

NASA Summer of Innovation: Excellence in Summer Learning Benchmarking Study

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Booz | Allen | Hamilton

NASA SoI Excellence in Summer Learning Benchmarking Study

Table of Contents

| | | |
|----------|--|----|
| I. | Executive Summary | 1 |
| II. | Introduction..... | 2 |
| II.1 | STEM Education in America | 2 |
| II.1.1 | The Cost of Inadequate STEM Education | 3 |
| II.1.2 | The Importance of Interest in STEM | 3 |
| II.2 | Solving the STEM Problem..... | 3 |
| II.2.1 | Leverage OST Programs to Engage Students in STEM | 3 |
| II.2.2 | Target Students that are Underrepresented and Underserved in STEM..... | 5 |
| II.2.3 | Focus on OST Programs for Middle School Students | 7 |
| II.3 | Background on Summer of Innovation | 8 |
| II.4 | Scope & Nature of Report..... | 8 |
| II.5 | Organization of This Report | 9 |
| III. | Profiles of Benchmarked OST Programs..... | 10 |
| III.1 | Criteria for Selection | 10 |
| III.2 | Benchmarked Programs..... | 10 |
| III.2.1 | 21 st Century Community Learning Centers | 10 |
| III.2.2 | Aim High | 12 |
| III.2.3 | Building Educated Leaders for Life (BELL) | 13 |
| III.2.4 | Breakthrough Collaborative | 15 |
| III.2.5 | Citizen Schools..... | 17 |
| III.2.6 | Girl Scouts..... | 18 |
| III.2.7 | Girlstart..... | 20 |
| III.2.8 | Higher Achievement..... | 21 |
| III.2.9 | Operation Smart (Girls Incorporated) | 22 |
| III.2.10 | Project Exploration | 23 |
| III.2.11 | Summer Advantage | 24 |
| III.2.12 | Techbridge..... | 25 |
| III.2.13 | TechREACH | 27 |
| IV. | Best Practices in Summer and Out-of-School Time STEM Programs | 28 |
| IV.1 | Program Planning and Development..... | 28 |

NASA SoI Excellence in Summer Learning Benchmarking Study

| | | |
|----------|---|----|
| IV.1.1 | Best Practices for Setting and Reaching Achievable Goals | 28 |
| IV.1.1.1 | Best Practice: Establish a Vision for Meeting Community Needs | 28 |
| IV.1.1.2 | Best Practice: Define Clear, Realistic, and Measureable Goals | 30 |
| IV.1.1.3 | Best Practice: Create a Detailed Strategic Plan for Accomplishing Goals | 32 |
| IV.1.2 | Best Practices for OST STEM Program Planning..... | 34 |
| IV.1.2.1 | Best Practice: Begin Program Planning Early..... | 34 |
| IV.1.2.2 | Best Practice: Prioritize Strong Leadership..... | 35 |
| IV.1.2.3 | Best Practice: Hire a STEM Specialist..... | 36 |
| IV.1.2.4 | Best Practice: Secure a Safe and Accessible Program Location | 37 |
| IV.1.2.5 | Best Practice: Begin Targeted Recruitment of Students and Staff Early | 39 |
| IV.1.3 | Best Practices for Leveraging Partnerships | 41 |
| IV.1.3.1 | Best Practice: Leverage Mutually Beneficial Partnerships to Increase Program Resources..... | 41 |
| IV.1.3.2 | Best Practice: Find Partners with Shared Goals and Priorities | 43 |
| IV.1.4 | Best Practices for Reaching Underrepresented and Underserved Students | 44 |
| IV.1.4.1 | Best Practice: Eliminate Cost Barriers to Student Participation | 44 |
| IV.1.4.2 | Best Practice: Provide Students with Transportation to Program | 45 |
| IV.1.4.3 | Best Practice: Provide Meals to Participating Students During Programming..... | 46 |
| IV.1.4.4 | Best Practice: Advertise and Recruit Strategically to Attract Underrepresented and Underserved Students | 47 |
| IV.2 | Engaging Students in OST STEM | 48 |
| IV.2.1 | Best Practices for Designing an OST STEM Curriculum | 49 |
| IV.2.1.1 | Best Practice: Design STEM Curriculum that Expands In-Class Learning | 49 |
| IV.2.1.2 | Best Practice: Prioritize STEM Learning Activities in OST Programming | 50 |
| IV.2.1.3 | Best Practice: Create a Supportive STEM Learning Environment with High Expectations for Students | 52 |
| IV.2.2 | Best Practices for Structuring Student-Educator Interaction in OST | 53 |
| IV.2.2.1 | Best Practice: Minimize Class Sizes..... | 53 |
| IV.2.2.2 | Best Practice: Differentiate Instruction Based on Student Needs | 54 |
| IV.2.2.3 | Best Practice: Connect Students with Mentors..... | 55 |
| IV.2.3 | Best Practices for Teaching STEM in OST | 56 |
| IV.2.3.1 | Best Practice: Engage Students in Hands-On Activities..... | 57 |

NASA SoI Excellence in Summer Learning Benchmarking Study

| | | |
|----------|--|----|
| IV.2.3.2 | Best Practice: Relate OST STEM Content to the Real World | 58 |
| IV.2.3.3 | Best Practice: Facilitate Opportunities for Students to Work in Groups..... | 59 |
| IV.2.3.4 | Best Practice: Personalize Students’ OST STEM Learning Experiences | 61 |
| IV.2.3.5 | Best Practice: Leverage Inquiry-Based Learning Methods | 62 |
| IV.2.3.6 | Best Practice: Emphasize the Fun of Learning STEM..... | 63 |
| IV.2.4 | Best Practices for OST STEM Educator Professional Development | 65 |
| IV.2.4.1 | Best Practice: Select Type of Educator Based on Program Needs and Objectives..... | 65 |
| IV.2.4.2 | Best Practice: Provide Professional Development Training for Educators Delivering STEM Content in OST | 67 |
| IV.2.4.3 | Best Practice: Make Training and PD Highly Accessible to Educators..... | 69 |
| IV.2.4.4 | Best Practice: Provide OST Educators with Ongoing Support | 70 |
| IV.2.5 | Best Practices for Supporting Students' Long-Term STEM Outcomes | 71 |
| IV.2.5.1 | Best Practice: Help Students Plan for Futures in STEM | 71 |
| IV.2.5.2 | Best Practice: Design Program Duration to Accomplish Predetermined STEM Goals .. | 73 |
| IV.2.5.3 | Best Practice: Engage Parents to Create a Supportive STEM Culture | 74 |
| IV.2.5.4 | Best Practice: Maximize Student Attendance | 76 |
| IV.3 | Evaluating Program Impact..... | 78 |
| IV.3.1 | Best Practices for Evaluation Strategy | 78 |
| IV.3.1.1 | Best Practice: Align Evaluation Design and Communication with Funding and Stakeholder Needs..... | 78 |
| IV.3.1.2 | Best Practice: Continually Evaluate Progress toward Each Goal and Implement Changes Based on Evaluation Results | 80 |
| IV.3.1.3 | Best Practice: Avoid Allowing Testing and Evaluation to Become the Sole Program Focus..... | 82 |
| IV.3.2 | Best Practices for Evaluation Execution | 83 |
| IV.3.2.1 | Best Practice: Contract with an External Evaluator..... | 84 |
| IV.3.2.2 | Best Practice: Evaluate Pre- and Post-Programming Data | 85 |
| IV.3.2.3 | Best Practice: Measure Interest, Attitude, and Skill..... | 88 |
| IV.3.2.4 | Best Practice: Conduct Longitudinal Studies | 89 |
| IV.3.2.5 | Best Practice: Collaborate with School Districts to Access Year-Round Academic Data..... | 90 |
| IV.4 | Sustainability and Scalability..... | 91 |
| IV.4.1 | Best Practices for Sustaining an OST STEM Program | 92 |

