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# Army Educational Outreach Program

Junior Solar Sprint (JSS)



## 2017 Annual Program Evaluation Report

### PART 1: Executive Summary

April 2018



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## 2 | 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 5<sup>th</sup>-8<sup>th</sup> 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 FY17 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 2017, students participated in JSS through 26 TSA-affiliated state competitions, two regional Army laboratory-hosted locations, and one national competition in Nashville, TN.

**Table 1. 2017 Fast Facts**

Table 1. 2017 Fast Facts	
Description of program (1-2 paragraph summary)	Junior Solar Sprint (JSS), managed by the Technology Student Association (TSA), is an army Educational Outreach Program (AEOP) which focuses on science, technology, engineering and mathematics (STEM) concepts. The program is available for 5 <sup>th</sup> to 8 <sup>th</sup> grade students and provides the opportunity for students to apply scientific understanding, creativity, experimentation, and teamwork to design, build, and race solar electric vehicles. Junior Solar Sprint activities occur

Table 1. 2017 Fast Facts	
	nationwide, in classrooms and schools, through extracurricular clubs, student associations and as community-based events that are independently hosted and sponsored. This year there were 4 regional events at Army laboratories, 22 TSA state events, and one national event hosted in conjunction with the national TSA conference.
Participant Population (who is eligible for program)	5 <sup>th</sup> -8 <sup>th</sup> grade students
Number of Registered Applicants	1,200 total registered registrants (based on Cvent)
Number of Underserved <sup>1</sup> applicants	239
Number of Registered Participants	893 (participants based on Cvent)
Number of Underserved registered participants	239
Registered teams (complete)	85 registered teams for the national conference
Students attending national event	Approximately 245 students attended the JSS event
Teams attending national event	75 teams participated
Number of All Adults (Team Advisors, Volunteers, S&Es and Teachers)	327
Number of Team Advisors	255
Number of Army S&Es	37
Number of Army/DoD Research Laboratories	3
Number of K–12 Teachers (including preservice)	300 (based on Cvent)
Number of K–12 Schools (Home, Private, Public, DoDEA)	312
Number of K–12 Schools — Title I	92
Number of DoDEA Students	496
Number of DoDEA Teachers	10
Number of DoDEA Teams	243
Number of DoDEA Schools	12
Total Cost	\$150,000

<sup>1</sup> AEOP's definition of underserved includes at least two of the following: low-income students; students belonging to racial and ethnic minorities that are historically underrepresented in STEM; students with disabilities; students with English as a second language; first-generation college students; students in rural, frontier, or other federally targeted outreach schools; females in certain STEM fields.

Table 1. 2017 Fast Facts	
Cost Per Student Participant – total cost/# of registered student (adult for RESET) participants	\$168.00

## Summary of Findings

The FY17 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.

2017 JSS Evaluation Findings	
<b>Participant Profiles</b>	
<b>JSS served increasing percentages of students from populations historically underrepresented and underserved in STEM, indicating that JSS’s efforts to engage these groups has been met with some success.</b>	In FY17 JSS experienced a 46% increase in enrollment compared to FY16. Over half (61%) of JSS participants in FY17 were female, a notable increase from FY16, when only about a quarter of participants were female (a population historically underrepresented and underserved in STEM fields).
	There were substantially more participants identifying as Black or African American in FY17 as compared to FY16 (15% in FY17 compared to 7% in FY16). There was an increase participants identifying as Hispanic/Latino in FY17 (10% in FY17 compared to 6% in FY16).
	A total of 29% of JSS participants were classified at U2 according to AEOP’s definition of U2. AEOP’s definition of underserved includes at least two of the following: low-income students; students belonging to race and ethnic minorities that are historically underrepresented in STEM; students with disabilities; students with English as a second language; first-generation college students; students in rural, frontier, or other Federal targeted outreach schools; females in certain STEM fields.
<b>Actionable Program Evaluation</b>	
<b>Students are motivated to participate in JSS by a variety of factors.</b>	Students in focus groups identified having fun, interest in STEM, a class requirement, and the opportunity for new experiences as motivators for participating in JSS.
<b>Students learned about STEM and engaged in STEM activities in JSS, however it was unclear how these experiences compared to</b>	A large majority of students reported learning about STEM during JSS. Approximately one-third to a half of students applied STEM learning to real-life situations (49%), communicated with other students about STEM (44%), learned about new STEM topics (37%), and learned about new discoveries in STEM (37%) on most or every day of their JSS experience.

