42.1%	0.0%	5.3%	31.6%	21.1%	
	16	0	2	12	8	**38**
Course Outline	50.0%	0.0%	7.9%	28.9%	13.2%	
	19	0	3	11	5	**38**
STEM Standards	37.8%	0.0%	8.1%	29.7%	24.3%	
	14	0	3	11	9	**37**
Lesson Plans	47.4%	0.0%	10.5%	31.6%	10.5%	
	18	0	4	12	4	**38**
Terminology	40.5%	0.0%	8.1%	40.5%	10.8%	
	15	0	3	15	4	**37**
Video Tutorials	56.8%	0.0%	10.8%	16.2%	16.2%	
	21	0	4	6	6	**37**
JSS Host Guide	65.8%	0.0%	5.3%	23.7%	5.3%	
	25	0	2	9	2	**38**
Calendar of Events	57.9%	0.0%	10.5%	21.1%	10.5%	
	22	0	4	8	4	**38**

Mentors were also asked to share their overall satisfaction with their JSS experience in an open-ended questionnaire item. Of the 13 mentors who responded to this question, 10 had something positive to say. For example:

> *My kids had a blast doing JSS. This was the first time we competed in this event. My students failed miserably in our district event and that was the best part. They were very eager to get back to school and start working on solutions to problems they experienced…We will definitely continue competing in JSS.* (JSS Mentor)

Of the he three mentors who expressed dissatisfaction with the experience, two cited the length of the survey and one indicated that it is inconvenient to compete.

In another open-ended question, mentors were asked to identify the three most important strengths of JSS. The 22 mentors who responded to this question mentioned several benefits of the program including problem solving skills and persistence (17 responses), teamwork (13 responses), and developing knowledge (11 responses).

Mentors were also asked to note three ways in which JSS should be improved for future participants. The 13 mentors who responded focused on improvements to the survey (6 responses) and improvements to the registration process and website (6 responses). Three responses indicated that mentors felt that eliminating kids would enhance students' experience. As one mentor responded "[the] kit takes away original thought and problem solving skills." Another two responses indicated a perceived need for more local events.

Mentors were also asked to respond to open-ended items specifically regarding the resources associated with JSS. Of the 21 mentors who responded to the item asking them which resources were most useful to them in JSS, 6 responded that the rules were most useful, while four reported that the TSA materials were useful. Four mentors also responded the kit was the most useful resource.

Twelve mentors responded to an open-ended item asking what resources could be improved or added to better support them in JSS. While four of these mentors had no suggestions for improvements, three indicated that competition guidelines and rules could be improved, three noted that registration and the quantity of paperwork were areas for improvement, and one mentor indicated that the motors could be improved ("several clips that the wires attach to broke off"). One mentor noted of the registration process,

> *As a TSA participant, the extra registration for this competition is cumbersome and has turned some of my students away from participation in this event.* (JSS Mentor)

Findings from the Actionable Program Evaluation indicate that JSS is actively engaging students in authentic STEM experiences. There is evidence that students are learning about STEM jobs/careers although they are learning about DoD STEM jobs/careers to a lesser extent, which may be an area for attention, particularly at TSA-hosted sites.

Furthermore, there is evidence that JSS actively engages students in learning about STEM and in STEM practices. The range of mentoring strategies employed to help make the learning activities relevant to students, support the diverse needs of students as learners, support students' development of collaboration and interpersonal skills, and support student engagement in authentic STEM activities supports student learning and engagement. Students and mentors alike reported overall satisfaction with the JSS features they experienced during their participation.

Outcomes Evaluation

The evaluation of JSS 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 towards research, and their knowledge of and interest in participating in additional AEOP opportunities.[8] STEM competencies, including foundational knowledge, skills, and abilities in STEM, as well as the confidence to apply them appropriately, are necessary for a STEM-literate citizenry. STEM competencies are important not only 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 JSS 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

The vast majority of participants reported at least some gains in their STEM knowledge after participating in the JSS program with medium or large gains reported by many (see Table 40). Medium or large gains were reported, for example, by 76% of students in their in-depth knowledge of a STEM topic(s), by 71% of students in their knowledge of research processes, ethics, and rules for conduct in STEM, and by 68% of students in their knowledge of how scientists and engineers work on real problems in STEM.

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

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

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

President's Council of Advisors on Science and Technology (P-CAST). (February 2012). Engage to excel: Producing one million additional college graduates with degrees in science, technology, engineering, and mathematics. Executive Office of the President.

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

Table 40. Student Report of Impacts on STEM Knowledge (n = 65-67)

	No gain	Small gain	Medium gain	Large gain	Response Total
In depth knowledge of a STEM topic(s)	4.5%	19.4%	53.7%	22.4%	
	3	13	36	15	**67**
Knowledge of research conducted in a STEM topic or field	4.5%	34.3%	41.8%	19.4%	
	3	23	28	13	**67**
Knowledge of research processes, ethics, and rules for conduct in STEM	7.7%	21.5%	52.3%	18.5%	
	5	14	34	12	**65**
Knowledge of how scientists and engineers work on real problems in STEM	12.1%	19.7%	42.4%	25.8%	
	8	13	28	17	**66**
Knowledge of what everyday research work is like in STEM	13.6%	19.7%	50.0%	16.7%	
	9	13	33	11	**66**

A composite variable[9] was compiled using these items (Table 40) to test for differential impacts across sub-groups of students in terms of gender and race/ethnicity. No significant differences were found between boys and girls or between races/ethnicities for this variable.

Participants were also asked to rate the impact of JSS on both their STEM competencies, i.e., their abilities to use STEM practices. Table 41 shows the percentage of responding students reporting gains in their STEM competencies. The majority of students reported medium or large gains in most STEM competencies. For example, 76% of students reported these gains in making a model of an object or system showing its parts and how they work, 72% in using knowledge and creativity to suggest a solution to a problem, 64% in considering different interpretations of data to decide if a solution to a problem works as intended, and 64% in using knowledge and creativity to suggest a testable explanation (hypothesis) for an observation.

Table 41. Student Gains in STEM Competencies (n = 65-68)

	No gain	Small gain	Medium gain	Large gain	Response Total
Asking a question that can be answered with one or	8.8%	32.4%	45.6%	13.2%	

[9] The Cronbach's alpha reliability for these 5 items was 0.918.

	No gain	Small gain	Medium gain	Large gain	Response Total
more scientific experiments	6	22	31	9	68
Using knowledge and creativity to suggest a testable explanation (hypothesis) for an observation	10.4%	25.4%	47.8%	16.4%	
	7	17	32	11	67
Using knowledge and creativity to suggest a solution to a problem	7.4%	20.6%	41.2%	30.9%	
	5	14	28	21	68
Making a model of an object or system showing its parts and how they work	7.5%	16.4%	41.8%	34.3%	
	5	11	28	23	67
Designing procedures for an experiment that are appropriate for the question to be answered	14.7%	22.1%	48.5%	14.7%	
	10	15	33	10	68
Identifying the limitations of the methods and tools used for data collection	10.4%	26.9%	43.3%	19.4%	
	7	18	29	13	67
Carrying out procedures for an experiment and recording data accurately	12.1%	21.2%	47.0%	19.7%	
	8	14	31	13	66
Using computer models of objects or systems to test cause and effect relationships	26.9%	22.4%	35.8%	14.9%	
	18	15	24	10	67
Organizing data in charts or graphs to find patterns and relationships	28.4%	26.9%	37.3%	7.5%	
	19	18	25	5	67
Considering different interpretations of data when deciding how the data answer a question	22.7%	22.7%	47.0%	7.6%	
	15	15	31	5	66
Considering different interpretations of data to decide if a solution to a problem works as intended	21.2%	15.2%	54.5%	9.1%	
	14	10	36	6	66
Supporting an explanation for an observation with data from experiments	19.4%	25.4%	41.8%	13.4%	
	13	17	28	9	67
Supporting an explanation with relevant scientific, mathematical, and/or engineering knowledge	15.4%	24.6%	44.6%	15.4%	
	10	16	29	10	65

