The SoI Pilot National Evaluation: Findings and Recommendations

NASA's Summer of Innovation Project - *Updated*

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Executive Summary

The National Aeronautics and Space Administration's (NASA) Office of Education recently launched Summer of Innovation (SoI), a national multi-year pilot project which targets middle school students who underperform, are underrepresented, and underserved in science, technology, engineering, and math (STEM) fields. SoI seeks to develop students' positive opinions of STEM activities and careers, increase their knowledge of STEM fields and careers, and improve their performance in science and math classes. During the pilot year, NASA awarded cooperative agreements to four Space Grant Consortiums, funded ten NASA Centers, and made one External Sub-Award to provide intensive, stimulating mathematics and science-based summer learning experiences using NASA's education content.

In April 2010, NASA's Office of Education contracted with Abt Associates Inc., and its subcontractor, the Education Development Center Inc. (EDC), to conduct a national, cross-site formative evaluation of the SoI Pilot Project. This report presents the results.

The evaluation addressed the following four questions:

1. What were the key characteristics of the SoI activities implemented during the pilot?
2. What successes were encountered during the pilot? How might these successes be repeated?
3. What challenges were encountered during the pilot? How might these be avoided in the future?
4. What are the pilot's implications for the next phase of the SoI project and evaluation?

Three key data sources (reporting forms, "technical assistance" communications, and participant surveys) were utilized to explore the different approaches that the sites used, understand the challenges the sites faced, and develop a sense of how these challenges could be avoided or overcome in a future implementation. The analysis generated a clear awareness of modifications that could be made to improve the success of the activities and of a cross-site evaluation within the SoI context. It also underscored the need for additional formative evaluation to support NASA's efforts to define SoI as a coherent model whose consistent implementation could be ensured, at which time it would be appropriate to evaluate its efficacy. The disparate implementation of SoI across sites and existing challenges with data collection, limited the ability to draw generalizations from the pilot evaluation, however, important lessons were learned. Below are highlights from the report's recommendations.

Guidance for NASA's Office of Education:

- Ensure that sites have sufficient time to plan for the implementation by making SoI awards in January
- Refine the project's logic model and ensure that sites are provided operationalized definitions of the key elements so it is clear how to implement activities as NASA envisions
- Clarify expectations for the national evaluation in the solicitation
- Make funding contingent on full participation in the national evaluation
- Provide a national evaluation "kick-off" meeting where the sites' evaluation responsibilities are discussed and all national evaluation materials are distributed
- Identify one NASA staff member who will be responsible for coordinating all evaluation, monitoring, and assessment efforts to eliminate overlap and minimize burden to sites

- Integrate forms so that sites are required to submit one set of reports and are not asked to provide duplicate information
- Prioritize relevant outcomes and constructs of interest to shorten the surveys

***Recommendations for the sites that implement SoI student activities*:**

- Initiate recruitment efforts no later than early spring (preferably in winter); starting the process earlier will allow the sites to develop relationships with key individuals in the community who might facilitate recruitment
- Maximize outreach in schools with large populations of underrepresented students, for example, by targeting schools with the desired proficiency rates and student demographics
- Use family events as opportunities to emphasize importance of STEM achievement with parents so that they too can help promote student interest in STEM
- Use field trips to provide both “real world” exposure to STEM as well as support the social development of students
- Contact field trip venues several weeks in advance, providing them estimates of the total number of students to ensure that they are available and can prepare for the students by bringing on additional staff and other strategies

***Recommendations for the sites that implement SoI educator activities*:**

- Initiate recruitment efforts no later than early spring (preferably in winter)
- Dedicate additional time for professional development so that teachers better understand and are more comfortable with the activities’ STEM content
- Consider engaging a NASA educator/expert to guide educators in selecting appropriate NASA resources during the educator activities
- Provide sufficient training to staff to ensure they clearly understand the specific challenges of working with adolescents and are prepared to address behavioral issues

Lessons learned to inform the future national evaluation of SoI:

- Initiate OMB clearance process in December
- Initiate communication between the national evaluation and the sites in April so that the local IRB approval processes can begin
- Integrate evaluation consent into participation consent forms so parents only need to sign one set of forms
- Collect baseline surveys as part of the application and/or registration process; if too many students apply, these surveys could be used as baseline data for a comparison group
- Request that sites identify a data collection coordinator who would be responsible for ensuring that his/her site understands the evaluation requirements and administers the surveys consistently; this key point person should be required to spend time in the field and be able to connect national evaluators with location coordinators to ensure key implementation data is collected

Chapter 1: Overview of the SoI Pilot Project

> "Make no mistake: Our future is on the line. The nation that out-educates us today is going to out-compete us tomorrow. To continue to cede our leadership in education is to cede our position in the world."[1]

When President Obama launched the "Educate to Innovate" campaign in late 2009, he made improving science, technology, engineering, and math (STEM) education a clear priority, calling on the nation to respond with urgency. The National Aeronautics and Space Administration (NASA) did just that by launching *Summer of Innovation (SoI*), a multi-year pilot project intended to engage large numbers of middle school students in STEM. Through partnerships with educators and a variety of organizations across the nation, SoI was designed to reach more than 100,000 middle school students who underperform, are underrepresented and underserved, and engage them in intensive STEM learning experiences to improve their achievement and, over the long term, bolster the future STEM workforce.[2]

Introduction

In April 2010, NASA's Office of Education contracted with Abt Associates Inc., and its subcontractor, the Education Development Center Inc. (EDC), to conduct a national, cross-site evaluation of the SoI Pilot Project, focusing on the following objectives:

1) Develop and/or identify data collection instruments to assess outcomes;
2) Provide technical assistance to SoI sites related to gathering outcome data from the Space Grant Consortiums, the External Sub-Awardee, and a sub-set of NASA Center Partnerships; and
3) Provide technical assistance to SoI sites related to project implementation reporting requirements so that lessons learned could be identified.

This report begins with a brief overview of the SoI Pilot Project's original vision and planned implementation, drawing data from NASA press releases, meeting handouts, the cooperative agreement notice, NASA's website, and conversations with NASA staff.

Vision for the SoI Pilot Project

SoI was designed to be an "innovative education program" that "inspires" and "engages" the nation's youth in NASA's mission, and ultimately strengthens the country's future STEM workforce. By harnessing the excitement that the Agency's mission generates, SoI would catalyze the expansion, alignment, and strengthening of existing STEM learning networks to assure that all students could

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1 January 6, 2010. Remarks by the President on the "Educate to Innovate" Campaign and Science Teaching and Mentoring Awards. Retrieved on October 10, 2010, from http://www.whitehouse.gov/the-press-office/remarks-president-educate-innovate-campaign-and-science-teaching-and-mentoring-awar .

2 SoI Planning Meeting Handout, April 2010, p. 4.

participate in summer learning experiences that increase the likelihood of their academic and life long success. [3] The SoI activities would complement the school year curricula and counter the potential loss of academic skills (and corresponding risk of academic decline) that occur over summer months.

For the pilot year, SoI focused on competitively awarding cooperative agreements to a few Space Grant Consortiums that would receive support from NASA and non-NASA partnerships. [4] NASA's Office of Education singled out the Space Grants as uniquely qualified to implement the pilot because of their "well-established state-based networks, strong STEM workforce development expertise, in-depth knowledge of and history of working in support of NASA's missions, and significant connections to formal and informal education providers."[5] Funded Space Grants awardees would use interactive in-person programs, including camps, Saturday programs or other events, as well as online activities, to engage participants in intensive NASA and STEM-focused experiences during the "opportune time" of summer and beyond.

The project's specific goals were to provide summer and ongoing intensive and interactive STEM education experiences to underrepresented, underserved, and underperforming middle school students (especially girls, minority, and low-income students), which would accelerate their learning and improve their STEM skills and knowledge. The activities themselves would center on NASA-themed topics such as space exploration, aeronautics, space science, earth science, and microgravity, and would be aligned with district and/or state standards. They would strategically use pre-existing NASA content and resources, while incorporating the non-NASA content needed to achieve success. [6] NASA identified that the SoI's key outcomes for students as: 1) fostering positive opinions and interest in STEM education, fields, and careers; 2) increasing knowledge of STEM fields and careers; and 3) improving STEM academic achievement such as grades in STEM-related classes and scores on state science and math achievement tests.[7]

Furthermore, NASA wanted SoI to develop "a community of STEM education stakeholders" that would "sustain engagement and accelerate student achievement."[8] Part of this community would be the educators leading the students in the summer activities. SoI would provide these educators with professional development and training, to ensure the delivery of a strong summer experience while improving the pedagogical skills that these educators would bring back to their classrooms. These activities were to produce the following educator outcomes: increased STEM content knowledge,

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3 *About the Summer of Innovation Pilot*. Retrieved on October 26, 2010, from http://www.nasa.gov/offices/education/programs/national/summer/about/index.html

4 NASA Office of Education (March 2010). *Statement of Work: Technical Assistance for the Summer of Innovation Cross-Consortium Evaluation*.

5 FY 2010 Cooperative Agreement Notice (CAN) for the *National Needs Grant: Summer of Innovation Pilot* (announcement NNH10ZNE004C, January 27, 2010, p.9).

6 FY 2010 Cooperative Agreement Notice (CAN) for the *National Needs Grant: Summer of Innovation Pilot* (announcement NNH10ZNE004C, January 27, 2010, p.13).

7 NASA Office of Education (March 2010). *Statement of Work: Technical Assistance for the Summer of Innovation Cross-Consortium Evaluation*.

8 *About the Summer of Innovation Pilot*. Retrieved on October 26, 2010, from http://www.nasa.gov/offices/education/programs/national/summer/about/index.html

improved STEM teaching skills, and an understanding of how to incorporate NASA content and education materials into their teaching practice.[9] The awardees' efforts would be evaluated in terms of their reach and performance using both local and national evaluators.

FY 2010 SoI Pilot Implementation

Pilot programs are typically small scale so that they can be flexible enough to incorporate rapid changes to address unexpected challenges that inevitably arise during the early stages of implementation and so that their staff can more easily continue to develop the models. However, the scale of the SoI expanded prior to implementation, as the Agency recognized the project's potential for offering summer STEM activities where few are available, and as its visibility - both internally at NASA and externally with the Obama Administration – heightened: in spring 2010, NASA increased SoI's emphasis on partnerships to fund strategic collaborations amongst federal agencies, academic and informal organizations, nonprofits and industry to "ensure that the learning experiences are available to all students."[10] Consequently, in addition to the Space Grant Consortiums, NASA named up to four other potential SoI mechanisms, including: 1) NASA Center Partnerships; 2) Federal Partnerships; 3) External Sub-Awards; and 4) an open call for entities interested in incorporating NASA content into existing non-NASA summer learning experiences.[11]

In all, NASA funded ten NASA Centers (April 2010), awarded cooperative agreements to four Space Grant Consortiums (Idaho, Massachusetts, New Mexico, and Wyoming) (May - June 2010), and provided one External Sub-Award to Paragon TEC (July 2010). Collectively, these efforts became the SoI pilot of 2010. No federal partnerships were funded.

All awardees were expected to solicit the involvement, participation, and/or contributions of a range of entities with relevant experience and ability to accomplish the goals of the SoI pilot project.[12] Both the Space Grant and Sub-Award sites were expected to meet the following requirements: 1) provide professional development and training opportunities for educators who would lead students through the SoI summer learning activities; 2) implement an intensive and interactive middle school education experience; 3) strategically infuse NASA content and educational resource materials into the activities; 4) develop a community of STEM education stakeholders; and 5) perform assessments of the effectiveness of the interventions.[13] Collectively, these sites implemented more than 85 activities across ten states.

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9 FY 2010 Cooperative Agreement Notice (CAN) for the *National Needs Grant: Summer of Innovation Pilot* (announcement NNH10ZNE004C, January 27, 2010, p.11).

10 *About the Summer of Innovation Pilot*. Retrieved on October 26, 2010, from http://www.nasa.gov/offices/education/programs/national/summer/about/index.html

11 SoI Planning Meeting Handout, April 2010, p. 4.

12 FY 2010 Cooperative Agreement Notice (CAN) for the *National Needs Grant: Summer of Innovation Pilot* (announcement NNH10ZNE004C, January 27, 2010, p.14).

13 FY 2010 Cooperative Agreement Notice (CAN) for the *National Needs Grant: Summer of Innovation Pilot* (announcement NNH10ZNE004C, January 27, 2010, p.12).

The expectations for the NASA Centers were different, reflecting the fact that they had fewer resources and were operating under tighter time constraints; Centers were not required to provide professional development activities nor did they necessarily need to provide follow-on activities during the academic school year. Instead, NASA provided more explicit guidance on the number of programming hours that student activities should provide – a minimum of 40 total contact hours, 30 STEM content hours, and 7.5 NASA content hours. Under these guidelines, the NASA Centers formed about 135 partnerships with youth and community organizations, federal agencies, industries, nonprofits, churches, institutions of higher education, and elementary and secondary schools, to provide more than 150 activities nationwide.

Furthermore, NASA maintained an open call for entities interested in incorporating NASA content into their existing non-NASA summer learning experiences during summer 2010. Although no funding was provided to the open call participants, they could access grade-appropriate NASA products and associated online professional development training on selected products.[14]

Organization of the Report

The organization of the subsequent chapters of this report is as follows. Chapter Two provides a description of the pilot evaluation's purpose and approach. Chapter Three describes the program models and activities implemented in the SoI pilot. Chapter Four presents the survey data collected from the NASA Center Partnerships. Chapters Five and Six discuss the sites' successes and implementation challenges. Chapter Seven focuses on the lessons learned by the pilot's national evaluation. Chapter Eight concludes with recommendations highlighting the key lessons learned and promising practices acquired during the pilot period.

Definition of Key Terms

Below we define the following terms used throughout the report:

- SoI sites: the eleven entities included in the national evaluation (e.g., Massachusetts Space Grant Consortium or Camp KSC) that entered into agreement with NASA to implement SoI.

- SoI activities: the individual program models at the SoI sites (e.g., Da Vinci Divas, a one-week camp for focusing on the seven principles of Da Vinci, implemented by the Massachusetts Space Grant Consortium). Note: only six of the more than 150 NASA Center partnership activities are included in the national evaluation of the pilot.

- SoI locations: the individual places where the SoI activities were implemented (e.g., Wyoming Space Grant Consortium's Casper site). Note: because some activities occurred only in one location, an activity and location may be one and the same in some instances.

[14] SoI Planning Meeting Handout, April 2010, p. 4.

Chapter 2. SoI Pilot National Evaluation

The SoI pilot project involved a combination of evaluation and assessment activities, including the cross-site national evaluation, benchmarking and “lessons learned” assessments, and NASA monitoring activities for Government Performance and Results Act (GPRA) reporting. All of these activities occurred during the pilot period. Furthermore, the Space Grant and the Sub-Award sites conducted local evaluations. These efforts were intended to inform the sites’ and NASA’s planning and management of subsequent SoI implementations while enabling NASA to meet its reporting obligations to the Office of Management and Budget (OMB). The national evaluation differed from the other SoI assessment and monitoring activities in that it examined data collected from across the 11 sites and paid special attention to the challenges encountered in evaluating the project.

Objectives for the SoI Pilot National Evaluation

The national evaluation was initially limited to examining teacher and student outcomes across the four awarded Space Grant sites and supporting sites’ local evaluation efforts. However, as plans for SoI expanded in the spring, so did the national evaluation’s scope to involve the Sub-Award and selected NASA Center Partnerships. During the pilot year, the national evaluation included SoI activities across 11 states (FL, ID, IL, LA, MA, MT, NM, OH, TX, UT, and WY), involving 6,734 students and 543 educators. Specifically, 11 sites participated in the national evaluation: all Space Grant activities, a subset of all 150 NASA Center Partnership activities, and a subset of the Sub-Award’s 75 activities that were implemented across 10 cities (Chicago, IL; Los Angeles, CA; Orlando, FL; Detroit, MI; Cleveland, OH; Columbus, OH; Dayton, OH; Toledo, OH; Youngstown, OH; and Sharon, PA; Exhibit 1). It focused on six NASA Partnerships selected to provide a variety of approaches and models as examples of these efforts. It also concentrated on the Sub-Award’s implementation in Chicago, its self-identified model city.

Exhibit 1. National Evaluation Sites

Site Name	Students[a]	Educators	Number of Activities: Student	Number of Activities: Educator
All National Evaluation Sites	6,734	543	41	16
Idaho Space Grant	270	135	2	2
Massachusetts Space Grant	742	127	7	5
New Mexico Space Grant	2,799	135	1	1
Wyoming Space Grant	595	39	1	1
Paragon TEC (Chicago only)	1,525	67	31 activities (counts for student or educator not clear)	
Camp KSC	265	0	1	0
GEAR Up Explorer I	54	0	1	0
Miami-Dade	97	8	1	1
Galena Park	174	10	1	1
Chicago Parks	128	0	3	0

[a] These are the counts of students who started the summer activities, which may be different than the number who completed them.

Sources: Site reports and the national evaluation reporting forms.

As SoI plans for summer 2010 developed, it became clear that there was not a single program model across the grantees, but rather, sites were planning to use considerably different activities that varied both in intensity and duration. The short amount of time available for planning also resulted in less centralized planning and coordination to ensure greater consistency across sites. Taken together, these factors indicated that an impact evaluation of SoI would be premature, even though NASA was eager to measure SoI's effects. Instead, the program was well-situated to benefit from a formative evaluation focusing on implementation.

Accordingly, the national evaluation refocused on four key objectives: to describe how the SoI pilot activities were implemented, discern lessons learned, identify promising practices to inform SoI planning, and generate hypotheses to be examined in future evaluation phases.

Our key evaluation questions were:

1. What were the key characteristics of the SoI activities implemented during the pilot?
2. What successes were encountered during the pilot? How might these successes be repeated?
3. What challenges were encountered during the pilot? How might these be avoided in the future?
4. What are the pilot's implications for the next phase of the SoI project and evaluation?

Design of the SoI Pilot National Evaluation

We used a process evaluative approach to explore the different activities implemented as part of the SoI pilot, as well as to identify the successes achieved and challenges encountered. Three key data sources were used: reporting forms, "technical assistance" communications, and participant surveys. Each is described below.

National Evaluation's Reporting Forms

We created two reporting forms to collect consistent implementation data from the sites: a planning and an implementation form (Appendices A and B, respectively). Sites provided information on the key program elements emphasized in SoI discussions and materials, including participant grade levels, content of student activities and professional development opportunities, the NASA content used, and the planned follow-on activities including both the programmatic and evaluation (tracking) efforts. They also provided information about operational elements, such as the total contact hours, attendance, participant attrition, staff, and funding. The data elements included on these forms were purposively limited as we planned to solicit details in subsequent telephone conversations to be held after the activities ended.

The *Planning Reporting Form* was designed to be completed before implementation to provide a "baseline" for the pilot; sites implementing multiple activities were to complete this form for each activity. In practice, however, many SoI activities had already started by the time the forms were available. Consequently, we pre-populated these forms using program documents, such as proposals, which were created prior to implementation. Local evaluators or SoI points of contact then reviewed the *Planning Reporting Forms*, filling in missing data based on their intentions prior to actual implementation.

Sites completed the *Implementation Report Forms* for each activity's location once summer activities concluded. These forms typically could not be filled out by the local evaluator or the NASA point of contact as these individuals were not usually onsite with the activities. Instead, in most cases the local evaluator or NASA point of contact sent the form to the site's local coordinators; the sites returned them to their local evaluators who then submitted them to the national evaluation team.

Towards the end of the summer, NASA asked the sites to complete its Office of Education Performance Measurement (OEPM) activity forms for the agency's GPRA reporting requirements. Because the OEPM activity and *Implementation Reporting Forms* were similar, the two were combined, with NASA's permission, to reduce sites' reporting burden. Accordingly, not all sites completed free-standing implementation forms but instead submitted combined forms.

National Evaluation's "Technical Assistance" Calls

The national evaluation team provided technical assistance to local evaluators (at the Space Grant Consortium and the Sub-Award sites) and program administrators or NASA points of contact (at the NASA Center Partnership sites) to facilitate participation in the national evaluation. Through regular phone calls and emails, we supported the sites' administration of the national evaluation's surveys and completion of the reporting forms. During these calls, the sites discussed their summer activities, challenges they had encountered, and the successes achieved. (See Appendix C for the technical assistance agenda.) These interactions produced information about the summer activities and how they were implemented, and also provided insight into the feasibility, appropriateness, and potential challenges involved in conducting a future impact evaluation of SoI.

As soon as it was feasible after the summer activities concluded, members of the Abt-EDC team conducted a *Post-Implementation Debrief* with the sites. Sites reflected on the summer's experience, overall and then in terms of specific areas including recruitment, retention, activities (planned vs. actual), plans for follow-up activities, partnerships, staffing and management issues, NASA resources/content used, funding, and budgeting. Topics covered in this conversation included the challenges sites encountered, the successes they achieved, and their recommendations for future SOI implementations. (See Appendix D for the post-implementation debrief protocol.)

National Evaluation's Participant Surveys

We designed two sets of baseline and follow-up surveys, one for students and one for educators, to measure outcomes of the pilot SoI summer activities and to test for promising practices (see Appendices E –H; justifications for the items are included in Appendices I and J). Experts reviewed the student and educator instruments for content validity and clarity and NASA's Office of Education (OE) staff reviewed them for fit with SoI objectives.

Student Surveys

Student surveys focused on key outcomes that were (1) central to SoI's vision and (2) applicable across all sites. Our survey development process was informed by reviews of relevant literature (including existing instruments) and NASA review and approval; the highest priority was to identify instruments with strong evidence of validity and reliability that could assess a wide range of student affective outcomes, as well as instruments that could be used among students of varying reading abilities and across a diversity of settings. Because of the substantial variation in content across the SoI activities, we did not identify measures for content knowledge; assessments of these measures were deferred to the sites.

Measures of student interest and self-confidence in science with established psychometric properties (i.e., those whose validity and reliability had been established among similar students) were found and easily modified to also measure students' self-confidence in math. Specifically, two student instruments meeting these requirements were identified: *Modified Attitudes Towards Science Inventory (MATSI)*[15] and *Test of Science Related Attitudes (TOSRA)*[16]. We selected items from these instruments, adjusting wording for reading-level considerations (as necessary) to produce student surveys measuring four constructs: student self-confidence in science, student self-confidence in math, student career interest in STEM, and student leisure interest in STEM. Items asked respondents to indicate their agreement with statements on a Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). For example, the surveys asked students the extent to which they agreed/disagreed with statements like "I do not do very well in science" and "A job as a scientist would be interesting." The same items were included on both the baseline and follow-up surveys to allow for measurements of change occurring between the start and end of the summer activities. We purposively omitted similar scales for technology and engineering, both because the distinctions between those fields and broader science fields may not be readily apparent to middle schoolers, and because we were concerned about the survey's length.

Educator Surveys

We focused the educator surveys on outcomes related to teacher practices relevant to middle school classroom instruction, using a similar process informed by relevant literature and regular NASA review. We found two instruments: *Science Teacher Efficacy Believe Instrument (STEBI)*[17] and *Horizon National Survey of Science and Math Education*[18] and selected items related to five constructs: personal science teaching efficacy; science teaching outcome expectancy (i.e., the extent to which teachers believe that certain behaviors lead to improved student outcomes); use of traditional teaching practices; use of strategies to develop students' abilities to communicate ideas; and the use of laboratory activities. As with the student surveys, the educator instruments asked respondents to indicate on a Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree) the extent to which they agreed/disagreed with statements such as, "I am continually finding better ways to teach" and "Even when I try very hard, I don't teach science/math well." Again, the same items were included on both the baseline and follow-up surveys to assess whether any changes occurred as the activities were implemented.

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15 Weinburgh, M..H., & Steele, D. (2000). The Modified Attitudes Toward Science Inventory: Developing an instrument to be used with fifth grade urban students. *Journal of Women and Minorities in Science and Engineering* 6, 87-94.

16 Fraser, B.J. (1981). *Test of Science Related Attitudes (TOSRA)*. http://ret.fsu.edu/Files/Tools/TOSRA_2.doc, accessed on 8/12/2010.

17 Riggs, I., & Knochs, L. (1990). Towards the development of an elementary teacher's science teaching efficacy belief instrument. *Science Education* 74, 625-637.

18 Weiss, I.R., Banilower, E.R., McMahon, K.C., & Smith, P.S. (2001). *Report on the 2000 National Survey of Science and Math Education*. Horizon Research, Inc. www.horizon-research.com.

SoI Pilot National Evaluation's Data Collection

National Evaluation Forms Compliance Rates

Of the 239 student and educator locations, 145 (61%) across the 11 sites submitted implementation reporting forms.[19] The NASA Center Partnerships and the Idaho Space Grant Consortium submitted forms from all locations, and Wyoming Space Grant Consortium submitted data from 91 percent of its locations. Two sites –those with the greatest number of locations –submitted implementation data from fewer sites: 65 percent of Paragon TEC's 31 Chicago locations and 46 percent of New Mexico Space Grant Consortium's 136 locations did not submit implementation reporting forms. Exhibit 2 summarizes the data available from each site.

Exhibit 2. Summary of Data for the National Evaluation Across Sites

Site Name	Participated in TA Calls	Total Locations (student and teacher activities)	Locations in National Evaluation	Locations Submitting Implementation Forms (%)	Student Surveys (Response Rate %)	Educators Surveys (Response Rate %)
Idaho Space Grant	yes	12	12	12 (100)	Baseline & follow-up (16)	Baseline & follow-up(78)
Massachusetts Space Grant	yes	33	33	23 (70)	Follow-up (30)	Follow-up(36)
New Mexico Space Grant	yes	136	136	73 (54)	Baseline & follow-up (46)*	Baseline (95)*
Wyoming Space Grant	yes	11	11	10 (91)	Baseline & follow-up (92)	Baseline & follow-up (22)
Paragon TEC	yes	10 cities	31 (in 1 city)	11 (35)	NA	NA
Camp KSC	yes	8	3	3 (100)	Baseline & follow-up (91)	NA
GEAR Up Explorer I	yes	4	1	1 (100)	Baseline & follow-up (2)	NA
Miami-Dade	yes	4	4	4 (100)	Follow-up (80)	Follow-up (40)
Galena Park	yes	2	2	2 (100)	Follow-up (64)	Follow-up (73)
Chicago Parks	yes	5	3	3 (100)	None	NA
Cincinnati GEAR UP	yes	3	3	3 (100)	Follow-up (24)	Follow-up (100)

* Because parental consent was not obtained for the national evaluators to access individual level data, New Mexico shared the survey results in aggregate form only.

Sources: Technical assistance calls, planning and implementation reporting forms.

Survey Administration

The study's data collection procedures were reviewed by Abt's Institutional Review Board (IRB) to ensure that all data collection activities met standards for obtaining consent. Some specific SoI sites also required the study to obtain local approvals before collecting any survey data. These processes generally entailed distribution of study fact sheets (with contact information for study staff) and consent forms in advance. The study also received OMB clearance in mid July, well after many SoI

19 Four Idaho Space Grant Consortium locations are excluded from our analyses of the implementation data; three will be implementing their programs in fall 2010 and one was missing almost all data.

sites had begun activities. As a result, most sites were only able to administer follow-up surveys rather than the intended baseline plus follow-up surveys.

The survey responses for the participating NASA Center Partnerships and the Space Grant Consortiums, except for New Mexico, are available in electronic form; accordingly, this report discusses surveys administered at these sites. Challenges with data collection resulted in completed surveys from 43 percent of the national evaluation's students and 45 percent of educators.

Analytic Approach

Qualitative Data Analysis

We uploaded the notes from our calls, the planning and reporting forms, as well as any additional project materials into NVivo, a qualitative analysis software program that facilitates the search and retrieval of qualitative data. All documents were coded based on the program's elements and issues of critical interest to NASA. See Appendix K for the coding scheme. The content of text associated with a given code was carefully reviewed to produce concise descriptions of the various activities as well as distill lessons learned and promising practices.