<p><b>their regular school course activities.</b></p>	<p>A large majority of students reported engaging in all STEM activities they were questioned about. For example, 80% of students who responded indicated working as part of a team on most days or every day, 59% reported coming up with creative explanations or solutions on most days or every day, and 57% indicated analyzing data or information on most days or every day of their JSS experience.</p>
	<p>While there were no significant differences between students' in-school and out-of-school STEM engagement, students reported significantly higher STEM learning in school than in JSS. Since students often participate in JSS as part of a school class, however, this may indicate that students do not differentiate between STEM learning in school and STEM learning in JSS.</p>
	<p>Students in focus groups reported that their JSS activities differed from regular school class activities because of the hands-on nature of activities and indicated that JSS engaged their interest in ways that science classes may not.</p>
<p><b>Students have limited awareness of STEM jobs and careers in general and even less awareness of Army or DoD jobs after participating in JSS.</b></p>	<p>About 30% of students had learned about no STEM jobs or careers during JSS, although 22% reported learning about 5 or more STEM jobs or careers.</p>
	<p>Nearly half of students (48%) had heard of no Army or DoD STEM jobs or careers during JSS and about a quarter (24%) reported that JSS had not increased their awareness of Army or DoD STEM research and careers. In spite of this, slightly over half (55%) indicated that JSS had resulted in them being more interested in pursuing a STEM career with the Army or DoD.</p>
<p><b>Mentors used a variety of strategies with students during JSS.</b></p>	<p>Large majorities of mentors reported using mentoring strategies as they advised teams. Mentors used strategies to establish the relevance of learning activities, support the diverse needs of students as learners, support students' development of collaboration and interpersonal skills, and support students' engagement in authentic STEM activities. Over three-quarters of mentors reported using most strategies associated with each area of these areas of mentoring.</p>
<p><b>Students and mentors reported overall satisfaction with the JSS experience and offered various suggestions for improvements</b></p>	<p>About three-quarters of students who commented on their satisfaction with JSS had only positive comments, focusing on the opportunity to work on hands-on engineering projects, meet people, build confidence, work with a team, and learn about STEM.</p>
	<p>As improvements for JSS, students suggested standardizing the experience by taking measures to equalize resource access and standardizing competition conditions.</p>
	<p>A large majority of mentors reported being satisfied with the program components they had experienced. For example, 83% of mentors were at least somewhat satisfied with their communications with the TSA and physical location(s) of JSS activities and 73% were at least somewhat satisfied with the JSS application or registration process.</p>

	As improvements for JSS, mentors suggested improvements to the clarity or detail of instructions provided, altering material and cost criteria, improving the registration process, and providing more Army presence in JSS.
<b>Outcomes Evaluation</b>	
<b>JSS students reported gains in STEM knowledge and competencies.</b>	<p>Medium or large gains were reported on all items related to STEM knowledge by two-thirds or more of JSS student participants. This included medium or large gains in areas such as learning about STEM topics (72%) and learning about research in a STEM field (72%).</p> <p>More than half of students reported medium to large gains on all STEM competencies except for making computer models, for which nearly half (46%) reported no gain. Around three-quarters of students reported gains at least medium gains in areas such as making a model of something showing its parts and how they work (74%), using knowledge and creativity to suggest a potential guess for the outcome of an experiment (74%), and using knowledge and creativity to suggest a solution to a problem (74%).</p>
<b>JSS students reported gains in 21<sup>st</sup> Century Skills.</b>	More than half of students reported medium or large gains in all areas of 21 <sup>st</sup> Century Skills. Over three-quarters of students reported at least medium gains in areas such as making changes when things do not go as planned (80%), including others' perspectives when making decisions (77%), in communicating effectively with others (76%), and in sticking with a task until it is finished (73%).
<b>JSS students reported gains in their STEM identities and reported that they were somewhat more likely to engage in STEM activities outside of regular school classes in the future.</b>	<p>More than half of students reported that JSS impacted them in all areas of STEM identity. The areas of greatest impact (students selected "somewhat agree" or "agree") included feeling more prepared for more challenging STEM activities (80%), feeling like they had accomplished something in STEM (76%), and thinking creatively about a STEM project or activity (72%).</p> <p>Approximately half of JSS students indicated they were more likely to engage in a number of STEM activities after participating in JSS. For example, 61% reported being more likely to participate in a STEM camp, club, or competition and 59% of students indicated being more likely to tinker with a mechanical or electrical device after participating in JSS. Between 25% and 41% of students reported no change in their likelihood of engaging in STEM activities after JSS.</p>
<b>Students participating in JSS have limited experience with and knowledge of other AEOPs, and adult mentors provided little information to students about AEOPs other</b>	<p>Fewer than 15% of students were aware of any AEOPs other than JSS.</p> <p>A large majority of students (70%) indicated interest in participating in JSS again.</p> <p>Most students did not indicate interest in participating in other AEOPs, including those for which they may be currently eligible including eCM (5% interested in participating) and GEMS (13% interested in participating).</p>