	No gain	Small gain	Medium gain	Large gain	Response Total
Identifying the strengths and limitations of explanations in terms of how well they describe or predict observations	15.4%	32.3%	43.1%	9.2%	
	10	21	28	6	**65**
Defending an argument that conveys how an explanation best describes an observation	19.7%	22.7%	47.0%	10.6%	
	13	15	31	7	**66**
Identifying the strengths and limitations of solutions in terms of how well they meet design criteria	7.6%	28.8%	43.9%	19.7%	
	5	19	29	13	**66**
Identifying the strengths and limitations of data, interpretations, or arguments presented in technical or scientific texts	20.0%	24.6%	44.6%	10.8%	
	13	16	29	7	**65**
Integrating information from technical or scientific texts and other media to support your explanation of an observation	21.5%	32.3%	33.8%	12.3%	
	14	21	22	8	**65**
Communicating about your experiments and explanations in different ways (through talking, writing, graphics, or mathematics)	12.1%	28.8%	50.0%	9.1%	
	8	19	33	6	**66**
Integrating information from technical or scientific texts and other media to support your solution to a problem	21.2%	21.2%	50.0%	7.6%	
	14	14	33	5	**66**

A composite score was calculated for items related to student-reported gains in STEM Competencies[10] to examine whether the JSS program had differential impacts on sub-groups of students related to gender or race/ethnicity. No significant differences were found for any of the groups (i.e. gender, ethnicity).

Students were asked to rate the impact of JSS on their 21st Century Skills, defined as skills such as communication and collaboration that are necessary across a wide variety of fields (see Table 42). A large majority of students reported medium or large gains in nearly all 21st Century Skills. For instance, 87% of students reported large or extreme impacts in making changes when thing do not go as planned, 82% in including others' perspectives when making decisions, and 82% in communicating effectively with others.

[10] The Cronbach's alpha reliability for these 20 items was 0.971.

Table 42. Student Report of Impacts on 21st Century Skills (n = 66-67)

	No gain	Small gain	Medium gain	Large gain	Response Total
Sticking with a task until it is finished	3.0%	17.9%	29.9%	49.3%	
	2	12	20	33	**67**
Making changes when things do not go as planned	3.0%	10.6%	34.8%	51.5%	
	2	7	23	34	**66**
Including others' perspectives when making decisions	3.0%	15.2%	30.3%	51.5%	
	2	10	20	34	**66**
Communicating effectively with others	4.5%	13.6%	39.4%	42.4%	
	3	9	26	28	**66**
Desire to build relationships with professionals in a field	13.6%	15.2%	40.9%	30.3%	
	9	10	27	20	**66**
Connecting a topic or field with their personal values	16.7%	21.2%	34.8%	27.3%	
	11	14	23	18	**66**

The items from Table 42 were combined into a composite variable[11] to test for differential impacts across sub-groups of students in gender and race/ethnicity. No statistically significant differences were found or any of the groups (i.e. gender, ethnicity).

STEM Identity and Confidence

In order to increase the likelihood that students will pursue STEM further in their education and/or careers, they must see themselves as capable of succeeding in STEM.[12] The student questionnaire therefore included a series of items intended to measure the impact of JSS on students' STEM identity. Table 43 displays student responses, which suggest that JSS positively impacted students' STEM identities. For example, 78% reported medium or large gains in their sense of accomplishing something in STEM, 73% in feeling prepared for more challenging STEM activities, and 61% in their decision on a path to pursue a STEM careers. A composite score for STEM Identity[13] was created to compare subgroup differences, and students reported similar gains regardless of gender or race/ethnicity.

[11] The Cronbach's alpha reliability for these 6 items was 0.896.

[12] 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.

[13] The STEM Identity composite with 7 items has a Cronbach's alpha reliability of 0.937.

Table 43. Student Report of Impacts on STEM Identity (n = 66)

	No gain	Small gain	Medium gain	Large gain	Response Total
Interest in a new STEM topic	15.2%	22.7%	34.8%	27.3%	
	10	15	23	18	**66**
Deciding on a path to pursue a STEM career	19.7%	19.7%	31.8%	28.8%	
	13	13	21	19	**66**
Sense of accomplishing something in STEM	6.1%	15.2%	36.4%	42.4%	
	4	10	24	28	**66**
Feeling prepared for more challenging STEM activities	7.6%	19.7%	37.9%	34.8%	
	5	13	25	23	**66**
Thinking creatively about a STEM project or activity	1.5%	19.7%	42.4%	36.4%	
	1	13	28	24	**66**
Desire to build relationships with mentors who work in STEM	10.6%	24.2%	39.4%	25.8%	
	7	16	26	17	**66**
Connecting a STEM topic or field to my personal values	18.2%	19.7%	36.4%	25.8%	
	12	13	24	17	**66**

Interest and Future Engagement in STEM

Since a key goal of the AEOP is to develop a STEM-literate citizenry, it is important that students be engaged in and out of school with high-quality STEM activities. To examine the impact of JSS on students' interest in future engagement in STEM, the questionnaire asked them to reflect on whether the likelihood of their engaging in STEM activities outside of school changed as a result of their experience (Table 44), as well as their interest level in participating in future AEOP programs (Table 45). As can be seen in Table 44, participants indicated they were more likely to engage in a number of STEM activities as a result of JSS. For example, 70% reported being more likely to tinker with a mechanical or electrical device, 65% to take an elective STEM class; and 59% to participate in a STEM camp, fair, or competition. A composite score was created from the items in Table 44,[14] and scores were compared across sub-groups of students. There were no statistically significant differences by gender or race/ethnicity.

[14] The behavioral STEM intentions composite with 10 items has a Cronbach's alpha reliability of 0.890.

Table 44. Change in Likelihood Students Will Engage in STEM Activities Outside of School (n = 64-67)

	Much less likely	Less likely	About the same	More likely	Much more	Response Total
Watch or read non-fiction STEM	3.0%	4.5%	62.7%	25.4%	4.5%	
	2	3	42	17	3	**67**
Tinker (play) with a mechanical or electrical device	0.0%	3.1%	26.6%	53.1%	17.2%	
	0	2	17	34	11	**64**
Work on solving mathematical or scientific puzzles	1.5%	4.5%	48.5%	36.4%	9.1%	
	1	3	32	24	6	**66**
Use a computer to design or program something	0.0%	4.6%	36.9%	41.5%	16.9%	
	0	3	24	27	11	**65**
Talk with friends or family about STEM	3.0%	4.5%	53.0%	31.8%	7.6%	
	2	3	35	21	5	**66**
Mentor or teach other students about STEM	0.0%	10.6%	48.5%	34.8%	6.1%	
	0	7	32	23	4	**66**
Help with a community service project related to STEM	0.0%	6.0%	49.3%	35.8%	9.0%	
	0	4	33	24	6	**67**
Participate in a STEM camp, club, or competition	1.5%	3.0%	35.8%	37.3%	22.4%	
	1	2	24	25	15	**67**
Take an elective (not required) STEM class	0.0%	3.1%	32.3%	41.5%	23.1%	
	0	2	21	27	15	**65**
Work on a STEM project or experiment in a university or professional setting	0.0%	4.5%	45.5%	31.8%	18.2%	
	0	3	30	21	12	**66**

Students were also asked how interested they are in participating in future AEOP programs. While a large majority (86%) indicated being somewhat or very much interested in participating in JSS again (see Table 45), there was generally less interest in participating in other AEOP programs and over half of all responding students had never heard of the other AEOPs. For example, 67% of students had never heard of JSHS and 63% had never heard of GEMS.