Quantitative Data Analysis

Our quantitative analysis used data extracted from the national evaluation's implementation reporting forms and surveys from the NASA Center Partnerships and three of the four Space Grant Consortiums. We calculated values for the overarching student and educator constructs by averaging responses to individual items related to the measure, given that a minimum threshold of the items had non-missing data. We examined cross-tabulations, percentages, means, and ranges. We examined the data across all sites as well as within a site-type (e.g., all Space Grant Consortiums), and by site (e.g., Cincinnati GEAR UP) where feasible.

Limitations to the Pilot Evaluation's Approach

The simultaneous launch of the SoI Project and the national evaluation led to some challenges for the study, due primarily to issues with timing. The study was not able to collect baseline data, and in many cases, programs began implementing activities as the design for those same activities were still being finalized. Consequently, the study neither has baseline data with which to compare end-of-pilot data nor data on fully-implemented programs. Further, the proportion of sites with completed baseline and follow-up surveys that we could analyze is small (i.e., the data from the NASA Center Partnerships constitute 5 and 6 percent, respectively, of the students and educators served), which means that we cannot have confidence that the responses received are representative of the larger populations of students and educators who participated. Another challenge is that the study team relied upon intermediaries to provide information and help with data collection activities. In light of these issues, the evaluation –of necessity—has focused on understanding the approaches sites used, the challenges sites faced, and how the issues experienced during the 2010 pilot year could be avoided or overcome in the future.

Chapter 3. SoI Pilot Activities

Between May and August 2010, and most frequently in July 2010, the SoI evaluation sites provided a variety of STEM-focused learning experiences for educators and students. In total, they offered 50 student and 15 educator activities. Programs' goals were comparable, yet their funding, structure, program models, as well as the strategies used to manage them, varied significantly across the 11 sites. We describe these variations, as well as the similarities, in this chapter.

The descriptions and statistics we present herein are based on the implementation and planning forms, and our conversations with sites. For our analyses across locations, we weighted each site according to its average population size so that larger sites receive more weight, as the site mean is likely to be a better estimate than the overall SoI population mean.

Note that many of the analyses exclude Paragon TEC, a Sub-Award site, which did not provide planning forms and submitted OEPM activity forms for 10 of its 31 Chicago locations. It also declined to answer specific questions about its models, due to concerns about protecting its intellectual property. This site served nearly one-quarter (22%) of the SoI participants within the national evaluation.

Sites' Goals & Objectives

Exhibit 3 provides an overview of the student and educator activities that were offered within each site included in the evaluation. Most sites sought to engage a diversity of students in STEM activities and NASA's mission. All aimed to increase students' STEM understanding and comfort with the topics, encouraging them to pursue further STEM studies and increase their awareness and interest in STEM careers. One Space Grant Consortium reported, "[Our goals and objectives are] to show [the students] that learning STEM can be really engaging, interesting, and useful…and to retain girls' interest in these fields. To make them see that engineering is 'modern day magic' and that they are on a trajectory of young people doing amazing science and engineering projects." Some activities also intended to build students' communication, team-work, and leadership skills as well as their research and lab-safety practices.

The general goal of the educator activities was to develop their STEM-related pedagogical skills that they would bring back to the classroom to improve their STEM instruction. However, sites had varied objectives. Ninety-one percent of locations with professional development activities were designed to engage the instructors who would lead their summer activities; as a result, around half of the participating teachers led instruction during the student summer activities.

Exhibit 3. Activities at Sites Participating in the SoI National Evaluation		
Site Name	**Student Activities**	**Educator Activities**
Idaho Space Grant	Three traveling teams comprised of university faculty and undergraduate / graduate students brought a one-week camp to remote locations on Tribal reservations and areas that have a large migrant, Hispanic population spread across 3 states – ID, MT, and UT. Camps addressed scientific and engineering topics through rocketry, cosmology, robotics, and Earth science	Provided four-day professional development training to educators at locations across three states – ID, MT, and UT; university faculty and NASA's AESP (Aerospace Education Service Project) staff provided hands-on examples of how NASA educational materials can be used in the classroom
Massachu-setts Space Grant	Implemented seven activities across the state in partnership with organizations such as Girls, Inc. of Worcester and the Christa McAuliffe Center at Framingham State University; each activity engaged students in 1 to 4 week camps that focused on a variety of topics including robotics, engineering design, and aeronautics	Offered six educator activities; one project developed a middle school classroom instructor development program which will be used in Boston Public Schools (fall 2010) while five focused on preparing educators for implementing the summer activities
New Mexico Space Grant	Held 135 summer camps across NM during which students participated in several experiments related to rocketry and engineering and worked as a team to design a science experiment; 20 teams were selected as having the "best" experiment design will build their experiment in the fall 2011 for the *Spaceport America* launch in April 2011	Provided a one-week professional development training for educators, during which teachers were engaged in hands-on activities and discussions about the curriculum and standards to be implemented during the student camps. All teachers were provided supplies and a manual for leading the student program.
Wyoming Space Grant	Implemented 10, 4-week wind energy summer camps to middle school students across WY; provided opportunities for relevant learning and practical applications of the lessons through interactive hands-on experiences about energy and climate science	Held a 4-day intensive workshop for educators to provide training on NASA materials and camp logistics
Paragon TEC	Provided 65 student activities across 10 cities that provided summer learning experiences using thematic units such as rocketry, meteorology, aviation, and robotics were delivered to students in a series of one-to four-week sessions	Provided professional development activities to teachers in one- to three-day sessions of training in NASA thematic units prior to the student activities, and then delivered the units to the SoI students in the camps; professional development also prepared teachers for infusing NASA content into their classroom teaching
Camp KSC	Provided fully paid scholarships for underserved/ underrepresented/ underperforming students to participate in Camp KSC, which infused NASA content into eight one-week programs implemented over the summer; student activities included the BEST (Beginning Engineering, Science, and Technology) curriculum, launch and landing simulations, multi-axis trainer, Micro-G wall, and field trips to Kennedy Space Center	None

Exhibit 3. Activities at Sites Participating in the SoI National Evaluation		
Site Name	**Student Activities**	**Educator Activities**
GEAR Up Explorer I	Implemented four week-long sessions during the summer at Louisiana Tech to strengthen students' math and science skills and promote leadership development; activities included leadership training, multimedia activities, science classes, and afternoon tutoring	None
Miami-Dade	Provided one week summer camp experience utilizing the Cosmic Connection to the Universe and Robots thematic units; also exposed students to STEM professionals to help increase awareness about possible STEM career opportunities	Provided teachers training using NASA content so they could implement the student activities
Galena Park	Provided students with seven days of summer camp during which they focused on aeronautics, engineering design, space science, and robotics; students participated in experiments including the parachute activity with an egg, wind tunnel simulations, and building a wood glider	Provided teachers training using NASA content so they could implement the student activities
Chicago Parks	Implemented three separate activities, one focusing on space exploration, one using NASA's Imagine Mars curriculum; and one in robotics	None
Cincinnati GEAR UP	Offered two-week summer camp that infused aeronautics and life content with NASA content to provide innovative experiments and hands-on activities to engage students in STEM	Provided teachers training using NASA content so they could implement the student activities

Sources: Technical assistance calls, planning and implementation reporting forms, and NASA staff.

SoI Pilot Funding

Excluding the Sub-Award's programs in Chicago, the national evaluation sites received a total of $5,431,050 in SoI funding. On average, this represents $955 per participant (both students and educators),[20] however, the amount available at each site varied widely, ranging from $0 to $2,143, as illustrated in Exhibit 4. Space Grant Consortium sites received more than ten times more NASA funding per participant ($1,103) than the NASA Center Partnerships ($107 per participant) and more than three times as much as the Sub-Award (on average, $459 per participant).[21] The amounts indicated per participant at the NASA Center Partnerships underestimate the total amount of NASA funding for these activities as these figures do not include the salaries of the NASA employees who were involved in the management of the activities to a various extent; this information was not available to the evaluators.

[20] Funding per participant was calculated by dividing the total number of students and educators participating at a site by its total SoI funding. The funding amounts for the NASA Center partnerships do not include the salaries of the NASA staff who were involved and consequently, underestimate the true expenditure per participant.

[21] Paragon TEC did not provide the amount of funding at its Chicago locations; instead, we estimated the site's per participant funding by dividing its total funding ($2 million) by the total participants across the ten cities (4,359 participants).

Most of the sites (8 of 11) also received funding from additional sources, typically from partnering organizations. It seems that the NASA Center Partnerships relied on their partners for funding more than the other sites; two of the selected NASA Center Partnerships reported not receiving any SoI funding and one reported only nominal funding.

Exhibit 4. Level of SoI Funding Across Sites

Site Name	Students Reached	Educators Reached	Total Funding ($1,000s)	SoI $ per Participant
Idaho Space Grant	270	135	$868	$2,143
Massachusetts Space Grant	742	127	$1,524	$1,754
New Mexico Space Grant	2,799	135	$1,999	$681
Wyoming Space Grant	595	39	$950	$1,498
Paragon TEC all locations[a]	4,071	288	$2,000	$459
Camp KSC[b]	265	0	$70	$264
GEAR Up Explorer I[b]	54	0	$0.25	$5
Miami-Dade[b]	97	8	$19	$181
Galena Park[b]	174	10	$0	$0
Chicago Parks[b]	128	0	$0	$0
Cincinnati GEAR UP[b]	85	22	$0.80	$7

[a] Because we did not know how much funding was allocated to Paragon's Chicago implementation, we used the total funding it received and the total number of participants to calculate the $ per participant. The Chicago location served 1,525 students and 67 educators.

[b] The funding amounts for the NASA Center Partnerships do not include the salaries of the NASA employees who were involved in managing and/or implementing the activities. As such, the figure underestimates of the true cost to NASA.

Sources: Technical assistance calls, planning and implementation reporting forms, and NASA staff.

Management of SoI Activities

Sites managed their activities in a variety of ways, including how they structured themselves, the roles fulfilled by their partners, and their staffing strategies. Furthermore, while their recruitment efforts were similar across activities, the participants differed as well.

Structure of Pilot Activities

As indicated in Exhibit 5, the number of program activities and implementation sites varied widely. While the Sub-Award (Paragon TEC) reported using 31 activities in Chicago, most sites provided only one student and one educator activity. In addition, all but three sites also provided educator activities. The number of activity locations also differed across sites, with five sites having more than 10 locations and five having three or fewer.

Duration of the activities also varied. The student activities ranged from a little less than one week to a maximum of five weeks, with an average of three weeks. The student activities at the Space Grant Consortiums lasted the longest on average (3.5 weeks), followed by the Sub-Award activities (average of almost 2 weeks), and the NASA Center Partnerships (1.5 weeks). Most locations provided an average of 30 total contact hours, with a minimum of 12 and a maximum of 40 hours. The educator activities spanned from 1 to 15 days, typically lasting 3 to 5 days. Massachusetts Space

Grant Consortium locations were unique in their approach to professional development, as they provided educators three times more training days (14 to 15 days) than the average site.

Student activities generally ran continuously, although only some educator activities did so. Some offered follow-on educator activities after their student activities had ended while others provided professional development on a weekly or monthly basis.

Exhibit 5. Structural Elements of Sites' Implementations

Site Name	Number of Student Activities	Number of Educator Activities	Site Locations	Student Activity Duration (days)	Education Activity Duration (days)
Idaho Space Grant	2	2	12	3–5	2–5
Massachusetts Space Grant	7	4	33	3–25	1–15
New Mexico Space Grant	1	1	136	17.5	4
Wyoming Space Grant	1	1	11	20	4.5
Paragon TEC (Chicago only)	(not clear how many student or educator)		31	4–20	0.4–1.5
Camp KSC[a]	1	0	3	5	N/A
GEAR Up Explorer I	1	0	1	5	N/A
Miami-Dade	1	1	4	5	3
Galena Park	1	1	2	5	2
Chicago Parks[b]	3	0	3	17.5–20	N/A
Cincinnati GEAR UP	1	1	3	10	5

N/A: Site did not implement educator activities.

[a] Camp KSC offered 8 one-week sessions; three of these were included in the national evaluation.

[b] Chicago Parks implemented multiple activities but only 3 were included in the national evaluation due to time constraints.

Sources: Technical assistance calls, planning and implementation reporting forms, and NASA staff.

Partnerships

Partnerships were key to the pilot SoI implementation: across the 11 sites, at least 75 different partner organizations were involved, including non-profit organizations and institutions of higher education (universities and community colleges), churches, museums, local, state or federal government organizations, school districts, and other NASA projects or Visitor Centers. Space Grant Consortiums were more likely to have university partners than either the Sub-Award or NASA Center Partnership sites.

The partnering organizations fulfilled a wide variety of roles, frequently hosting the summer activities, recruiting students and teachers, providing student curriculum, and assisting in the planning and coordination of student activities. At the NASA Center Partnership sites in particular, partners ran the student activities themselves (except for Camp KSC) and a few provided the professional development. Partners also contributed food, materials, equipment, transportation, volunteers, field trip activities, guest speakers, and provided additional funding at 8 of the 11 sites.

Staffing

Across the sites, 609 staff were employed in the student activities, including 288 teachers, 13 professors, 204 undergraduate and graduate students, 9 interns, and 48 "other" employees, commonly informal educators but also aides addressing students' special needs (e.g., translators and nurses).[22] Reporting locations averaged about 16 students per staff member, with 43 students per staff member on the high end (Massachusetts' Talented & Gifted Latino Program and Youth Astronomy Apprentices) and one student per staff member on the low end of the range (Idaho's Blackfoot location). Generally, student-to-staff ratios were higher in Space Grant Consortium sites than in the Sub-Award and NASA Center Partnership sites.

Three-quarters of the camp's staff were classroom teachers, consistent with the SoI focus of bringing classroom teachers into the summer programs. Generally, the Space Grant Consortium sites employed more teachers than the Sub-Award and NASA Center Partnerships. New Mexico Space Grant Consortium and Cincinnati employed the largest percentage of classroom teachers relative to the rest of their staff (100% and 85%, respectively), in contrast to GEAR UP Explorer I and the Massachusetts Space Grant Consortium, whose staff included fewer than 15 percent teachers.

The majority of locations reported information on the number of staff involved in their educator activities, ranging from 1 to 19 across with an average of 9. New Mexico's educator activities included the largest staff (19), while Miami had the least (2). Further, Space Grant Consortium sites tended to have more help, on average, from outside staff than the NASA Center Partnership sites. Educator activities were often conducted with staff from a partner organization; these partners included NASA's Aerospace Education Services (AESP), Wyoming's Department of Education, Regional Science Resource Center, NASA's JSC White Sands Test Facility, and Duke Energy.

Participant Recruitment

Sites reported using a variety of approaches to recruit students and educators. Many used their partners' existing networks, schools, and teachers to identify good candidates and provide materials. Most sites distributed flyers and brochures while some sent emails and made phone calls directly to students. One site reported using Craigslist and another reported posting a notice on the school district's website. Some sites targeted their approach: a couple used the class rosters for a future engineering and physics class or the school's "Scholar's Academy", a group of high-performing students identified through their 5th grade test score results. Educators were recruited with similar flyers and phone calls. In addition, sites reached out to school administrators of low-performing schools, sent out emails to teacher listservs, and worked their partners' networks to spread the word.

Student Participants and Participation Rates

Although some recruitment efforts were directed at students outside the targeted SoI participant groups, sites recruited a wide range of underrepresented and underserved students as substantiated by both the implementation reporting forms and the student surveys (see Chapter 4). Participating students were in grades 3 through 11 and came from urban areas such as Boston, Miami, Houston, and Chicago, as well as from harder to reach rural communities and tribal reservations in states

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22 Note that these figures differ from the educator counts provided in Exhibit 1, as some of the staff who worked with the students did not participate in the educator activities. Also, we found that the counts reported by the sites across the various forms and in conversations were not always consistent.

including Wyoming, Montana, Nevada, and Utah. Low-income students as well as African-American, Latino/Hispanic, and Native-American youth participated.

Reports from 41 locations[23] suggest that students typically attended for the duration of the camp sessions, as the count of students was similar at the beginning and end of the activities.[24] This result corresponds with student reports of high attendance rates on the national evaluation's surveys (see Chapter 4). Location-specific completion rates, however, varied dramatically, ranging from 47 percent to 156 percent (i.e., students joined the activities at some point along its implementation but were not present on the first day). Indeed, two Space Grant Consortiums (Idaho and Massachusetts) ended with more students than they began. According to these sites, this likely occurred because participants would tell their friends about the activities and encourage them to attend.

Educator Participants and Participation Rates

Nearly all sites recruited educators from schools and communities with underserved and underperforming students. One site in particular, the Idaho Space Grant Consortium, specifically recruited minority teachers, focusing on Native Americans and Hispanic/Latino educators.
The classroom teachers who were recruited typically teach math, science, and/or technology subjects at the middle school level. However, a number of sites also welcomed teachers who taught non-STEM subjects, informal educators (e.g., after-school assistants, pre-service teachers), special education, and gifted and talented teachers.

Recruited educators reportedly remained engaged in the educator activities. Although no educator attendance data were available for Cincinnati or Massachusetts, average daily attendance rates reached nearly 100 percent across the reporting locations. Further, 98 percent of teachers present at the start of the PD activity were present at the end, with only Miami reporting a high attrition rate (50 percent).

Site's Program Models

Sites used multiple program models for both the student and educator activities (see Exhibit 5 on p.18). Across the student activities, seven sites provided one model, while two implemented more than five models. One site – the Sub-Award – implemented 31 different models in Chicago alone and overall, used 75 models across its 10 cities. Sites commonly used one model to provide professional development for teachers, however, a few used as many of five.

Models were distinguished by their phase of development (e.g., how long they had been previously implemented), content, activities used, and the number of STEM content hours provided. Further, as demonstrated in Exhibit 6, the student program models were also differentiated by whether they included a parent component.

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23 Thirteen locations are excluded because of data availability.

24 Caution is warranted when interpreting this result: we do not know whether students who began the program are the same students who finished, as the forms asked for counts (not names).

Exhibit 6. Sites' Program Models

Site Name	Program Maturity (Years)	Content Focus	Total Student STEM Hours	Parent Component
Idaho Space Grant	0	Space exploration, aeronautics, earth science	12–25	Y
Massachusetts Space Grant	0–25	Human physiology, physics, engineering design, earth science, technology, mathematics, physical science, aeronautics, astronautics, space exploration, molecular biology, robotics, computer programming	21–156	Y & N
New Mexico Space Grant	0	Rocketry	40	Y
Wyoming Space Grant	0	Climate change and energy	58–112	N
Paragon TEC (Chicago)	0	Rocketry, meteorology, aviation, robotics, and other STEM areas	20–60	N
Camp KSC	18	Engineering design process	38	Y
GEAR Up Explorer I	8	Math and science	38	N
Miami-Dade	8	Earth science; Force and motion; energy; physical science	38	Y
Galena Park	0	Aeronautics, Engineering & design; robotics	35	N
Chicago Parks	0	Space exploration and robotics	28–46	N
Cincinnati GEAR UP	0	Aeronautics	70	N

Sources: Technical assistance calls, planning and implementation reporting forms, and NASA staff.

Models' Stage of Development

Both the educator and students activities were typically new: 81 percent of the locations implemented new programs, including all Sub-Award locations and the majority of Space Grant Consortiums. Most of the NASA Center Partnerships, as well as a few locations included in the Massachusetts Space Grant Consortium site, used existing programs at one or more of their locations.

Four sites, however, infused NASA content into pre-existing models that had been developed at least 8 years ago. For example, the Massachusetts' Talented & Gifted Latino Program and Youth Astronomy Apprentices Space Grant site used a program that had existed for 25 years and Camp KSC, a NASA Center Partnership, has been in operation for 18 years. Most of the time, where sites used pre-existing program models, all of the students who participated were part of the overall SoI project. Camp KSC, however, took a different tactic and provided camp scholarships, whereby the SoI students participated alongside students paying a full fee.

Content and Use of NASA Resources

The content of the activities were typically interdisciplinary, frequently combining engineering (e.g., mechanical, astronautics, aeronautics, systems, electrical) with space science, physics, and technology. To a lesser extent, activities drew on the fields of mathematics, chemistry, and biology (e.g., physiology, molecular biology). The locations utilized NASA content to varying degrees, from a minimum of 5 to a maximum of 125 hours for an average of 41 hours. During this time, key resources for the sites included NASA's website, its videos and DVDs, podcasts, educator guides, and curricula. The specific NASA curricula used varied tremendously across sites. Examples include "Imagine Mars", "Robotics Explore", "Space Math I", "Getting Dirty on Mars", and "Building a Moon Habitat." Some sites reported using content from several NASA education projects including Science, Engineering, and Aerospace Academy (SEMAA), Beginning Engineering Science and Technology (BEST), Aerospace Education Services Project (AESP), and Aerospace Education Lab (AEL). Sites used additional NASA resources as well, including NASA facilities, NASA visitor and educator resource centers, and personnel. For instance, several sites arranged for visits from or videoconferences with NASA personnel such as scientists and NASA education staff.

Activities

Sites implemented two types of student activities, STEM-specific and more general youth development. Multiple STEM-specific activities were provided. Sites frequently reported using inquiry-based, hands-on activities or experiments, during which students built gliders, model rockets, motorized skate boards and cars, and LED computer displays, among other things. Engineering design challenges and competitions were also offered, leveraging students' natural competitiveness to further engage them. Sites also provided students with more typical "educative" activities including lectures covering the key concepts explored through hands-on work as well as tutoring. Some locations held STEM-specific special events, involving STEM professionals as guest speakers and/or were the summer activities' culminating competitions. Lastly, field trips were especially popular, through which students experienced science operating in the "real world" and accessed STEM resources not available in their schools. These included visits to NASA facilities, science museums, observatories and planetariums, weather stations, and an IMAX theater to watch "Hubble."

In the educator activities, participants typically received a brief overview of the program followed by training in STEM education related to the theme of the student program. Activities usually focused on engaging teachers in several hands-on activities and experiments to facilitate their learning of the material and prepare them for leading their own students through the activities. One Space Grant Consortium specifically taught teachers how to do hands-on activities at a minimal cost: "For the teacher training, I have a term: cheap science. Having teachers know they can do stuff with a really low budget. We have a teacher who implemented a community science camp, and the whole thing costs less than $400 a year…We realized that in the communities we work in, teachers don't have the funds and in a lot of places don't have close access to stores where they can buy the materials."

Some sites used educator activities to develop lesson plans and practice presenting the materials to the group to get feedback and coaching from the staff. Nearly all sites provided teachers with a take-home manual or kit that contained materials and resources that they had used during the week.

Total STEM Content Hours

Because we found that sites were confused by the meaning of "NASA content" and likely did not report the NASA content hours consistently, we focus our analysis on the reported STEM content hours. Across the sites reporting, over half (58%) of the student activities time was devoted to STEM, ranging between 7 and 156 hours. Generally, the Sub-Award and NASA Center Partnerships spent more of their time using NASA resources and focusing on STEM content than the Space Grant Consortium sites. The Sub-Award and three NASA Center Partnerships, Camp KSC, Cincinnati GEAR UP, and Miami Dade, reported focusing on STEM content 100% of time.

Similarly, locations reported using most of the educator activity time to focus on STEM topics, with locations devoting 91 percent of the total contact hours to STEM.[25] Across sites, Massachusetts, New Mexico, and Cincinnati GEAR-UP's educator activities focused solely on STEM topics and only one site, Wyoming, spent less than half of its time on STEM activities.

Parent Component

A few sites, including the Idaho Space Grant Consortium, Camp KSC, Galena Park, and Miami SoI (NASA Center Partnerships) provided opportunities for students' parents to participate. Two other sites indicated that they would have provided these if there had been more planning time. Parent involvement in SoI camps included a required parent meeting prior to camp, kick-off events such as barbeques, invitations to commencement, post-SoI celebrations, and volunteer opportunities such as chaperoning field trips and preparing student lunches.

Plans for Post-Summer 2010 Implementation

Student Activities

Many sites indicated that they are planning to provide students with additional opportunities to engage in STEM activities after this summer: 86 percent of locations planned to provide follow-on activities after the camp. NASA Center Partnership sites generally did not have follow-on plans. Sites planning to provide additional opportunities indicated that they would sponsor SoI –specific events, such as rocket launches, regional and state competitions, and a Forum focused on one or two of the summer's activities. Two of the sites plan to use the fall to implement activities which they had originally planned to administer over the summer, including Wyoming's installation of wind turbines event and additional camps in the fall at three locations in Idaho. Two other sites are planning field trips to Kennedy Space Center to observe shuttle or rocket launches. Yet other sites will capitalize on pre-existing informal STEM programs and activities available to students, including FIRST robotics teams, GEAR UP's Explorer Club, and various science-oriented workshops. The frequency of these planned events varies from once during the school year to quarterly; one site reported monthly opportunities. Some sites plan to provide virtual communities, through Facebook or Twitter, or through a web portal. Usually, the sites plan to use the Internet to facilitate further networking amongst participants; one site is planning to use their portal to share live feeds and video of the turbine sites, as well as share wattage and weather data, which could be used in additional student activities.

[25] Most Massachusetts Space Grant educator activities did not report the total number of STEM hours provided.

Educator Activities

Fewer sites are planning to provide follow-on educator activities, and those that reported having plans provided very few specifics. Some sites reported that they will "follow up" with teachers to see whether they are using the activities in their classrooms by meeting with teachers or conducting online surveys. Others are planning to create virtual communities with the participating educators, to facilitate communication with the program developers. One site plans to provide professional development to educators who did not participate over the summer while others are planning on providing webinars or will post "STEM experiments of the month" for teachers to download.

Participant Tracking

NASA asked that the Space Grant Consortiums and the Sub-Award track their participating students and teachers over the next two years to gather student outcomes (See Exhibit 7). At this point, three of these sites are making plans for accessing student data. One site has initiated contact with schools, and another will access a data system that already collects the relevant data. All are planning to collect test scores, most will also examine grades, and two sites indicate that they will also consider student behaviors as reported using surveys and teacher reports.

Exhibit 7. Student Tracking Across Sub-Award & Space Grant Consortium Sites

Site	Indicators	Source	Status
Idaho Space Grant	Grades, test scores	Not clear	Planning
Massachusetts Space Grant	Test scores	State administrative data	Planning
New Mexico Space Grant	Course taking & career aspirations, grades, test scores	Surveys	Planning
Wyoming Space Grant	Attendance data, grades, proficiencies- math & ELA test scores, behaviors as reported by teachers	Wyoming's Department of Education's 21 CCLC Data System	Implementing
Sub-Award (Contractor)	Grades, test scores	Districts' administrative data	Initiating (working to establish relationships with districts)

Sources: Reports from sites during technical assistance calls.

There are significant challenges to accessing the student test scores and grades housed at the state and district levels (see the August 2010 report, *Considerations and Recommendations for Evaluating SoI's Impact*). Moreover, the test score data that sites plan to obtain may not necessarily exist in science or be consistently available in future grades. Under current federal law, all students are required to participate in math assessments each year between grades 3-8 and in one additional high school grade (as determined by the state). There are currently no comparable requirements for testing students in science. As such, the sites' efforts to track students may face substantial logistical challenges.

The sites' plans for tracking educators are less developed. One site intends to assess changes in teacher instructional practice using surveys and site visits while another plans solely to monitor educators' use of the online resources provided through the virtual learning community only.

Chapter 4. SoI Pilot Survey Results

Sites administered baseline and follow-up surveys, where possible, to participating students and educators during the pilot. In this chapter, we describe what these surveys revealed, including the characteristics of the participants and the similarities and differences observed across sites.