NASA SoI Excellence in Summer Learning Benchmarking Study

| | | |
|----------|---|-----|
| IV.4.1.1 | Best Practice: Pursue Sustainability through Diverse Partnerships | 92 |
| IV.4.1.2 | Best Practice: Seek In-Kind Donations..... | 95 |
| IV.4.1.3 | Best Practice: Cultivate Strong Stakeholder Dialogues | 96 |
| IV.4.1.4 | Best Practice: Secure Funding Early in the Year | 98 |
| IV.4.1.5 | Best Practice: Find Creative Ways to Save Money on Staff and Materials | 100 |
| IV.4.2 | Best Practices for Scaling Up | 101 |
| IV.4.2.1 | Best Practice: Assess Current Program to Determine Readiness to Scale-Up | 101 |
| IV.4.2.2 | Best Practice: Identify Communities with Strong Potential for Program Success | 103 |
| IV.4.2.3 | Best Practice: Build Capacity to Manage Multiple Sites..... | 104 |
| V. | Works Cited | 106 |
| VI. | Appendix A – Best Practices by Category and Importance to SoI | 113 |
| VII. | Appendix B – Benchmarked Program Best Practices Highlighted in Report..... | 118 |
| VIII. | Appendix C – Acronyms and Abbreviations | 119 |

NASA SoI Excellence in Summer Learning Benchmarking Study

I. Executive Summary

In response to President Barack Obama's 2009 *Educate to Innovate* campaign, NASA launched the Summer of Innovation (SoI) in summer 2010. SoI was designed to provide thousands of middle school students and teachers across the country with exciting out-of-school time (OST) science, technology, engineering, and mathematics (STEM) experiences. To support the continuous improvement of SoI, Booz Allen Hamilton compiled an exhaustive review of best practices for providing middle school out-of-school time (OST) educational programs and teacher professional development (PD) in fall 2010. This report included a set of benchmarked programs that successfully supported students' academic achievement and incorporated a number of the identified best practices. NASA used the 2010 report extensively when designing the 2011 Summer of Innovation project. Following the implementation of SoI in summer 2011, NASA requested that Booz Allen Hamilton build on the 2010 report with a similarly comprehensive best practices benchmarking study with a narrower focus: OST programs that provide STEM learning experiences to middle school students from demographic groups that are traditionally underrepresented and underserved in STEM. This report is designed to inform the refinement of the SoI project model in 2012 and beyond by outlining OST STEM best practices while illustrating these strategies in practice with examples from benchmarked organizations that have successfully established sustainable middle school OST STEM programs.

This report will provide background on the current state of STEM education in America, elaborate on the potential for OST STEM to mitigate the STEM education crisis by targeting middle school students from demographic groups that are traditionally underrepresented and underserved in STEM fields, expound on best practices in building, sustaining, and scaling a successful OST STEM program, and illustrate the implementation of these best practices by showcasing benchmark OST programs that have demonstrated success engaging students in STEM.

Booz Allen's research will:

- Offer examples of exemplary middle school OST STEM programs for NASA SoI to learn from when refining the SoI model
- Identify best practices within discrete strategic priority areas of SoI leadership, including evaluation and program scalability
- Develop a framework from which SoI can evaluate potential future program partners

By examining exemplary programs and specific best practices for engaging SoI's target audience in OST STEM education activities, this report will provide context for refining the SoI model to better meet project goals and highlight opportunities to expand successful components of the 2011 project.

II. Introduction

II.1 STEM Education in America

While America is still a top global competitor in STEM and innovation, with the highest concentration of knowledge and technology industries as a percentage of gross national product out of all major economies (at 38%),¹ recent trends suggest that the United States' ability to remain competitive in STEM is at risk. Research shows that almost 80 percent of careers in the coming decades will necessitate familiarity with STEM² and that opportunities in STEM fields have increased at triple the rate of other sectors in the labor market in the last decade.³ The Department of Labor estimates that by 2018, the U.S. will have over 1.2 million job openings for STEM professionals.⁴

While the American economy is becoming increasingly reliant on STEM professionals, the U.S. education system is failing to adequately prepare students to enter STEM professions. Statistics show that STEM education in the United States pales in comparison to STEM education in many other developed nations: the 2009 Programme for International Student Assessment (PISA) revealed that the U.S. ranks 25th out of 34 OECD nations in mathematics education and 17th out of 34 in science education for 15-year-old students.⁵ Research suggests that the U.S. does not have enough highly qualified STEM teachers, as only 40 percent of engineering and chemistry teachers actually have a background in these fields⁶ and a 68 percent of 5th and 8th grade mathematics teachers in American public schools do not have a mathematics degree or certificate.⁷

Failure to prepare K-12 students in STEM prevents them from pursuing STEM at higher levels. While the percentage of college graduates in America has continued to grow over the last 15 years, the ratio of graduates that majored in STEM fields has plateaued at one third.⁸ In fact, only 25 percent of high school students in the U.S. are qualified to pursue higher-level mathematics, a key component of any postsecondary STEM major.⁹ Data from a recent survey by the Microsoft Corporation revealed that only 20 percent of undergraduate students pursuing STEM degrees believed that they were prepared "extremely well" for the demands of postsecondary STEM courses.¹⁰

These grim statistics expose America's failure to fully develop its students' talents in STEM. As a result of this failure, the U.S. may struggle to produce a new generation of STEM professionals at a time when STEM is becoming the fulcrum of the American economy and the demand for STEM professionals is greater than the supply.

¹ National Science Board 2010

² The Afterschool Alliance, National AfterSchool Association, and National Summer Learning Association 2010

³ U.S. News and World Report 2011a

⁴ Microsoft 2011

⁵ Ibid

⁶ U.S. News and World Report 2011b

⁷ National Center for Education Statistics 2003

⁸ National Science Board 2010

⁹ The Education Trust 2010

¹⁰ Microsoft 2011

NASA SoI Excellence in Summer Learning Benchmarking Study

II.1.1 The Cost of Inadequate STEM Education

America's inability to nurture the STEM expertise of its students negatively impacts the individual earning potential of its citizens and depresses the future potential of the national economy. Research shows that professionals who majored in a STEM discipline, regardless of whether or not they enter a STEM career, earn about \$500,000 more in their lifetimes than professionals with degrees in other disciplines.¹¹ On a national scale, the OECD estimates that if the United States were to simply raise the proficiency of all of its students to a "baseline level" for the OECD over the next 20 years, the U.S. GDP could increase by up to \$72 trillion over the lifetime of citizens born in 2010.¹² In addition, the U.S. could increase its GDP by up to \$103 trillion over the same period if it could successfully match the quality of education in Finland, the nation with the highest ranked education system among OECD nations.¹³ One 2009 study on the national impact of the achievement gap compared the economic effects of the gap to be of the same magnitude as a "permanent national recession."¹⁴ The available research and statistics suggest that STEM education in America is in critical condition and must be resuscitated for the United States to prosper.

II.1.2 The Importance of Interest in STEM

Student interest in STEM is crucial for increasing the number of future STEM professionals, as research shows that interest in STEM in middle school is a better predictor of pursuing STEM fields than middle school STEM achievement.¹⁵ A 2010 report prepared by the President's Council of Advisors on Science and Technology explains that in order to meet longer-term goals of strengthening the STEM workforce, American students must cultivate a passion for STEM subjects that inspires a lifetime of STEM pursuits.¹⁶

II.2 Solving the STEM Problem

Aside from reforming the traditional education system, research shows that the following steps have the potential to help alleviate the STEM crisis:

- Leverage OST programs to engage students in STEM
- Target students that are underrepresented and underserved in STEM
- Focus on OST programs for middle school students

The report further explains the importance of expanding STEM opportunities in these areas.