<p><b>than JSS.</b></p>	<p>Only 18% of adult mentors reported recommending other AEOPs to students. Slightly over a third of mentors reported discussing GEMS with students and similar numbers reported discussing AEOP but without reference to a specific program. Few mentors (between 9% and 14%) reported discussing any other AEOPs with students.</p>
<p><b>Students had positive opinions about DoD research and researchers after JSS.</b></p>	<p>About two-thirds of students reported favorable opinions about DoD research and researchers. For example, most students agreed most with DoD researchers solving real-world problems (69%) and DoD research being valuable to society (69%). Around a quarter of students (24% - 30%) did not register an opinion about DoD research and researchers, however, and 21% of students reported that JSS did not impact their appreciation of Army or DoD STEM research.</p>
<p><b>JSS had positive impacts on students.</b></p>	<p>Students reported that JSS had a substantial impact on them, with more than 50% of students indicating that JSS impacted them both in terms of STEM interest in school and outside-of-school. Most students believed JSS contributed to their increased confidence in STEM knowledge, skills, and abilities (76%), and their interest in pursuing STEM careers (65%).</p>

**Responsiveness to FY17 Evaluation Recommendations**

The primary purpose of the AEOP program evaluation is to serve as a vehicle to inform future programming and continuous improvement efforts with the goal of making progress toward the AEOP priorities. In previous years the timing of the delivery of the annual program evaluation reports has precluded the ability of programs to use the data as a formative assessment tool. However, beginning with the FY17 evaluation, the goal is for programs to be able to leverage the evaluation reports as a means to target specific areas for improvement and growth.

Evaluation recommendations from FY16 made to programs are highlighted along with a summary of efforts and outcomes reflected in the FY17 APR toward these areas.

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



**FY16 Finding:** 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<sup>th</sup> or 6<sup>th</sup> 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.

#### **JSS FY17 Efforts and Outcomes:**

- Solar panels were provided to populations/schools that are interested in participating but unable to due to lack of financial support. Examples of these populations included a rural school in Oklahoma serving an underserved population and a summer based STEM program for an underserved Native American population in Florida.
- TSA Title 1 schools were provided with an incentive of receiving two free solar kits for participating in JSS.
- A new initiative, JSS Jumpstart, was created to grow the JSS program. 5<sup>th</sup> and 6<sup>th</sup> graders housed in elementary schools interested in participating in JSS at a local level is the target population. Kits were provided to five elementary schools that were classified as Title 1.
- The number of participants registered in Cvent reflect a higher diversity of participants as compared to last year.

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

**FY16 Finding:** 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. Further, TSA may consider providing some presentation to the full group at the conference during general

sessions regarding the partnership with AEOP in JSS.

#### **JSS FY17 Efforts and Outcomes:**

- AEOP materials (AEOP brochures, pencils, RITR notebooks and AEOP banners) were sent to all state conferences holding a JSS event. Brochures contained rack cards-specifically JSHS and GEMS- which are age appropriate for JSS participants.
- Over 300 postcards promoting the Junior Solar Sprint program were distributed to schools; postcards included the AEOP website address and Cvent registration link.
- Interested JSS participants were required to register on the Cvent link which is found on the AEOP site.
- The AEOP special interest session at the 2017 national TSA conference was heavily promoted prior to the conference. AEOP representatives attended the national TSA conference and conducted a special interest session for students, teachers, and parents on AEOP programs and the AEOP pipeline.
- AEOP representatives attended the TSA Meet and Greet, a networking opportunity for students, teachers, parents and other conference attendees, at the national TSA conference and spoke to conference attendees about AEOP programs.
- TSA ran a full-page ad on the inside back cover of the national conference program promoting the AEOP and their STEM programs.

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

**FY16 Finding:** 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.

#### **JSS FY17 Efforts and Outcomes:**

- Marketing/promotion emails were sent to all TSA chapter advisors providing information on



those AEOP programs rising 9<sup>th</sup> graders would be eligible for.