Data from the surveys collected at the national evaluation's NASA Center Partnership sites were available in fall 2010 and data from the Space Grant Consortium sites were received in January 2011.[26] The data from the Space Grant sites differ from those from the NASA Center Partnership sites in two regards. First, most of the Space Grant Consortium sites made changes to the original surveys, omitting and/or changing questions, which affected the extent to which they could be included in cross-site analyses. Second, data from New Mexico were received at the aggregate level because survey consent forms did not authorize the release of individual level information. As a result, we worked closely with New Mexico's local evaluator to receive aggregate results that paralleled analyses conducted at the other Space Grant Consortium sites.[27] When feasible, the aggregated results were combined with results from other Space Grant Consortiums; where this was not possible, results from New Mexico are presented separately. Throughout this chapter we highlight inconsistencies in data availability across sites.

Survey Response Rates

Students completed paper surveys in July and August 2010. In total, baseline and/or follow-up survey responses were received from 2,419 students with parent consent (43 percent of all SoI participants). These included 56 percent of students at NASA Center Partnership sites and 28 percent of students at the Space Grant Consortium sites. The individual NASA Center Partnership response rates were 91 percent at Camp KSC, 2 percent at GEAR UP Explorer I, 80 percent at Miami Dade, 24 percent at Cincinnati GEAR UP, and 64 percent at Galena Park (See Exhibit 8). Given the small response size, GEAR UP Explorer I data (n=1) are included only in aggregate analyses. The individual Space Grant Consortium response rates were 16 percent in Idaho, 30 percent in Massachusetts, 46 percent in New Mexico, and 92 percent in Wyoming.

Across the NASA Center Partnership and the Space Grant Consortium sites with educator activities, two hundred and seventy four educators (45 percent of all educators) completed the national evaluation's surveys in July and August 2010. Among the NASA Center Partnership sites, 40 percent of educators completed the follow-up survey in Miami and 73 percent completed the follow-up survey in Galena Park; 100 percent of educators at Cincinnati GEAR UP responded. Among the Space Grant Consortium sites, 78 percent of educators in Idaho, 36 percent of educators in Massachusetts, 95 percent of educators in New Mexico, and 22 percent of educators in Wyoming

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[26] NASA has not determined whether the surveys collected at the Paragon TEC Chicago locations will be analyzed as it is in the process of understanding what data were collected.

[27] Student surveys in New Mexico were converted into usable data files for students with baseline and follow-up data in the order they were received. Thus, the New Mexico student sample is limited to students who filled out both surveys and whose surveys were first received by the local evaluator. At the time of writing, about half of nearly 2,600 surveys had been keyed in.

completed baseline and/or follow-up surveys. Although our original plans included a baseline and follow-up survey for all educators, two waves of data are available only for Idaho and Wyoming, both Space Grant Consortium sites.[28] Because of small educator response sizes at many sites, the discussion that follows generally focuses on their aggregate results.

Exhibit 8. National Evaluation Survey Number of Respondents and Response Rates

Site	N (Response Rate, %)
All Student Surveys	2,419 (43)
NASA Center Partnership Sites	421 (56)
Camp KSC	226 (91)
GEAR UP Explorer I	1 (2)
Miami Dade	59 (80)
Cincinnati GEAR UP	20 (24)
Galena Park	115 (64)
Space Grant Consortium Sites	1,998 (28)
Idaho	36 (16)
Massachusetts	229 (30)
New Mexico	1,289 (46)
Wyoming	444 (92)
All Educator Surveys	274 (45)
NASA Center Partnership Sites	31 (19)
Miami Dade	6 (40)
Cincinnati GEAR UP	14 (100)
Galena Park	11 (73)
Space Grant Consortium Sites	243 (63)
Idaho	66 (78)
Massachusetts	33 (36)
New Mexico	128 (95)
Wyoming	16 (22)

Sources: 2010 Summer of Innovation Student and Educator Surveys.

Response rates below 70 percent in social science research generally raise concerns that non-response bias might exist and the representativeness of the sample in relation to total populations that participated. The evaluation's response rates are both variable and below 70 percent, indicating that we are not confident that the responses we received are indeed representative. However, they provide illustrative information about those participants that did respond, which in turn can help generate hypotheses for future SoI evaluations.

Survey Analysis

From individual survey item responses, we created composite measures for student and educator constructs by averaging responses to individual items related to the construct; responses on a minimum threshold of the items had to be non-missing.[29] We examined cross-tabulations,

28 New Mexico administered a site specific follow-up questionnaire at the end of their professional development, but these questions were not comparable to those asked in the baseline survey.

29 Over 80 percent of respondents answered all of the items included in the constructs. In New Mexico, however, student survey measures were created only if respondents answered all items related to the construct.

percentages, means, and ranges. In addition to assessing the variables across all sites, we also examined them within a site-type (e.g., all Space Grant Consortiums), and by site location (e.g., Cincinnati GEAR-UP) where feasible. Cronbach's alphas for the four student and five teacher measures are presented in Exhibit 9.[30]

Exhibit 9. National Evaluation Survey Student and Educator Construct Cronbach's Alphas

Measure	NASA Center Partnership Sites		Space Grant Consortium Sites		New Mexico (Space Grant Consortium)	
	Baseline	Follow-up	Baseline	Follow-up	Baseline	Follow-up
Students						
Science self-confidence	0.77	0.82	0.77	0.80	0.76	0.77
Math self-confidence	0.77	0.84	0.84	0.82	0.81	0.81
Career interest in STEM	0.86	0.87	0.89	0.89	0.81	0.85
Leisure interest in STEM	0.77	0.81	0.86	0.87	N/A	N/A
Educators[1]						
Use of traditional teaching strategies	N/A	0.75	0.50	0.79	N/A	N/A
Use of strategies to develop students' abilities to communicate ideas	N/A	0.82	0.69	0.85	.83	N/A
Use of laboratory activities	N/A	0.82	0.73	0.81	N/A	N/A
Personal science teaching efficacy	N/A	0.92	0.85	0.91	N/A	N/A
Teaching outcome expectancy	N/A	0.83	0.70	0.57	N/A	N/A

[1] Educator data are particularly variable among the Space Grant Consortium sites. Only Idaho and 9 educators from Wyoming have baseline data for any of the educator measures, which likely explains the lower alphas for these constructs. Massachusetts only has follow-up educator data and was the only site to include the questions about personal science teaching efficacy and teaching outcome expectancy in the follow-up surveys.

Sources: 2010 Summer of Innovation Student and Educator Surveys.

Participant Characteristics

Educator Characteristics

NASA Center Partnerships

The SoI survey results suggest that the sampled NASA Center Partnership sites recruited a diverse group of certified, middle-school, STEM teachers. Twenty-four percent of the respondents were male and almost 70 percent were non-white (see Exhibit 10). All respondents with non-missing educational information reported having at least a bachelor's degree. Half also hold a master's degree and three percent hold a doctoral degree. Although teachers were non-randomly recruited, these figures correspond relatively closely to national public school teacher samples, with the exception of teacher race/ethnicity: in 2007-2008, 24 percent of teachers were male, 17 percent were non-white, 45 percent held masters degrees in addition to bachelor's degrees, and 0.9 percent held doctoral degrees as their highest degree attained.[31]

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30 Cronbach's alpha (α) is a statistic of internal consistency with values ranging between 0 and 1. It assesses reliability of a rating comprising individual items combined to create a measure the construct. Typically, a Cronbach's alpha above 0.7 indicates that the scale is sufficiently reliable.

31 Snyder, T.D., and Dillow, S.A. (2010). *Digest of Education Statistics 2009 (NCES 2010-013).* National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education. Washington, DC. Retrieved on October 14, 2010, from http://nces.ed.gov/programs/digest/d09/tables/dt09_068.asp?referrer=report

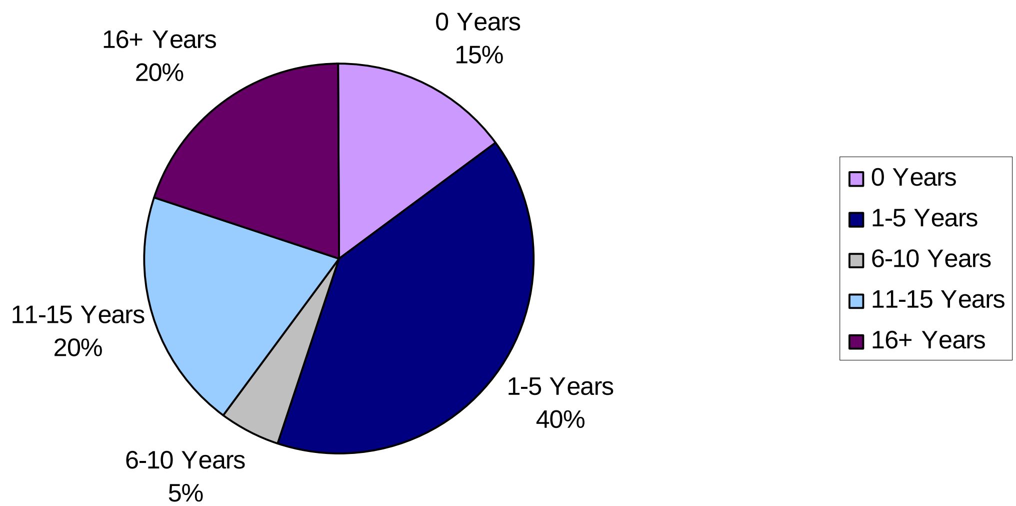
Exhibit 10. Educator Characteristics

Characteristics	NASA Center Partnership Sites	Space Grant Consortium Sites		
	All (N = 31)	All (N = 183)	Idaho and Wyoming (N = 55)	New Mexico (N = 128)
Male (%)	24	30	27	31
Race/Ethnicity (%)				
Any Minority	69	46	8	63
Hispanic/Latino	4	34	0	48
American Indian	4	9	4	11
Asian	14	1	0	1
African American	50	3	0	4
Pacific Islander	0	1	4	0
White	32	87	92	84
Highest Degree (%)				
Bachelor's	100	99	100	99
Master's	50	48	23	59
Doctorate	3	1	0	2
Have a teaching license of certificate (% reporting)	73	98	98	98
Type of teaching license or certificate (%)				
National board certificate	5	3	8	1
State certificate	86	94	98	92
Provisional certificate	5	1	0	2
Emergency certificate	0	0	0	0
Other certificate	24	5	6	5
Subject area of teaching license or certificate (%)				
Elementary education (K-5)	43	52	61	49
Secondary education (6-12)	62	46	61	40
Science education	33	32	22	36
Mathematics education	33	15	6	19
Special education	19	10	8	12
Other	29	23	39	16
Elementary grades (K-5)	8	30	44	24
Middle grades (6-8)	71	63	44	69
High school grades (9-12)	50	17	31	11
Not teaching in a K-12 classroom	20	7	15	4
Subject area teaching in 2010/2011 school year (%)				
Any STEM subject	84	94	87	97
Mathematics	35	44	45	44
Science	42	66	66	66
Computer science	0	9	8	10
Technology	3	13	21	9
Engineering	3	4	4	4
Other	16	11	38	0

Note: Percentages may not sum to 100 as educators could check all categories that applied.
Sources: 2010 Summer of Innovation National Evaluation Baseline and Follow-up Educator Surveys.

According to survey reports, the NASA Center Partnership educator participants ranged in experience from none (i.e., respondents who were not classroom teachers) to 15 years or more, with 40 percent having between one and five years of experience (see Exhibit 11).

Exhibit 11. NASA Center Partnership Educators' Years of Teaching Experience



Includes respondents to the follow-up Educator Survey in Miami, Galena Park, and Cincinnati: N = 31; Missing = 11.
Sources: 2010 Summer of Innovation National Evaluation Follow-up Educator Surveys.

Seventy three percent of the respondents were certified or licensed and almost 90 percent of these educators held state certifications; those not licensed or certified were from Cincinnati's GEAR UP site, who likely utilized full-time GEAR UP staff members during the summer activities. Over half of respondents were specifically certified in math or science (57%) and 62 percent were certified to teach secondary students (grades 6-12).

Many educator respondents expected to teach middle school students during the 2010/2011 school year (71%). However, educators at the Miami site had fewer teachers expecting to teach middle school, as most anticipated teaching elementary or high school students. Furthermore, 84 percent of responding educators reported that they would be teaching a STEM subject in the fall.

Space Grant Consortiums
Information about educator characteristics is available from baseline surveys administered in Idaho, Wyoming, and New Mexico. Massachusetts sites omitted this set of questions and are not represented in the results that follow. New Mexico provided results in aggregate. Because information on individual educator characteristics is limited at the Idaho and Wyoming sites, their data are presented together (30 percent of respondents in Idaho are missing this data and only 9 educators filled out the

baseline survey in Wyoming). Thus, while the results provide valuable information on a subsample of educators at these sites, they are not reflective of all educators who participated in Space Grant Consortium activities.[32] Finally, Idaho interpreted the requirements for educator professional development differently from the other sites, such that the educators who participated in the professional development activities and filled out the surveys are not necessarily those that implemented the summer programs.

Results indicate that educators in Idaho, Wyoming, and New Mexico Space Grant Consortium sites were experienced, state certified educators from diverse backgrounds. Thirty percent of respondents were male and 46 percent were non-white (see Exhibit 10). However, there were large differences in racial and ethnic composition across sites, with few respondents in Idaho and Wyoming reporting that they were from minority backgrounds (8%), and no respondents from these sites reporting that they were Hispanic, Asian, or African-American. In contrast, 63 percent of New Mexico's respondents were non-white and almost half were Hispanic.

Similar to the educators at the NASA Center Partnership sites, nearly every respondent at the Space Grant Consortium sites held a Bachelor's degree (99%), with 48 percent also holding a master's degree, and 1 percent a doctoral degree. Percentages differed across sites, however, with about 60 percent of respondents from New Mexico holding master's degrees, compared to 23 percent of respondents in Idaho and Wyoming. In Idaho, where sites were mainly located in rural, American Indian reservations, limited access to continuing education may explain the lower number of educators with master's degrees. It should also be noted that a small portion (.8%) of New Mexico's educators reported that they had not yet received a degree. Overall, respondents from the Space Grant Consortium sites were similar to those from NASA Center Partnerships sites and the national public school teacher sample, with the exception of having more male and non-white respondents than the national average.

Respondents at the Space Grant Consortium sites were more experienced educators than respondents at the NASA Center Partnership sites. Years of teaching experience ranged from 1 to over 15, with 33 percent of teachers across the three sites reporting that they had over 15 years of teaching experience (see Exhibit 12). Respondents in Idaho were particularly seasoned educators, with over half reporting more than 10 years of teaching experience.

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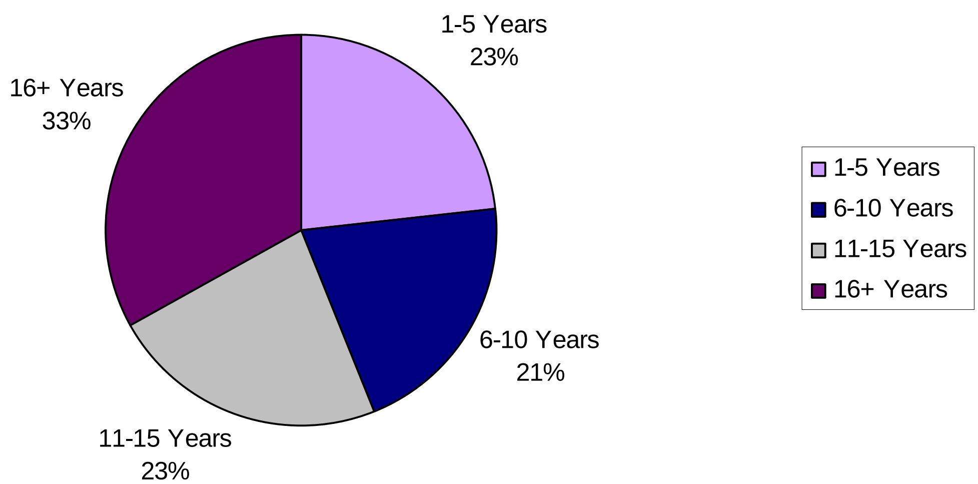
32 Although New Mexico's results were received in aggregate, we added their responses on individual items to those from Idaho and Wyoming. For example, if Idaho and Wyoming had 50 teachers who were certified and New Mexico had 100 teachers who were certified, these two numbers were summed and then divided by the total number of educators at all three sites to get an aggregate percentage.

Exhibit 12. Space Grant Consortium Educators' Years of Teaching Experience



Includes respondents to the baseline Educator Survey in Idaho, Wyoming, and New Mexico: N = 205; Missing = 63.
Sources: 2010 Summer of Innovation National Evaluation Baseline Educator Surveys.

In contrast to educators at the NASA Center Partnership sites, where about three quarters of respondents were certified or licensed, almost all educators in Idaho, Wyoming, and New Mexico were certified or licensed (98%) and a similar percentage held state certifications (94%).[33] However, compared to educators at the NASA Center Partnership sites, fewer Space Grant Consortium educators were certified to teach science or math or secondary education: forty three percent were certified to teach science or math and 46 percent were certified to teach secondary education.[34] In Idaho, less than a quarter of respondents were certified in math or science and almost three quarters were certified in elementary education.

Over 60 percent of Space Grant Consortium respondents expected to teach middle school students in the 2010/2011 school year. Again, Idaho was unique among the Space Grant Consortium sites, with more respondents expecting to teach elementary grades than at other sites and fewer expecting to teach secondary grades. Finally, similar to the NASA Center Partnerships' educators, many respondents expected to teach a STEM subject in the next school year (94%).

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33 In Idaho and Wyoming, the percentage of teachers with state certification was calculated only among those who responded they were certified. In New Mexico, the percentage was calculated among those who reported they were teaching in the subsequent school year.

34 In the New Mexico surveys, secondary education was defined as ranging from 7th to 12th grade, whereas surveys administered in other sites defined secondary education as ranging from 6th to 12th grade.

Student Characteristics

NASA Center Partnerships

The survey responses from the select NASA Center Partnerships suggest that these sites successfully recruited students from the groups targeted by SoI. For example, 53 percent of the responding students were female, with little variation across location (see Exhibit 13). Further, although there were a handful of respondents in 3rd and 4th grades, over 90 percent of respondents at the NASA Center Partnerships were middle school students in 5th through 9th grades; only Camp KSC and Miami Dade included students in 3rd and 4th grades.

Similarly, respondent demographics suggest that the NASA Center Partnerships were particularly successful in recruiting minority students. Eighty-two percent of respondents reported that they were American Indian, Asian, African American, Hispanic, or Pacific Islanders, although the makeup of the minority students varied substantially by site. For example, 70 percent of respondents at Galena Park reported that they were Hispanic[35] compared to fewer than 20 percent of respondents at Camp KSC and Miami. Likewise, we found that slightly over 85 percent of Miami Dade and Cincinnati GEAR UP respondents were African American, compared to 35 percent of students in Galena Park.

Space Grant Consortiums

Information about student characteristics at Space Grant Consortium sites was obtained primarily from Idaho and Wyoming baseline surveys. Massachusetts and New Mexico omitted all questions about student race, ethnicity, and gender and New Mexico surveys also excluded the question about student grade. Responses from students in Idaho and Wyoming indicate that these Space Grant Consortium sites had fewer non-white or female participants than the NASA Center Partnership sites, but successfully reached middle school students (see Exhibit 13). Thirty seven of the respondents overall were female; only a quarter of respondents were female in Idaho. Further, only about a quarter of students across Idaho and Wyoming Space Grant Consortiums (i.e., the sites providing demographic data at the individual level) reported that they were American Indian, Asian, African American, Hispanic, or Pacific Islanders, although percentages differed to a great degree by site. In Idaho, slightly over 60 percent of students at the site were non-white and almost half were American Indian (48%). Wyoming, on the other hand, had 10 percent or fewer students reporting that they were Hispanic, American Indian, Asian, African-American, or Pacific Islander. This result is likely related to the fact that the overall minority population in Wyoming is small: the U.S. Census Bureau reported in 2009 that 86.2 percent of Wyoming's population was white/ non-Hispanic, while nationally this rate was 65.1 percent.[36]

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[35] Students in this site appeared to have been confused by questions differentiating between the ethnicity and race questions—a large proportion of students from this site answered the question about their ethnicity (all saying they were Hispanic), but skipped the question about their race.

[36] U.S. Census Bureau. *Wyoming Quick Facts from the U.S. Census Bureau*. Retrieved on February 2, 2011 from http://quickfacts.census.gov/qfd/states/56000.html

Exhibit 13. Student Characteristics

Construct	NASA Center Partnership Sites					Space Grant Consortium Sites[1]		
	All Students N=421	Camp KSC N=226	Miami Dade N=59	Cincinnati GEAR-UP N=20	Galena Park N=115	All Students N=480	Idaho N=36	Wyoming N=444
Grade (mean)	6.1	6.0	5.6	6.8	6.4	6.5	4.8	6.5
Female (%)	53	54	55	42	49	37	24	38
Any Minority	82	78	98	84	91	24	64	21
Hispanic/Latino	26	15	19	0	70	8	18	7
American Indian	6	6	4	6	6	13	48	10
Asian	4	4	0	0	6	4	0	4
African American	60	62	85	89	35	3	4	3
Pacific Islander	3	3	6	0	0	3	4	3
White	35	33	7	17	60	90	48	93
Attended every day	87	90	83	39	81	N/A	N/A	N/A
Attended almost every day	12	9	13	50	19	N/A	N/A	N/A
Attend half the days	1	1	0	11	0	N/A	N/A	N/A
Missed more than half the days	0	0	4	0	0	N/A	N/A	N/A

[1] Student characteristics are not available for New Mexico or Massachusetts. In addition, students at Space Grant Consortium sites did not receive questions about participation.

[2] Proportions do not sum to 1 as students could check all that apply.

Sources: 2010 Summer of Innovation National Evaluation Baseline Student Surveys.

Data on students' grade levels, available from Idaho, Wyoming, and Massachusetts, suggest that over 90 percent of respondents were in middle school (5th through 9th grade) and only a small number of students were in 3rd, 4th, or 10th grades.[37]

Student Participation in the Activities

NASA Center Partnerships

Students at the NASA Center Partnership sites were active participants; 87 percent reported that they attended every day and 12 percent reported that they attended almost every day (see Exhibit 13). At Cincinnati GEAR UP, however, only 39 percent of the students reported attending every day, while 50 percent reported attending almost every day, and 11 percent reported that they had missed more than half of the days.

We examined the characteristics of students attending Camp KSC and GEAR UP Explorer I (where baseline and follow-up surveys were administered) who filled out baseline but no follow-up surveys to explore whether there might be patterns across the students who disengaged from the surveys, possibly because they had disengaged from the summer activities. Comparing the 31 students with baseline but no follow-up data to those with both, more were male (70 percent versus 42 percent of those who remained) and fewer were white (15 percent versus 35 percent of those who remained). Further, these students indicated less career and leisure interest in STEM at baseline than the remaining respondents.

Space Grant Consortiums

Although the Space Grant Consortium student surveys contained no questions on attendance, it is possible to compare demographic characteristics of students who filled out only the baseline survey to those who filled out baseline and follow-up surveys. Note, however, that these data are only available in Idaho and Wyoming; Massachusetts only administered one survey to students and New Mexico only keyed in data for students with baseline and follow-up surveys.

In contrast to patterns observed among the NASA Center Partnership sites, there were few demographic differences between students who filled out two surveys (n = 243) and those who filled out only baseline surveys (n = 174) at the Space Grant Consortium sites. Gender and racial/ethnic compositions across the two groups were about the same. However, students who only filled out baseline surveys indicated slightly lower science self-confidence and career and leisure interest in STEM at baseline than students who filled out both surveys.

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[37] Although the original survey asked students to report what grade they had completed in spring 2010, surveys in Idaho and Massachusetts asked students to report what grade they were entering in August or September 2010. To make these results comparable to sites that used the original wording, one grade level was subtracted from student grades in Idaho and Massachusetts.

Survey Results

Educator Measures

As described in Chapter 2, educator surveys included items whose responses could be combined to produce measures of key constructs including educator's teaching strategies, personal science teaching efficacy, and teaching outcome expectancy (i.e., the extent to which teachers believe that certain behaviors lead to improved student outcomes). We report results on a five-point scale, where 1 corresponds to strongly disagree and 5 to strongly agree. Analyses are cross-sectional, as the study collected primarily follow-up educator surveys only.[38] Finally, it should be noted that there was wide variability in the items included in the Space Grant Consortium educator surveys. Thus, as highlighted in the discussion below, not all constructs are available at each site.

NASA Center Partnerships

Because the number of respondents is relatively small (31) at the NASA Center Partnership sites, we must bear in mind that these results represent responses from only a small proportion of participating educators and may not be generalizable to all participating educators. Overall, averages for the educator measures ranged between 3.5 and 4.4 on a 5-pt scale; see Exhibit 14. Educators generally agreed more strongly that they use strategies to develop students' ability to communicate (average = 4.4) than that they use laboratory activities (average = 4.1) or traditional teaching practices (average = 3.5). Further, educators generally agreed (an average rating of 3.5) that teachers play an integral role in student achievement.

Educators also agreed that they have high levels of teaching self-efficacy (4.2). It may be the case that respondents were reluctant to rate themselves as less able to teach science, since no respondents rated their own abilities below a 3 on a 5 pt scale. It is also possible that educators who volunteer to lead a STEM summer camp may do so because they are confident in their ability to teach these subjects.

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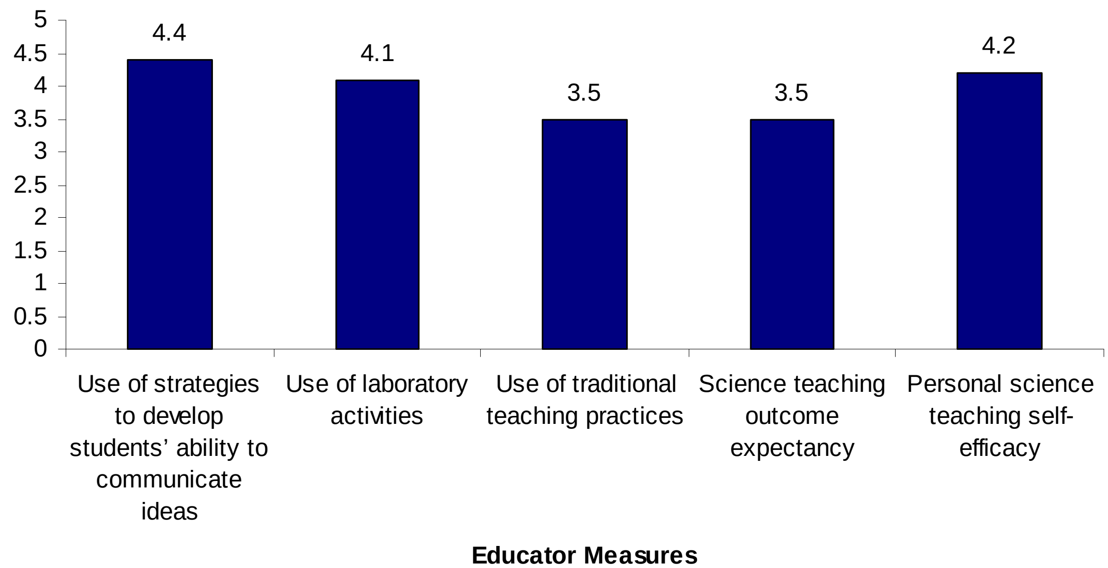
[38] Idaho, New Mexico, and Wyoming administered baseline and follow-up educator surveys; however questions in the Idaho and New Mexico baseline and follow-up surveys were not comparable across survey administration waves. Further, although Wyoming administered baseline and follow-up surveys, only one educator answered questions that tapped into educator constructs.

Exhibit 14. Educator Results, NASA Center Partnership Sites



Includes respondents to the follow-up Educator Survey in Miami, Galena Park, and Cincinnati: N = 31; Missing = 1-2.
Sources: 2010 Summer of Innovation National Evaluation Follow-up Educator Surveys.