II.2.1 Leverage OST Programs to Engage Students in STEM

Informal and OST STEM experiences are uniquely positioned to spark students' STEM interests and talents. Research shows that attending OST academic programs can boost students' academic success,

¹¹ Koebler 2011

¹² OECD 2010

¹³ Ibid

¹⁴ McKinsey & Company 2009

¹⁵ Tai, et al. 2006

¹⁶ President's Council of Advisors on Science and Technology 2010

NASA SoI Excellence in Summer Learning Benchmarking Study

as a myriad of studies have linked OST program participation to higher graduation rates, increased higher-education enrollment rates, and increased standardized test scores.^{17,18} The Harvard Family Research Center concluded that America should leverage OST programs in order to achieve its goals in educational equality and in equipping a workforce to face “21st century challenges.”¹⁹ Summer and afterschool are ideal time slots for these programs because students have free time and are otherwise often left alone while their parents are at work.²⁰ This afterschool time gives educators the opportunity to develop expanded learning opportunities that could be used to keep students engaged in STEM for longer than they would during the traditional school day.

In addition, OST programs have the potential to spark students’ interest in STEM, improve student attitudes toward science, develop their science knowledge base, and increase the number of students studying STEM in college.²¹ In fact, approximately 75 percent of science Nobel Prize winners discovered their scientific passions outside of school time.²² OST programs are well-positioned for providing impactful STEM activities because the environment feels less intimidating and academic than the school day and supports opportunities for students to work together on more engaging and hands-on STEM activities.²³

OST programs are an especially important educational resource for students because research shows that students tend to fall behind one grade level over summer vacation if they do not have access to further enrichment opportunities.²⁴ Studies dating back to 1906 show that students do not perform as well on standardized tests at the start of school in the fall as they did at the end of the previous school year. This summer learning loss is commonly referred to as the “summer slide” and particularly impacts students’ mathematics skills.²⁵

Despite the cost, the potential academic benefit of developing and implementing extended learning opportunities for all American students suggests that an investment in OST may save taxpayers money in the long run. For example, the Manchester, New Hampshire school district estimated that they saved over \$70,000 in three years by implementing afterschool programs aimed at preventing students from repeating grades or moving to special education programs.²⁶ In addition, these types of afterschool programs have been linked to lower crime rates because students are no longer unsupervised after school, and research estimates that every dollar spent on an afterschool program saves between \$1.87 and \$5.29 by reducing crime rates.²⁷ Given the potential to increase student achievement, generate more STEM professionals, save money over time, and reduce crime rates, there is significant evidence

¹⁷ Afterschool Alliance 2011b

¹⁸ Afterschool Alliance 2011a

¹⁹ Weiss, et al. 2009

²⁰ Afterschool Alliance n.d. c

²¹ Central Valley Afterschool Foundation n.d.

²² Afterschool Alliance 2010a

²³ Chun and Harris 2011

²⁴ Afterschool Alliance 2008b

²⁵ McCombs, et al. 2011

²⁶ Afterschool Alliance 2005

²⁷ Ibid

NASA SoI Excellence in Summer Learning Benchmarking Study

supporting the pursuit and development for expanding OST STEM programs. In addition, according to a 2009 study, 83 percent of American parents support public funding for afterschool.²⁸

II.2.2 Target Students that are Underrepresented and Underserved in STEM

While STEM education in America is inadequate for students of all backgrounds, statistics minority students paint an even bleaker picture among these underrepresented and underserved demographics. Research dating as far back as 1966 shows that white students tend to outperform their African American and Hispanic peers academically.²⁹ Unfortunately, this disparity, which is commonly referred to as “the achievement gap,” that existed in 1966 still plagues society today despite widespread efforts to close it.³⁰ African American, Latino, and low-income students of all races fall two grade-levels behind their Caucasian and higher income peers by the end of fourth grade and three grade-levels behind by the eighth grade, showing that the gap only increases with time.³¹ By the end of high school, African American and Hispanic students’ reading and mathematics skills are equivalent to the average white student’s skills in 8th grade.³² The achievement gap also correlates directly with students’ socioeconomic status (SES), as more Hispanic and black children live in poverty than non-Hispanic white children.³³

Underrepresented and underserved students’ poor performance in elementary and secondary STEM impacts these students’ ability to pursue higher education in STEM disciplines. In fact, only four percent of the 690,000 minority students who graduated from high school in 2002 had taken the necessary mathematics and science courses required to pursue STEM degrees in college.³⁴ This lack of preparation severely limits the potential pipeline of postsecondary STEM students. While minorities make up 30 percent of undergraduate students in the United States, they earn fewer than 12 percent of America’s undergraduate engineering degrees.³⁵ Additionally, only two percent PhDs awarded in the physical sciences in the United States went to African American students.³⁶ African American representation in STEM disciplines is only declining, as the percentage of African Americans pursuing degrees in STEM has actually fallen since 2000.³⁷

While the cause of this disparity could be attributed to myriad contributing factors, many studies indicate that the poor quality of schools attended by low SES students is a significant concern. In a survey of female and minority chemists and chemical engineers conducted by the Bayer Corporation in 2010, 75 percent of the respondents believed that the poor quality of STEM education that students in lower-income school districts receive is largely responsible for the lack of underserved and

²⁸ Afterschool Alliance n.d. c

²⁹ Coleman 1966

³⁰ Singham 2003

³¹ Afterschool Alliance 2004

³² Haycock 2002

³³ Education Week 2011

³⁴ NACME 2008

³⁵ Ibid

³⁶ Journal of Blacks in Higher Education 2006

³⁷ Ibid

NASA SoI Excellence in Summer Learning Benchmarking Study

underrepresented minorities in STEM fields.³⁸ Minority students are even more likely than their white peers to have a STEM teacher who is not highly trained in their content area. In fact, a 2004 study revealed that while more than half of white fifth grade students had a highly qualified STEM teacher with an advanced degree in the field, only 39 percent of African American and 42 percent of Hispanic fifth-grade students had similarly qualified teachers.³⁹ The U.S. is in desperate need of more highly qualified STEM teachers fluent in the field and able to effectively engage students in science, technology, engineering, and mathematics.

Women are also highly underrepresented in STEM fields. While women make up 48 percent of the workforce, they only fill 24 percent of all STEM professions.⁴⁰ Distressingly, many minority and female students are simply not exposed to STEM and do not personally know any STEM professionals, which makes it nearly impossible for them to understand what a STEM career would entail.⁴¹ A survey revealed that 77 percent of female and minority chemists and chemical engineers believe that the lack of women and minorities in STEM fields is impacted by educators' failure to notice, cultivate, and encourage their STEM talents early in their education.⁴² Furthermore, STEM is often perceived as "a man's world," which can discourage women from pursuing STEM careers.⁴³ Given these realities, part of the solution to the STEM dilemma may lie in identifying and encouraging underrepresented and underserved students to pursue their interests and talents in STEM.

If the United States can close the achievement gap and increase the number of underserved and underrepresented students entering STEM fields, including women and minorities, there is tremendous potential to increase the number of STEM professionals in the U.S. Because America has not yet capitalized on the talents of many females and underrepresented minorities in STEM, a huge potential STEM talent pool is squandered. Women and underrepresented minorities make up close to two-thirds of the American workforce, yet only represent about 25 percent of STEM professionals. If the number of STEM degrees among underrepresented and underserved students increased to the level that would align with their demographic representation, there would be an increase of one million American workers in quantitative fields.⁴⁴ Mae Jemison, the first African American female astronaut, recently spoke to the importance of cultivating the talents of underrepresented students and stated: "White men make up less than 50 percent of the U.S. population. We're drawing [future scientists] from less than 50 percent of the talent we have available. The more people you have in STEM, the more innovations you'll get."⁴⁵

Supporting OST STEM programming for underrepresented and underserved students is crucial for improving this population's STEM outcomes because students from disadvantaged backgrounds

³⁸ The Council of State Governments 2010

³⁹ Ibid

⁴⁰ Afterschool Alliance 2011b

⁴¹ Citizen Schools n.d.