To lend insight to these responses, when a Purdue University evaluator visited a regional TSA event, the Army representatives on site reported never having heard of AEOP, had never seen the AEOP brochure, and were unaware that JSS is an AEOP-sponsored program. No AEOP brochures were available at this event. Given the goal of having students move through a continuum of AEOP programs, this is an area with potential for growth.

Table 45. Student Interest in Future AEOP Programs (n = 64-67)

	I've never heard of this program	Not at all	A little	Somewhat	Very much	Response Total
Camp Invention	50.7%	6.0%	25.4%	7.5%	10.4%	
	34	4	17	5	7	**67**
eCYBERMISSION	61.2%	7.5%	16.4%	6.0%	9.0%	
	41	5	11	4	6	**67**
Junior Solar Sprint (JSS)	0.0%	1.6%	12.5%	29.7%	56.3%	
	0	1	8	19	36	**64**
Gains in the Education of Mathematics and Science (GEMS)	63.1%	4.6%	13.8%	10.8%	7.7%	
	41	3	9	7	5	**65**
UNITE	66.7%	7.6%	18.2%	4.5%	3.0%	
	44	5	12	3	2	**66**
Junior Science & Humanities Symposium (JSHS)	67.2%	7.5%	14.9%	6.0%	4.5%	
	45	5	10	4	3	**67**
Science & Engineering Apprenticeship Program (SEAP)	63.6%	7.6%	10.6%	12.1%	6.1%	
	42	5	7	8	4	**66**
Research & Engineering Apprenticeship Program (REAP)	65.7%	6.0%	11.9%	10.4%	6.0%	
	44	4	8	7	4	**67**
High School Apprenticeship	65.7%	4.5%	13.4%	10.4%	6.0%	

	I've never heard of this program	Not at all	A little	Somewhat	Very much	Response Total
Program (HSAP)	44	3	9	7	4	**67**
College Qualified Leaders (CQL)	65.7%	7.5%	11.9%	7.5%	7.5%	
	44	5	8	5	5	**67**
GEMS Near Peer Mentor Program	70.8%	4.6%	10.8%	6.2%	7.7%	
	46	3	7	4	5	**65**
Undergraduate Research Apprenticeship Program (URAP)	61.2%	9.0%	16.4%	6.0%	7.5%	
	41	6	11	4	5	**67**
Science Mathematics, and Research for Transformation (SMART) College Scholarship	59.7%	3.0%	14.9%	14.9%	7.5%	
	40	2	10	10	5	**67**
National Defense Science & Engineering Graduate (NDSEG) Fellowship	64.2%	7.5%	11.9%	6.0%	10.4%	
	43	5	8	4	7	**67**

In order to understand the effectiveness of various resources on student awareness of AEOPs, students were asked to identify which resources impacted their awareness of the various AEOPs. Table 45 illustrates that the TSA website was most likely to be rated as impacting students' awareness somewhat or very much (69% of respondents), followed by participation in JSS (56%), and JSS mentors (49%). Most students had not experienced resources such as the It Starts Here! Magazine (84%), the AEOP brochure (76%), or AEOP on social media (75%). Interestingly, in the FY14 evaluation, 73% of reporting students indicated never having heard of the AEOP website, while in FY15 that percentage dropped to 37%. Since 62% of students in the current (FY16) evaluation were unfamiliar with the AEOP website, it may be useful to consider what practices in FY15 led to the increased exposure to this resource. Likewise, in FY14, 71% of students reported never having heard of the AEOP brochure, while in FY15 only 56% indicated that they were not familiar with this resource. Since 76% of students reported being unfamiliar with the brochure in this evaluation it may be useful to consider what practices led to the increased exposure to this resource in FY15.

Table 46. Impact of Resources on Student Awareness of AEOPs (n = 66-67)

	Did not experience	Not at all	A little	Somewhat	Very much	Response Total

TSA website	10.4%	6.0%	14.9%	14.9%	53.7%	
	7	4	10	10	36	**67**
AEOP website	62.1%	9.1%	12.1%	10.6%	6.1%	
	41	6	8	7	4	**66**
AEOP on Facebook, Twitter, Pinterest or other social media	74.6%	9.0%	11.9%	4.5%	0.0%	
	50	6	8	3	0	**67**
AEOP brochure	76.1%	9.0%	9.0%	6.0%	0.0%	
	51	6	6	4	0	**67**
It Starts Here! Magazine	83.6%	9.0%	3.0%	4.5%	0.0%	
	56	6	2	3	0	**67**
My JSS mentor(s)	32.8%	4.5%	13.4%	17.9%	31.3%	
	22	3	9	12	21	**67**
Invited speakers or "career" events during JSS	68.2%	12.1%	9.1%	6.1%	4.5%	
	45	8	6	4	3	**66**
Participation in JSS	17.9%	3.0%	22.4%	13.4%	43.3%	
	12	2	15	9	29	**67**

Attitudes toward Research

An indicator of students' potential future involvement in DoD STEM careers and research is students' attitudes about the importance of DoD research. Therefore, students were asked their opinions of what DoD researchers do and the value of DoD research more broadly (see Table 47). The data indicate that majority of students have favorable opinions about DoD research and researchers. Over half of students strongly agreed or agreed that that DoD researchers solve real-world problems (71%), advance science and engineering fields (66%), develop cutting-edge technologies (62%), and that DoD research is valuable to society (70%).

Table 47. Student Opinions about DoD Researchers and Research (n = 64-66)

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree	Response Total
DoD researchers advance science and engineering fields	1.5%	0.0%	32.3%	50.8%	15.4%	
	1	0	21	33	10	**65**
DoD researchers develop new, cutting edge technologies	1.5%	1.5%	34.8%	43.9%	18.2%	
	1	1	23	29	12	**66**
DoD researchers solve real-world problems	1.6%	0.0%	28.1%	51.6%	18.8%	
	1	0	18	33	12	**64**
DoD research is valuable to society	3.1%	0.0%	26.6%	50.0%	20.3%	
	2	0	17	32	13	**64**

Education and Career Aspirations

The evaluation also examined the program's impact on students' education and career aspirations. In terms of education, the questionnaire asked students how far they wanted to go in school before and after participating in JSS (see Tables 48 and 49). When students were asked to think back on how far they wanted to go in school before they participated in JSS, 43% indicated wanting to complete a Bachelor's degree and 49% indicated wanting to get more education after college. In contrast, after JSS 30% wanted to finish college while 66% reported wanting to get more education after college.