Space Grant Consortiums

Although availability of construct measures varied widely by site, results from the Space Grant Consortium sites closely mirrored those from the NASA Center Partnership sites, with averages on the constructs ranging from 3.4 to 4.2 on a 5-pt scale (see Exhibit 15).[39] Similar to their NASA Center Partnership counterparts, respondents from Idaho, Wyoming, and Massachusetts were more likely to agree that they use strategies to develop students' ability to communicate ideas (average = 4.2) than that they use laboratory activities (average = 4.1) or traditional teaching practices (average = 3.4).

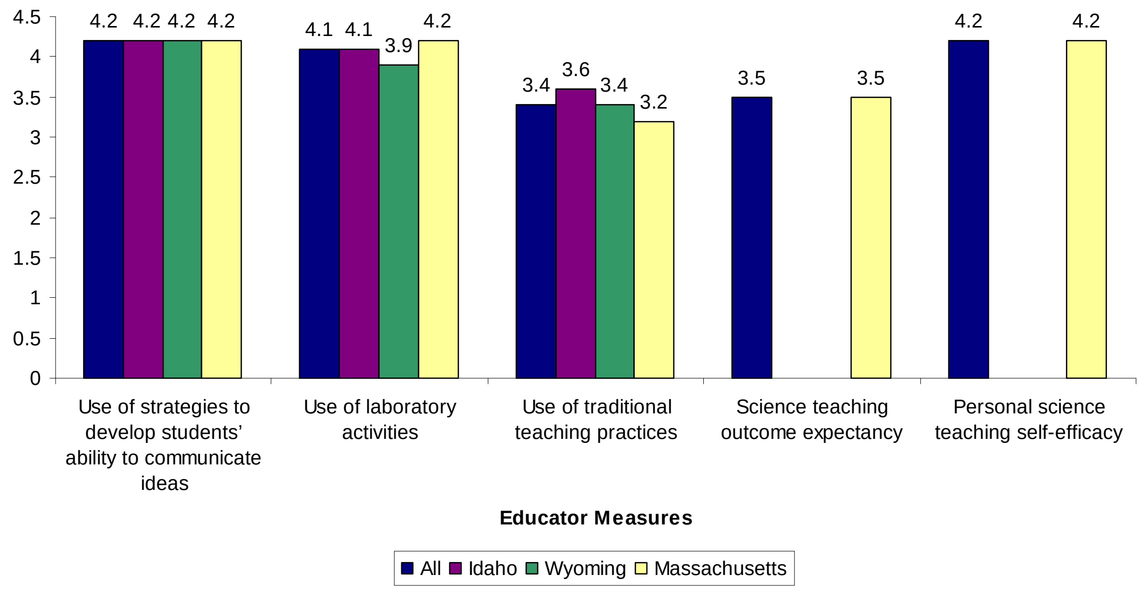
Only Massachusetts administered questions about educator's personal science teaching efficacy and their belief that teachers play an integral role in student achievement in their follow-up surveys.[40]

[39] New Mexico only administered questions related to educator use of strategies to develop students' ability to communicate ideas. Further, these questions were only included in the baseline survey and are thus not readily comparable to results presented from the follow-up surveys at other sites. Nonetheless, educators in New Mexico, like educators at the other sites, agreed strongly that they use strategies to develop students' ability to communicate ideas (average = 4.2).

[40] Educators in Idaho were administered these questions at baseline, but not follow-up; thus, results are not directly comparable to the follow-up means. However, averages on the two constructs were similar to those at the NASA Center Partnership sites and Massachusetts, with educators being slightly less likely to agree that teachers play an integral role in student achievement (average = 3.4) than report that they were effective teachers (average = 4.0).

Averages are identical to those from the NASA Center Partnership sites, with educators generally agreeing (average = 3.5) that teachers play an integral role in student achievement and that they are effective teachers (average = 4.2). Again, high averages on the teaching self-efficacy measure may indicate that educators who volunteered for the programs were particularly confident in their ability to teach science or a reluctance to report that they are less able to teach science.

Exhibit 15. Educator Results, Space Grant Consortium Sites



Includes respondents to the follow-up Educator Survey in Idaho, Wyoming, and Massachusetts: All N = 110; All Missing = 10-13; Idaho N = 61; Idaho Missing = 4-7; Wyoming N = 16; Wyoming Missing = 1; Massachusetts N = 33; Massachusetts Missing = 1-5.

Sources: 2010 Summer of Innovation National Evaluation Follow-up Educator Surveys.

Student Measures

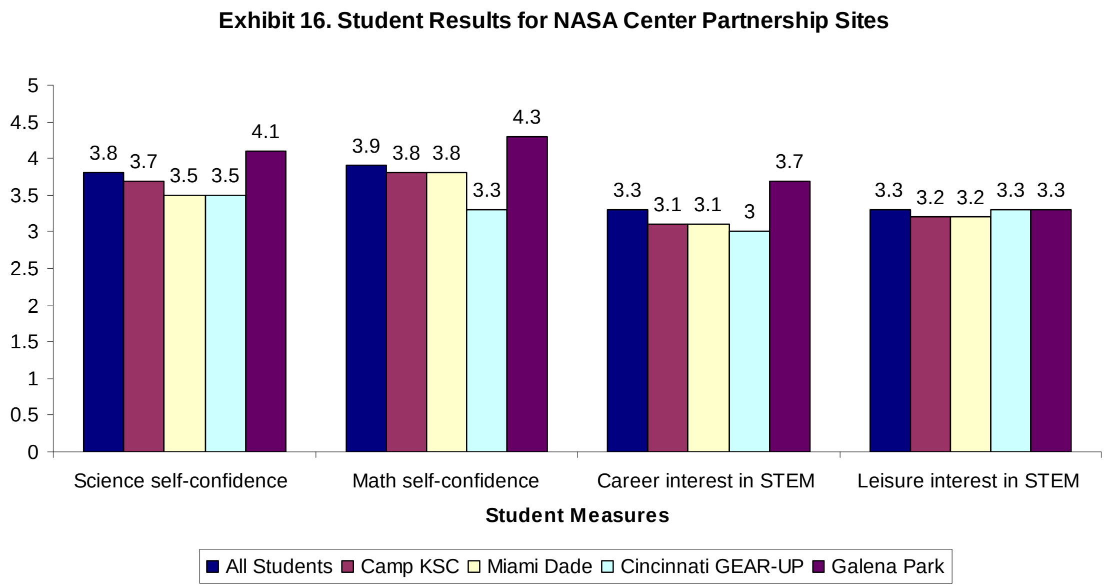
Student surveys included items whose responses could be combined to produce measures of self-confidence in math and science, and career and leisure interest in STEM. Because most sites only administered follow-up surveys, discussion of these measures will first focus on the patterns across these data, followed by an exploration of the baseline and follow-up survey results that are available. Aggregate results from New Mexico are presented separately.

Follow-up Student Survey Results

NASA Center Partnerships. Generally, self-confidence in math and science was high among students who completed the follow-up surveys at the NASA Center Partnership sites. Averages across all sites for self-confidence in science were 3.8 out of 5 (where 1 corresponds to strongly disagree and 5 to strongly agree) and 3.9 for math self-confidence (see Exhibit 16).

We explored the data looking for trends across sites and differences among sites. Compared to students in other locations, students in Galena Park were more confident in their math and science abilities, with their self-confidence in science averaging 4.1 and their self-confidence in math averaging 4.3; these results may be explained at least in part by the fact that this site targeted high-performing students from its Scholar's Academy, a program for top students selected based on their 5th grade Texas Assessment of Knowledge and Skills (TAKS) standardized scores in reading and math. Compared to students at other sites, Cincinnati GEAR UP student respondents scored the lowest on the math and science self-confidence indices (3.5 for science and 3.3 for math). Across all sites, career and leisure interest in STEM averages were both 3.3 (on a scale from 1 to 5). Again, students in Galena Park reported higher levels of STEM interest than their counterparts at other NASA Center Partnership sites.

Exhibit 16. Student Results, NASA Center Partnership Sites



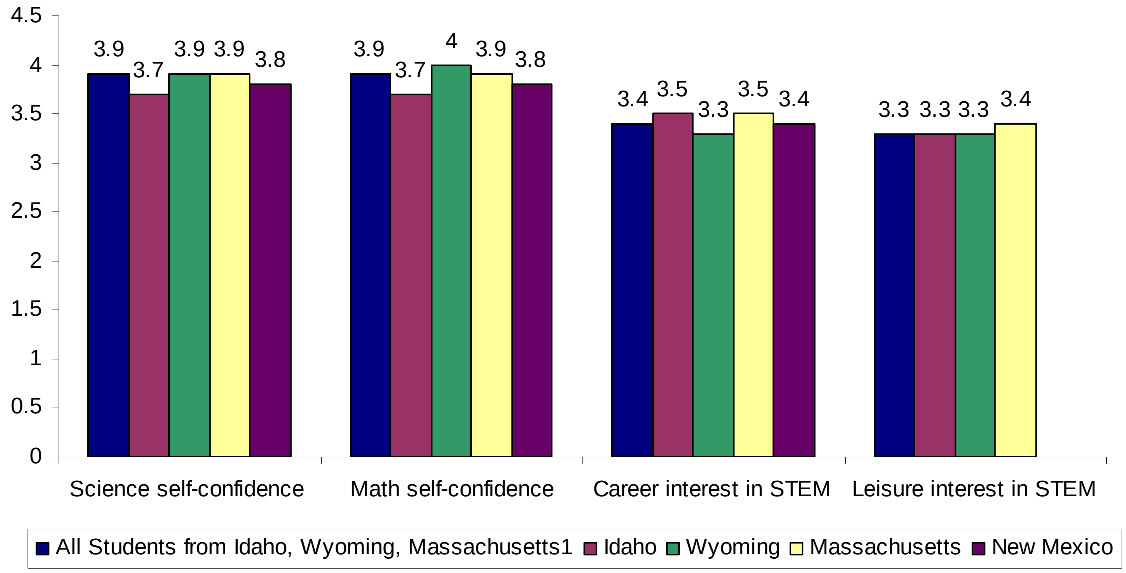
Includes respondents to the follow-up Student Survey: All N = 390; All Missing = 3-7; Camp KSC N = 195; Camp KSC Missing = 3-6; Miami Dade N = 59; Miami Dade Missing = 1; Cincinnati GEAR-UP N = 20; Cincinnati GEAR-UP Missing = 0; Galena Park N = 115; Galena Park Missing = 0.

Sources: 2010 Summer of Innovation National Evaluation Follow-up Student Surveys.

Space Grant Consortiums. Similar to the NASA Center Partnership participants, students at the Space Grant Consortium sites who took follow-up surveys reported high levels of math and science self-confidence. Overall averages on the math and science self-confidence measures at the Idaho, Wyoming, and Massachusetts sites were 3.9 out of 5 (where 1 corresponds to strongly disagree and 5 to strongly agree) and 3.8 in New Mexico (see Exhibit 17).

Averages on the career and leisure interest in STEM measures were strikingly similar across Space Grant Consortium sites, and closely mirrored overall means at the NASA Center Partnership sites. Career interest in STEM averaged 3.4 (on a scale from 1 to 5) across Idaho, Wyoming, and Massachusetts sites, as well as in New Mexico. The measure of leisure interest in STEM, available at all sites except New Mexico, averaged 3.3 (on a scale from 1 to 5).

Exhibit 17. Student Follow-up Results, Space Grant Consortium Sites



Includes respondents to the follow-up Student Survey: Idaho, Wyoming, and Massachusetts N = 535; Idaho, Wyoming, and Massachusetts Missing = 2-5; Idaho N = 25; Idaho Missing = 0; Wyoming N = 281; Wyoming Missing = 3; Massachusetts N = 229; Massachusetts Missing = 2; New Mexico N = 1,289; New Mexico Missing = 439-487.

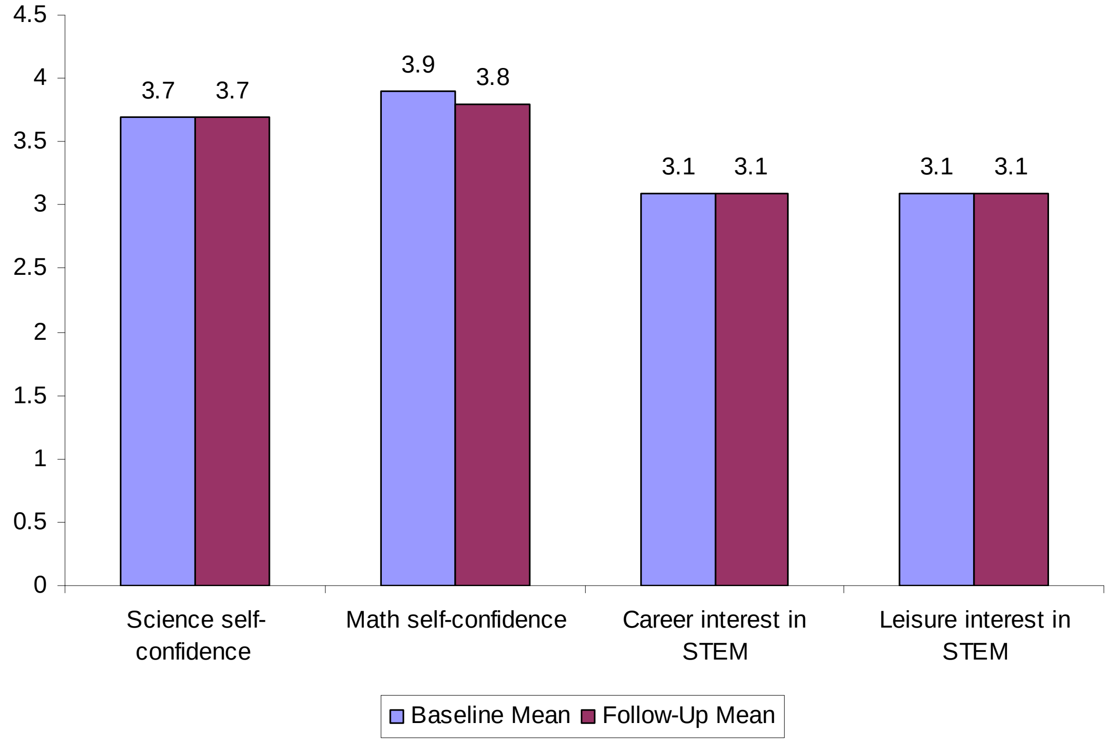
Note: New Mexico is not included in the overall mean as their results were received in aggregate form.

Sources: 2010 Summer of Innovation National Evaluation Follow-up Student Surveys.

Baseline and Follow-up Student Survey Results

NASA Center Partnership Sites. Two NASA Center Partnerships, Camp KSC and GEAR Up Explorer I, attempted to collect baseline surveys at the start of their student activities and follow-up survey data on the last day of activities (Camp KSC students with baseline and follow-up N = 188, GEAR Up Explorer I students with baseline and follow-up N = 1); on average, only three days elapsed between the surveys. We explored the data to see whether there were any changes in students' math and science self-confidence and career and leisure interest in STEM mean scores between the start and end of the summer activities; see Exhibit 18.

Exhibit 18. Baseline and Follow-up Student Measures, NASA Center Partnership Sites



Includes respondents with baseline and follow-up surveys at Camp KSC and GEAR UP Explorer I: N = 189; Missing N = 7-10.

Sources: 2010 Summer of Innovation National Evaluation Baseline and Follow-up Student Surveys.

Overall, the exploratory analysis did not detect meaningful changes in any of the measures. Math self-confidence means decreased slightly from 3.9 to 3.8; this difference, which on a five-point scale represents a 2 percent loss, is not a particularly meaningful result. Furthermore, the minor decrease was concentrated among the students SoI was not targeting: only males and non-minority students had decreases in the construct while females and minority students showed no changes (note that about 40 percent of the students at these sites were minorities *and* females). We did not detect meaningful differences between younger students (i.e., grades 5 and below) and older students (i.e., grades 6 and above).

Differences in pre- to post-program means for the other measures were minimal. Both baseline and follow-up measures of self-confidence in science averaged about 3.7. Baseline and follow-up averages for career interest in STEM and for leisure interest in STEM were virtually identical. Additional analyses exploring the possibility of gains for groups targeted by SoI, including females and minority students, did not identify any meaningful differences.

The relatively short amount of time between the baseline and follow-up surveys – on average, three days – may explain in part why the study was able to detect only a minimal difference. This is especially important since those two sites for which we have both baseline and follow-up data operated relatively short programs—programs that lasted one week. There likely was not enough time for the programs to affect student outcomes in a measureable way.

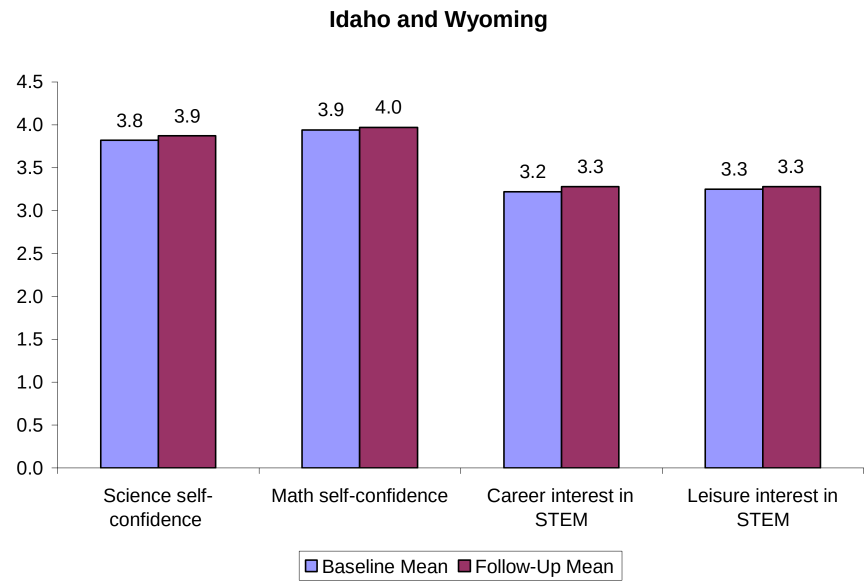
Space Grant Consortium Sites. Three Space Grant Consortium sites, Idaho, Wyoming, and New Mexico, administered baseline and follow-up surveys to students (Idaho students with baseline and follow-up N = 16; Wyoming students with baseline and follow-up N = 227; New Mexico students with baseline and follow-up N = 1,289). Because New Mexico's results were received in aggregate form, they are presented separately from the other two sites. Results from Idaho and Wyoming are combined due to Idaho's small sample size (see Exhibit 19).

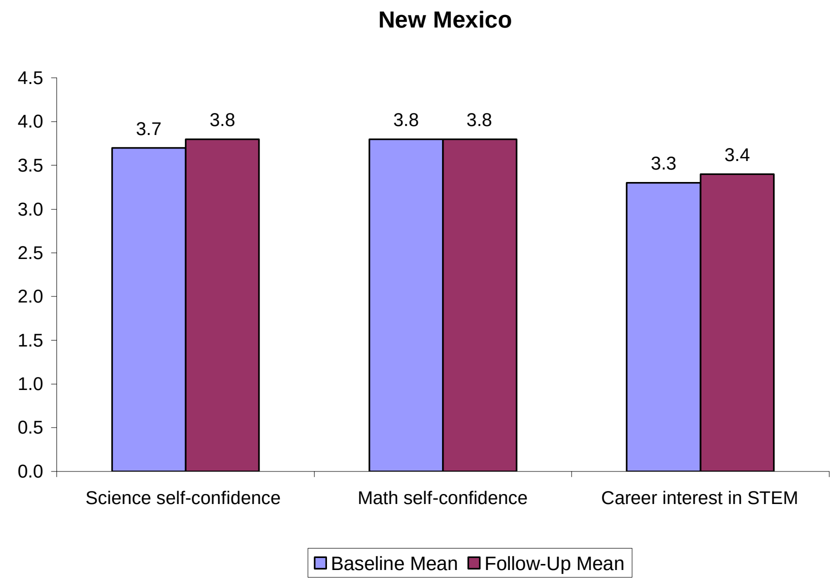
Similar to the NASA Center Partnership longitudinal results, there were no meaningful differences between the follow-up and baseline measures. Baseline and follow-up means for leisure interest in STEM were virtually identical, while math and science self-confidence as well as career interest in STEM increased slightly in the follow-up survey.

We also explored the possibility that patterns in pre to post-program gains differed by gender, grade level (5^{th} grade and below vs. 6^{th} grade and above), and race/ethnicity in Idaho and Wyoming (recall that New Mexico did not collect information about student background on their surveys). While the sub-group analyses are useful for generating future hypotheses, caution is warranted when interpreting these results as they are based on small sample sizes and are particularly susceptible to non-response bias.

While the grade level analysis did not reveal noteworthy patterns, some interesting trends appeared when exploring results by ethnicity and gender. Although only a limited number of minority students filled out baseline and follow-up surveys at these sites, analyses suggest that they gained more math self-confidence and career and leisure interest in STEM than non-minority students (see Exhibit 20). Further, while minority students' baseline averages were lower than averages for non-minority students, by the end of the program averages between the two groups were almost equivalent, particularly for career and leisure interest in STEM. Thus, over time, minority students appeared to have made gains that diminished gaps on the averages for these constructs.

Exhibit 19. Baseline and Follow-Up Student Measures, Space Grant Consortium Sites





Includes respondents with baseline and follow-up surveys in Idaho, Wyoming, and New Mexico: Idaho and Wyoming N = 243; Idaho and Wyoming Missing = 29-32; New Mexico N = 1,289; New Mexico Missing = 525- 602.

Notes: New Mexico's results were received in aggregate form and presented separately. Students in New Mexico were not administered questions about their leisure interest in STEM.

Sources: 2010 Summer of Innovation National Evaluation Baseline and Follow-up Student Surveys.

Exhibit 20. Baseline and Follow-up Measures for Minority and Non-Minority Students, Space Grant Consortium Sites

	Minority Students				Non-Minority Students			
Measure	N	Baseline Mean	Follow-Up Mean	Difference	N	Baseline Mean	Follow-Up Mean	Difference
Science self-confidence	49	3.7	3.7	0.0	151	3.9	4.0	0.1
Math self-confidence	50	3.7	3.9	0.2	152	4.0	4.0	0.0
Career interest in STEM	50	3.0	3.3	0.3	153	3.3	3.3	0.0
Leisure interest in STEM	50	3.1	3.3	0.2	152	3.3	3.3	0.0

Sources: 2010 Summer of Innovation National Evaluation Student Baseline and Follow-Up Surveys.

Likewise, comparing female and male student gains suggests that females had larger increases in their math and science self-confidence and career and leisure interest in STEM over time than male students at these sites (see Exhibit 21). At baseline, female students scored lower on the math and science self-confidence measures; however, by follow-up, averages were almost equivalent to males. In addition, although females and males began the programs with almost identical means on the career and leisure interest in STEM measures, females' interest increased by a larger amount than males' interest. Thus although Space Grant Consortium sites had fewer minority and female respondents, they made larger gains than non-targeted students at these locations.

Exhibit 21. Baseline and Follow-up Measures for Female and Male Students, Space Grant Consortium Sites

	Female Students				Male Students			
Measure	N	Baseline Mean	Follow-Up Mean	Difference	N	Baseline Mean	Follow-Up Mean	Difference
Science self-confidence	79	3.7	3.8	0.2	122	3.9	3.9	0.0
Math self-confidence	81	3.8	4.0	0.2	122	4.1	4.0	-0.1
Career interest in STEM	82	3.2	3.3	0.1	122	3.2	3.2	0.0
Leisure interest in STEM	81	3.3	3.3	0.1	122	3.2	3.3	0.0

Sources: 2010 Summer of Innovation National Evaluation Student Baseline and Follow-Up Surveys.

Potential Areas for Future SoI Professional Development

NASA Center Partnership Sites

Educator follow-up surveys asked respondents for their recommendations about topics for future SoI professional development efforts. Their responses indicated a need for professional development addressing issues such as understanding student thinking in STEM, learning how to use inquiry/investigation-oriented teaching strategies, and learning how to teach STEM in a class that includes students with special needs, as about a quarter of the responding educators reported that professional development in these areas are either "very" or "critically needed" (Exhibit 22).

Exhibit 22. Educator Reports of Professional Development Needs, NASA Center Partnership Sites

Professional Development Activity	None or Slightly Needed % (N)	Needed % (N)	Very or Critically Needed % (N)
Learn how to teach STEM in a class that includes students with special needs	17 (5)	55 (16)	28 (8)
Understand student thinking in STEM	17 (5)	59 (17)	24 (7)
Deepen STEM content knowledge	24 (7)	59 (17)	17 (5)
Learn how to use inquiry investigation-oriented teaching strategies	28 (8)	48 (14)	24 (7)
Learn how to assess student learning in STEM	31 (9)	59 (17)	10 (3)
Learn how to use technology in STEM instruction	48 (14)	41 (12)	10 (3)

Sources: 2010 Summer of Innovation National Evaluation Follow-up Educator Surveys.

Space Grant Consortium Sites

Responses about professional development needs collected at follow-up from Idaho, Wyoming, and Massachusetts Space Grant sites[41] indicate that about a quarter of the responding educators felt that learning how to teach STEM in a class that includes students with special needs, understanding student thinking in STEM, learning how to assess student learning in STEM, and learning how to use technology in STEM instruction were either "very" or "critically needed" (see Exhibit 23). However, compared to educators at the NASA Center Partnership sites, Space Grant Consortium respondents felt that learning how to use inquiry/investigation-oriented teaching strategies was less critically needed, while learning how to assess student learning and use technology in STEM instruction was more critically needed. Further, note that educators across all NASA Center Partnership and Space Grant Consortium sites felt that learning how to teach STEM in a class that includes students with special needs was the most critically needed professional development item.

[41] Educators from New Mexico were administered questions about professional development in baseline surveys, thus although they are not directly comparable to the responses, they suggest that educators at this site felt more strongly that more professional development was "very" or "critically needed" for each of the items asked.

Exhibit 23. Educator Reports of Professional Development Needs, Space Grant Consortium Sites

Professional Development Activity	Idaho, Wyoming, and Massachusetts		
	None or Slightly Needed % (N)	Needed % (N)	Very or Critically Needed % (N)
Learn how to teach STEM in a class that includes students with special needs	36.4 (39)	34.6 (37)	29.0 (31)
Understand student thinking in STEM	26.9 (29)	50.9 (55)	22.2 (24)
Deepen STEM content knowledge	31.5 (34)	51.9 (56)	16.7 (18)
Learn how to use inquiry investigation-oriented teaching strategies	50.0 (54)	33.3 (36)	16.7 (18)
Learn how to assess student learning in STEM	33.3 (36)	45.4 (49)	21.3 (23)
Learn how to use technology in STEM instruction	38.9 (42)	36.1 (39)	25.0 (27)

Sources: 2010 Summer of Innovation National Evaluation Follow-up Educator Survey.

Conclusions

Although results must be interpreted with caution as the response rates were low, the educator and student surveys provide a snapshot of respondent characteristics from NASA Center Partnership and Space Grant Consortium sites. Below we summarize the key findings.

Educators

Results from the educator surveys suggest that SoI awardees recruited a diverse group of certified educators who expected to teach STEM topics to middle school students in the following school year. Generally, these teachers were more likely to be from a minority background than nationally, particularly at the NASA Center Partnership sites. Respondents tended to be certified or licensed teachers, especially in Space Grant Consortium sites, and over 60 percent expected to teach middle school students in the upcoming school year. Although respondents ranged widely in their years of teaching experience, educators at Space Grant Consortium sites were more experienced on average than those at the NASA Center Partnership sites, with one third having over 15 years of teaching experience.

Averages on the educator outcomes were strikingly similar across the NASA Center Partnership and Space Grant Consortium sites and high. Averages on the educator constructs were almost identical for both sets of educators, with participants indicating high levels of science teaching self-efficacy and generally agreeing more strongly that they use strategies to develop students' ability to communicate than they use laboratory activities or traditional teaching practices. Further, educators at both sites generally agreed that teachers play an integral role in student achievement.