⁴² The Council of State Governments 2010

⁴³ Chute 2009

⁴⁴ Campbell, et al. 2002

⁴⁵ Washington 2011

NASA SoI Excellence in Summer Learning Benchmarking Study

experience even greater summer learning loss than wealthier peers who are more likely to spend their summer in enrichment camps and educational activities.⁴⁶ Research finds that this summer learning loss is cumulative and adds up over time, and experts estimate that up to two-thirds of the achievement gap between high and low SES students in 9th grade can be attributed to summer learning loss over the course of their primary school careers.⁴⁷ Low SES students have a great need for educational and enrichment opportunities that match the quality of the opportunities their wealthier peers receive, making summer programming a prime venue for impacting academic achievement amongst low SES students.

Unfortunately, the majority of the 30 million students that qualify for free or reduced-price school lunches in the U.S. lack access to summer learning activities,⁴⁸ and studies conclude that a total of about 43 million American students do not take advantage of summer learning opportunities.⁴⁹ It would require a significant investment to equalize access to programming for all American children, and policymakers may be particularly hesitant to fund programs during the current national economic climate.

II.2.3 Focus on OST Programs for Middle School Students

While reaching students in STEM at every age is important, OST STEM programs may be especially crucial for middle school students because it is during middle school that students' academic performance, self-esteem, and perception of their own academic ability may begin to deteriorate.⁵⁰ Research shows that middle school is one of the most critical times for students in high-poverty environments, and it strongly influences whether or not students graduate from high school and go on to pursue higher education. According to a policy report by Dr. Robert Balfanz, Director of the Everyone Graduates Center, middle school is the time in low-performing schools when "achievement gaps often become achievement chasms,"⁵¹ as this time period has the potential to either launch students on the path to graduation or knock them off of that path. A research brief from the afterschool organization *Breakthrough Collaborative* states that middle school represents a "fork in the road on the path to college," and describes it as a time when "students are choosing who they want to be in the world and are solidifying their academic path."⁵²

Because of their smaller and more informal learning environments, OST programs are particularly equipped to combat these negative trends by designing and providing learning experiences that are more personal than the formal education system and more tailored to meet students' individual learning needs. By focusing on middle school students, OST STEM programs can help prevent or reverse declines in the performance of students and keep them on a path of pursuing a STEM career.

⁴⁶ Washington 2011

⁴⁷ Alexander, Entwisle and Olson 2007

⁴⁸ Drehle 2010

⁴⁹ Afterschool Alliance 2010

⁵⁰ Breakthrough Collaborative 2010b

⁵¹ Balfanz 2009

⁵² Breakthrough Collaborative 2010b

NASA SoI Excellence in Summer Learning Benchmarking Study

II.3 Background on Summer of Innovation

In 2009, President Obama announced the “Educate to Innovate” campaign to foster a renewed commitment to strengthen America’s literacy in STEM.⁵³ In response to the President’s call to action, NASA launched the Summer of Innovation (SoI) project with a pilot effort in 2010 and a more formal effort in 2011. The Summer of Innovation strategically partners with summer and other out-of-school time (OST) programs to build the capacity of school- and community-based organizations, tailors NASA support to address local needs, and facilitates the infusion of NASA content into summer and OST learning. SoI is specifically targeted at underserved and underrepresented students in grades 4-9.

SoI leverages a multi-faceted implementation approach to maximize the projects’ scale and reach while also allowing for a measure of flexibility and innovation across its partners’ interventions. In 2011, NASA implemented the Summer of Innovation across four different approach models:

- National Awards (duration of up to 4 years and budget up to \$750,000 per awardee)
- Center Awards (duration of up to 9 months and a total budget of \$1,500,000)
- Mini-Grant Awards (one time award and budget of up to \$2,500 per awardee)
- Website access available on an ongoing basis to the general public

For each approach, SoI dedicated resources and personnel to help ensure successful and meaningful student and teacher interactions.

In 2011, SoI made eight large National Awards, partnered with more than 130 organizations and school districts through its Center Awards (implemented across all nine of NASA’s Field Centers and at the Jet Propulsion Laboratory), and distributed almost 200 Mini-Grant awards. The SoI project had a presence in 47 states and Puerto Rico.

In FY2011, SoI served 40,099 middle school students in grades 4-9 during its summer programming. SoI also engaged a total of 3,773 teachers (2,878 certified and 895 informal educators) in professional development related to SoI STEM content or activities.⁵⁴ Recipients of SoI 2011 Awards have completed summer programming and are currently engaged in activities for the sustained engagement, or school year, component of the project.

II.4 Scope & Nature of Report

To determine best practices for effectively engaging underrepresented and underserved middle school students in STEM education through OST programs, this report incorporates research from a variety of academic sources and policy reports, as well as information gathered from interviews with directors and thought-leaders representing well-established OST programs, federal initiatives, and OST advocate coalitions and organizations across the nation. The interviews provided great insight into effective OST STEM program design, implementation, evaluation, and expansion, and provided both anecdotal

⁵³ The White House n.d.

⁵⁴ Student and teacher numbers were derived from *NASA Office of Chief Financial Officer (OCFO) Report: Summer of Innovation (SoI) Project Fiscal Year 2011 (October 1, 2010 – September 30, 2011)*. SoI Project leadership used this report to brief Office of Management and Budget in October, 2011.

NASA Sol Excellence in Summer Learning Benchmarking Study

evidence and research-proven outcomes that strengthened Booz Allen's analyses of the available academic research.

After surveying the academic research and conducting these targeted interviews, Booz Allen identified 13 well-established benchmark programs with a specific STEM focus that target underserved and underrepresented middle school students. These programs have clearly defined goals to engage students in STEM and documented success in accomplishing their educational goals. Selected programs also emphasize providing professional development for educators and improving program quality through evaluation and continuous improvement.

After identifying and selecting the 13 OST STEM benchmark programs, Booz Allen analyzed the research from academic and policy sources, interview findings, and promising practices from benchmarked programs to synthesize best practices for creating and maximizing the impact of STEM-focused OST programs that serve underrepresented and underserved middle school students. Particular focus was placed on identifying best practices that would be relevant to NASA Sol's vision and goals to better support NASA Sol moving forward. Each individual best practice described in this report also includes descriptions of at least two examples of how benchmarked programs have successfully incorporated the best practice into their program. These practical examples illustrate how these best practices can be incorporated into programs to strengthen program quality. In addition, Booz Allen conducted a series of interviews with 12 internal Sol personnel encompassing project leadership and core team, NASA Office of Education leadership, the content and PD team, and the Awardee Technical Representative team. These interviews were used to collect promising practices and areas for improvement from Sol 2011 and to ensure that the best practices identified in this report address the project's needs.

The 49 best practices were broken down into four major categories: program planning and development, engaging students in STEM, evaluating program impact, and building a sustainable and scalable program. These four categories were further divided into best practice sub-categories to create a more easily searchable and accessible resource. Finally, these best practice sub-categories were broken down further into individual best practices for middle school OST STEM and teacher PD programs. Each of these best practices contains a description of the best practice and a best practice in action section, which includes at least two examples of benchmarked organizations that have effectively incorporated the best practice into their program to improve quality. Finally, based on the findings from the interviews and knowledge of the Sol 2011 project, the importance of each best practice for helping Sol meet its objectives was assessed.

II.5 Organization of This Report

The findings of this report are divided into two main sections: benchmark programs and best practices. The benchmark programs section of this report includes an overview of each of the 13 benchmarked programs as well as an easily-accessible program profile for each one containing information about the program's location, vision, history, target audience, student reach, type, duration, STEM content incorporation, educator type, funding sources, professional development, and evaluation. When referred to throughout the report, benchmarked programs will be *italicized* in the text.