Table 48. Before JSHS – Student Education Aspirations (n = 67)

Choice	Response Percent	Response Total
Graduate from high school	2.99 %	2
Go to a trade or vocational school	1.49 %	1
Go to college for a little while	2.99 %	2
Finish college (get a Bachelor's degree)	43.28 %	29
Get more education after college	49.25 %	33

Table 49. After JSHS – Student Education Aspirations (n = 67)

Choice	Response Percent	Response Total

Graduate from high school	1.49 %	1
Go to a trade or vocational school	0.00 %	0
Go to college for a little while	2.99 %	2
Finish college (get a Bachelor's degree)	29.85 %	20
Get more education after college	65.67 %	44

To gauge shifts in their career aspirations, students were asked what kind of work they expect to be doing at age 30, both reflecting on what their aspirations were before participating in JSS and after JSS. Substantial portions of expressed interest in STEM-related careers both before and after participating in JSS (see Table 50), although more students expressed interest in these STEM careers after their JSS participation. For example, 17% indicated aspiring to a career as an engineer or architect before JSS, and 24% expressed interest this career path after participating in JSS.

Table 50. Student Career Aspirations (n = 66)

Choice	Before JSS	After JSS
Undecided	19.70 %	16.67 %
Scientist or researcher	4.55 %	7.58 %
Work in computers or technology	16.67 %	16.67 %
Engineer or architect	16.67 %	24.24 %
Work in the medical field (doctor, nurse, lab technician)	10.61 %	10.61 %
Teacher	3.03 %	1.52 %
Business person or manager	1.52 %	1.52 %
Lawyer	7.58 %	4.55 %
Military, police, or security	1.52 %	1.52 %
Artist (writer, dancer, painter)	4.55 %	3.03 %
Skilled craftsperson (carpenter, electrician, machinist)	1.52 %	1.52 %
Athlete or other work in sports	3.03 %	3.03 %
Other	9.09 %	7.58 %

Another questionnaire item asked students about the extent to which they expect to use their STEM knowledge, skills, and/or abilities in their work when they are age 30. As can be seen in Table 51, 97% students expect to use STEM somewhat in their career. Over half expect to use STEM 76-100% of the time in their work.

Table 51. Students Expecting to Use STEM in Their Work at Age 30 (n = 68)

Choice	Response Percent	Response Total
not at all	2.94 %	2
up to 25% of the time	8.82 %	6
up to 50% of the time	25.00 %	17
up to 75% of the time	32.35 %	22
up to 100% of the time	30.88 %	21

Overall Impact

Finally, students were asked about impacts of participating in JSS more broadly. These data illustrate that students thought the program had a substantial impact on them (see Table 52). For instance, 79% of students reported that JSS contributed to their increased confidence in their STEM knowledge, skills, and abilities and 72% in their being more interested in taking STEM classes in schools as a result of their JSS participation. This effect extended to out-of-school activities as evidenced by the majority of students who indicated that JSS contributed to them being more interested in participating in other AEOPs (58%) and being more interested in participating in STEM activities outside of school (72%). Similarly, 76% of students reported that JSS contributed to their greater appreciation of DoD STEM research and careers 65% reported that JSS contributed to their interest in pursuing a career in STEM. A composite was created from the items in Table 52,[15] and scores were compared across sub-groups of students. There were no statistically significant differences by gender or race/ethnicity.

Mentors were also asked about impacts on students in these areas and reported similar gains. Mentor reports of impacts were somewhat higher than those of the students in some areas, including confidence in STEM knowledge, skills, and abilities and interest where 89% of mentors reported that JSS contribute, while mentors were less likely than students to report that JSS impacted student awareness of other AEOPs (50%).

Table 52. Student Opinions of JSS Impacts (n = 64-67)

	Disagree - This did not happen	Disagree - This happened but not because of JSS	Agree - JSS contributed	Agree - JSS was primary reason	Response Total
I am more confident in my STEM knowledge,	4.5%	16.4%	65.7%	13.4%	

[15] The Cronbach's alpha reliability for these 10 items was 0.949.

skills, and abilities	3	11	44	9	**67**
I am more interested in participating in STEM activities outside of school requirements	10.6%	16.7%	60.6%	12.1%	
	7	11	40	8	**66**
I am more aware of other AEOPs	33.3%	7.6%	37.9%	21.2%	
	22	5	25	14	**66**
I am more interested in participating in other AEOPs	32.3%	9.2%	43.1%	15.4%	
	21	6	28	10	**65**
I am more interested in taking STEM classes in school	4.5%	24.2%	54.5%	16.7%	
	3	16	36	11	**66**
I am more interested in earning a STEM degree	9.1%	25.8%	51.5%	13.6%	
	6	17	34	9	**66**
I am more interested in pursuing a career in STEM	13.8%	21.5%	50.8%	13.8%	
	9	14	33	9	**65**
I am more aware of Army or DoD STEM research and careers	34.4%	9.4%	37.5%	18.8%	
	22	6	24	12	**64**
I have a greater appreciation of Army or DoD STEM research	33.3%	9.1%	40.9%	16.7%	
	22	6	27	11	**66**
I am more interested in pursuing a STEM career with the Army or DoD	43.1%	10.8%	33.8%	12.3%	
	28	7	22	8	**65**

Summary of Findings

The FY16 evaluation of JSS collected data about participants; their perceptions of program processes, resources, and activities; and indicators of achievement in outcomes related to AEOP and program objectives. A summary of findings is provided in the Table 53.

2016 JSS Evaluation Findings	
Participant Profiles	
JSS served relatively small percentages of students from historically underrepresented and underserved populations; there is room for growth in this.	Female participation in JSS remained close to FY15 levels. In FY16 only 26% of JSS student participants were female (a population historically underrepresented and underserved in STEM fields) as compared to 27% in FY15.
	Slightly fewer participants identified themselves as Black or African American or as Hispanic or Latino in FY16 as compared to FY15 (7% versus 6% and 9% versus 6% respectively). This indicates that JSS has had limited success in engaging students from these groups.
	Participant demographic data was readily available in FY16. This is an improvement as compared to previous years, however there are significant discrepancies between Cvent registration data and data reported by state advisors.
JSS participants have little experience with other AEOPs and only limited interest in participating in other AEOPs in the future.	As in previous years, only very small number of students reported having participated in other AEOPs. This may be due to the grade levels that are eligible for JSS – as one of the first AEOP programs that are open to elementary students. The majority of students have not heard of AEOPs that they currently qualify for or that they may qualify for in high school, suggesting that AEOP information may not be reaching students through JSS.
Actionable Program Evaluation	
TSA markets JSS widely to its members, although there is little evidence that students learn about AEOPs more generally through JSS or the TSA.	In FY16, TSA continued to market JSS by mailing postcards to TSA chapter advisors, and through print and electronic mailings to TSA state advisors and middle school advisors.
	Students and mentors reported high levels of satisfaction with TSA online resources. Although the TSA website was identified by students as a source of information about other AEOPs, most students had not heard of the other programs in the AEOP portfolio.
JSS students reported a variety of motivators for participating in the program.	Students identified having fun, interest in STEM, teacher encouragement, and the desire to learn something new as the primary motivators for participating in JSS.
JSS students reported engaging in meaningful STEM learning through team-based and hands-on activities.	Large proportions of students reported gains in skills related to teamwork such as including others' perspectives when making decisions and communicating effectively with others. Student responses to open-ended questionnaire items also indicated that they place a high value on the teamwork components of JSS.
	The majority of students reported gains in skills related to problem solving such as using knowledge and creativity to suggest testable explanations (hypotheses) for observations and making models of an object or system showing its parts and how they work. Student responses to open-ended questionnaire items also indicated that participants place a high value these aspects of JSS.
	Students reported engaging in a variety of other STEM practices on a frequent basis, including analyzing data or information (59%) and drawing conclusions from an investigation (55%).