Finally, when asked about topics for future professional development, educators across all NASA Center Partnership and Space Grant Consortium sites indicated that learning how to teach STEM in a class that includes students with special needs was the most critical need for professional development of the items presented.

Students

With the exception of both sites recruiting mainly middle school students, there were demographic differences between respondents at the NASA Center Partnership sites and those at the Space Grant Consortium sites. Respondents at the NASA Center Partnership sites largely reflected SoI's targeted population: 82 percent were from minority backgrounds and about half were female. At the Space Grant Consortium sites, however, only a quarter of respondents were from minority backgrounds and 37 percent were females. Please note that the percentage of minority students at these sites was driven in large part by Wyoming's respondents, who, reflecting demographic patterns in the state, were generally white. More respondents from Idaho, on the other hand, were minorities and almost 50 percent were American Indian, the highest percentage of any site in the evaluation.

As was the case with the educator outcomes, student averages were strikingly similar across the NASA Center Partnership and Space Grant Consortium sites. Averages on constructs measuring math and science self-confidence, as well as those measuring career and leisure interest in STEM, were virtually identical and high across sites. Although only a small sub-sample of students at both NASA Center Partnership and Space Grant Consortium sites completed baseline and follow-up surveys, there were no meaningful differences in the constructs between the two survey administrations.

Limitations to the SoI National Evaluation Surveys

It is important to reiterate that responses to educator and student surveys are illustrative, rather than representative of all participants in the SoI's pilot. Only 43 percent of participating students (with parental consent) and 55 percent of educators are represented in the survey data.[42] If students whose parents provided consent differed systematically from those who did not, our sample is predicated on a very selective group of students.

In addition, an inherent limitation of the survey results is that they rely on self-reports. Students and educators may vary in whether their recollections are completely accurate, for example, especially when asking questions about activities that have occurred at some point in the past. Self-reports are also prone to social desirability bias, such that respondents may select responses they perceive to be the "right" answers rather than reporting their actual perceptions and/or activities.

[42] However, the survey results suggest that not all of the educators that took the educator survey were teachers. Further, as mentioned, in Idaho, not all of the educators who received professional development were involved in the summer programs.

Chapter 5. SoI Pilot Successes

During SoI's pilot summer, sites reported successful student and educator activities notwithstanding the challenges posed by the pilot's ambitious time line. Sites reached a substantial number and diversity of students across the country, engaging them in the SoI activities. Participating teachers appreciated the opportunity to establish relationships with university faculty and learn about and use NASA content, with several making plans to integrate it in their classrooms during the school year.

Extensive, National Reach

Chief amongst the pilot's achievements was the project's impressive reach (Exhibit 14). SoI activities engaged nearly 7,000 students and almost 550 teachers in 11 states, and served participants in both urban and rural areas. In some of these communities, the SoI activities represented the only summer STEM learning experiences available for students and educators. As one Space Grant Consortium director explained, "It is well understood that teachers from rural areas, due to remoteness, do not have opportunities to participate in rich STEM professional development. The Summer of Innovation begins to close this opportunity gap."

Exhibit 24. Reach of National Evaluation Sites' Student Activities

Site Name	State	Students	Educators	%Female Students	%Minority Students
Space Grant Consortiums[a]					
Idaho Space Grant	ID, MT, UT	270	135	24	64
Massachusetts Space Grant	MA	742	127	NA	NA
New Mexico Space Grant	NM	2,799	135	NA	NA
Wyoming Space Grant	WY	595	39	38	21
Sub-Award Site[b]					
Paragon TEC (Chicago)	IL	1,525	67	39	98
NASA Center Partnerships[a]					
Camp KSC	FL	265	0	54	78
GEAR Up Explorer I	LA	54	0	NA	NA
Miami-Dade	FL	97	8	55	98
Galena Park	TX	174	10	49	91
Chicago Parks[d]	IL	128	0	NA	NA
Cincinnati GEAR UP	OH	85	22	42	84

[a] Student demographic reports based on student self-reports on national evaluation surveys.
[b] Based on the ten OEPM activity forms received from Chicago locations.
[c] Only one student completed national evaluation surveys; consequently, we will not report demographics at GEAR UP Explorer 1's site.
[d] National evaluation surveys were not administered at this site as parental consent was not obtained.

Sources: OEPM activity forms, national evaluation implementation reporting forms, technical assistance calls with the sites.

Exhibit 14 presents the number of students and educators involved in the SoI sites, and the percent of students who were female and members of minority racial or ethnic groups. Both student and educator participants were diverse, reflecting the SoI emphasis on engaging often under represented minority students and teachers. One director remarked, "Having Hispanic teachers like myself, Hispanic parents and students felt more comfortable being a part of the program."

SoI helped to expand the availability of partnerships/resources in remote areas and underserved communities. Several sites commented that the pilot summer helped build capacity for future efforts to reach into underserved communities and engage greater numbers of students and educators in STEM learning outside of the school year. As the Sub-Award site reported, during SoI FY2010, it built "new infrastructures, implementation procedures, and program models for many locations that didn't have any existing summer academic enrichment programs, thereby reaching students who would not have otherwise participated in summer STEM programming."

Engaging Student Activities

The implementation data, the national evaluation surveys, and reports from the sites all point to success in engaging students in a wide array of hands-on, inquiry and team-based activities. Several project developers described activities intended to "enrich" not "remediate," and they generally succeeded in transforming scientific and engineering topics into meaningful activities. One site noted that, "The kids were part of the activities, not observers."

Student behaviors demonstrated engagement across many sites evident in the adjectives sites used to describe them: "enthusiastic", "energetic", "focused", "meticulous", and "involved," busy "maneuvering", "problem solving", "connecting", and "probing." At one site, a teacher commented that during the student event, she saw a "spark" in many of the students she had not previously observed. Students themselves recognized their engagement: one Space Grant Consortium student exclaimed during a design challenge that "This is the most fun I've ever had during a summer!" Another chimed in, adding "AND we were still learning. With hands-on, I learn more." Sites reported that in many cases the nature of the activities encouraged students to come each day. One NASA Center Partnership commented, "Kids are kids and if they don't like something, they'll let you know and shut it down and not come back. There must have been something that hooked them and made them come back." Parents observed the engagement; several thanked their respective site directors for the experience. At one Space Grant Consortium, parents of one boy reported that their son would come home "bouncing off the walls" with excitement, which they deeply appreciated as he rarely showed emotion: "He looked forward to each and every single day… and has just now started talking about college and a possible future within NASA."

A few sites found that students were enjoying the activities so much that these adolescents were actively telling others about the experiences. For example, one boy at a NASA Center Partnership called his mother every day at lunch to share what he was doing. Students also recruited additional participants: one Space Grant Consortium site reported that "After the first full day of camp, word would spread through the community about the exciting camp activities, resulting in more student participants each and every subsequent day." At another Space Grant Consortium, the students begged for a second week of activities.

One site specifically commented that this enthusiasm had much to do with the rich NASA content and NASA brand. Several reported that the NASA visuals that they had retrieved from the NASA website were dramatic successes as most of the students had never seen them before, provoking outbursts like, "Wow! So that's what it looks like." Sites reported that the NASA content materials surpassed what students had previously experienced. For instance, one student was so taken with the Hubble IMAX movie that it was declared “better than any 3D movie.” Several sites also reported that the SoI-sponsored field trips to venues such as planetariums and science museums were critical to the activities, as they exposed students to both STEM in the “real” world while broadening the students’ horizons beyond their communities, be they rural or urban. One Space Grant Consortium, where the majority of participating students qualified for schools’ free and reduced lunch programs (an indicator of low socio-economic status) found that “traveling somewhere new was in itself a learning experience,” and one critical for the students’ overall development.

Several sites also engaged parents in summer activities, by hosting evening events, where students would present their projects and the sites would honor their achievements, or through welcoming parent volunteers. During these activities, the sites had the opportunity to help parents recognize and celebrate their children’s accomplishments and to emphasize the importance of STEM achievement with parents, so that they might also encourage their children to take more classes in science and math after the activities ended.

Beyond the immediate engagement with the activities, sites reported that the summer experiences influenced participating students’ future plans. In Houston, students discussed joining the robotics team at the high school; some students who participated in the Massachusetts Space Grant Consortium activities discussed enrolling at MIT in a few years. One student in New Mexico described how her experience made her reconsider her career plans: “This program…makes you enjoy science. I liked the NASA program because before I went, I didn’t like science and I knew I wanted to become a lawyer. But after I went, I actually started enjoying science and I’m not sure if I want to be a lawyer anymore. I am thinking of becoming an engineer.”

Exposure to NASA Content and Materials

The pilot suggests that there is great potential in expanding the number of sites and educators utilizing NASA content, particularly with students who are underserved and underrepresented in STEM. The summer professional development activities were designed to expose educators to the wealth of NASA resources, “opening their eyes to everything [NASA] has to offer.” Several educators were impressed with the NASA materials and were planning on using them in their classrooms: “Best manipulatives ever – great in-depth information and explanations” and “ORIGINAL, new useful ideas!” A number of sites reported that NASA educators and points-of-contact were particularly helpful in directing them to appropriate content and sharing their expertise with them. For instance, a Space Grant Consortium reported that “having Aerospace Education Specialists guide us during our kick-off event was the key to success of the program. Their expertise and experience with NASA materials helped us choose the best way to organize our respective teacher and student events.” These NASA educators also modeled how to engage students with the NASA curriculum, and the end results were rich conversations concerning both pedagogical concerns, such as when a lesson would fit within the teacher’s existing practice and the practical considerations of cost. The Space Grant Consortium site continued, “Educators were very excited about the activities and had many “aha” moments, [when] something counter intuitive would happen or… [when the educators] were able to make a NASA task a reality.” Several sites reported that the educators had made plans to use the NASA materials in their classrooms in fall 2010.

The sites also provided partnering organizations with access to the wealth of NASA education resources, prompting a few to plan additional student activities where these NASA resources will be used. At one NASA Center Partnership, the PTA president (and parent of one of the participating students) vowed to go back to the school and to expand the existing NASA Science, Engineering, Mathematics and Aerospace Academy (SEMAA) project and engage more students, saying, “This is what we need more of!”

Developing Relationships between Educators and University Faculty

At half of the Space Grant Consortium sites, the SoI professional activities provided opportunities for teachers to observe and work with STEM university faculty. For some educators, the summer experiences developed into professional networks that may help teachers access resources needed to deepen their own - and their students’ – understanding of STEM topics in the future. One site director commented, “Summer of Innovation enabled the opportunity to build positive relationships of trust and respect which resulted in collegial friendships based on the common goals of helping students realize the excitement of learning and discovering that science and math can be fun.”

Chapter 6. SoI Pilot Program Implementation Challenges

Even though sites reported that many aspects of implementation went well, the sites indicated having encountered significant implementation challenges. Chief amongst these was the ambitious time frame in which the SoI activities were implemented. In addition, the sites were not always certain how to interpret SoI's priorities and also confronted logistical concerns including staffing issues related to working with students in SoI's targeted groups.

Time Frame

All sites reported one key limited resource: time. The NASA Centers learned about their SoI involvement in April, Space Grant Consortiums received their funding in late May/early June, and the Sub-Award contract was signed in July. The date of award affected many aspects of the SoI project, including limiting sites' ability to plan their camps. One Space Grant Consortium commented, "It's like going into a war zone every day. There's so much chaos – we're running around trying really hard to make this work. We're trying to make the impossible happen. I don't know if I would accept a grant like this again with so little time to prepare." The timing also created challenges related to the national evaluation efforts (see Chapter 7). Below we describe how the time line affected three key SoI components: recruitment and attendance, the availability of resources, and the activities themselves.

Student Recruitment and Attendance

Sites recruited students primarily in May and June 2010, at the end of the school year, and in some cases, after the school year had already ended (sites in Florida, Illinois, and Texas reported that school had ended before they were able to begin recruitment). Across all sites, 6,734 students were ultimately recruited and few sites were able to meet their original recruitment goals. The exceptions had strong pre-existing networks with local community organizations. In fact, two sites - one NASA Center Partnership and a Space Grant Consortium- had student interest that exceeded capacity.

Receiving funding in late spring and starting recruitment at the end of the school year created several key problems. Recruitment had to begin immediately, before many of the sites had the opportunity to plan the summer events, so the sites could only provide general information rather than specific examples that may have been more effective recruitment materials. One Space Grant Consortium reported, "…we were developing the program as we were recruiting. As a result, we had to be vague about exactly [what] we were offering."

Recruiting at the end of the school year was problematic in two other ways. First, many students and their families had already made their summer plans, whether to attend other summer camps or go on family vacations. Some sites reported that families had made vacation plans as early as January. Second, sites could not leverage schools, the key place to find students, adequately if at all: even where school was still in session, students and teachers were wrapping up the school year and were more focused on starting their summers than engaging in additional educational activities.

In response, sites reported that they had to become less selective, accepting students that they had not targeted and in grades other than the typical middle school years. One Space Grant Site reported, “Teachers recruited students who weren’t necessarily the target audience (college-bound students). One teacher commented that a student couldn’t even read the application to fill it out. Clearly, the content would be too difficult for them to grasp. This wouldn’t have been [our] first choice of students, but because we started recruitment late (May), there was no other choice than to expand [the] target.” Even with the “relaxed” requirements, the site resorted to adding financial incentives to motivate the teachers who were recruiting students; instead of teachers getting the full stipend regardless of how many students participated, they were paid per student they recruited.

A number of sites reported a mismatch in terms of students’ reading and math skills and the activities offered: some students were reportedly “bored” while others commented that the material was “too advanced.” A number of teachers at a Space Grant Consortium remarked on the complexity of trying to motivate all students to participate: “The age difference and level of knowledge among students [was a challenge]. It was hard at times to keep everyone on the same page.” Another teacher at a different Space Grant Consortium needed more preparation: “I felt that we did not have enough training [for] the sounding rocket experiment. Some of the students in the camp were very young (5^{th} going into 6^{th} grade) and I found it difficult to get them to think of a sounding rocket experiment.”

A few sites mentioned some difficulty with student attendance (although these issues did not appear in our analysis of the NASA Center Partnerships’ surveys). One site reported that they encountered issues with keeping students engaged in the three to four week camps. Other sites that observed high levels of student attrition reported that the students who left were “double booked” – a couple of sites, particularly at camps that lasted more than a week, reported losing students over the summer because the students and their family’s pre-existing plans. A parent told a Space Grant Consortium’s local evaluator that, “I already paid $100 for him to go to this other camp. He wants to stay at this camp, but I already paid for it, so he needs to go.”

Educator Recruitment

Sites recruited educators in May and June 2010; this recruitment effort was also less successful than planned and led to nearly 35 percent fewer educators than anticipated. Of the locations who reported their educator recruitment targets, only 14 percent (most locations at one Space Grant Consortium locations and at one NASA Center Partnership) met or exceeded their recruitment goals. The remaining locations missed their targets by between 9 and 87 percentage points.

Sites reduced qualification requirements for educators to increase their numbers. They accepted teachers from elementary and high schools and who were not categorized as “highly qualified,” as well as non-classroom educators, typically youth development staff who did not have background in STEM (recall that only about three-quarters of the NASA Center Partnerships’ educators who completed surveys were certified teachers). One site had initially proposed to only recruit teachers who met a higher certification level and who were already participating in one of two programs, NASA SEMAA and the Mathematics Engineering Science Achievement (MESA) program. However, given the short recruitment period, both of these two criteria were not applied and the site allowed teachers from outside the SEMAA and MESA networks and from any certification level to participate. Another Space Grant Consortium site decided to include high school teachers. Yet another site tried to attract more teachers by not requiring that the camps be full days, cutting in half the number of contact hours provided to participating students.

While reducing the requirements for educators allowed sites to increase their educator participant counts, it created challenges when preparing the educators for the student activities. One NASA Center Partnership coordinator commented that the hardest part of integrating NASA content into the summer activities was that the educators were not comfortable enough with the content, which she found to be especially true of the non-classroom teachers. Nor were all classroom teachers up to the task. One Space Grant Consortium location reported that one of their four teachers quit after the first week because she was unaccustomed to working with students in a less formal atmosphere.

Partnerships and Funding Resources

The late start also limited sites' ability to obtain additional resources and partners. Although all but three sites obtained additional funding, the majority commented they could have leveraged the NASA funding to acquire more resources if granted further time. The time line also meant that partnerships were rapidly formed, leaving little time to discuss how to maximize each partner's strengths or conduct the due diligence that could help ensure partnership fit. Other times, potential partnerships were simply not formed; several sites reported that many organizations were very enthusiastic about collaborating but they simply did not have sufficient time to figure out how to go about it, preventing potentially valuable partners from participating in the SoI activities. Schools needed to be engaged earlier in the spring, one site reported, because securing commitments for such resources as facilities, free breakfasts or lunches, and child care, took time.

Accessing NASA Resources

Moreover, limited time meant that NASA content was not fully utilized in the SoI pilot. Some sites reported not having enough time to look for and identify appropriate NASA materials and integrate it with their existing curriculum, commenting that they would have used more NASA resources if they better understood what was available. In addition, sites had difficulty getting to the appropriate NASA content. At least one site reported that the NASA content they found was geared towards high-performing, high school students and not underrepresented youth in middle school. As a Space Grant Consortium reported, "NASA material, while covering a breadth of [content], did not necessarily have the materials for each of our program areas. We were able to pull some NASA content into the majority of our lessons, but so much of it we had to adapt to our target audience." One site reported problems with some of the NASA materials, finding that certain lessons that it downloaded from the website did not have clear directions for implementation and also contained inaccurate facts.

Not all sites were certain what NASA resources they could use during the summer, commenting that they would have appreciated having NASA staff make a guest appearance had they known it were possible. Even when the sites were aware of these resources, they were not always able to access them. Several sites tried to have NASA astronauts, engineers, and other personnel meet their students in person or by video, but oftentimes could not make the scheduling work. One Space Grant Consortium commented, "We tried to use NASA personnel for a live video chat but they were booked at the times we needed them. We had hoped to connect with one of NASA's flight directors, but were not able to."

SoI Activities

A number of sites reported that because of the late start they could not implement the activities as described in their proposals. This was especially true at the sites that were developing new and innovative activities. A Space Grant Consortium reported, “We realized that there was not enough time realistically to design and build the experiment – there was not even enough time to buy the supplies.” Likewise, sites affiliated with bureaucratic entities such as school districts and government needed more time to process the funding and sign the contracts that would allow sites, for example, to pay venues they planned to visit on field trips. A NASA Center Partnership noted, “Especially, with big school districts, there’s much more of a process to go through to actually get the funds.”

Accordingly, some plans had to be cut: for instance, one Space Grant Consortium site had to eliminate one set of activities as the key piece of equipment – the hybrid wind turbine - required six weeks for delivery but funding was not received until four weeks before the camp’s start. It could also not insert the two turbines in city parks because there was not enough time to obtain the necessary approval from the city. Some sites were not able to schedule the field trips they had intended as the places they wanted to visit had already been booked by other camps. The Space Grant Consortium that had to eliminate the residential wind turbine activity could also not get into the Denver Zoo’s exhibit, “From Poop to Energy”, although it aligned well the camp’s content, during its field trip to the city because another group had already reserved all the tickets. Furthermore, planning for follow-up SoI activities at multiple sites had to be postponed to address the immediate concerns of implementing the summer camps.

Lack of Clarity about SoI Priorities

Sites varied in their understanding and interpretations of NASA’s priorities and expectations for the summer’s pilot. Evaluation responsibilities were especially unclear (see Chapter 7). Key aspects of the SoI project’s programming were also misunderstood. Two Space Grant Consortium sites understood that they were expected to provide professional development activities, but reported that they were unaware that these activities were intended for the educators who were instructing the summer’s student activities. One site explained, “NASA wanted every SoI program to have the teachers implement the student camps, but we had no idea. We wrote our proposal and did not have this type of structure – we had the teacher training as completely separate from the student program… and [NASA] decided to fund us. When they told us we couldn’t do it the way we proposed, we had to cut the teacher training one day short and add an observation day.” There also seemed to be confusion over whether post-summer 2010 activities were expected, so that not all sites were planning events for the 2010/2011 school year.

In addition, sites were not always sure of what was meant by certain terms. Overall, the least understood priority was “NASA content.” Some sites assumed that any content related to NASA “themes” (e.g., space exploration) would qualify and the sites did not need to look further; fewer NASA resources were likely used as a result.

Engaging Underserved and Underrepresented Adolescents

Targeting underserved and underrepresented middle school youth had its challenges. One site reported that recruitment was more difficult when parents did not actively encourage their children to participate. Other sites commented that the mismatch between student's math skills and reading comprehension too was problematic, as underserved students are more likely to be below grade level in these competencies. One NASA Center Partnership commented, "Some of the students had difficulty reading the instructions for the activities. They became frustrated, pouty."

Most prominently, teachers and counselors reported that they sometimes struggled to maintain discipline. As extreme examples, during a field trip a coordinator discovered a boy urinating off a building; at another site, the NASA coordinator had to interrupt a food fight. While certainly the exception and not the rule, incidents of bad behavior were disruptive to other students and interrupted engagement in the camp activities. A few sites explained that these issues arose because they were working with students who were not necessarily interested in science and who were more reluctant to initiate the hands-on activities they were to complete.

Furthermore, the coordinators and teachers were not always prepared to address the disciplinary issues or engage the more hesitant students. At one Space Grant Consortium site, the local evaluator expected teachers to anticipate how "the teenage brain works" but found that many were unprepared for student management in the less formal environment of summer camp. This site found that some of its non-teacher coordinators, individuals with experience working with adolescents in youth development organizations, were better equipped to address the disciplinary issues that emerged. Other sites reported that using rewards for good behavior helped improve the overall student conduct.

Sites also found that the students who participated in their activities were particularly sensitive to changes in programs' plans. One site's school district partner decided not to assume the liability associated with a scheduled field trip to the Kennedy Space Center and cancelled the event. Students and families were, as the site described, enraged, and while the site's coordinators worked to dampen the impact and postpone the trip until the fall, a good number of students failed to return to the camp. As the coordinator explained, "The students are familiar with organizations making promises that they cannot keep. These practices make the community very upset." At another NASA Center Partnership site, the engineers that the coordinator had recruited provided content unrelated to the camp's purported focus of robotics. As a result, many students who came expecting robotics did not return when their expectations were not met.

Logistics

Nearly all sites also experienced a variety of logistical issues not directly related to timing. Areas affected included staffing, transportation and scheduling, and communication.

Staffing

Several sites indicated that they had difficulty finding teachers, coordinators and counselors with specific expertise in STEM. One site reported that many middle school teachers do not have sufficient comfort with the NASA science content: "The biggest issue with teachers is …teaching them how to use the data [from the NASA website] with their students. They get incredibly overwhelmed and have fear [about] how to teach this to their kids…some have problems delivering basic science content already." Beyond teachers and coordinators, sites reported they needed additional staff, such as nurses and translators, to address students' specific needs. Committed chaperones were also in high demand.

Transportation & Scheduling

Several sites reported challenges related to managing multiple locations from the central site. Activities with large numbers of students had more trouble coordinating logistics and scheduling, which included finding sufficiently large locations, providing daily transportation from students' homes to the activities (as not all of the students' parents had access to a car), and coordinating field trips. For example, some venues that coordinators wanted to take the students to could only serve 20 students at time, which necessitated the creation of alternative plans and additional bussing to occupy the students exceeding the venue's capacity. Next year, at least one of the sites plans to let individual locations, rather than the central office, handle these planning and coordination issues.

Communication

Communication was a challenge for some of the SoI sites where the program's managers were not co-located with the activities. For example, one of the NASA Centers included in the national evaluation had partnered with an organization located in another state (but within the geographical region it serves) to expand SoI's reach. The communication lines with these distal locations were inconsistently reliable and questions passed between the two were not always resolved.

Chapter 7. SoI Pilot National Evaluation's Lessons Learned

The SoI evaluation was able to connect with all 11 sites and obtain meaningful and useful data about most sites' plans and implementations and in some circumstances, collected baseline and follow-up survey data. In addition, the evaluation unearthed important lessons that will inform subsequent phases of evaluation. Many of these lessons emerged from the challenges that were faced in launching an evaluation as the project was beginning its implementation. The chief evaluation challenges were related to three issues: 1) communication; 2) the data collection process; and 3) the content of the data collected. Together, the experience of addressing these challenges has generated important lessons that will enhance next year's national evaluation.

Communication

Over the course of the pilot implementation, issues were encountered related to communication about the evaluation and coordination across the various evaluation and monitoring activities. Communication issues arose between 1) NASA and the SoI sites about their participation in the national evaluation, 2) between the national evaluation team and the sites, and 3) among NASA and the SoI monitoring, assessment, and evaluation contractors.

Communication Between NASA's Office of Education and Sites

During the proposal phase, only limited information was provided to prospective applicants about the national evaluation. The FY2010 SoI solicitation described the grantees' reporting and evaluation requirements as follows:

> The PI will report project data related to the accomplishment of project outcomes and propose project-specific evaluation measures against which NASA will evaluate the performance of its proposed activities…Proposals funded under this announcement will be expected to contribute data to support NASA Education's performance metrics. Information typically required includes numbers of participants involved, cost per participant, cost savings experienced through use of education technologies, changes in student attitudes about STEM and STEM careers, educators using NASA education materials, etc. Details on applicable Office of Education performance measures, required data collection, and how to input information to the appropriate data collection system will be provided when awards are made. Other non-annual reports may be identified by the project manager for the Summer of Innovation. [43]

The language above is vague with respect to the role of the awardees in the national evaluation. Nor did they learn more upon award receipt. Although the solicitation had indicated that additional details would be provided upon grant receipt, specifics were not provided, and sites' cooperative agreements incorporated only vague reference to their participation in a national evaluation. Simply put, at the

[43] FY 2010 Cooperative Agreement Notice (CAN) for the *National Needs Grant: Summer of Innovation Pilot* (announcement NNH10ZNE004C, January 27, 2010, p.26).

start of the pilot sites did not know what was expected in terms of the requirements for their participation in the evaluation. They only learned mid-stream as they were already implementing their activities. While sites were usually willing to participate in the national evaluation and made the time to speak with the evaluation team during periods of intense project activity, sites were generally unprepared and under-resourced (in time and funds) to comply with all of SoI's evaluation and monitoring requirements. The lack of timely information about the national evaluation requirements was particularly evident in the implementation of data collection via the national evaluation surveys and implementation reporting forms.

National Evaluation Surveys

To collect data that would allow for aggregation and comparison across sites, sites were asked to administer the national surveys. In June, members of the national evaluation team held preliminary conversations with the Space Grant Consortiums' local evaluators and PIs to introduce themselves, discuss the plans for the pilot's national evaluation, alert them to the forthcoming surveys, and ask questions about the sites' plans for local evaluation. The national evaluation team made similar calls to the NASA Center Partnership sites and the Sub-Award in July. The conversations with the Space Grant Consortiums revealed that because sites had not been given details about the national evaluation at the time of award, they had proceeded without integrating those requirements into their evaluation plans. For example, sites had already initiated contact with their Institutional Review Boards (IRBs) and were preparing their own surveys. Consequently, to administer the national evaluation surveys most sites had to go back to their IRBs and submit these instruments. It also became clear that if the sites did not want to increase the participants' survey burden, they would have to decrease the amount of survey time dedicated to the local evaluator's questions.

While the national evaluation team provided the NASA Center Partnerships with hard copies of the national surveys, electronic copies of the surveys were sent to other sites, because they were expected to cover the costs of printing. This created the opportunity for the sites to modify them. Although the intent was for sites to use the surveys as they were provided, a few sites reformatted the surveys or dropped/edited items to better suit the local evaluation's objectives and preferences of their evaluators. For instance, one site omitted the items measuring students' STEM self-efficacy because it reported that the students were coming in with high levels of self-efficacy—as evidenced by their voluntary registration for a STEM summer program—which it thought the summer activities would not change. Consequently, survey data was not uniform across all sites, limiting the national evaluation's ability to aggregate to the SoI project level and to make comparisons across sites on key outcome measures.