- AEOP marketing materials were disseminated at the SAME (Society of American Military Engineers) conference; the conference attendees included small businesses looking to connect with STEM based programs in schools.

**FY16 Finding:** 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.

#### **JSS FY17 Efforts and Outcomes:**

- The Cvent registration link was provided to all state and chapter advisors in TSA as well as those participants wanting to compete in a JSS event at an army hosted site for FY17 via email and mailings. The link was also provided to all inquiries (email and phone) from teachers/administrators that were interested in participating in Junior Solar Sprint. Results of Cvent registration improved this year as it was communicated to all those participating (and those interested in participating) that registration was required. The number of Cvent registrations, however, still does not account for all that participate in a JSS event and still does not capture all those participants participating at a state conference holding a JSS event. State conferences do not require Cvent registration to participate at their JSS event.

**FY16 Finding:** 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.

#### **JSS FY17 Efforts and Outcomes:**

- The Cvent registration was provided to all state and chapter advisors as well as those participants wanting to compete in a JSS event at an army hosted site for FY17. Evaluation surveys were provided via Cvent link to participants and chapter advisors prior to, and after the state level conferences. Email reminders were also sent multiple times to state and chapter



advisors prior to, and after state level conferences. At the national level, tablets were used for student participants to complete the surveys and the link was provided to adult participants. The link was sent again after the completion of the national conference. An incentive was sent via email to both student and adult participants in May to increase completion of the surveys.

- Focus groups attendance and access to evaluations (via tablets) were included in the Junior Solar Sprint schedule of events at the national conference. Attendance of the focus groups was required to participate in the JSS national event. Adults were provided incentives upon attending the focus group.

## Recommendations for FY18 Program Improvement/Growth

FY17 was an overall successful year for JSS, as reflected in the evaluation findings. JSS was able to increase their participant base by 46% from FY16. Further, the percentage of female participants grew from around 25% in FY16 to over half (61%) in FY17 and there was also growth in the percentages of Black/African American (up to 15% from 7% in FY16) and Latino/Hispanic groups (up to 10% from 6% in FY16).

As in FY16, JSS had high levels of mentor and student satisfaction with the program and there was continued evidence of gains in students' STEM knowledge and competencies and gains in students' 21<sup>st</sup> 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. 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**

JSS has made strong strides in FY17 to grow the representation of participants from underserved groups, as mentioned above. We recommend that JSS continues to focus on growing the percentage of ethnic/racial groups again in FY18 to bring even more participation of students from those groups in the program.

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

As in FY16, participants (adult and youth) valued the resources available to them through TSA. However, many students reported that directions for the JSS competition were unclear or incorrect. It is

recommended that TSA review all rules, guidelines, and resources and update with relevant current information.

Nearly half of students (48%) reported no awareness of Army/DoD STEM jobs or careers. Further, 24% shared JSS had not increased their awareness of Army/DoD STEM research. Mentors reported very little knowledge of other AEOPs and AEOP/DoD careers. Interestingly, 55% of participants indicated an interest in STEM careers with the Army/DoD. Therefore, it is recommended that JSS continue to find ways to integrate this content into the programming at regional and national competitions. Further, JSS should provide more support to adults who will serve as mentors to students in the form of training and awareness of AEOPs and AEOP/DoD careers. One potential strategy may be to engage more Army/DoD scientists & engineers in the national and regional competitions.

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

1. As in FY16, student participants continued to report having little knowledge of other programs in the AEOP. In fact, fewer than 15% were aware of any AEOPs besides JSS. As a result, most students did not indicate interest in participating in other AEOPs. Only 5% were interested in eCM and 13% in GEMS specifically. This may be due to the fact that most mentors (82%) reported they did not recommend other AEOPs to students. Similar to FY16, it is recommended that JSS invest significant efforts into making this a focus of the marketing and programming for JSS at both regional and national levels. JSS should specifically promote all AEOPs with special emphasis on those programs that would be next in the pipeline for participants (e.g. eCM, GEMS).
2. The low response rates for regional completion of JSS evaluation survey(s) continued to be an issue that was more persistent in FY17. A new effort to grow national level participation produced excellent participation through the use of evaluators on site with tablets and facilitated groups of students completing the evaluation survey. It is recommended that this format continue to be followed in FY18. Further, after discussion with TSA and the CAM the evaluation will only focus on Army labs for the regional level evaluation completion in FY18. TSA should work closely with the Army labs to provide support and encouragement to complete the required components.