2016 JSS Evaluation Findings	
	Mentors reported using a variety of strategies to help make learning activities to students relevant, support the needs of diverse learners, develop students' collaboration and interpersonal skills, and engage students in authentic STEM activities.
JSS has an opportunity to improve student and mentor awareness of other AEOPs and DoD STEM careers.	Although 78% of students reported that participating in JSS had some impact on their awareness of other AEOPs, most students reported that they had never heard of the other AEOPs. Although 28% of mentors reported discussing AEOPs in general with their students, the vast majority of mentors (97%-100%) reported that they did not discuss specific programs, and 80% of mentors reported that they did not recommend AEOPs that align with students' goals to participants.
	Mentors (89%) reported that found the TSA website was a useful resource to expose students to DoD STEM careers and, to a lesser extent, that the JSS website was useful for this purpose (68%). This suggests that there is an opportunity for these websites to be used for targeted marketing of programs for which JSS students are or will soon be eligible such as GEMS, JSHS, and SEAP.
	Although student attitudes toward DoD researchers and research were positive, over half of responding students (55%) of students reported that they did not learn about any DoD STEM careers during JSS. Over a third of students (34%) reported that JSS participation did not impact their awareness of Army and DoD STEM careers.
Students and mentors reported overall satisfaction with the JSS experience.	The majority of students reported satisfaction with program features including mentoring during JSS and the location of JSS activities. The only area in which more than four responding students reported dissatisfaction was the process of applying or registering for the program (12% or respondents were "not at all satisfied" with this aspect of JSS).
	Mentors also reported satisfaction with program features that they had experienced. Mentor satisfaction with the application or registration process was higher than for students (71% of mentors were at least "somewhat satisfied" with this process).
Outcomes Evaluation	
JSS students reported gains in STEM knowledge and competencies.	A majority of students (62-76%) reported medium or large gains in their STEM knowledge, including knowledge of research processes, ethics, and rules for conduct in STEM, Knowledge of how scientists and engineers work on real problems in STEM, and in-depth knowledge of a STEM topic(s).
	Additionally, students (45-76%) reported medium or large gains in most STEM competencies, including using knowledge and creativity to suggest a solution to a problem, identifying the limitations of the methods and tools used for data collection, and carrying out procedures for an experiment and recording data accurately.

2016 JSS Evaluation Findings	
JSS participants reported gains in 21st Century Skills.	Most participants (62-87%) also reported medium or large gains in all 21st Century Skills, including sticking with a task until it is finished, making changes when things do not go as planned, and communicating effectively with others.
JSS participants reported gains in their identity in STEM and in their interest in engaging in STEM in the future.	JSS participants (61-79%) reported medium or large gains in all aspects of their STEM identities, including their decisions to pursue a STEM career, thinking creatively about a STEM project or activity, and feeling prepared for more challenging STEM activities.
	Participants reported being more likely to engage in STEM activities outside of school, with a majority indicating that they are more likely to engage in activities such as using a computer to design or program something (59%), take an elective (not required) STEM class (65%), and work on a STEM project or experiment in a university or professional setting (50%).
Students' education aspirations were higher after participating in JSS, and there were shifts in their career aspirations toward STEM careers.	Participants were more likely to aspire to continue their education after college after JSS as compared to before participation (66% after versus 50% before).
	More students aspired to careers as scientists and researchers and as engineers or architects after participating in JSS as compared to before participation. The vast majority of students (97%) reported that they expect to use STEM knowledge, skill, and abilities in their jobs when they are 30.
Although JSS students are largely unaware of AEOP initiatives, students showed some interest in future AEOP opportunities.	Over half of students indicated that JSS contributed to their interest in participating in other AEOPs. Most students were at least somewhat interested in participating in JSS again in the future. While strong interest in participating in other AEOPs was limited (10% or fewer of students were "very much" interested in any particular program), most students reported being at least "a little" interested in participating in future programs.

Responsiveness to FY14 and FY15 Evaluation Recommendations

The TSA has been generally responsive to the recommendations made in FY14 and FY15 evaluation reports, although progress has been limited in all areas. In particular:

- The TSA has responded to recommendations for attracting students from groups historically underrepresented in STEM by sending postcards and emails to Title 1 schools with TSA chapters promoting JSS and the free solar car kit. There is no evidence that specific efforts were made to engage female participants.
- FY14 and FY15 evaluation reports recommended that the TSA work with JSS sites and with other AEOPs to enhance awareness of AEOP initiatives across programs. While the TSA website contains links to the AEOP website and other AEOP information and the program reported providing AEOP brochures for each state TSA conference, questionnaire results indicate that these brochures may not have reached students. Awareness of AEOP materials including the website, print materials, and social media remain at low levels.

- The TSA responded to recommendations to communicate expectations for and the importance of evaluation activities to individual program sites by providing opportunities to complete evaluations at check-in at the national event, sending evaluation links to state and chapter advisors and sending follow-up emails, and sending evaluation links to national competitors. In spite of these efforts, participation in evaluation activities remains low. It should be noted that, because of the transition in evaluation activities from Virginia Tech to Purdue University, the response to the recommendation to streamline the questionnaire has been delayed.

Recommendations for FY17 Program Improvement/Growth

Evaluation findings indicate that FY16 was a success overall for the JSS program. Notable successes for the year include high levels of mentor and student satisfaction with the program, expansion in the number of regional JSS sites, and satisfaction with TSA resources. There is continued evidence of gains in students' STEM knowledge and competencies and gains in students' 21st Century Skills as a result of the JSS experience.

While these successes are commendable, there are some areas that remain with potential for growth and/or improvement. Specifically, in spite of the increase in the number of regional competitions, the JSS program again experienced a decline in number of participants and overall lack of diversity in participant demographics. The membership model associated with TSA chapters being the main source of recruitment (along with Army lab-based efforts) may be limiting the ability of JSS to grow and reach the desired target populations. In addition, JSS participants continue to report little familiarity Army and DoD STEM careers and with other programs in the AEOP portfolio, suggesting that AEOP resources are not reaching students and mentors. The evaluation team therefore offers the following recommendations for FY17 and beyond:

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

Although not an explicit goal of JSS, the AEOP objective of broadening, deepening, and diversifying the pool of STEM talent continues to be a challenge for JSS. The available demographic enrollment data for the past three years suggests that little change in the rates of participation of underserved and underrepresented groups of students has occurred. Previous recommendations (made in the 2013, 2014, and 2015 JSS evaluation reports) for the program to consider doing more to recruit students from schools serving historically underrepresented and underserved groups are therefore repeated. In particular, since many students participate in JSS via the TSA, it is important to consider ways of reaching a broader range of schools through both the TSA and through Army-hosted events. One strategy may be to market the program to fifth graders, a group that has been largely unrepresented in JSS to date. JSS has not marketed the program to 5th or 6th grade students housed in elementary schools in the past due to TSA's focus being middle and high school. Therefore, it is recommended that TSA consider reaching out to potential elementary school participants to engage more students from younger age groups in the program.