Furthermore, most sites did not have the budget required to administer the national surveys and provide the data in electronic format for use in the national evaluation. This resulted, in part, because sites did not have sufficient detail about the expectations for the national evaluation at the time they submitted their budgets for SoI. One site did not have funds to print the national evaluation's surveys (accordingly, we printed the surveys for them) and only one could afford the necessary data entry work to prepare an electronic file for our analysis.

National Evaluation Reporting Forms

We produced the national evaluation's planning and implementation reporting forms and obtained NASA's approval for their use in July, after many of the activities had already begun. Once the reporting forms were sent to sites, four sites indicated that they had not been collecting some of the key implementation data required, such as student attendance and the number of NASA and STEM content hours, and thus could not provide full reporting. Furthermore, as some sites reported confusion regarding what NASA had meant as "NASA content", sometimes interpreting it to mean "NASA themes" (e.g., space exploration) rather than the use of specific NASA materials and resources, the total NASA content hours figures that the sites indicated on the forms are suspect.

In August, the Space Grant Consortium sites were asked to collect NASA's Office of Education Performance Measurement (OEPM) participant surveys and complete OEPM activity forms, which asked sites to report on their implementation. The request for collecting this additional data came after some camps had already concluded their activities, making it impossible to collect baseline data and extremely difficult to collect post-camp data. In response to the late request for additional survey administration, one site remarked: "It felt like they cut the legs out from under you." To address site coordinators' concerns about form fatigue, the national evaluation team, with NASA's approval, combined the OEPM and the activity forms. Although this alleviated some of the burden on the sites and participants, it also resulted in creating confusion as to whom the reports were to be submitted.

Also in August, NASA asked the Space Grant Consortium sites to submit quarterly reports, and later that month to complete "lessons learned" templates for the "SoI Lessons Learned Conference." Not surprisingly, one of the big challenges that the sites discussed at that conference was the reporting requirements, and the lack of timely and clear communication about them. As one NASA Center Partnership reported, "Having the forms ahead of time would have been helpful. I didn't know what I was getting myself into."

Communication Between National Evaluation Team and Site Coordinators

The evaluation team engaged in regular communication with the individual SoI sites. Our direct contacts were the local evaluators at the Space Grant Consortiums and Sub-Award site as well as the NASA Center education points of contact. In some circumstances, we were able to talk with site administrators. Several sites reported that participating in the national evaluation provided them immediate value; a few reported that the "technical assistance" calls prompted them, while in the midst of a very intensive activity period, to reflect on the summer activities, helping them plan for the future. A few contacts reported that they found value in completing the reporting forms as these prompted them to track students on a regular basis, so that they had regular summaries of the activities. Other sites appreciated having someone to contact regarding reporting requirements in addition to the overly burdened SoI staff at NASA headquarters.

However, the national evaluation team did not always have direct access to the individuals who facilitated the professional development activities or who led the student activities. In a number of cases, our contacts were not able to answer questions regarding the activities' implementation, such as how many students were participating and how many hours of STEM content was provided. In fact, our contacts typically passed the national evaluation's implementation forms to their staff in the field, whose diligence and detail in completing them varied. A number of times our contacts needed to phone others to obtain an answer, resulting in multiple phone relays. Furthermore, the relationships between our contact and the field was not always strong, which meant that some of our key implementation questions went unanswered or were filled in with "best guesses" from individuals who were not present during the camps' implementations. In addition, our contacts were not usually the individuals administering the surveys, so that the instructions we provided over the phone were not necessarily communicated to those who were actually administering the surveys.

Communication across Monitoring, Evaluation, and Assessment Activities

As mentioned earlier, multiple measurement activities involving the sites occurred during the pilot SoI, including assessment efforts, monitoring for GPRA reporting, NASA-specific reporting, the national evaluation, as well as local evaluations at some sites. Having multiple groups engaged in data collection enabled NASA to benefit from the different perspectives including project management expertise and education program evaluation, however, it also meant that several groups were approaching the sites for information at the same time, and no central point of contact at NASA was responsible for managing all the activities and ensuring that efforts were not duplicated. Furthermore, NASA did not want the national evaluation team to communicate directly with the contractor engaged in the assessment activities, which resulted in a lack of coordination across the various efforts.

Consequently, data collection efforts overlapped and sites were asked to complete multiple forms, templates, and administer multiple surveys. Not surprisingly, contacts reported "form fatigue", and complained that the reporting and survey administration had become a "full-time" job, leaving less time for managing the summer activities.

Beyond exasperating the sites, the lack of coordination may have negatively influenced the quantity and quality of data that was collected. As the data collection requests continued to come with minimal warning, sites became frustrated, which could have affected their willingness to participate, perhaps partly explaining why some sites did not complete the national reporting forms.

The site's staff members were not the only ones exhausted by the data requests. Respondents too were affected: a few sites observed some students randomly circling answers to complete the task as quickly as possible. As one Space Grant Consortium evaluator commented, "The sheer amount of survey material (local, statewide, national) overwhelmed the students. We fear that this affected the quality of their answers, or skewed their answers in an inaccurately negative direction. Some survey answers may be a reflection of survey fatigue, not lack of enthusiasm for the program." Furthermore, a few sites worried that including such a heavy survey burden at the start of the activities may have caused some students to disengage immediately.

Data Collection Process

One of the key successes for the national evaluation team was the development of the survey instruments. The surveys allowed us to collect data and produce psychometrically sound measures of constructs integral to SoI. They also provided insight into the participants' backgrounds and characteristics. In all cases, these surveys produced a description of the participants at the end of summer, so that the numbers of students, for example, who are moving forward with high levels of interest in STEM after the summer activities can be discerned. When administered to participants before and after the summer activities, the surveys' data could reveal any immediate gains in SoI's key outcomes, and if the same surveys were again administered to the earlier respondents in the future, the resulting data could indicate whether the summer gains were sustained over time.

Before surveys can be administered, however, certain administrative and consent processes need to be navigated to ensure that the data collection procedures sufficiently inform participants and protect their rights. The national evaluation completed these processes, however, we received the approvals after most of the summer activities had already begun so that only a few sites were able to collect baseline and follow-up data.

Obtaining OMB Clearance and IRB Approval

Prior to collecting data from participants in federally-funded programs like SoI, federal agencies need to obtain clearance from the Office of Management and Budget (OMB). In addition, the evaluator, grantees, and partnering organizations (e.g., universities, school districts) frequently have Institutional Review Boards (IRBs) that also must approve data collection. Although they have different mandates, both of these groups review the data collection and analytic strategy and the surveys and consent forms, to weigh the risk and burden to participants against the benefits of collecting the information.

These review processes take time. The standard OMB process typically takes up to 6 months, and IRB reviews at Abt Associates take about a month.[44] OMB awarded emergency clearance on July 21, 2010, after most of the educator and student activities had started and after some of the activities had ended. Consequently, baseline and follow-up surveys that would have provided the data critical for identifying gains in participants attitudes and for using quantitative means to generate promising practices, were not collected at all sites.

We also supported sites' efforts to obtain approval from their local IRBs. In the case of the Sub-Award, which does not have its own IRB, we provided an approved process and the assurances that its participants' rights would be respected by both the national evaluators and the contractor itself. However, as mentioned earlier, some of the sites had already initiated review processes with their own IRBs – to ensure approval for the data that their local evaluators wished to collect – *before* the national evaluation's surveys and consents had been approved by OMB. Before these sites could use the national evaluation materials at their sites, they had to "amend" their original IRB submissions to include them, necessitating additional IRB review work (and time).

Obtaining Parental Consent

Using data collected from students frequently requires written consent from a minor's parent or guardian. This consent process must also be approved by OMB and any relevant IRBs. Again, we encountered the challenge of clearances arriving once the summer activities were already underway. Overall, we succeeded in obtaining limited parental consent for their children's participation in the national evaluation at 9 of the 11 sites.

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44 Even the emergency OMB clearance process, for which SoI qualified this summer, took time: for SoI, 5.5 weeks elapsed before the proper go-ahead was obtained (submitted on June 11, 2010; PRA # provided on July 21, 2010).

Sometimes, obtaining parental consent was straightforward. For example, one NASA Center Partnership held a parent meeting before the student activities began, providing an ideal situation to obtain the necessary signatures prior to the activity's start. At one of the Space Grant sites, it was not even necessary to obtain parental consent as the language in the original form parents signed at registration was sufficiently broad to permit access to the survey data.

However, the process was more complicated at other sites. Some of the Space Grant sites' had very specific application forms that did not allow them to share participants' data with us; these sites had to collect additional consent forms – which their IRBs had to review in advance – so that their sites could participate in the national evaluation.

For the NASA Center Partnership sites without pre-session and post-registration contact with parents, obtaining parental consents was an unexpected and challenging task. They had to rely on students bringing the forms home, asking their parents to sign them, and then remembering to return the forms, a multi-step process that can be particularly challenging with adolescents. Some sites attempted to obtain consent when students were dropped off for camp; however, this strategy was generally unsuccessful as many students were bussed to the activities and others were dropped off by individuals other than their parents or guardians.

Not including parental consent forms in the registration materials also made some parents suspicious of the national evaluation's intentions. One site reported that parents did not understand why they would need to provide consent after they had already agreed to allow their children to participate in the activities and were worried that their contact information or their children's grades, which the forms requested access to, would be misused.[45]

Content of Collected Data

This summer's pilot provided the opportunity to field test the national evaluation's reporting forms and surveys across all sites. In the process, the national evaluation team obtained valuable feedback about their content and will use the feedback to further refine the instruments where the data that the national evaluation seeks may not be provided.

National Evaluation's Survey Instruments

Sites reported that the student surveys were too long, particularly as students were also expected to complete OEPM surveys; a few sites noted that students spent nearly 40 minutes answering the surveys. The most problematic and time-consuming questions were those asking for students' contact and other personal information (data necessary for tracking students); for example, students had trouble spelling their school's name, remembering their street address or their parent's contact information. Other students were confused by the fact that the surveys had separate questions regarding "race" and "ethnicity", oftentimes writing in "Hispanic" as their race rather than checking it as their ethnicity.

[45] To facilitate tracking of the students after the summer, surveys asked students to report parental contact information.

A few students had trouble comprehending the surveys' items or understanding how to answer them where double negatives were present (e.g., being asked whether they agree or disagree with the statement "I do not do very well in science."). Some sites requested that the surveys be translated into Spanish. We speculate that these issues may be related to the fact that students who were younger than middle school age (3rd through 5th grades) completed the same surveys as those in middle school or higher grades (6th through 11th). It also may be related to the fact that SoI targeted underrepresented and underperforming students who are more likely to be behind in their reading skills, speak English as their second language, or have a learning disability, than students at large.

Less feedback was provided on the educator surveys, as sites reported that these administrations went more smoothly. However, there were some cases where the educators did not want to answer specific items, feeling that their responses would be perceived as bragging (e.g., Strongly agree with items like "I understand science/math concepts well enough to be an effective teacher.")

National Evaluation's Planning Report Forms

The Sub-Award site is unique from the other SoI sites in that it is a for-profit company. This contractor considers its SoI program models as intellectual property that sets it apart from its competitors. Therefore, the Sub-Awardee was reluctant to complete the national evaluation's planning report form and to answer many of the national evaluation's implementation questions because the answers, as the contacts explained, were proprietary. Offers to sign non-disclosure agreements did not assuage the contractor's concerns. Accordingly, the national evaluation team was not able to develop a clear understanding of what activities were offered and what implementation challenges were encountered by this site.

Chapter 8. Conclusions and Recommendations

The national evaluation of the SoI pilot summer examined the implementation of SoI across sites and investigated its outcomes of interest. The evaluation uncovered important successes and challenges within the individual sites, for the project overall, and related to the evaluation of the project. Based on the findings available from this study, in this chapter we make recommendations for subsequent phases of project refinement, implementation, and evaluation. These are organized below according to whether the national SoI project, local sites, or the national evaluation team might take the lead in implementing them.

SoI Project

Expand the Project Timeline to Allow for Sufficient Planning and Start-Up

The evaluation clearly revealed that sites need more time, from notification of their involvement in SoI to the beginning of their summer activities, to recruit participants, plan and schedule activities, purchase materials, train staff members, and explore NASA resources. In addition, the national evaluation activities necessitate more time than was available during the SoI pilot. Based on our conversations with the sites, and our experience as evaluators of STEM education programs, we recommend the time line outlined in Exhibit 13.

Refine and Clarify the Program Model

The SoI pilot contained a great deal of variation in activities and participation, which did not always align with the SoI intended model. The SoI project should refine what constitutes the SoI project and clearly describe this model to a variety of audiences, including sites.

A clearly specified program logic model can help the SoI project articulate its program theory to a broad audience. This not only helps refine the SoI model – the framework for the project itself – it also helps translate the model into operational terms for the sites. For instance, the input box regarding teacher professional development currently states "Teacher professional development and training opportunities for educators who will lead students through SoI and bring those skills back to the classroom the following year." This could be translated to mean that the educator activities should target classroom teachers with plans for teaching middle school students in the next school year, and that leadership in SoI includes summer experiences working with SoI middle school students. Operationally, then, sites should be prepared to turn away high school teachers, pre-service teachers, and youth development staff. Sites should also be aware that these teachers are expected to be engaged in the instruction of the students participating in the summer activities. However, NASA may want to include youth development staff as they will lead students in STEM exploration outside the classroom in informal settings. If so, the logic model should be updated and sites informed of the operational definition.

Exhibit 25. Recommended Time Line for SoI FY2011

November 2010:

- Release solicitation (NASA)
- Convene advisory panel to guide NASA's scope of work for continued national evaluation work (NASA)
- Prepare deliverable describing packages to be submitted in January and meet with OMB to discuss, per OMB's request (NASA, national evaluator, OMB)
- Revise national evaluation survey instruments (national evaluator based on NASA's further refinement of the constructs that the instruments must measure)
- Initiate OMB clearance review process by publishing notice in the Federal Register (NASA & national evaluator)
- Initiate national evaluator's IRB process (national evaluator)

January 2011:

- Announce SoI sites (NASA)

February 2011:

- Launch recruitment efforts for teachers and students (SoI sites)

April 2011:

- Host national evaluation kick-off meeting, discussing expectations for the SoI evaluation and monitoring requirements and sharing the materials and reporting forms/templates (NASA & national evaluator)
- Begin regular calls between the national evaluator and the sites' evaluation coordinators to support local IRB reviews, ensure planning forms completed prior to implementation, and establish tracking systems to collect implementation data (e.g., attendance) (national evaluator & sites)
- Send evaluation instruments and OEPM surveys to SoI sites (national evaluator & NASA)
- Initiate local IRB review processes (sites, supported by national evaluator)

June–August 2011:

- Implement SoI activities (sites)
- Administer national evaluation's and OEPM surveys (sites)
- Communicate regularly about challenges and successes during implementation (national evaluator & sites)
- Submit required national evaluation reporting and OEPM forms as soon as activities end (sites)

September 2011:

- Provide electronic files of survey responses to national evaluator (sites)
- Complete submission of all OEPM and national evaluation implementation reporting forms (sites)

December 2011:

- Submit annual report summarizing national evaluation results (national evaluator)

Refinement of the SoI logic model should provide critical insight into how NASA envisions the chain of events that lead to SoI's desired overall impact. SoI's current logic model identifies in general terms and outputs; however, the relationships amongst and between the identified elements are less clear, so that the hypothesized change process and how to evaluate it is uncertain. For example, student short-term outcomes are specified as "student improvement in STEM knowledge and skills;

improved student knowledge of and attitudes toward STEM college study and careers." However, it is not clear what the relationship is between students' improved knowledge and attitudes towards STEM careers or if these improvements are expected to occur simultaneously.

The refined SoI project model should be grounded in existing theory and prior empirical research, as well as the lessons learned during the SoI pilot and NASA's experience more broadly. For example, empirical research and expert opinion supports the link between student informal STEM activities and STEM engagement, and the value of STEM engagement as it relates to student achievement and preparation for STEM careers. The National Academies' recent report on learning science in informal environments states that "research suggests that personal interest and enthusiasm are important for supporting participation in learning science" and that a nationally representative study found that "the expressed interest in science during early adolescence is a strong predictor of science degree attainment."[46] Experts, including the President's Council of Advisors on Science and Technology, argue that these inspiring and engaging opportunities are critical as they enable students to develop "personal connections with the ideas and excitement of STEM fields" that maximize students' overall success in STEM education.[47]

The literature, however, provides less support connecting STEM informal activities directly with student achievement, as measured through student test scores. Generally, annual gains in test scores decrease as students progress through school. In middle school, the average annualized gain on nationally normed tests in math and science range in effect size from 0.22 to 0.32; this range drops to 0.01 to 0.25 during the high school years.[48] In practical terms, this means that a program with an effect size of 0.15, while considered "small" by statistical standards,[49] would represent nearly a 50 percent or more improvement over the growth we would expect to see from students' full year of seventh grade studies, for example. Therefore, a summer program lasting anywhere between one to six weeks – 3 to 15 percent of a school year[50] – would not likely produce a measureable impact on standardized test scores.

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46 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. Board on Science Education, Center for Education. Division of Behavioral and Social Sciences and Education. Washington, DC: The National Academies Press.

47 President's Council of Advisors on Science and Technology (September 2010). Prepare and Inspire: K-12 Education in Science, Technology, Engineering, and Math (STEM) for America's Future. Report to the President. Pre-publication Version. Retrieved on October 14, 2010, from http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast-stemed-report.pdf

48 Bloom, H., Hill, C., Black, A.R., & Lipsey, M. (2008). Performance Trajectories and Performance Gaps on Achievement Effect-size Benchmarks for Educational Interventions. *Journal of Research on Educational Effectiveness* 1(4), 289-328.

49 Lipsey, M. W. (1990). Design Sensitivity: Statistical Power for Experimental Research. Newbury Park, CA: Sage Publications.

50 Assuming schools are in session for 40 weeks a year.

Clearly Articulate Requirements for Site Participation

Further, the SoI project should clearly specify what the expectations are for sites' participation, and hold sites accountable for conforming to these requirements. SoI should make all expectations clear to sites as early as possibly, preferably through operational guidelines in the solicitation that can be reinforced at subsequent key times (e.g. the discussions leading to an award, the final terms of the cooperative agreement, and SoI kick-off events). Once defined, expectations and requirements should not shift and the SoI should hold sites accountable for aligning with project requirements.

The evaluation uncovered numerous instances where sites misinterpreted or ignored SoI goals and/or requirements. For example, some sites included 3^{rd}, 4^{th}, 10^{th} and 11^{th} graders, even though the SoI model specified "middle school". Likewise, a few sites were confused by what was meant by "NASA content" and interpreted it to mean any material related to space exploration. In addition, most sites were not aware that they would be expected to field national evaluation surveys and provide the data in electronic form to NASA's contractor.

Specifically, the pilot evaluation found that the sites needed more information about the following:

- Key programmatic elements NASA required by activities to receive SoI funding. For example, sites needed clarification on the meaning of "educator," "middle school," "professional development," and "NASA content"
- Locations of particular online resources, preferably organized by discipline, that are well-suited for the underrepresented and underserved middle school students
- Participant requirements, including restricting students to those *entering* middle grades (6^{th} to 9^{th} grade) in the fall and the educators to those with a middle school classroom teaching assignment in an accredited school for fall 2011
- NASA's willingness to provide sites with NASA educators/experts during the educator and student activities, to help access and customize NASA content, as well as provide a human face for STEM careers

In addition, the SoI project should make clear sites' requirements for participation in the national evaluation and hold sites accountable for them. To support a successful national evaluation, we recommend the following steps:

- Clarify expectations for the national evaluation in the solicitation, including the requirement that sites will work with the national NASA evaluator by participating in regular communication with the contractor, completing planning and implementation reports in a timely fashion, administering national evaluation surveys, and preparing electronic files with the survey responses
- Make funding contingent on full participation in the national evaluation, requiring them to cooperate with an independent, third party evaluator
- Require sites to use surveys printed by NASA to ensure that the items are not edited, that all pages are provided to the participants and that the surveys will remain in a format that will facilitate data entry

- Provide a national evaluation "kick-off" meeting where sites' evaluation responsibilities are clearly discussed and all national evaluation materials (surveys, consent forms, planning and implementation forms) are distributed and explained
- Provide written guides to completing national evaluation forms, highlighting "frequently asked questions"

Coordinate Monitoring and Evaluation Activities

The SoI project needs to ensure coordination across the project's monitoring and evaluation efforts. During the pilot, the lack of coordination resulted in undue burden on sites, and may have negatively impacted both the quantity and quality of the data reported. We recommend that the SoI project:

- Identify one NASA staff member responsible for coordinating all evaluation, monitoring, and assessment efforts to eliminate overlap and minimize burden to sites
- Integrate forms so that sites are required to provide one set of reports and are not asked to provide duplicate information
- Prioritize relevant outcomes and constructs of interest to reduce those measured by the surveys, thereby shortening the surveys by reducing the number of items

SoI Sites

Implement Promising Practices from the SoI Pilot

Both the challenges that sites confronted this summer and the successes they experienced provide some promising practices that should be considered by sites planning to implement SoI in subsequent years. These strategies relate to improving participant recruitment, staffing, logistical planning, and communication.

Participant recruitment:

- Begin educator recruitment as early as possible, preferably in the winter
- Initiate student recruitment efforts no later than early spring (preferably in winter), depending on the community's practices (i.e., in some communities, parents typically begin planning for the summer activities in February, others in April). Starting the process earlier will also allow the sites to develop relationships with key individuals in the community who might help facilitate recruitment
- Maximize outreach in schools with large populations of underrepresented students, for example, by targeting schools with the desired average proficiency rates and student demographics

Staffing for the activities:

- Include behavioral management training in educator professional development activities
- Dedicate additional professional development time so that teachers better understand and are more comfortable with the activities' STEM content
- Budget and hire aides to address students' special needs; if field trips and overnights are involved, be sure to have a nurse available to dispense student medications

- Provide sufficient training to staff to ensure they clearly understand the specific challenges of working with adolescents and are prepared to address behavioral issues

Logistical planning:

- Push logistical planning, where possible, to the local level as scheduling for groups of 20 students is far simpler than for 600
- Contact field trip venues several weeks in advance, providing them estimates of the total number of students to ensure that they are available and can prepare for the students by, for example, bringing on additional staff

Communication:

- Ensure sufficient resources to build a relationship with partnering organizations, including the time and expense of a site visit prior to the camp's implementation
- Emphasize the importance of open and frequent contact with NASA in the partnership selection process and ensure that the partner has the capacity to fulfill it

National Evaluation Team

Improve Logistics of Evaluation

Finally, the national evaluation's experience throughout implementation has generated an additional set of lessons focused on maximizing the amount and quality of data collected to bolster the effort's ability to identify promising practices across all sites. Specifically, below we offer guidance regarding the requisite administrative approvals of the data collection, the national evaluator's access to the "field," and revisions for the national evaluation surveys.

Administrative approvals:

- Initiate OMB clearance process in December, six months before first activities are scheduled to begin
- Provide approved consent forms and NASA surveys to the sites at least 2 months prior to start of activities to ensure sites have sufficient time for the IRBs to review
- Initiate communication between the national evaluations and the sites in April, so the local IRB approval processes can begin
- Mention that data will be shared between the site and the national evaluation in the consent form
- Request that sites submit their IRB approval letters for the data collection prior to the start of their program
- Integrate evaluation consent into participation consent so parents only need to sign one form

Access to sites:

- Require sites to participate in the national evaluation
- Request that sites identify a data collection coordinator who would be responsible for ensuring that his/her site understands the evaluation requirements and will administer the surveys consistently. This key point person should be required to spend time in the field and

be able to connect national evaluators with location coordinators to ensure key implementation data is collected

- Review the implementation reporting forms in detail during the evaluation kick-off meeting so that the designated data collection coordinator can train the site implementers at *each* location to complete them as accurately as possible
- Provide thorough, written survey administration instructions for the evaluation coordinator to share with the individuals administering the surveys. These instructions should be reviewed with all survey administrators and the national evaluation team via conference call to ensure that the requirements are clear

National evaluation survey instruments:

- Require that surveys are administered in a controlled, quiet environment, preferably a classroom, where an adult sets and maintains a serious tone
- Stress the importance of the surveys with students so that they understand that their responses will be taken seriously
- Prepare detailed survey administration guidelines and conduct a conference call/meeting "survey orientation" with individuals administering the surveys to review and answer questions
- Have sites administer pre-printed surveys and consent forms to prevent them from revising the surveys; attach a participant ID to both the consent form and the surveys to facilitate matching consent form and surveys
- Consider feasibility of online survey administration – some sites had only limited connectivity to the Internet (e.g., Idaho), and not all students have email addresses – but this strategy could reduce data entry costs
- Collect baseline surveys, including student contact information (address, parent's name etc.), as part of the application and/or registration process; if too many students apply, will have baseline data for a comparison group
- Consider providing incentives for filling out the surveys but be aware that they may also invite students to rush through the questions

Refine and Implement a Progressive Evaluation Plan for SoI

Building the clearly defined SoI logic model and operational definitions of the core SoI elements is key step in moving the SoI national evaluation forward. In our report, *Considerations and Recommendations for Evaluating SoI's Impact* (August 2010), we discuss the issues involved in measuring the impact of SoI as it has been implemented to date. Now that we have collected additional data and have had time to reflect on the pilot's results, we underscore the necessity of continuing with formative evaluation efforts. We anticipate that the national evaluation will focus on implementation but also consider outcomes to identify promising practices to be rigorously examined in a future impact study.

Requirements for an Efficacy Study

The Society for Prevention Research (SPR) has established standards for identifying effective prevention programs and policies. While not necessarily focused on education programs, the standards regarding what is required for an efficacy study (an evaluation of a program's effect under optimal conditions that typically constitutes the first step towards learning whether a program creates impact) are on point. First and foremost, "the intervention must be described at a level that would allow others to implement/replicate it." The description should include:

> …a clear statement of the population for which it is intended; the theoretical basis or a logic model describing the expected causal mechanism by which the intervention should work; and a detailed description of its content and organization, its duration, the amount of training required, and intervention procedures. [51]

Without a clear description of SoI impact mechanisms and activities, an impact evaluation could not definitively ascertain which practices are linked to significant effects, upending the key purpose of an efficacy study. Given that these components are not yet in place, the 2011 SoI national evaluation should facilitate NASA's refinement and focus of the SoI model based on the 2011 implementation.

Revise SoI Measures and Data Collection Techniques

The next phase of formative evaluation should also invest more thought into the appropriate measures for a future efficacy study. Over the course of the SoI pilot, we have considered the different measures originally suggested for assessing SoI outcomes. These included student grades, test scores, engagement surveys, and student course-taking behaviors. As discussed in *Considerations and Recommendations for Evaluating SoI's Impact* (August 2010), we have serious concerns about the feasibility of some of these measures in a SoI impact evaluation, as briefly described below:

- ***Grades*** – lack of comparability across teachers, subjects, and grades, while also influenced by factors beyond student learning
- ***Test scores*** – incomplete data as few states conduct standardized science and math tests at the necessary time points (before the SoI activities, immediately after, and at a future point in time for follow up); In addition, there are significant analytic concerns regarding the standardization of scores across state tests
- ***Course-taking behaviors*** – likely influenced by factors other than student interest, including ability tracking and any prerequisite criteria

Given the pilot's experience and the empirical evidence in the literature, it may be more meaningful for NASA to focus SoI on the objective of inspiration and sustaining engagement in STEM, eliminating the evaluation of achievement measures. We would focus on identifying additional indicators of engagement and inspiration - particularly those occurring close to when the activities are implemented. Developing and testing these instruments should be a key task of the formative evaluation going forward. Measures of inspiration and engagement could include tracking students' enrollment in science clubs or other voluntary STEM-related activities outside of the school immediately following participation in SoI.