NASA SoI Excellence in Summer Learning Benchmarking Study

Following the descriptions and profiles of the benchmarked OST STEM programs, the best practices section is divided up into four main categories: program planning and development, engaging students in STEM, evaluating program impact, and building a sustainable and scalable OST program. Each of these categories is divided into best practice categories, which are broken down further into individual best practices. Each best practice contains three sections, including a description of the best practice, a best practice in action section that includes at least two practical examples of how the best practices have been incorporated into specific benchmarked programs, and an assessment of the importance of the best practice for the success of NASA SoI with examples from the 2011 implementation. Best practices were rated as *highly important*, *moderately important*, or *not important* to SoI.

For a summary chart of the best practices and their importance to SoI, see Appendix A.

For an illustration of which benchmarked programs were used as examples in the best practice in action section of each best practice sub-category, see Appendix B.

III. Profiles of Benchmarked OST Programs

III.1 Criteria for Selection

The following 13 OST programs were selected as benchmarks based on the following criteria:

- *Offers afterschool or summer learning experiences to students*
- *Serves underrepresented and underserved middle school students (4th-9th grades)*
- *Devotes a significant portion of programming to engaging students in STEM*
- *Offers hands-on, experiential STEM experiences for students*
- *Evaluates program success in order to improve programming*

III.2 Benchmarked Programs

III.2.1 21st Century Community Learning Centers

The *21st Century Community Learning Centers (21st CCLC)* program is the only source of federal funding that is entirely dedicated to support OST programs. The program began in 1998 with an allotment of \$40 million to support the broader community, not just students, and was initially administered by the U.S. Department of Education. In 2002, the purpose of the funding was reshaped by the No Child Left Behind Act, and the program began to focus on serving students from high-poverty areas and from low-performing schools. The administration of the grants was also handed over to individual State Education Agencies in 2002, giving states the authority to select the individual grantees. The funding allotment has increased over the years and reached \$1.154 billion during FY11. The amount each state is allocated is determined based on its population of low-income students and the amount of Title I funding the state receives.

NASA SoI Excellence in Summer Learning Benchmarking Study

OST programs can apply to use the funding for various types of efforts, including tutoring and mentoring programs, arts and recreational programs, and counseling and drug prevention programs. Additionally, 21st CCLC's definition of "afterschool programs" includes summer programs and before-school programs. While the purpose of this funding extends beyond STEM, 21st CCLC is now launching a STEM initiative that will take place in two phases. The first year will involve supporting grantees that have an existing STEM focus, and the second year will involve infusing a STEM component into grantee programs that do not already have one. In order to launch this initiative, 21st CCLC has developed Technical Working Groups (TWG) comprised of members from NASA and other nationally represented organizations with an interest in OST STEM, to help determine what the objectives, goals, and intended outcomes of the 21st CCLC STEM initiative should be and how to measure its success.

21st CCLC has also built an extensive online portal as a professional development tool for its programs' educators. The website, <http://y4y.ed.gov>, includes online courses for program staff and educators on project-based learning, STEM, aligning programs with the school day, strengthening partnerships, and getting families involved. The tool also includes a discussion board for programs to share ideas and ask questions and a space for archived webinars. A significant portion of the website is devoted to a course on STEM, and it includes information about why STEM is important, the potential of OST programs to impact STEM education, how to build a team of STEM education experts to help plan and implement a STEM program component, and tools to deepen educators' understanding of STEM content.^{55,56,57}

| Benchmark Profile: 21 st Century Community Learning Centers | |
|--|--|
| Location | Nationwide |
| Vision | 21st CCLC was designed to "support the creation of community learning centers that provide academic enrichment opportunities during non-school hours for children, particularly students who attend high-poverty and low-performing schools" ⁵⁸ |
| Founded | 1998 |
| Target Audience | Students who attend high-poverty and low-performing schools |
| Student Reach | 1,153,866 students nationwide in FY11 ⁵⁹ |
| OST Program Type | Supports a variety of summer programs and before and after school programs, including STEM programs, remedial and tutoring programs, arts and recreational programs, counseling programs, and drug prevention programs |
| Program Duration | Varies by program |
| STEM Content Incorporation | Currently launching a multi-tier, two-phased approach to improve quality of STEM programs |
| Type of Educators Delivering Content | Varies by program |
| Major Sources of Funding | The only source of federal funding established with the sole purpose of |

⁵⁵ Parker 2011

⁵⁶ Afterschool Alliance n.d. d

⁵⁷ U.S. Department of Education n.d.

⁵⁸ 21st Century Community Learning Centers - U.S. Department of Education n.d.

⁵⁹ Afterschool Alliance n.d. d

NASA SoI Excellence in Summer Learning Benchmarking Study

| | |
|---------------------------------|--|
| | funding OST programs |
| Professional Development | Provides programs with access to an extensive range of online professional development resources at http://y4y.ed.gov . |
| Evaluation | Relies on programs to self-report about surveys and student data representing program success through annual progress reports; currently receives self-reported data from all grantees |

III.2.2 Aim High

Aim High was founded in 1986 to give middle school students from low-income families and under-resourced neighborhoods a summer educational experience designed to develop a life-long love of learning and to put students on the path to college. The program started by serving 50 students at one site and has grown to serve over 1,000 students each summer at 12 sites. Students are admitted to the program based on their socioeconomic status (SES) rather than their performance history in school because of the program's commitment to serving the underserved. The program believes that students benefit most from participating for three to four consecutive years, so students enter the program after completing the 5th or 6th grade and over 80 percent of students return each summer until the 8th grade. The program lasts for five weeks each summer, five days each week for seven hours a day. In addition, many afterschool and weekend opportunities are offered to the students during the school year to keep them involved in the program.

A day at *Aim High* includes four academic classes in the morning, two of which are devoted to science and mathematics. Science classes are project-based, and students participate in a variety of experiments. Students focus on a different scientific topic at each grade-level, including Earth Science, Human Anatomy and Nutrition, Astronomy and Physics, and Environmental Science. The science program culminates in a week-long outdoor education experience for students who are about to graduate from the program. The mathematics classes are more standardized and follow the "Math Navigator" curriculum for rising 6th through 8th grade students.

Aim High also advises students on preparing for high school and college during the program and continues to support students in their high school and college application processes after they have graduated from the program. Alumni are also invited back to become educators at *Aim High* because part of the program's mission is to inspire a new generation of teachers. The program invites high school and college students, including their alumni, to return and serve as assistants, interns, and certified teachers. Currently 24 percent of the program's educators are alumni.^{60,61}

| Benchmark Profile: Aim High | |
|-----------------------------|--|
| Location | 12 sites around the Bay Area of California, with campuses in San Francisco, Oakland, Marin County, and San Mateo County |
| Vision | Inspire a life-long love of learning and instill a sense of community, opportunity, and respect so that students are prepared for success in school and life |