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

Mentors and students expressed overall satisfaction with the resources available to them through TSA. At the same time, however, both mentors and students reported little familiarity with Army resources such as the AEOP website, the It Starts Here! Magazine, and the AEOP brochure. This suggests that participants may not make connections between JSS and Army sponsorship, particularly since participants' primary organizational connection is with the TSA. The fact that Army representatives at one regional TSA event were unaware that JSS is an AEOP initiative and, more importantly, were unfamiliar with the AEOP, suggests that stronger connections between JSS and the AEOP could be made. Although the TSA website makes clear the association of JSS with the AEOP, it may be useful to ensure that AEOP brochures are on hand at all state and regional TSA events, and to educate Army personnel who staff student events about the AEOP and its various initiatives.

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

1. Students continue to report having little knowledge of other programs in the AEOP. Because of the goal of creating a pipeline of programs in which participants progress from JSS into other AEOPs, this is an area of concern. While over half of students indicated that JSS had an impact on their interest in participating in AEOPs in the future, students were largely unaware of programs for which they are or will soon be eligible such as JSHS and GEMS. In spite of this, over half of responding students reported that the TSA website was helpful in learning about JSS and other AEOPs. Likewise, over half of responding students reported that their JSS mentors were helpful in learning about AEOPs. A large majority of mentors reported that found the TSA website was a useful resource to expose students to DoD STEM careers and, to a lesser extent, that the JSS website was useful

for this purpose. This suggests that there is an opportunity for these websites to be used for targeted marketing of programs for which JSS students are or will soon be eligible such as GEMS, JSHS, and SEAP. In addition, since mentors are an important source of student information, additional efforts should be made to educate mentors about the AEOP and programs for which their students are eligible. Further, JSS should consider marketing participation in eCM – as it is available to students regardless of location and is a similar competition-based AEOP.

2. The TSA provided support to the JSS objective of creating a national infrastructure to support events and increase participation in JSS. The expansion of the number of regional events is evidence of this work, however it should be noted that JSS participation declined in 2016. As noted above, since many students participate in JSS via the TSA, it is important to consider ways of reaching a broad range of schools through both the TSA and through Army-hosted events. In addition, although demographic data for participants is more widely available than in past years, use of Cvent remains limited and, for some regional competitions, no participation data was available. The TSA should therefore continue to emphasize the importance of collecting enrollment and participation data with state and regional TSA chapters and other groups holding state and regional competitions.

3. The low response rates for student and mentor questionnaires continue to be an area with potential for growth. There were 10 regional sites and one Army Lab that did not participate in the evaluation survey. Although response rates for mentors have displayed an upward trend over the past three years, the student response rate remained constant from FY15 to FY16. The program may want to consider ways to communicate the importance of these evaluations with individual program sites. Streamlining evaluation instruments may also increase response rates by reducing the time commitment of respondents.

Appendices

Appendix A

FY16 JSS Evaluation Plan

Purpose:

As per the approved FY16 AEOP APP (continuation of Virginia Tech evaluation plan), the external evaluation of JSS included two post-program questionnaires:

1. AEOP Youth Questionnaire to be completed by student participants of the National TSA Conference JSS event and the three local Army-sponsored JSS events; and
2. AEOP Mentor Questionnaire to be completed by competition advisors, chaperones, or event organizers who supported students as they prepared for or participated in National TSA Conference JSS event and the three local Army-sponsored JSS events.

Questionnaires were the primary method of data collection for AEOP evaluation and collected 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 are 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 Youth and Mentor questionnaires provided for their program. Both the Youth and Mentor questionnaires have two versions, an "advanced" version (JSHS and apprenticeship programs) or a "basic" version (all other programs). The same basic set of items are used in both, with slightly modified items and/or additional items used in the advanced version. Additionally, the surveys are customized to gather information specific structures, resources, and activities of programs.

Site Visits/Onsite Focus Groups

Purpose:
The external evaluation of JSS includes site visits/onsite focus groups at the National TSA Conference JSS event.

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

Evaluation Activities during JSS 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 your 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.
- Evaluators may also conduct rapid (3-5 minute) interviews with a random sampling of participants.

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 JSS program. Statistical significance indicates whether a result is unlikely to be due to chance alone. Statistical significance was determined with t-tests, chi-square tests, and various non-parametric tests as appropriate, with significance defined at $p < 0.05$. Because statistical significance is sensitive to the number of respondents, it is more difficult to detect significant changes with small numbers of respondents. Practical significance, also known as effect size, indicates the magnitude of an effect, and is typically reported when differences are statistically significant. The formula for effect sizes depends on the type of statistical test used, and is specified, along with generally accepted rules of thumb for interpretation, in the body of the report.

Appendix B

FY16 JSS Student Focus Group Protocol

2016 Junior Solar Sprint (JSS) Evaluation Study Student Focus Group Protocol

Facilitator: My name is [evaluator] and I'd like to thank you for meeting with us today! We are really excited to learn more about your experiences in JSS. 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 JSS this year?**
    - How did you hear about JSS?
    - Who did you hear about it from?

The Army Educational Outreach Program (AEOP) is a primary sponsor of JSS. 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 JSS is teaching students about STEM career opportunities in the Army and Department of Defense.**
    - During JSS, did you learn anything about STEM careers in the Army or Department of Defense?
    - How did you learn about them (e.g., field trips, invited speakers, other activities, etc.)?
    - Are you interested in pursuing a career in STEM with the Army or Department of Defense?

-

3. **The AEOP sponsors a wide range of national STEM outreach programs other than JSS. You are definitely eligible to participate in some of these programs and we need to know if you learned about them during JSS.**
   - During JSS, did you learn about any of the outreach programs that the AEOP sponsors? (Camp Invention, GEMS, JSHS, 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 JSS this year?**
   - What, specifically do you think you got out of participating in JSS?
   - Were there any other benefits of participating in JSS?

5. **Do you have any suggestions for improving JSS 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 JSS Mentor Focus Group Protocol

2016 Junior Solar Sprint (JSS) Evaluation Study Adult Focus Group Protocol

Facilitator: My name is [evaluator] and I'd like to thank you for meeting with us today! We are really excited to learn more about your experiences in JSS. 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 JSS, what kind of value does this program add**?
    - How do you think students benefit from participating in JSS?
    - Can you think of a particular student or group of students that benefit the most from JSS?
    - How have you benefited from participating in JSS?

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

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

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

3. **The AEOP needs to know if JSS is teaching students about the other STEM outreach programs that it sponsors.**
    - First, are you aware of the other programs offered by the AEOP? (e.g., GEMS, JSHS, etc.)
    - Have you seen any efforts at JSS 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 JSS to help engage underserved or underrepresented groups of adults and youth?
    - What strategies seem to work the best? The worst?
    - Any suggestions for helping JSS reach new populations of adult and youth participants?

5. **What suggestions do you have for improving JSS?**

6. **Last Chance - Have we missed anything? Tell us anything you want us to know that we didn't ask about.**

Appendix D

FY16 JSS Student Questionnaire

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

*1. Do you agree to participate in this survey? (required)(*Required)		
Select one.		
○	Yes, I agree to participate in this survey	
○	No, I do not wish to participate in this survey	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? (select one)	
Select one.	
○	4th
○	5th
○	6th
○	7th
○	8th
○	9th
○	Choose not to report
○	Other, (specify)::

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

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

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

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

8. At which of the following JSS sites did you participate? (Select ONE)	
Select one.	
○	Alabama
○	Arizona
○	California
○	Colorado
○	Delaware
○	Florida
○	Georgia
○	Idaho
○	Illinois
○	Kansas
○	Kentucky
○	Louisiana
○	Maryland
○	Mississippi
○	Missouri
○	Montana
○	New Hampshire
○	New Jersey
○	New Mexico
○	New York
○	North Carolina
○	North Dakota
○	Ohio
○	Oklahoma
○	Oregon
○	Pennsylvania

8. At which of the following JSS sites did you participate? (Select ONE)	
○	Rhode Island
○	South Carolina
○	Tennessee
○	Texas
○	Utah
○	Virginia
○	Washington
○	West Virginia

9. 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)	○	○	○	○

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

Select one per row.