[51] Flay, B.P., Biglan, A., Boruch, R.F., Castro, F.G., Gottfredson, D., Kellam, S., Moscicki, E.K., Schinke, S, Valentine, J.C., & Ji, P. (2005). Standards of Evidence: Criteria for Efficacy, Effectiveness and Dissemination. *Prevention Science 6*(3). Retrieved on October 14, 2010, from http://www.springerlink.com/content/k548g7161207w045/fulltext.pdf

Capturing these indicators would be vastly improved if a strategy could be devised to collect reports from students more frequently than in an annual survey. Consequently, during the formative evaluation we could explore how best to acquire this behavior data and track students over time. We could experiment with various techniques to remain in contact with the students after the SoI summer experiences, included text messages, emails, handheld devices, or telephone and mail surveys to learn which are most successful in keeping the targeted population of students engaged. This will also allow us to generate best practices for the data collection of longer term engagement measures in a future efficacy study.

Conclusion

This summer's pilot set a baseline against which future SoI implementations can be compared, providing insight into what might be expected and how these challenges might be successfully addressed. Given the glimmers of success observed this summer, we look forward to seeing what next summer's SoI brings and what an eventual impact study finds.

References

Bloom, H., Hill, C., Black, A.R., & Lipsey, M. (2008). Performance Trajectories and Performance Gaps on Achievement Effect-size Benchmarks for Educational Interventions. *Journal of Research on Educational Effectiveness 1*(4), 289-328.

Flay, B.P., Biglan, A., Boruch, R.F., Castro, F.G., Gottfredson, D., Kellam, S., Moscicki, E.K., Schinke, S, Valentine, J.C., & Ji, P. (2005). Standards of Evidence: Criteria for Efficacy, Effectiveness and Dissemination. *Prevention Science 6*(3). Retrieved on October 14, 2010, from http://www.springerlink.com/content/k548g7161207w045/fulltext.pdf

Fraser, B.J. (1981). Test of Science Related Attitudes (TOSRA). http://ret.fsu.edu/Files/Tools/TOSRA_2.doc, accessed on 8/12/2010.

Hulett, L.D., Williams, T.L., Twitty, L.L., et al. (2004). Inquiry-Based Classrooms and Middle School Student Perceptions about Science and Math. Paper presented at the 2004 Annual Meeting of the American Educational Research Association, San Diego, CA.

Lipsey, M. W. (1990). *Design Sensitivity: Statistical Power for Experimental Research.* Newbury Park, CA: Sage Publications.

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. 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 (September 2010). *Prepare and Inspire: K-12 Education in Science, Technology, Engineering, and Math (STEM) for America's Future.* Report to the President. Pre-publication Version. Retrieved on October 14, 2010, from http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast-stemed-report.pdf

Riggs, I., & Knochs, L. (1990). Towards the development of an elementary teacher's science teaching efficacy belief instrument. *Science Education 74*, 625-637.

Snyder, T.D., and Dillow, S.A. (2010). Digest of Education Statistics 2009 (NCES 2010-013). National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education. Washington, DC. Retrieved on October 14, 2010, from http://nces.ed.gov/programs/digest/d09/tables/dt09_068.asp?referrer=report

Weinburgh, M..H., & Steele, D. (2000). The Modified Attitudes Toward Science Inventory: Developing an instrument to be used with fifth grade urban students. *Journal of Women and Minorities in Science and Engineering* 6, 87-94.

Weiss, I.R., Banilower, E.R., McMahon, K.C., & Smith, P.S. (2001). *Report on the 2000 National Survey of Science and Math Education.* Horizon Research, Inc. www.horizon-research.com.

Appendix A. Planning Reporting Form

Overview of All Activities at SOI Site

SOI Site:

Number of distinct student activities:

Number of educator PD activities:

Total SOI funding: $

Are there any source(s) of any additional funding?

☐ Yes **If yes, please specify additional resources provided:**

☐ No *Source #1:* *Source #1 amount:* $

Source #2:` *Source #2 amount:* $

Is there an educator professional development activity at this site?

☐ Yes *If yes, please complete Table A.*

☐ No *If no, please skip to Table B.*

Do the educators who receive the SOI professional development also provide the student summer SOI activity?

☐ Yes

☐ No

Comments:

TA Provider: **Date:**

Table A: Educator Professional Development Activities Plans

Table A will be completed for each educator PD activity.

1. **Setting/Location:**

   Total number of locations:

   Please identify all locations:

2. **Is this a pre-existing or a new activity?**

   ☐ Pre-existing   *If pre-existing, number of years in operation:*

   ☐ New

3. **Is this a NASA or partner PD activity?**

   ☐ NASA/SOI stand-alone PD (includes PD developed by Space Grant Consortium's grantees)

   ☐ Partner's PD utilizing NASA resources

4. **Program staff implementing PD activity: (If multiple "classes", please report for each.)**

   Number of NASA staff:

   +

   Number of partner staff:

   +

   Number of Space Grant consortium grantee staff:

   +

   Number of other staff: *Please identify title(s) of any "other" staff involved:*

   =

   Total staff:

5. **Goals and objectives:**

6. **Description of planned educator professional development activity:**

7. **Content area to be addressed:**

8. **NASA resources to be used:**

9. **Partnership(s) and role(s):**

Partner #1:

Partner #1 role:

Partner #2:

Partner #2 role:

Partner #3:

Partner #3 role:

10. **Planned dates and times of educator PD:**

Dates of PD:

Total # of PD days:

Hours per day:

11. **How many hours of training will educators receive in STEM? In using NASA resources?**

Hours of training in STEM: Hours of training in using NASA resources:

12. **Targeted number of educators:**

Total targeted: Total targeted per "class" *(If multiple groups @ same location)*

13. **What's the target population(s) of educators?** *If multiple groups of educators trained per program model, please specify for each group.*

Group 1

Description:

Cert. level: Grade level(s): Subject(s) teach:

Total pre-service teachers: Total in-service teachers: Total non-teachers:

Youth development staff: Other (please describe):

Group 2

Description:

Cert. level: Grade level: Subjects:

Total pre-service teachers: Total in-service teachers: Total non-teachers:

Youth development staff: Other (please include description):

Group 3
Description:

Cert. level: Grade level: Subjects:

Total pre-service teachers: Total in-service teachers: Total non-teachers:

Youth development staff: Other (please include description):

14. How are educators recruited?

15. Planned training for staff delivering PD: *(If none, enter "none".)*

16. Planned STEM learning community or network: *(If none, enter "none").*

17. Additional follow-up activities post-summer 2010: *(If none, enter "none".)*

18. (For Space Grant & Sub-Award) **Will educators be tracked over time?** ☐ **Yes** ☐ **No**

Comments:

Table B: Student SOI Activities Plans

Table B will be completed for each student activity implemented.

1. **Activities name:**

2. **Setting/location:**

   Total number of locations:

   Please identify all the location (if multiple):

3. **Is this a pre-existing or a new activity?**

   ☐ Pre-existing   *If pre-existing, number of years in operation:*

   ☐ New

4. **Is this a NASA or partner activity?**

   ☐ NASA stand-alone or Space Grant Consortium activity developed for SOI

   ☐ Partner's activity utilizing NASA resources

5. **Goals and objectives:**

6. **Description of activity:**

7. **Content area(s) to be addressed:**

8. **NASA resources to be used:**

9. **Partnership(s) and role(s):**

   Partner #1:

   Partner #1 role:

   Partner #2:

   Partner #2 role:

   Partner #3:

   Partner #3 role:

10. **Planned dates and times of student activity:**

    Dates:

    Total # of days:

    Hours per day:

11. **Total hours of STEM programming that will be offered:**

12. **Total hours during which NASA resources will be used:**

13. Targeted number of students:

Total targeted: Total targeted per "class" *(If multiple groups @ same location)*

14. Targeted student population:

Grade Level(s)* % Female % African American

% Free/reduced lunch % special needs *Please specify type of special needs:*

Other** *(please specify:)*

* Grade level students will be entering in fall 2010

** Specific subgroup of interest, e.g., Native American students, rural students

15. Student recruitment process:

16. Are the educators receiving professional development (as described in Table A) **implementing the student summer activity?**

☐ Yes *If Yes, number of teachers implementing student activities:*

☐ No/NA

16. Planned STEM learning community or network: *(If none, enter "none".)*

17. Staff implementing student activity: *(If multiple "classes", please report for each.)*

Number of classroom teachers:

+

Number of undergraduate students

+

Number of graduate students

+

Number of university professors

+

Number of other educators | *Please identify title(s) of other educators:*

=

Total number of staff:

18. Planned staff training prior to camp: *(If none, enter "None".)*

19. Planned parent involvement: *(If none, enter "None".)*

20. Planned STEM learning community or network: *(If none, enter "None".)*

21. Planned follow-up activities post-summer 2010: *(If none, enter "None".)*

22. (For Space Grant & Sub-Award) **Will students be tracked over time?** ☐ **Yes** ☐ **No**

Comments:

Appendix B. Implementation Reporting Form

SOI Site:

Number of distinct student activities:

Number of educator PD activities:

Total SOI Funding: $

Is there an educator professional development activity at this site?

☐ Yes *If yes, please complete Table A.*

☐ No *If no, please skip to Table B.*

Do the educators who receive the SOI professional development also provide the student summer SOI activity?

☐ Yes

☐ No

Form completed by:

Title:

Email:

Telephone:

Date form completed:

Table A: Educator Training/Professional Development

Table A should be completed for each educator PD activity.

1. **Dates and times of educator PD:**

   Dates of PD:

   Total # of PD days:

   Hours per day:

2. **Total number of PD hours in STEM:**

3. **Total number of PD hours in use of NASA resources:**

4. **Total number of educators at start and end of PD:**

   Number at start:

   Number at end:

   Number added mid-course:

   Number who did not complete PD: *(If zero, skip to 6.)*

5. **Reason(s) educators did not complete PD:**

6. **Average attendance at site:**

   Total program attendance

   divided by

   Total number of program days:

   =

   Average number of educators/day

7. **Staff who implemented PD activity:** *(If multiple "classes", please report for each.)*

   Number of NASA staff:

   \+

   Number of partner staff:

   \+

   Number of other staff: | *If other staff involved, please describe:*

   =

   Total staff:

Comments:

Table B: Student SOI Plans

Table B should be completed for each activity.

1. **Activity name:**

2. **Dates and times of implementation:**

   Dates:

   Total contact hours:

3. **Total number of STEM programming hours:**

4. **Total number of hours NASA resources utilized:**

5. **Total number of students at start and end of activity:**

   Number at start:

   Number at end:

   Number added during activity:

   Number not completing activity: *(If zero, skip to 7.)*

6. **Reason(s) students did not complete the activity:**

7. **Average daily attendance:**

   Total program attendance

   divided by

   Total number of program days:

   =

   Average number of students/day

8. **Staff who implemented student activity:**

   Number of classroom teachers:

   \+

   Number of undergraduate students

   \+

   Number of graduate students

   \+

   Number of university professors

   \+

   Number of other educators | *Please identify title(s) of any other educators involved:*

   =

   Total number of staff:

Comments:

Appendix C. "Technical Assistance" Call Agenda

Technical Assistance Call Topic #1
Timing: Immediately after intro email sent
Purpose: Introductions and purpose of technical assistance
Topics:

I. Introductions of site administrator, PI, local evaluator, Abt/EDC staff
II. Role of national evaluators and technical assistance
III. Discussion regarding SOI proposed activities
   a. Programming and units of analysis
      i. How many models?
      ii. How many locations/classes per model?
   b. Recruitment
   c. Duration & scheduling
   d. Activities
   e. Alignment with state standards
   f. Two year community of learning (follow-on activities)
IV. Discussion regarding SOI evaluation and management plan
   a. Research questions of local evaluation
   b. Data collection plan
      i. Tracking of students?
      ii. Tracking of teachers?
   c. Analysis plan and reporting
   d. Requirements for the national evaluation (e.g., surveys, planning form, implementation form)
   e. IRB - NASA Centers will defer to Abt's IRB- need to check whether partners have own IRBs
   f. Parent consent & student assent forms to be completed

Technical Assistance Call Topic #2
Timing: Pre-implementation (where possible)
Purpose: Student and teacher surveys, survey data collection plan, implementation data & data collection
Topics:

I. Status update on planning (any "lessons learned"?)
II. Student survey domains
   a. Self-confidence in science
   b. Self confidence in math
   c. Career interest in STEM
   d. Leisure interest in STEM
III. Teacher survey domains (note: not all Centers have teachers participating)
   a. Personal science teaching efficacy
   b. Science teaching outcome expectancy
   c. Use of traditional teaching practices
   d. Use of strategies to develop students' ability to communicate ideas
   e. Use of laboratory activities
IV. Review Survey data collection plan including plans for obtaining parental and student consent/ assent
V. Establishing respondent ID and data management issues

a. We don't want identified data! Instead, ask to create a list (secured with password) where assign each student a unique identifier. Remind them to remove name before sending data.

VI. Reporting of survey & outcomes data to national evaluators

a. Data transfer portal will be available to securely submit data to us. We'll send them an email with information on how this will work.

VII. Planning & implementation data requirements

a. Share planning form. Explain we will pre-populate with info we have (proposals, other calls etc.) and then ask the evaluator/site administrator to check for accuracy. Set date when will have pre-populated form for evaluator to review.

b. Share implementation form. Ensure site collecting necessary quantitative data (attendance; student to staff ratio). Tell them we will schedule call right after camp ends to discuss how things went (i.e., the questions on the last page of the form).

Follow up to Technical Assistance Call Topic #2

Timing: Pre-implementation (where possible)

Purpose: Review planning form

Topics:

I. Share planning form prior to call

II. Discuss form's accuracy

III. Fill in remaining gaps

Technical Assistance Call Topic #3

Timing: late July/Early August

Purpose: Extant data collection plan

Topics:

I. Status update on implementation (any lessons learned?)

II. Our recommendations re. extant data and implications for NASA Center sites

III. Outcomes collecting (extant data and their own survey data)

IV. Plans for acquiring extant data

V. Issues with confidentiality, data security and data access

VI. Coordination plans with State Department of Education, districts

VII. Tracking plans

Appendix D. Post-Implementation Debrief Protocol

Timeline: August 2010
Respondents: Site administrators at NASA Centers, local evaluators

- Ask respondent to reflect on SOI experience as whole and respond to the following questions:
  - What part of your program do you think was most successful? Why?
  - What did you find most challenging? Why? How did you address these challenges? What was the outcome?
  - If you were able to start over, what would you do the same? Why?
  - If you were able to start over, what would you do differently? Why?

- Review planning report from June 2010 with respondent to ascertain differences between planned activities and actual activities. Space Grant Sites – also review the quarterly report. Probe on the following key areas for both students and teachers (if applicable): recruitment, retention, activities (planned vs. actual), plans for follow-up activities, partnerships, staffing and management issues, and NASA resources used – materials, curricula, personnel, and electronic media. Where differences exist, inquire why.
  For example:
  - "I see here that you planned on implementing the three different types of hands-on activities with the teachers. Were you able to do all three? Why not? Which do you think were most successful? Which were least successful?"
  - "In your proposal, you planned on engaging 200 students but I see that only 50 participated. What challenges did you encounter in recruitment? What challenges did you encounter in retention? How would you change the process if you were going to do it again?"
  - "Originally, you thought you would use NASA's curriculum and materials for the engineering challenge. Were you able to implement your plan? How successful do you think you were in using NASA's content? "
  - "According to our notes, you initially planned on holding follow-on activities across the school year. Are you still planning these events? How are you planning to keep the students engaged?"

- Ask respondent about issues related to evaluation.
  - What aspects of participating in the national evaluation of the Summer of Innovation Project did you find most challenging? How might we mitigate these challenges?
  - What part of the technical assistance did you find most useful? What aspects of it should we be sure to replicate next year?
  - [If applicable] Both NASA and Abt asked your students complete pre and follow-up surveys. Did this create any issues on your end? If so, please explain.
  - What feedback can you provide on the surveys? Did you encounter any problems administering them?

- Ask respondent about the budget for the project. Explain that NASA is interested in learning how resources were used to revise their expectations in the future. Our objective is to learn what resources were needed to implement SOI.
    - Was the budget that NASA provided adequate to meet the goals you outlined in your proposal?
    - What unanticipated costs arose?
    - If the budget increased 30%, how would you have spent the funds? If the budget decreased by 30%, what would you have cut?
    - Approximately how much of the budget did you allocate to planning? For staff? For transportation? For space? For equipment? For food? For supplies and materials? For evaluation? For student follow-on activities? For any additional costs? Was the allocation sufficient to meet the program's goals? If you were to run the program again, what areas would you allocate more funding? What areas would you allocate less funding?
    - Did you attempt to obtain additional funding? How successful were these efforts?

- CLOSING QUESTIONS: Do you have any recommendations or suggestions for next year's Summer of Innovation?

Appendix E. Baseline Student Survey

National Aeronautics and Space Administration
www.nasa.gov

Welcome! Congratulations on being part of NASA's Summer of Innovation. Students who attend the Summer of Innovation program during summer 2010 are being asked to complete this survey. There are no "right" or "wrong" answers to any of the questions. Your opinion is what is wanted. We estimate that it will take about 15 minutes to complete the questions. Thank you very much for your help!

NASA Office of Education, and the researchers at Abt Associates and Education Development Center, follow strict rules to protect your confidentiality and the confidentiality of any information you give us. No report will describe you in any way that could identify you. Your answers will be kept confidential from Summer of Innovation staff, your school staff, friends, and your family. No one will see your answers to this survey or future surveys besides trained members of the study team, except as required by law.
If you have any questions about the survey, please call 1-877-520-6840 (toll free), or email at NASA-SOI@abtassoc.com. If you have questions about the study, please call Dr. Hilary Rhodes, Study Director, at 617-520-3516 (toll call). If you have any questions about subjects' rights, please contact Abt's Institutional Review Board Administrator, Dr. Teresa Doksum (617) 349-2896 (toll call).

Contact Information

1. Please print your name, address, telephone numbers, and e-mail address.

Name: ____
Last name   First name   MI

Address *(include number, street, apartment number, P. O. box, etc.)* ____
____
____
City   State   Zip Code

Home Telephone: (_____) _______ - ___________   ❑ I do not have a home telephone.

Cell Telephone: (_____) _______ - ___________   ❑ I do not have a cell telephone.

E-mail address: ____________________________ ❑ I do not have an email address.

2. What is your date of birth?

   Month: _________________ Day:____________

   Year:______________________________

3. What is the name of one parent or guardian with whom you live most of the time?

   Last name ____________________________________First name _____________________________

4. What is your parent or guardian's work phone number?

   Work telephone: (_____) _______ - ________ ext. ____ ❑ He/she does not have a work telephone.

5. Is your parent or guardian's address and telephone number the same as yours? *Please check one.*

   ❑No

   ❑Yes → Skip to Question 7

6. Please fill in your parent or guardian's address and telephone number in the space below. If you don't know the complete address, fill in as much as you know.

   Address *(include number, street, apartment number, P. O. box, etc.)* ____________________

   ____

   ____

   ____

   ____

   ______

   City State Zip Code

   Home Telephone: (_______) _______ - _________ ❑ He/she does not have a home telephone.

7.

8. What grade level did you complete spring 2010? *Please check one only.*

❑5th ❑6th ❑7th ❑8th ❑9th ❑10th School's name:

____

9. What school will you be attending in the upcoming year?

____

10. Do you consider yourself to be Hispanic or Latino? *Please check one only.*

❑Yes
❑No

11. What is your gender? *Please check one only.*

❑Male
❑Female

12. What is your race? *Please check all that apply.*

❑American Indian or Alaska Native
❑Asian
❑Black or African American
❑Native Hawaiian or Other Pacific Islander
❑White

13. Today's Date:______________________________

The next question contains a number of statements about math/science. You will be asked what you think about these statements. There are no "right" or "wrong" answers. Your opinion is what is wanted.

1= Strongly Disagree, 2 = Disagree, 3 = Uncertain, 4 = Agree, 5 = Strongly Agree

14. For each statement, draw a circle around the specific value corresponding to how you feel about each statement. Please circle only ONE value per statement.

Statement	**Strongly Disagree**	**Disagree**	**Uncertain**	**Agree**	**Strongly Agree**
a. I would like to belong to a science or math club.	1	2	3	4	5
b. I do not do very well in science.	1	2	3	4	5
c. I would like to be a scientist when I leave school.	1	2	3	4	5
d. I get bored when watching science or math related programs on TV at home.	1	2	3	4	5

Statement	Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree
e. Math is easy for me.	1	2	3	4	5
f. I would dislike becoming a scientist because it needs too much education.	1	2	3	4	5
g. I would like to be given a science or math book or a piece of scientific equipment as a present.	1	2	3	4	5
h. I usually understand what we are talking about in science.	1	2	3	4	5
i. A job as a scientist would be interesting.	1	2	3	4	5
j. I dislike reading books about science or math during my free time.	1	2	3	4	5
k. No matter how hard I try, I cannot understand math.	1	2	3	4	5
l. A job as a scientist would be boring.	1	2	3	4	5
m. I would like to do science experiments or math problems at home.	1	2	3	4	5
n. I often think, "I cannot do this," when a science assignment seems hard.	1	2	3	4	5
o. I would like to teach science when I leave school.	1	2	3	4	5
p. I would like to teach math when I leave school.	1	2	3	4	5
q. Talking to friends about science or math after school would be boring.	1	2	3	4	5
r. I do not do very well in math.	1	2	3	4	5
s. A career in science would be boring.	1	2	3	4	5
t. A career in math would be boring.	1	2	3	4	5
u. I would enjoy having a job in a science laboratory during my summer vacation.	1	2	3	4	5

Statement	Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree
v. Science is easy for me.	1	2	3	4	5
w. Working in a science laboratory would be an interesting way to earn a living.	1	2	3	4	5
x. Watching a video about science or math would be boring.	1	2	3	4	5
y. I usually understand what we are talking about in math.	1	2	3	4	5
z. I would dislike a job in a science laboratory after I leave school.	1	2	3	4	5
aa. I would enjoy visiting a science museum on the weekend.	1	2	3	4	5
bb. No matter how hard I try, I cannot understand science.	1	2	3	4	5
cc. When I leave school, I would like to work with people who make discoveries in science or math.	1	2	3	4	5
dd. I dislike looking at websites about science or math.	1	2	3	4	5
ee. I often think, “I cannot do this,” when a math problem seems hard.	1	2	3	4	5
ff. I would dislike being a scientist after I leave school.	1	2	3	4	5

For the next set of questions, please indicate how often each described activity occurs by circling the appropriate number to the right of each statement.

1= Never, 2 = Rarely (e.g., a few times a year), **3 = Sometimes** (e.g., once or twice a month), **4 = Often** (e.g., once or twice a week), **5 = Always or almost always** (e.g., everyday)

15. How often did one or both of your parents or guardians do the following during the past school year (the school year that just ended)? Please circle only ONE value per statement.

	Never	**Rarely (a few times a year)**	**Sometimes (once or twice a month)**	**Often (once or twice a week)**	**Always or almost always (everyday)**
a. Helped you with your homework or a project for school	1	2	3	4	5
b. Checked on whether you had done your homework	1	2	3	4	5
c. Went with you to an event (e.g., movie, play, museum, concert, sports event)	1	2	3	4	5
d. Got upset or angry about your behavior	1	2	3	4	5
e. Got upset or angry about your grades	1	2	3	4	5
f. Rewarded you for your grades	1	2	3	4	5

16. How often did you talk about the following with one or both of your parents or guardians during the past school year (the school year that just ended)? Please circle only ONE value per statement.

	Never	Rarely (a few times a year)	Sometimes (once or twice a month)	Often (once or twice a week)	Always or almost always (everyday)
a. Selecting courses or programs at school	1	2	3	4	5
b. School activities or events of particular interest to you	1	2	3	4	5
c. Things you've studied in class	1	2	3	4	5
d. Your school work or grades	1	2	3	4	5
e. Switching to a different school	1	2	3	4	5
f. Going to college	1	2	3	4	5
g. A personal problem you were having	1	2	3	4	5
h. Getting in trouble at school	1	2	3	4	5
i. Getting rewarded at school	1	2	3	4	5

17. How often did your friend or friends do the following during the past school year (the school year that just ended)? Please circle only ONE value per statement.

	Never	Rarely (a few times a year)	Sometimes (once or twice a month)	Often (once or twice a week)	Always or almost always (everyday)
a. Encourage you to disobey your parents or teachers	1	2	3	4	5
b. Encourage you to do what your parents or teachers want you to do	1	2	3	4	5
c. Get in trouble at school	1	2	3	4	5
d. Get rewarded at school	1	2	3	4	5

18. How often did you talk about the following with a friend or friends during the past school year (the school year that just ended)? *Please circle only ONE value per statement*.

	Never	Rarely (a few times a year)	Sometimes (once or twice a month)	Often (once or twice a week)	Always or almost always (everyday)
e. Selecting courses or programs at school	1	2	3	4	5
f. School activities or events of particular interest to you	1	2	3	4	5
g. Things you've studied in class	1	2	3	4	5
h. Your school work or grades	1	2	3	4	5
i. Switching to a different school	1	2	3	4	5
j. Going to college	1	2	3	4	5
k. A personal problem you were having	1	2	3	4	5
l. Getting in trouble at school	1	2	3	4	5
m. Getting rewarded at school	1	2	3	4	5

Appendix F. Follow-Up Student Survey

National Aeronautics and Space Administration

www.nasa.gov

Welcome! Congratulations on being part of NASA's Summer of Innovation. Students who attend the Summer of Innovation program during summer 2010 are being asked to complete this survey. There are no "right" or "wrong" answers to any of the questions. Your opinion is what is wanted. We estimate that it will take about 15 minutes to complete the questions. Thank you very much for your help!

NASA Office of Education, and the researchers at Abt Associates and Education Development Center, follow strict rules to protect your confidentiality and the confidentiality of any information you give us. No report will describe you in any way that could identify you. Your answers will be kept confidential from Summer of Innovation staff, your school staff, friends, and your family. No one will see your answers to this survey or future surveys besides trained members of the study team, except as required by law.

If you have any questions about the survey, please call 1-877-520-6840 (toll free), or email at NASA-SOI@abtassoc.com. If you have questions about the study, please call Dr. Hilary Rhodes, Study Director, at 617-520-3516 (toll call). If you have any questions about subjects' rights, please contact Abt's Institutional Review Board Administrator, Dr. Teresa Doksum (617) 349-2896 (toll call).

Name: ____
Last name First name MI

Today's Date:____

1. Which of the following best describes your attendance at this NASA summer camp? *Please check only one.*

   ❑I attended every day that the camp was in session

   ❑I attended almost every day that the camp was in session, missing only one or two days

   ❑I attended about half of the days that the camp was in session

   ❑I missed more than half of the days that the camp was in session

This question contains a number of statements about math/science. You will be asked what you think about these statements. There are no “right” or “wrong” answers. Your opinion is what is wanted.

1= Strongly Disagree
2 = Disagree
3 = Uncertain
4 = Agree
5 = Strongly Agree

2. For each statement, draw a circle around the specific value corresponding to how you feel about each statement. Please circle only ONE value per statement.