⁶⁰ Capobres 2011

⁶¹ Aim High n.d. a

NASA SoI Excellence in Summer Learning Benchmarking Study

| | |
|---|--|
| Founded | 1986 |
| Target Audience | 5 th to 8 th grade students from low-income families who will be the first in their families to graduate from college |
| Student Reach | 1,000+ students each summer; 7,000 students since the beginning of the program |
| OST Program Type | Summer academic program, with many weekend and afterschool experiences offered to students during the school year to provide further enrichment and keep them involved in the program |
| Program Duration | 7 hours/day, 5 days/week, 5 weeks/summer, with additional enrichment opportunities offered for students afterschool and on weekends at various times throughout the school year |
| STEM Content Incorporation | Implemented an expanded mathematics program in 2010 with the goal of preparing all students to take Algebra before the 9 th grade; Mathematics program was piloted in 2009 and then fully implemented across all 12 sites |
| Type of Educators Delivering Content | Each classroom includes one lead teacher who is certified, one college-aged intern educator, and one high school teaching assistant; 77% of staff are professional educators with an average of 3.8 years of classroom experience; 24% of educators are alumni of the program |
| Major Sources of Funding | Relies primarily on funding from the community, including the Department of Children, Youth, and Their Families and the Oakland Fund for Children and Youth; also receive grants for specific pieces of their curriculum, such as a grant from the Silicon Valley Community Foundation and the Walter and Elise Haas, Sr. Foundation for the mathematics program |
| Professional Development | Two weeks are devoted to PD at the beginning of the program; the first week is only mandatory for mathematics teachers and the second is mandatory for all teachers; mathematics coaches are also used throughout the summer to support the mathematics educators |
| Evaluation | Conducts pre-, mid-, and post-surveys of teachers, students, parents, and site directors; also surveys alumni four years after they graduate from Aim High; administers pre- and post-program skills tests, which show that students' mathematics scores on crucial Pre-Algebra skills typically improved an average of 15% in 5 weeks |

III.2.3 Building Educated Leaders for Life (BELL)

Building Educated Leaders for Life (BELL) was founded as a small tutoring program at a local school in Boston by a group of Black and Latino Harvard Law School students in the early 1990s. Since then, the program has expanded to provide afterschool and summer academic programs to over 10,000 students from low-income, urban communities around the country each year. Through *BELL*, students receive an additional 375 hours of instruction during the school year and 240 hours each summer, and the curriculum focuses on building mathematics and literacy skills. In addition to academic courses, students participate in enrichment activities, such as financial literacy, creative arts, environmental science courses, career exploration, and community service.

BELL partners with school districts and schools and works with school administrators to identify and hire the top teachers in the district to provide instruction. These teachers are assisted by volunteers who are

NASA SoI Excellence in Summer Learning Benchmarking Study

professional educators, college students, and community members. The program has developed an extensive professional development web portal for its teachers, known as “BELL Success!” Other OST programs can now purchase access to this web portal in order to use the resources for their educators’ professional development.

The program emphasizes evaluation and begins and ends the program with a series of diagnostic tests and quizzes. These evaluation tools inform teachers of their students’ academic strengths and weaknesses and allow *BELL* to measure the academic growth of students during the program. The curriculum is aligned to state and national learning standards, and students learn in small group environments. An external evaluation conducted by the Urban Institute and Mathematica Policy Research found that *BELL* scholars scored significantly higher on standardized tests than peers in a control group. The study also showed the parents of *BELL* students spent more time reading with their students each night.^{62,63}

| Benchmark Profile: Building Educated Leaders for Life | |
|---|---|
| Location | Georgia, Maryland, Massachusetts, Michigan, New York |
| Vision | “ <i>BELL</i> exists to transform the academic achievements, self-confidence, and life trajectories of children living in under-resourced, urban communities” |
| Founded | Afterschool Program: 1992; Summer Program: 1996 |
| Target Audience | K-8 students |
| Student Reach | 10,000 students/year |
| OST Program Type | Afterschool and Summer Programs |
| Program Duration | Afterschool Program: 2.5 hours/day, 3-5 days/week, up to 30 weeks; total of 375 hours of instruction each year Summer Program: 6-8 hours/day, 5 days/week, 5-6 weeks; total of up to 240 hours of instruction each summer |
| STEM Content Incorporation | Mathematics and literacy are the two subjects on which the program focuses, so students spend approximately half of their time receiving tutoring and instruction in mathematics |
| Type of Educators Delivering Content | Certified teachers lead instruction, and highly trained college students serve as teaching assistants and mentors to scholars |
| Major Sources of Funding | Partnerships with schools and school districts provides access to funding through Title I funding, School Improvement Grants, and often city, county, or state funding; donations from private foundations and companies, including Houghton Mifflin Harcourt, New York Life Foundation, Sovereign Bank/Santander, Target, Walmart, and Wilmer Hale LLP |
| Professional Development | All program educators participate in professional development through an online portal designed by <i>BELL</i> in partnership with the C.S. Mott Foundation. Courses instructed include: Introduction to E-Learning, Mentoring & Student Efficacy, Classroom & Behavior Management, Differentiating Instruction, Youth Development & Learning, Interactive Read Aloud, and Professionalism. Other OST programs can purchase |

⁶² Building Educated Leaders for Life n.d.

⁶³ Phalen 2011

NASA SoI Excellence in Summer Learning Benchmarking Study

| | |
|-------------------|--|
| | access to this professional development site for their teachers. Additionally, there are <i>BELL</i> -specific courses on After School Literacy, After School Math, Summer Literacy, and Summer Math, which train <i>BELL</i> teachers in delivering <i>BELL</i> 's curriculum. |
| Evaluation | <i>BELL</i> contracted with the Urban Institute and Mathematica Policy Research to conduct a random-assignment design study that showed that <i>BELL</i> scholars received significantly higher achievement test scores than students in the control group. The study also showed an increase in parent engagement in students' educations, based on the time they spent reading with their students each night. |

III.2.4 Breakthrough Collaborative

Breakthrough Collaborative is a summer program that was established in 1978 with a dual mission of increasing academic opportunities for highly motivated, underserved students and of inspiring and developing a new generation of teachers and education leaders. The program selects underserved and underrepresented middle school students to participate in two 6-week-long intense summer academic programs, during which students take courses in English literature, mathematics, science, social studies, and foreign language. They also select academic and enrichment electives, such as African American history, study skills, music, athletics, and public speaking. After the summer is over, *Breakthrough* supports these students throughout the year with academic advising and one-on-one tutoring. The program also supports students after they complete their two summers and move on to high school by providing further tutoring and support in the high school and college application process. Students and families have access to college campus tours, test prep classes, financial aid information sessions, and opportunities for scholarships and internships because the program aims to send all of its students to four-year colleges and universities.

Breakthrough Collaborative has expanded to 33 sites around the United States and one site in Hong Kong and has served over 27,000 students since its inception. The program hires college students to serve as teaching interns for the summer programs, and these interns participate in intense training before the program begins. Interns learn how to plan lessons, deliver curriculum, and manage a classroom during this training. Class sizes are kept small, with a student to teacher ratio of 3:1, and teaching interns receive mentoring and support from professional educators throughout the program.

Breakthrough Collaborative has a demonstrated record of success, and a study conducted by Stanford University showed that students who participate in the program perform better academically than those who do not. The study also showed that 85 percent of *Breakthrough Collaborative* students go on to pursue higher education at a four-year college or university.

While not being entirely devoted to STEM, *Breakthrough Collaborative* does offer challenging mathematics and science curriculum for each student in order to prepare them to excel in these subjects in high school and beyond. In fact, the program was recognized as one of the Bayer Corporation's 2010 Compendium of Best Practice K-12 STEM Education Programs for its inquiry-based