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

11. How often did you do each of the following in JSS 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	○	○	○	○	○

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*
Use laboratory procedures and tools	○	○	○	○	○
Participate in hands-on STEM activities	○	○	○	○	○
Work as part of a team	○	○	○	○	○
Identify questions or problems to investigate	○	○	○	○	○
Design an investigation	○	○	○	○	○
Carry out an investigation	○	○	○	○	○
Analyze data or information	○	○	○	○	○
Draw conclusions from an investigation	○	○	○	○	○
Come up with creative explanations or solutions	○	○	○	○	○
Build or make a computer model	○	○	○	○	○

13. How often did you do each of the following while preparing for and participating in JSS 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	○	○	○	○	○

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

Select one per row.

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

15. 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*
Technology Student Association (TSA) website	○	○	○	○	○
Army Educational Outreach Program (AEOP) website	○	○	○	○	○
AEOP on Facebook, Twitter, Pinterest or other social media	○	○	○	○	○
AEOP brochure	○	○	○	○	○
It Starts Here! Magazine	○	○	○	○	○
My JSS mentor(s)	○	○	○	○	○
Invited speakers or “career” events during JSS	○	○	○	○	○
Participation in JSS	○	○	○	○	○

16. How SATISFIED were you with the following JSS 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 JSS host site organizers	○	○	○	○	○
The physical location(s) of JSS's activities	○	○	○	○	○
The variety of STEM topics available to you in JSS	○	○	○	○	○
Teaching or mentoring provided during JSS activities	○	○	○	○	○
Educational materials (e.g., workbooks, online resources, etc.) used during program activities	○	○	○	○	○
Invited speakers or "career" events	○	○	○	○	○
Field trips or laboratory tours	○	○	○	○	○

17. How USEFUL were the following JSS resources provided at the AEOP website?

Select one per row.

	Did not use	*Not at all*	*A little*	*Somewhat*	*Very much*
Official Technology Student Association Competition Rules	○	○	○	○	○
Local Competition Rules	○	○	○	○	○
Build A Car resources	○	○	○	○	○
Course Outline	○	○	○	○	○
STEM Standards	○	○	○	○	○
Lesson Plans	○	○	○	○	○
Terminology	○	○	○	○	○
Video Tutorials	○	○	○	○	○
JSS Host Guide	○	○	○	○	○
Calendar of Events	○	○	○	○	○

18. The list below includes effective teaching and mentoring strategies. From the list, please indicate which strategies that your coach or advisor used when working with you in JSS:

Select one per row.

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

19. As a result of your JSS 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	○	○	○	○

20. Which category best describes the focus of your student(s) JSS activities?

Select one.

○	Science
○	Technology
○	Engineering
○	Mathematics
○	Integrated STEM (more than one of the above)

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

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 how the data answer a question	○	○	○	○
Considering different interpretations of data to decide if a solution to a problem works as intended	○	○	○	○
Supporting an explanation for an observation with data from experiments	○	○	○	○
Supporting an explanation with relevant scientific, mathematical, and/or engineering knowledge	○	○	○	○
Identifying the strengths and limitations of explanations in terms of how well they describe or predict observations	○	○	○	○

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

Defending an argument that conveys how an explanation best describes an observation	○	○	○	○
Identifying the strengths and limitations of solutions in terms of how well they meet design criteria	○	○	○	○
Identifying the strengths and limitations of data, interpretations, or arguments presented in technical or scientific texts	○	○	○	○
Integrating information from technical or scientific texts and other media to support your 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	○	○	○	○

22. As a result of your JSS 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*
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	○	○	○	○
Desire to build relationships with professionals in a field	○	○	○	○
Connecting a topic or field with their personal values	○	○	○	○

23. As a result of your JSS 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	○	○	○	○
Thinking creatively about a STEM project or activity	○	○	○	○
Desire to build relationships with mentors who work in STEM	○	○	○	○
Connecting a STEM topic or field to my personal values	○	○	○	○

24. AS A RESULT OF YOUR JSS 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	○	○	○	○	○

25. Before you participated in JSS, 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

26. After you have participated in JSS, 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

27. 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

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

Select one.

○	Undecided
○	Scientist or researcher
○	Work in computers or technology
○	Engineer or architect
○	Work in the medical field (doctor, nurse, lab technician)
○	Teacher
○	Business person or manager
○	Lawyer
○	Military, police, or security
○	Artist (writer, dancer, painter)
○	Skilled craftsperson (carpenter, electrician, machinist)
○	Athlete or other work in sports
○	Other, (specify)::

29. After you have participated in JSS, what kind of work do you want to do when you are 30 years old? (select one)

Select one.

○	Undecided
○	Scientist or researcher
○	Work in computers or technology
○	Engineer or architect
○	Work in the medical field (doctor, nurse, lab technician)
○	Teacher
○	Business person or manager
○	Lawyer
○	Military, police, or security
○	Artist (writer, dancer, painter)
○	Skilled craftsperson (carpenter, electrician, machinist)
○	Athlete or other work in sports
○	Other, specify::

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

Select one per row.

	I've never heard of this program	*Not at all*	*A little*	*Somewhat*	*Very much*
Camp Invention	○	○	○	○	○
eCYBERMISSION	○	○	○	○	○
Junior Solar Sprint (JSS)	○	○	○	○	○
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	○	○	○	○	○

31. How many jobs/careers in STEM did you learn about during JSS?	
Select one.	
○	None
○	1
○	2
○	3
○	4
○	5 or more

32. How many Army or Department of Defense (DoD) STEM jobs/careers did you learn about during JSS?	
Select one.	
○	None
○	1
○	2
○	3
○	4
○	5 or more

33. 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	○	○	○	○	○

34. Which of the following statements describe you AFTER PARTICIPATING IN THE JSS PROGRAM?

Select one per row.

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

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

36. What are the three ways that we could make JSS better?	
Improvement #1:	
Improvement #2:	
Improvement #3:	

37. Please tell us about your overall satisfaction with your JSS experience.

Appendix E

FY16 JSS Mentor Questionnaire

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

*1. Do you agree to participate in this survey? (required)(*Required)		
Select one.		
○	Yes, I agree to participate in this survey	(Go to question number 2.)
○	No, I do not wish to participate in this survey	Go to end of chapter

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 13.)
○	Scientist, Engineer, or Mathematician in training (undergraduate or graduate student, etc.)	(Go to question number 13.)
○	Scientist, Engineer, or Mathematics professional	(Go to question number 13.)
○	Other, (specify):: _____	(Go to question number 13.)

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

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

10. At what kind of school did you teach while participating in JSS?	
Select one.	
○	Public school
○	Private school
○	Home school
○	Online school
○	Department of Defense school (DoDDS, DoDEA)

11. Do you work at a "Title-I" school?	
Select one.	
○	Yes
○	No
○	I am not sure

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

Select all that apply.