Statement	Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree
a. I would like to belong to a science or math club.	1	2	3	4	5
b. I do not do very well in science.	1	2	3	4	5
c. I would like to be a scientist when I leave school.	1	2	3	4	5
d. I get bored when watching science or math related programs on TV at home.	1	2	3	4	5
e. Math is easy for me.	1	2	3	4	5
f. I would dislike becoming a scientist because it needs too much education.	1	2	3	4	5
g. I would like to be given a science or math book or a piece of scientific equipment as a present.	1	2	3	4	5
h. I usually understand what we are talking about in science.	1	2	3	4	5
i. A job as a scientist would be interesting.	1	2	3	4	5
j. I dislike reading books about science or math during my free time.	1	2	3	4	5

Statement	Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree
k. No matter how hard I try, I cannot understand math.	1	2	3	4	5
l. A job as a scientist would be boring.	1	2	3	4	5
m. I would like to do science experiments or math problems at home.	1	2	3	4	5
n. I often think, "I cannot do this," when a science assignment seems hard.	1	2	3	4	5
o. I would like to teach science when I leave school.	1	2	3	4	5
p. I would like to teach math when I leave school.	1	2	3	4	5
q. Talking to friends about science or math after school would be boring.	1	2	3	4	5
r. I do not do very well in math.	1	2	3	4	5
s. A career in science would be boring.	1	2	3	4	5
t. A career in math would be boring.	1	2	3	4	5
u. I would enjoy having a job in a science laboratory during my summer vacation.	1	2	3	4	5
v. Science is easy for me.	1	2	3	4	5
w. Working in a science laboratory would be an interesting way to earn a living.	1	2	3	4	5
x. Watching a video about science or math would be boring.	1	2	3	4	5
y. I usually understand what we are talking about in math.	1	2	3	4	5
z. I would dislike a job in a science laboratory after I leave school.	1	2	3	4	5
aa. I would enjoy visiting a science museum on the weekend.	1	2	3	4	5
bb. No matter how hard I try, I cannot understand science.	1	2	3	4	5
cc. When I leave school, I would like to work with people who make discoveries in science or math.	1	2	3	4	5
dd. I dislike looking at websites about science or math.	1	2	3	4	5
ee. I often think, "I cannot do this," when a math problem seems hard.	1	2	3	4	5

Statement	Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree
ff. I would dislike being a scientist after I leave school.	1	2	3	4	5

Appendix G. Baseline Educator Survey

National Aeronautics and Space Administration
www.nasa.gov

Welcome! This survey is being conducted by Abt Associates Inc. for the National Aeronautics and Space Administration (NASA) as part of its efforts to learn about the teachers who participate in the Summer of Innovation program. Teachers who participate in the Summer of Innovation program during summer 2010 are being asked to complete this voluntary survey. We estimate that it will take approximately 20 – 25 minutes to complete the survey twice this year. Thank you very much for your cooperation!

The Summer of Innovation is a 3-year initiative that provides middle school students, who underperform, are underrepresented, and underserved in science, technology, engineering and mathematics (STEM) fields, with intensive, stimulating math and science based learning experiences using NASA's STEM assets. Your participation is voluntary and nonparticipation will not affect your relationship with program or NASA.

Your responses to this survey will be combined with about 750 other teachers and reported in a summary. No names will be disclosed in reports. All information that would permit identification of individual respondents will be held in confidence, will be used only by persons engaged in and for the purposes of the survey, and will not be disclosed or released to others for any purpose except as required by law. NASA will not have access to the individual survey responses; other researchers may have access to de-identified survey results (i.e., they will not know your identity). For more information about this data collection, including OMB clearance and burden estimates, please contact Brenda Maxwell, NASA PRA Clearance Officer (Brenda.maxwell@nasa.gov, 202-358-4616—not a toll-free number). For questions about your rights as a participant in this study, contact Teresa Doksum at the Abt Associates Inc. Institutional Review Board at 877-520-6835 (toll-free).

Contact Information

Please print your name, address, telephone numbers, and e-mail address.

Name: _________________________ _____________________ _____
Last name First name MI

Address (*include number, Street, apartment number, P.O. box, etc.*)
____
____
____

Home Telephone: (___) ______-_____________ ❑ I do not have a home telephone

1. For items a–y, please consider your practice within your own subject area of science or math and indicate the degree to which you agree or disagree with each statement below by circling the appropriate number to the right of each statement. *Please circle only ONE value per statement.*

1= Strongly Disagree
2 = Disagree
3 = Uncertain
4 = Agree
5 = Strongly Agree

Statement	**Strongly Disagree**	**Disagree**	**Uncertain**	**Agree**	**Strongly Agree**
a. When a student does better than usual in science/math class, it is often because the teacher exerted a little extra effort.	1	2	3	4	5
b. I am continually finding better ways to teach.	1	2	3	4	5
c. Even when I try very hard, I don't teach science/math well.	1	2	3	4	5
d. When the grades of students improve, it is most often due to their teacher having found a more effective teaching approach.	1	2	3	4	5
e. I know the steps necessary to teach science/math concepts effectively.	1	2	3	4	5
f. I am not very effective in monitoring science/math hands-on activities or investigations.	1	2	3	4	5
g. If students are underachieving in science/math classes, it is most likely due to ineffective teaching.	1	2	3	4	5
h. I generally teach science/math ineffectively.	1	2	3	4	5
i. The inadequacy of a student's science/math background can be overcome by good teaching.	1	2	3	4	5
j. The low science/math achievement of some students cannot generally be blamed on their teachers.	1	2	3	4	5
k. When a low achieving child progresses, it is usually due to extra attention given by the teacher.	1	2	3	4	5
l. I understand science/math concepts	1	2	3	4	5

Statement	Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree
well enough to be an effective teacher.					
m. Increased effort in teaching produces little change in some students' achievement.	1	2	3	4	5
n. The science/math teacher is generally responsible for the achievement of students in science/math.	1	2	3	4	5
o. Students' achievement in science/math is directly related to their teacher's effectiveness in science/math teaching.	1	2	3	4	5
p. If parents comment that their child is showing more interest in science/math at school, it is probably due to the performance of the child's teacher.	1	2	3	4	5
q. I find it difficult to explain to students why science experiments or math problems work.	1	2	3	4	5
r. I am typically able to answer students' science/math questions.	1	2	3	4	5
s. I wonder if I have the necessary skills to teach science/math.	1	2	3	4	5
t. Effectiveness in science/math teaching has little influence on the achievement of students with low motivation.	1	2	3	4	5
u. Given a choice, I would not invite the principal to evaluate my science/math teaching.	1	2	3	4	5
v. When a student has difficulty understanding a concept, I am usually at a loss as to how to help the student understand it better.	1	2	3	4	5
w. When teaching science/math, I usually welcome student questions.	1	2	3	4	5
x. I don't know what to do to turn students on to science/math.	1	2	3	4	5
y. Even teachers with good science/math teaching abilities cannot help some kids learn.	1	2	3	4	5

For items a-q, please indicate the degree to which each described behavior occurs by circling the appropriate number to the right of each statement. *Please circle only ONE value per statement*.

1= Never
2 = Rarely (e.g., a few times a year)
3 = Sometimes (e.g., once or twice a month)
4 = Often (e.g., once or twice a week)
5 = All or almost all science / math lessons

2. About how often do **you** do each of the following in your instruction?

Statement	**Never**	**Rarely (a few times a year)**	**Sometimes (once or twice a month)**	**Often (once or twice a week)**	**All or almost all science/ math lessons**
a. Introduce content through formal presentations	1	2	3	4	5
b. Pose open-ended questions	1	2	3	4	5
c. Engage the whole class in discussions	1	2	3	4	5
d. Require students to supply evidence to support their claims	1	2	3	4	5
e. Ask students to explain concepts to one another	1	2	3	4	5
f. Ask students to consider alternative explanations	1	2	3	4	5
g. Help students see connections between science/math and other disciplines	1	2	3	4	5
h. Assign homework	1	2	3	4	5

3. About how often do **students** in your class take part in the following types of activities?

Statement	Never	Rarely (a few times a year)	Sometimes (once or twice a month)	Often (once or twice a week)	All or almost all science/ math lessons
a. Listen and take notes during presentation by teacher	1	2	3	4	5
b. Work in groups	1	2	3	4	5
c. Read from a science/math textbook in class	1	2	3	4	5
d. Do hands-on activities or investigations	1	2	3	4	5
e. Answer textbook or worksheet questions	1	2	3	4	5
f. Record, represent, and/or analyze data or numbers	1	2	3	4	5
g. Follow specific instructions in a hands-on activity or investigation	1	2	3	4	5

4. How often do you assess student progress in each of the following ways?

Statement	Never	Rarely (a few times a year)	Sometimes (once or twice a month)	Often (once or twice a week)	All or almost all science/ math lessons
a. Review student homework	1	2	3	4	5
b. Give predominantly short-answer tests (e.g., multiple choice, true/false, fill in the blank)	1	2	3	4	5

5. Do you hold a teaching license or certificate?

❑ Yes

❑ No (*skip to question 8*)

6. What type of teaching license or certificate do you hold? *Please check ALL that apply.*

❑ National board certificate

❑ State certificate (not national board certificate)

❑ Provisional certificate

❑ Emergency certificate

❑ Other, please specify:________________________________

7. What subject area is your license or certificate? *Please check ALL that apply.*
   - ❑ Elementary education (K-5)
   - ❑ Secondary education (6-12)
   - ❑ Science education
   - ❑ Mathematics education
   - ❑ Special education
   - ❑ Other, please specify:_______________________________

8. Do you have each of the following degrees? *Please check only ONE value per row.*

	Yes	**No**
Bachelor's	◻	◻
Master's	◻	◻
Doctorate	◻	◻

9. What grade(s) are you teaching in the upcoming 2010-2011 school year? *Please check ALL that apply.*
   - ❑ Elementary grades (K-5)
   - ❑ Middle grades (6-8)
   - ❑ High school grades (9-12)
   - ❑ I will not be teaching in a K-12 classroom in the 2010-2011 school year (*skip to question 12)*

10. What is the name of the school where you will be teaching in the upcoming 2010-2011 school year?

____

11. Which of the following subject area(s) are you teaching in the upcoming 2010-2011 school year? *Please check ALL that apply.*
   - ❑ Mathematics
   - ❑ Science
   - ❑ Computer Science
   - ❑ Technology
   - ❑ Engineering
   - ❑ Other, please specify: _________________________

12. Counting this past school year, how many years have you taught at the elementary and secondary level? Please also note the number of years in total. *Enter the number of years in each row EXCLUDING any student teaching that you've done. If zero, enter 0.*

    Elementary (K-5) _____ yrs

    Secondary (6-12) _____ yrs

    Total (K-12) _____yrs

13. To what extent have you used NASA content, materials or experts for instructional purposes in a K-12 classroom? *Please check only ONE value per statement.*

    - ❑ Never
    - ❑ Rarely (e.g., a few times a year)
    - ❑ Sometimes (e.g., once or twice a month)
    - ❑ Often (e.g., once or twice a week)
    - ❑ Always (e.g., all or almost all science / math lessons)

14. How would you rate your current level of need for professional development in each of these areas? *Please circle only ONE value per statement*.

    1= None Needed
    2 = Slightly Needed
    3 = Needed
    4 = Very Needed
    5 = Critically Needed

    STEM = Science, Technology, Engineering, and/or Mathematics

	None Needed	Slightly Needed	Needed	Very Needed	Critically Needed
a. Deepening my own STEM content knowledge	1	2	3	4	5
b. Understanding student thinking in STEM	1	2	3	4	5
c. Learning how to use inquiry/investigation-oriented teaching strategies	1	2	3	4	5
d. Learning how to use technology in STEM instruction	1	2	3	4	5
e. Learning how to assess student learning in STEM	1	2	3	4	5
f. Learning how to teach STEM in a class that includes students with special needs	1	2	3	4	5

15. Do you consider yourself to be Hispanic or Latino? *Please check only one.*

- ❑ Yes
- ❑ No

16. What is your race? *Please check all that apply.*

- ❑ American Indian or Alaska Native
- ❑ Asian
- ❑ Black or African American
- ❑ Native Hawaiian or Other Pacific Islander
- ❑ White

17. What is your gender? *Please check only one.*

- ❑ Male
- ❑ Female

Appendix H. Educator Follow-Up Survey

National Aeronautics and Space Administration
www.nasa.gov

Welcome! This survey is being conducted by Abt Associates Inc. for the National Aeronautics and Space Administration (NASA) as part of its efforts to learn about the teachers who participate in the Summer of Innovation program. Teachers who participate in the Summer of Innovation program during summer 2010 are being asked to complete this voluntary survey. We estimate that it will take approximately 10 minutes of your time. Thank you very much for your cooperation!

The Summer of Innovation is a 3-year initiative that provides middle school students, who underperform, are underrepresented, and underserved in science, technology, engineering and mathematics (STEM) fields, with intensive, stimulating math and science based learning experiences using NASA's STEM assets. Your participation is voluntary and nonparticipation will not affect your relationship with program or NASA.

Your responses to this survey will be combined with about 750 other teachers and reported in a summary. No names will be disclosed in reports. All information that would permit identification of individual respondents will be held in confidence, will be used only by persons engaged in and for the purposes of the survey, and will not be disclosed or released to others for any purpose except as required by law. NASA will not have access to the individual survey responses; other researchers may have access to de-identified survey results (i.e., they will not know your identity). For more information about this data collection, including OMB clearance and burden estimates, please contact Brenda Maxwell, NASA PRA Clearance Officer (Brenda.maxwell@nasa.gov, 202-358-4616—not a toll-free number). For questions about your rights as a participant in this study, contact Teresa Doksum at the Abt Associates Inc. Institutional Review Board at 877-520-6835 (toll-free).

Contact Information

Please print your name and e-mail address.

Please print your name, address, telephone numbers, and e-mail address.

Name: ________________________ ______________________ _____
Last name First name MI

E-mail address: ______________________________ ❑ I do not have an email address

1. For items a–y, please consider your practice within your own subject area of science or math and indicate the degree to which you agree or disagree with each statement below by circling the appropriate number to the right of each statement. *Please circle only ONE value per statement.*

1= Strongly Disagree
2 = Disagree
3 = Uncertain
4 = Agree
5 = Strongly Agree

Statement	**Strongly Disagree**	**Disagree**	**Uncertain**	**Agree**	**Strongly Agree**
a. When a student does better than usual in science/math class, it is often because the teacher exerted a little extra effort.	1	2	3	4	5
b. I am continually finding better ways to teach.	1	2	3	4	5
c. Even when I try very hard, I don't teach science/math well.	1	2	3	4	5
d. When the grades of students improve, it is most often due to their teacher having found a more effective teaching approach.	1	2	3	4	5
e. I know the steps necessary to teach science/math concepts effectively.	1	2	3	4	5
f. I am not very effective in monitoring science/math hands-on activities or investigations.	1	2	3	4	5
g. If students are underachieving in science/math classes, it is most likely due to ineffective teaching.	1	2	3	4	5
h. I generally teach science/math ineffectively.	1	2	3	4	5
i. The inadequacy of a student's science/math background can be overcome by good teaching.	1	2	3	4	5
j. The low science/math achievement of some students cannot generally be blamed on their teachers.	1	2	3	4	5
k. When a low achieving child progresses, it is usually due to extra attention given by the teacher.	1	2	3	4	5
l. I understand science/math concepts well enough to be an effective teacher.	1	2	3	4	5

Statement	Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree
m. Increased effort in teaching produces little change in some students' achievement.	1	2	3	4	5
n. The science/math teacher is generally responsible for the achievement of students in science/math.	1	2	3	4	5
o. Students' achievement in science/math is directly related to their teacher's effectiveness in science/math teaching.	1	2	3	4	5
p. If parents comment that their child is showing more interest in science/math at school, it is probably due to the performance of the child's teacher.	1	2	3	4	5
q. I find it difficult to explain to students why science experiments or math problems work.	1	2	3	4	5
r. I am typically able to answer students' science/math questions.	1	2	3	4	5
s. I wonder if I have the necessary skills to teach science/math.	1	2	3	4	5
t. Effectiveness in science/math teaching has little influence on the achievement of students with low motivation.	1	2	3	4	5
u. Given a choice, I would not invite the principal to evaluate my science/math teaching.	1	2	3	4	5
v. When a student has difficulty understanding a concept, I am usually at a loss as to how to help the student understand it better.	1	2	3	4	5
w. When teaching science/math, I usually welcome student questions.	1	2	3	4	5
x. I don't know what to do to turn students on to science/math.	1	2	3	4	5
y. Even teachers with good science/math teaching abilities cannot help some kids learn.	1	2	3	4	5

2. Will you be teaching at least one course in the fall?

- ❑ Yes
- ❑ No (*Please skip to question 7.*)

For items a-q, please indicate the degree to which each described behavior occurs by circling the appropriate number to the right of each statement. *Please circle only ONE value per statement.*

1= Never
2 = Rarely (e.g., a few times a year)
3 = Sometimes (e.g., once or twice a month)
4 = Often (e.g., once or twice a week)
5 = All or almost all science / math lessons

3. In the *upcoming* school year, how often are you planning on doing each of the following in your instruction?

Statement	**Never**	**Rarely (a few times a year)**	**Sometimes (once or twice a month)**	**Often (once or twice a week)**	**All or almost all science/ math lessons**
a. Introduce content through formal presentations	1	2	3	4	5
b. Pose open-ended questions	1	2	3	4	5
c. Engage the whole class in discussions	1	2	3	4	5
d. Require students to supply evidence to support their claims	1	2	3	4	5
e. Ask students to explain concepts to one another	1	2	3	4	5
f. Ask students to consider alternative explanations	1	2	3	4	5
g. Help students see connections between science/math and other disciplines	1	2	3	4	5
h. Assign homework	1	2	3	4	5

4. In the *upcoming* school year, how often are you planning on having **students** in your class take part in the following types of activities?

Statement	Never	Rarely (a few times a year)	Sometimes (once or twice a month)	Often (once or twice a week)	All or almost all science/ math lessons
a. Listen and take notes during presentation by teacher	1	2	3	4	5
b. Work in groups	1	2	3	4	5
c. Read from a science/math textbook in class	1	2	3	4	5
d. Do hands-on activities or investigations	1	2	3	4	5
e. Answer textbook or worksheet questions	1	2	3	4	5
f. Record, represent, and/or analyze data or numbers	1	2	3	4	5
g. Follow specific instructions in a hands-on activity or investigation	1	2	3	4	5

5. In the *upcoming* school year, how often are you planning on assessing student progress next year in each of the following ways?

Statement	Never	Rarely (a few times a year)	Sometimes (once or twice a month)	Often (once or twice a week)	All or almost all science/ math lessons
a. Review student homework	1	2	3	4	5
b. Give predominantly short-answer tests (e.g., multiple choice, true/false, fill in the blank)	1	2	3	4	5

6. In the upcoming school year, to what extent are you planning on using NASA content, materials or experts for instructional purposes in a K-12 classroom? Please check only ONE value per statement.

- ❒ Never
- ❒ Rarely (e.g., a few times a year)
- ❒ Sometimes (e.g., once or twice a month)
- ❒ Often (e.g., once or twice a week)
- ❒ Always (e.g., all or almost all science / math lessons)

7. How would you rate your current level of need for professional development in each of these areas? *Please circle only ONE value per statement*.

1= None Needed
2 = Slightly Needed
3 = Needed
4 = Very Needed
5 = Critically Needed

STEM = Science, Technology, Engineering, and/or Mathematics

	None Needed	**Slightly Needed**	**Needed**	**Very Needed**	**Critically Needed**
a. Deepening my own STEM content knowledge	1	2	3	4	5
b. Understanding student thinking in STEM	1	2	3	4	5
c. Learning how to use inquiry/investigation-oriented teaching strategies	1	2	3	4	5
d. Learning how to use technology in STEM instruction	1	2	3	4	5
e. Learning how to assess student learning in STEM	1	2	3	4	5
f. Learning how to teach STEM in a class that includes students with special needs	1	2	3	4	5

Appendix I. Teacher Survey Justification

Instrument	Pilot Group	Format	Scale	Alpha	Items (*= reverse code)
Science Teacher Efficacy Belief Instrument (STEBI) Riggs, I., & Knochs, L. (1990). Towards the development of an elementary teacher's science teaching efficacy belief instrument. *Science Education*, *74*, 625-637.	Field tested version—327 elementary teachers. Also later revised and used on pre-service elemen. teachers.	5 point Likert, SD to SA.	Personal Science Teaching Efficacy-- the extent to which teachers believe they have the skills to teach science	0.95	2. I am continually finding better ways to teach.
					3. Even when I try very hard, I don't teach science/math well.*
					5. I know the steps necessary to teach science/math concepts effectively.
					6. I am not very effective in monitoring science/math hands-on activities or investigations.*
					8. I generally teach science/math ineffectively.*
					12. I understand science/math concepts well enough to be an effective teacher.
					17. I find it difficult to explain to students why science experiments or math problems work.*
					18. I am typically able to answer students' science/math questions.
					19. I wonder if I have the necessary skills to teach science/math.*
					21. Given a choice I would not invite the principal to evaluate my science/math teaching.*
					22. When a student has difficulty understanding a concept, I am usually at a loss as to how to help the student understand it better.*
					23. When teaching science/math I usually welcome students' questions.
					24. I don't know what to do to turn students on to science/math.*
			2. Science teaching outcome	0.77	1. When a student does better than usual in science/math class, it is often because the teacher exerted a little effort.

Instrument	Pilot Group	Format	Scale	Alpha	Items (*= reverse code)
			expectancy (STOE)-- The extent to which teachers believe that certain behaviors lead to improved student outcomes		4. When the grades of students improve, it is most often due to their teacher having found a more effective teaching approach.
					7. If students are underachieving in science/math classes it is most likely due to ineffective science teaching.
					9. The inadequacy of a student's science/math background can be overcome by good teaching.
					10. The low science/math achievement of some students cannot generally be blamed on their teachers.*
					11. When a low achieving child progresses in science/math it is usually due to extra attention given by the teacher.
					13. Increased effort in teaching produces little change in some students' achievement.*
					14. The science/math teacher is generally responsible for the achievement of students in science/math.
					15. Students' achievement in science/math is directly related to their teacher's effectiveness in science/math teaching.
					16. If parents comment that their child is showing more interest in science/math at school, it is probably due to the performance of the child's teacher.
					20. Effectiveness in science/math teaching has little influence on the achievement of students with low motivation.*
					25. Even teachers with good science/math teaching abilities cannot help some kids learn.*

Instrument	Pilot Group	Format	Scale	Alpha	Items (*= reverse code)
Horizon National Survey of Science and Math Education Weiss, IR, Bandilower, ER, McMahon, KC, Smith, PS (2001). Report on the 2000 National Survey of Science and Math Education, Horizon Research, Inc. www.horizon-research.com	Details of pilot and field testing not provided, but the survey was developed based on previous Horizon National surveys. The sample in this report consisted of 5,728 math and science teachers across all grade levels	5 pt Frequency scale from 0=never to 5= All or almost all lessons	Use of traditional teaching practices	0.78	26a. Introduce content through formal presentations
					26h. Assign science homework.
					27a. [Students] listen and take notes during presentation by teacher.
					27c. [Students] read from a science textbook in class.
					27e. [students] answer textbook or worksheet questions
					28a. Review student homework
					28b. Give predominantly short-answer tests (e.g., multiple choice, true/false, fill in the blank)
			Use of Strategies to Develop Students' Abilities to Communicate Ideas	0.79	26b. Pose open-ended questions
					26c. Engage the whole class in discussions
					26d. Require students to supply evidence to support their claims
					26e. Ask students to explain concepts to one another.
					26f. Ask students to consider alternative explanations
					26g. Help students see connections between science and other disciplines.
			Use of Laboratory Activities	0.80	27b. [Students] work in groups
					27d. [Students] do hands-on activities or investigations
					27g. [Students] follow specific instructions in a hands-on activity or investigation.
					27f. [Students] record, represent and/or analyze data or numbers.

Appendix J. Student Survey Justification

Source	Pilot group	Scale	Format	Alpha	Items (*=reverse code)
mATSI (Modified Attitudes Toward Science Inventory) Weinburgh & Steele, 2000	Urban fifth grade students, n=1404. 49% male, 51% female; 69% African-American, 31% Caucasian. (Note: During the pilot, items were read aloud as students read them silently.)	Self-confidence in science	Six-point Likert-type, 1=SD to 6=SA	0.68	(2)I do not do very well in science.*
					(20)Science is easy for me.
					(8)I usually understand what we are talking about in science.
					(26)No matter how hard I try, I cannot understand science.*
					(14)I often think, "I cannot do this," when a science assignment seems hard.*
Adapted from mATSI self-confidence in science scale	N/A	Self-confidence in math	Six-point Likert-type, 1=SD to 6=SA	TBD	(17)I do not do very well in math.*
					(5)Math is easy for me.
					(23)I usually understand what we are talking about in math.
					(11)No matter how hard I try, I cannot understand math.*
					(29)I often think, "I cannot do this," when a math problem seems hard.*

Weinburgh & Steele (2000) did not provide information about the factor structure, although the authors state that they performed factor analysis on their data using the ATSI in order to guide modifications and create the current shorter version.

Source	Pilot group	Scale	Format	Alpha	Items (*=reverse code)
Adapted from TOSRA (Test of Science Related Attitudes) Fraser, 1981	Original scale (Career Interest in Science): Students in Sydney, Australia, metropolitan area, n=1337. One 7th, one 8th, one 9th, and one 10th grade class from each of 11 schools. N of 7th graders=340, 8th=335, 9th=338, 10th=324.	Career Interest in STEM	Five-point Likert-type, SA to SD	Original scale (Career Interest in Science): 7th grade =0.72 8th grade =0.70 Lott (2002): 0.91	(30)I would dislike being a scientist after I leave school.*
					(27)When I leave school, I would like to work with people who make discoveries in science or math.
					(24)I would dislike a job in a science laboratory after I leave school.*
					(21)Working in a science laboratory would be an interesting way to earn a living.
					(18)A career in science or math would be dull and boring.*
					(15)I would like to teach science or math when I leave school.
					(12)A job as a scientist would be boring.*
					(9)A job as a scientist would be interesting.
					(6)I would dislike becoming a scientist because it needs too much education.*
					(3)I would like to be a scientist when I leave school.

Source	Pilot group	Scale	Format	Alpha	Items (*=reverse code)
Adapted from TOSRA (Test of Science Related Attitudes) Fraser, 1981	Original scale (Career Interest in Science): Students in Sydney, Australia, metropolitan area, n=1337. One 7^{th}, one 8^{th}, one 9^{th}, and one 10^{th} grade class from each of 11 schools. N of 7^{th} graders=340, 8^{th}=335, 9^{th}=338, 10^{th}=324.	Leisure Interest in STEM	Five-point Likert-type, SA to SD	Original scale (Career Interest in Science): 7^{th} grade =0.93 8^{th} grade =0.92 Lott (2002): 0.89	(1)I would like to belong to a science or math club.
					(4)I get bored when watching science or math related programs on TV at home.*
					(7)I would like to be given a science or math book or a piece of scientific equipment as a present.
					(10)I dislike reading books about science or math during my free time*
					(13)I would like to do science experiments or math problems at home.
					(16)Talking to friends about science or math after school would be boring.*
					(19)I would enjoy having a job in a science laboratory during my summer vacation
					(22)Watching a video about science or math would be boring.*
					(25)I would enjoy visiting a science museum on the weekend.
					(28)I dislike looking at websites about science or math.*

Lott (2002): Used a modified version of all 3 of these scales in a study of 224 HS chemistry students. Alphas included above.

Ricks (2006) used Career Interest in Science, Enjoyment of science lessons, one additional TOSRA scale and 3 mATSI scales. She reported an overall alpha of 0.90.

Appendix K. Qualitative Coding Scheme

SoI models

- Camp dates
- Site mgmt
- Content/subject area
- NASA resources
- Parent component
- Partners
- PD dates
- Student goals/objectives
- Student activities
- Student recruitment
- Student participants
- Student tracking
- Educator goals/objectives
- Educator activities (PD)
- Educator recruitment
- Educator participants
- Educator tracking
- STEM learning community/follow-up activities

SoI successes/ promising practices

- Program
- Evaluation

SoI program implementation challenges

- Summer activities
- Site management (includes staffing, procurement, coordination, budget)
- HQ management
- NASA resources
- Partners
- Recruitment
- Site lessons learned
- Student recruitment
- Student attendance
- Teacher recruitment
- Teacher attendance

National evaluation challenges

- Consent process
- Intellectual property
- OMB-IRB compliance
- Reporting
- Respondent burden
- Survey administration