NASA SoI Excellence in Summer Learning Benchmarking Study

learning format, challenging content, commitment to the community, and proven successful outcomes.^{64,65}

| Benchmark Profile: Breakthrough Collaborative | |
|---|--|
| Location | 33 sites around the United States and 1 site in Hong Kong |
| Vision | <i>Breakthrough Collaborative</i> aims to increase academic opportunity for highly motivated, underserved students and put them on the trajectory of a successful college path. The program also aims to inspire and develop the next generation of teachers and educational leaders. |
| Founded | 1978 |
| Target Audience | High-achieving middle school students ,most of whom are underserved, underrepresented, and from low-income families |
| Student Reach | 5,400 students per year; 27,000+ students in the past 32 years |
| OST Program Type | Summer program and year-round afterschool academic tutoring for students |
| Program Duration | 6-weeks each summer |
| STEM Content Incorporation | Students participate in mathematics and science classes as part of the program, and the program was recently chosen as one of Bayer's 2010 Compendium of Best Practice K-12 STEM Education Programs because of its challenging content, inquiry-based learning environment, proven successful outcomes, and continued commitment to community support. |
| Type of Educators Delivering Content | College Interns |
| Major Sources of Funding | 95% of the national organization's funding comes from private donations, with the main for supporters being the GAP Foundation, General Atlantic Corporation, John A. and Cynthia Fry Gunn, and the Jack Kent Cooke Foundation. Each individual site is its own independent 501c3, and they are each required to find their own funding, hire their own personnel, and secure their own facilities. The national organization provides training for the local sites on how to raise funds and diversify their pool of donors. |
| Professional Development | Educators are assigned reading material before they arrive for an intensive week-long training on how to write lesson plans, how to evaluate student learning, and on the curriculum they will be delivering. In addition to this week of training, educators participate in ongoing PD throughout the summer and attend meetings within their content area cohorts led by a certified teacher in that content area. These educators also meet one-on-one with certified teachers to receiving mentoring and feedback. |
| Evaluation | Stanford conducted a study on <i>Breakthrough Collaborative</i> that showed that they are more successful with their students than students who did not go through a similar program. This study measured success based on how many students attended a 4-year college and showed that 85% of <i>Breakthrough Collaborative</i> students go on to pursue higher education. |

⁶⁴ Martinez 2011

⁶⁵ Breakthrough Collaborative n.d.

NASA SoI Excellence in Summer Learning Benchmarking Study

III.2.5 Citizen Schools

Citizen Schools was designed in 1995 to transform low-performing schools by extending the school days to provide additional learning opportunities for students who attend these schools. The program now has 31 sites around the United States and serves 4,500 middle school students each year. Students attend the program for the entire school year, three hours each day for four days each week. They receive additional academic instruction and support and participate in 11-week apprenticeships, during which they create a project, also called a “Wow!” to demonstrate what they learned.

Citizen Schools has increased its focus on STEM in the past year and has begun to recruit volunteers to provide apprenticeships at various STEM companies. Currently, 30 percent of apprenticeships are with STEM professionals. One group of students, for example, interned with a biomedical company, Genzyme, and learned to analyze chromosomes to diagnose Turner’s Syndrome, Edward’s Syndrome, and Down Syndrome. Students then conducted a case study for their “Wow!” project and shared their findings with professional scientists. In addition to these STEM apprenticeships, students receive science and mathematics instruction and participate in hands-on experiments and projects in their academic classes during the program.

Citizen Schools hires “teaching fellows,” who are recent college graduates and AmeriCorps volunteers to lead instruction for the program. These educators typically pursue their Master’s of Education during the program. Additionally, the program recruits community volunteers to provide the apprenticeship opportunities for students. The apprentice program gives students a chance to interact with professionals in their communities, providing them a glimpse into possible careers and a chance to see how what they learn in the classroom can apply in the real world.

Citizen Schools is devoted to program evaluation and even broke away from its initial partnerships with the Boys and Girls Club because the program did not share a commitment to continuous improvement through evaluation. A seven-year longitudinal study conducted by Policy Studies Associates determined that *Citizen Schools* outperforms similar programs in terms of student achievement and engagement, as evidenced by attendance rates, performance on state exams, and high school graduation rates. This year, *Citizen Schools* contracted with Abt Associates, Inc. to begin an interrupted time series study to compare the impact of *Citizen Schools* to the impact of a select set of similar programs.^{66,67}

| Benchmark Profile: Citizen Schools | |
|------------------------------------|--|
| Location | 31 school sites around the United States, including sites in North Carolina, Massachusetts, California, New York, New Mexico, New Jersey, and Texas |
| Vision | <i>Citizen Schools</i> aims to close the achievement gap and transform low-performing schools by partnering with middle schools to expand the learning day for children in low-income communities across the United States |
| Founded | 1995 |

⁶⁶ Cohen and Alfaro 2011

⁶⁷ Citizen Schools n.d.

NASA SoI Excellence in Summer Learning Benchmarking Study

| | |
|---|---|
| Target Audience | Middle school students in low-income communities |
| Student Reach | 4,500 students/year |
| OST Program Type | Afterschool program |
| Program Duration | 3 hours/day, 4 days/week for the entire school year |
| STEM Content Incorporation | About 30% of apprenticeships are with STEM companies such as Google, IBM, and Cisco; students participate in hands-on science activities in their afterschool classes |
| Type of Educators Delivering Content | Each program site consists of: <i>Campus Director</i> —a college graduate with teaching or management experience who oversees program operations and educators <i>Teaching Fellows</i> —recent college graduates who are AmeriCorps volunteers and who are typically enrolled in a Master’s of Education program; the “fellows” teach the academic curriculum <i>Team Leaders</i> —part-time educators who are college students and recent graduates interested in education careers and who support the teaching fellows in teaching academic curricula <i>Citizen Teachers</i> —community volunteers who teach apprenticeship courses |
| Major Sources of Funding | Citizen Schools partners with schools and the schools provide facilities and other operational costs. Other top donors include AmeriCorps, Bank of America, Cognizant, Fidelity Investments, Google, and the National Science Foundation (NSF). |
| Professional Development | Teaching fellows are part of a 2-year national teaching fellow program that begins with an intensive summer training. Educators are supported with instructional coaches who observe, evaluate, and advise them, and professional development meetings and classes are held throughout the year. |
| Evaluation | A seven-year longitudinal study conducted by Policy Studies Associates determined that <i>Citizen Schools’</i> programs similar programs in terms of student achievement and engagement, evidenced by attendance rates, performance on state exams, and high school graduation rates. <i>Citizen Schools</i> also recently contracted with Abt Associates, Inc. to conduct an interrupted time series study that will compare the impact of <i>Citizen Schools</i> to the impact of a select set of similar programs |

III.2.6 Girl Scouts

Girl Scouts was founded in 1912 to build character, confidence, and courage in girls ages 5 to 17, in order to inspire and equip them to make the world a better place. There are currently 2.3 million girl scouts organized into local troops around the country and led by volunteer troop leaders. The girls participate in enrichment and learning activities for which they earn badges. *Girl Scouts* now incorporates a range of science and mathematics badges that girls can earn by completing projects or by conducting experiments. For example, girls can earn a “Science Sleuth” badge for conducting a pre-designed experiment.

Girl Scouts was selected as a benchmark for this study because it is a program with a vast student reach and is intentionally infusing STEM components, such as science discovery camps, and opportunities to

NASA SoI Excellence in Summer Learning Benchmarking Study

earn STEM badges into its program. *Girl Scouts* already receives support from NASA and the National Science Foundation, and also announced a partnership with AT&T in October 2011 to develop the “IMAGINE: Your STEM Future” initiative designed to introduce 6,000 underserved girls to career options in STEM. Efforts such as this demonstrate the possibility of improving students’ STEM literacy and increasing their STEM interest through existing programs that are already well-established youth programs, but are not solely focused on STEM.^{68,69,70}

| Benchmark Profile: Girl Scouts | |
|---|--|
| Location | 100 local <i>Girl Scout</i> councils in the United States in addition to troops in 92 countries |
| Vision | <i>Girl Scouts</i> is designed to build girls of courage, confidence, and character, who make the world a better place. |
| Founded | 1912 |
| Target Audience | Girls ages 5 to 17 |
| Student Reach | 2.3 million girl scouts |
| OST Program Type | Afterschool and Summer |
| Program Duration | Varies by troop |
| STEM Content Incorporation | <p><i>Girl Scouts</i> can participate in STEM experiences such as “Intel Fair Play & Discovery Camps,” which is sponsored by the Intel Foundation and the U.S. Department of Education and gives <i>Girl Scouts</i> the opportunity to work with female engineers and scientists in a hands-on curriculum. The girl scouts also create science and engineering fair projects during this program. There are various other STEM-focused experiences available for girls, and some of the badges available for STEM are the “Math Whiz” badge, the “Computer Fun” badge, and the “Science Sleuth” badge. These badges reward girls for their participation and completion of STEM activities.</p> <p>In October 2011, AT&T contributed \$1 million to <i>Girl Scouts</i> of the USA for a STEM initiative. This “IMAGINE: Your STEM Future” program was developed to reach 6,000 underserved girls to introduce them to STEM career options.</p> |
| Type of Educators Delivering Content | Informal educators who volunteer as <i>Girl Scout</i> troop leaders in addition to volunteer mentors who are STEM professionals |
| Major Sources of Funding | NASA, NSF, various other U.S. government departments, AT&T, Dove, and a variety of other corporations and individual donors |
| Professional Development | A variety of professional development courses are available to volunteers, but they are not required |
| Evaluation | The <i>Girl Scouts’</i> STEM initiative is relatively new, and so far there was no evidence that its impact has yet been assessed. |