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

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

Select one.

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

14. At which of the following JSS sites did you participate? (Select ONE)	
Select one.	
○	Alabama
○	Arizona
○	California
○	Colorado
○	Connecticut
○	Delaware
○	Florida
○	Georgia
○	Idaho
○	Kansas
○	Kentucky
○	Louisiana
○	Maryland
○	Mississippi
○	Missouri
○	Montana
○	New Hampshire
○	New Jersey
○	New Mexico
○	New York
○	North Carolina
○	North Dakota
○	Ohio
○	Oklahoma
○	Oregon
○	Pennsylvania
○	Rhode Island

○	South Carolina
○	Tennessee
○	Texas
○	Utah
○	Virginia
○	Washington
○	West Virginia

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

Select one.

○	Competition advisor
○	Event or site host/director
○	Other, (specify)::

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

_____ students.

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

Select all that apply.

☐	Technology Student Association (TSA) 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 JSS participant
☐	A student
☐	A colleague
☐	My supervisor or superior
☐	A JSS site host or director
☐	Workplace communications
☐	Someone who works with the Department of Defense (Army, Navy, Air Force)
☐	Other, (specify)::

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

Select one per row.

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

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

Select one per row.

	Did not experience	*Not at all*	*A little*	*Somewhat*	*Very much*
Application or registration process	○	○	○	○	○
Communicating with Technology Student Association (TSA)	○	○	○	○	○
Communicating with JSS site coordinators	○	○	○	○	○
The physical location(s) of JSS's activities	○	○	○	○	○
Support for instruction or mentorship during program activities	○	○	○	○	○
Stipends (payment)	○	○	○	○	○
Invited speakers or "career" events	○	○	○	○	○
Field trips or laboratory tours	○	○	○	○	○

20. How USEFUL were the following JSS resources provided at jrsolarsprint.org?

Select one per row.

	Did not experience	*Not at all*	*A little*	*Somewhat*	*Very much*
Official Technology Student Association Competition Rules	○	○	○	○	○
Local Competition Rules	○	○	○	○	○
Build A Car resources	○	○	○	○	○
Course Outline	○	○	○	○	○
STEM Standards	○	○	○	○	○
Lesson Plans	○	○	○	○	○
Terminology	○	○	○	○	○
Video Tutorials	○	○	○	○	○
JSS Host Guide	○	○	○	○	○
Calendar of Events	○	○	○	○	○

21. Which resources were MOST USEFUL for you in JSS?

22. What resources could be IMPROVED OR ADDED to better support you in JSS?

23. 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 JSS.

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 JSS 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 JSS	○	○

24. 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 JSS.

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 JSS 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	○	○

25. 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 JSS.

Select one per row.

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

26. 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 JSS.

Select one per row.

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

27. 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 JSS.

Select one per row.

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

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

Select one per row.

	Did not experience	*Not at all*	*A little*	*Somewhat*	*Very much*
The Junior Solar Sprint website (jrsolarsprint.org)	○	○	○	○	○
Technology Student Association (TSA) website	○	○	○	○	○
Army Educational Outreach Program (AEOP) website	○	○	○	○	○
AEOP on Facebook, Twitter, Pinterest or other social media	○	○	○	○	○
AEOP brochure	○	○	○	○	○
It Starts Here! Magazine	○	○	○	○	○
JSS Program administrator or site coordinator	○	○	○	○	○
Invited speakers or “career” events	○	○	○	○	○
Participation in JSS	○	○	○	○	○

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

Select one per row.

	Did not experience	*Not at all*	*A little*	*Somewhat*	*Very much*
The Junior Solar Sprint website (jrsolarsprint.org)	○	○	○	○	○
Technology Student Association (TSA) website	○	○	○	○	○
Army Educational Outreach Program (AEOP) website	○	○	○	○	○
AEOP on Facebook, Twitter, Pinterest or other social media	○	○	○	○	○
AEOP brochure	○	○	○	○	○
It Starts Here! Magazine	○	○	○	○	○
JSS Program administrator or site coordinator	○	○	○	○	○
Invited speakers or “career” events	○	○	○	○	○
Participation in JSS	○	○	○	○	○

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

Select one per row.

	Yes - I discussed this program with my student(s)	*No - I did not discuss this program with my student(s)*
Gains in the Education of Mathematics and Science (GEMS)	○	○
UNITE	○	○
Junior Science & Humanities Symposium (JSHS)	○	○
Science & Engineering Apprenticeship Program (SEAP)	○	○
Research & Engineering Apprenticeship Program (REAP)	○	○
High School Apprenticeship Program (HSAP)	○	○
College Qualified Leaders (CQL)	○	○
GEMS Near Peer Mentor Program	○	○
Undergraduate Research Apprenticeship Program (URAP)	○	○
Science Mathematics, and Research for Transformation (SMART) College Scholarship	○	○
National Defense Science & Engineering Graduate (NDSEG) Fellowship	○	○
I discussed AEOP with my student(s) but did not discuss any specific program	○	○

31. 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	○	○	○	○	○

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

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	○	○	○	○	○

33. AS A RESULT OF THEIR JSS EXPERIENCE, how much did your student(s) 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 professionals work on real problems in STEM	○	○	○	○
Knowledge of what everyday research work is like in STEM	○	○	○	○

34. Which category best describes the focus of your student(s) JSS activities?

Select one.

○	Science
○	Technology
○	Engineering
○	Mathematics
○	Integrated STEM (more than one area)

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

Select one per row.

If answered, go to question number 37.

	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	○	○	○	○
Making a model of an object or system showing its parts and how they work	○	○	○	○
Carrying out procedures for an experiment and recording data accurately	○	○	○	○
Using computer models of objects or systems to test cause and effect relationships	○	○	○	○
Organizing data in charts or graphs to find patterns and relationships	○	○	○	○
Considering different interpretations of data when deciding how the data answer a question	○	○	○	○
Supporting an explanation for an observation with data from experiments	○	○	○	○
Defending an argument that conveys how an explanation best describes an observation	○	○	○	○
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)	○	○	○	○

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

Select one per row.

	No gain	*Small gain*	*Medium gain*	*Large gain*
Defining a problem that can be solved by developing a new or improved object, process, or system	○	○	○	○
Using knowledge and creativity to propose a testable solution for a problem	○	○	○	○
Making a model of an object or system to show its parts and how they work	○	○	○	○
Carrying out procedures for an experiment and recording data accurately	○	○	○	○
Using computer models of an object or system to investigate cause and effect relationships	○	○	○	○
Considering different interpretations of the data when deciding if a solution works as intended	○	○	○	○
Organizing data in charts or graphs to find patterns and relationships	○	○	○	○
Supporting a solution for a problem with data from experiments	○	○	○	○
Defend an argument that conveys how a solution best meets design criteria	○	○	○	○
Integrating information from technical or scientific texts and other media to support your solution to a problem	○	○	○	○
Communicating information about your design experiments and solutions in different ways (through talking, writing, graphics, or math equations)	○	○	○	○

37. AS A RESULT OF THE JSS 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*
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	○	○	○	○
Desire to build relationships with professionals in a field	○	○	○	○
Connecting a topic or field with their personal values	○	○	○	○

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

Select one per row.

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

39. What are the three most important strengths of JSS?

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

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

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

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

Appendix F

Technology Student Association (TSA)
FY16 Evaluation Report Response