⁶⁸ Girl Scouts of the USA 2010

⁶⁹ PR Newswire 2011

⁷⁰ Girl Scouts of the USA 2010

NASA SoI Excellence in Summer Learning Benchmarking Study

III.2.7 Girlstart

Girlstart was established in Austin, TX in 1997 with the goal of empowering girls in STEM. Since then, the program has served over 22,000 girls in the 1st through 8th grades by providing afterschool and summer STEM programs. The afterschool programs are held throughout the year at various partner schools, and summer camps are week-long, 40-hour experiences that immerse students in hands-on STEM projects.

Girlstart has acquired its own STEM building, which is rare for an OST program because it is expensive, but it also still holds programs throughout Central Texas at partner school sites. Recently *Girlstart* conducted a pilot “mobile camp,” meaning the program transported the teachers and equipment to areas of Texas that were too far from Austin for most students to attend. The mobile program was successful, and *Girlstart* plans to scale up the mobile camp to five locations outside of Texas during the summer of 2012.

Girlstart recently contracted with SEDL, formerly the Southwest Educational Development Laboratory, to perform a benchmarking study of similar programs in STEM. SEDL will also conduct a longitudinal evaluation of *Girlstart*’s afterschool and summer programs in the coming years. Additionally, *Girlstart* is leveraging its partnerships with the schools that provide facilities and students for afterschool programs to collect student standardized test scores over the next five years. These scores will be used to assess *Girlstart*’s impact on student academic success.^{71,72}

| Benchmark Profile: Girlstart | |
|--------------------------------------|---|
| Location | Headquartered in Austin, TX, with camps throughout Central Texas; expanding to five mobile camps around the United States in 2012 |
| Vision | <i>Girlstart</i> was developed to empower girls in STEM. |
| Founded | 1997 |
| Target Audience | 1 st -8 th grade girls |
| Student Reach | 22,000 students since 1997 |
| OST Program Type | Afterschool and Summer |
| Program Duration | Afterschool programs are year-round, and summer programs last for one week and include 40 hours of instruction |
| STEM Content Incorporation | The entire program is focused on STEM. |
| Type of Educators Delivering Content | <i>Girlstart</i> hires college interns to lead programs, and many of them are in education programs. These young educators tend to have their summers free, making them more readily available to lead camps. |
| Major Sources of Funding | NSF, DELL, NASA, Best Buy, the City of Austin, and various other corporations and foundations |
| Professional Development | <i>Girlstart</i> provides educators with PD in informal education and STEM, and they include courses on their content modules, such as technology, robotics, and 3D modeling and visualization. They invite all teachers at the |

⁷¹ Girlstart n.d.

⁷² Hudgins 2011

NASA SoI Excellence in Summer Learning Benchmarking Study

| | |
|-------------------|---|
| | schools where they offer programs, not just <i>Girlstart</i> educators, to participate in PD so that they can benefit their partner schools. |
| Evaluation | Contracted with SEDL, an evaluation contractor with a strong STEM acumen, to conduct a multi-phase external evaluation of <i>Girlstart's</i> afterschool and summer programming. The first phase of the study involved an evaluation and refinement of <i>Girlstart's</i> assessment tools. <i>Girlstart</i> has just embarked on a five year plan of collecting data from partner schools. |

III.2.8 Higher Achievement

Higher Achievement is an intensive academic afterschool and summer program for underserved and underrepresented 5th through 8th graders in low income communities. The program was founded in 1975 and has expanded to five sites around the country, serving over 10,000 students in the past 35 years. The program has plans to expand to 17 sites by 2017.

Higher Achievement students undergo a rigorous application process that includes an interview to ensure that both they and their parents are invested in the program and are willing to make the necessary time commitment to the *Higher Achievement* program that includes 650 additional hours of education each year from the 5th to 8th grades. Once accepted, students work with volunteer mentor educators who provide tutoring and who lead additional educational courses.

Higher Achievement recently hired a former science teacher as the program's STEM specialist. She has been tasked to find ways to improve the program's science curriculum and to incorporate more science into *Higher Achievement*. As part of this increasing STEM focus, students will participate in STEM-related seminars on topics such as robotics and rockets, and attend year-round mathematics and science classes through both the afterschool and summer programs.

Higher Achievement released a landmark study for OST programs in October 2011 that indicated that the program produces statistically significant academic gains in students. *Higher Achievement* paid \$3 million to contract with Public/Private Ventures (P/PV) and Dr. Leigh Linden from the University of Texas at Austin. The evaluation lasted two years and found that participation in *Higher Achievement* produces significant increases in student scores on standardized mathematics and reading tests.^{73,74,75}

| Benchmark Profile: Higher Achievement | |
|---------------------------------------|--|
| Location | Washington, DC; Alexandria, VA; Baltimore, MD; Richmond, VA; Pittsburgh, PA |
| Vision | <i>Higher Achievement</i> aims to close the opportunity gap for middle school youth in at-risk communities by providing rigorous afterschool and summer academic programs. |
| Founded | 1975 |
| Target Audience | Middle school students from low-income communities and low-performing |

⁷³ Higher Achievement 2011

⁷⁴ Higher Achievement n.d.

⁷⁵ Jefferies 2011

NASA SoI Excellence in Summer Learning Benchmarking Study

| | |
|---|---|
| | schools |
| Student Reach | 700 students/year; 10,000+ students over the past 35 years |
| OST Program Type | Afterschool and summer academies |
| Program Duration | 650 hours per year from 5 th to 8 th grade Summer Program: 40 hours/week, 6 weeks Afterschool Academy: 4.5 hours/day, 3 days/week |
| STEM Content Incorporation | Recently hired a former science teacher as a STEM specialist to improve science curriculum for students and to incorporate more science into the program; students participate in seminars, which are often STEM-related; all students attend mathematics and science classes throughout both the afterschool and summer programs |
| Type of Educators Delivering Content | Volunteer mentors who do not necessarily have an education background |
| Major Sources of Funding | 50% of funding comes from foundations, 15% from government funds, and 35% from corporate and individual donations; major donors include Atlantic Philanthropies, Jack Kent Cooke Foundation, William T. Grant Foundation, Baltimore City Public Schools, Freddie Mac Foundation, DC Public Schools, 21st CCLC, Department of Justice, etc. |
| Professional Development | Mentor educators participate in an orientation day and are paired with scholars to help them in their designated subject |
| Evaluation | <i>Higher Achievement</i> conducted one of the first longitudinal studies that indicated that the program produces statistically significant academic gains on standardized tests. The program contracted with Public/Private Ventures (P/PV) and Dr. Leigh Linden from the University of Texas at Austin, to conduct the 24-month evaluation and found that participation in <i>Higher Achievement</i> significantly increases students' standardized test scores in mathematics and reading. The study cost \$3 million and was released on October 2011. |

III.2.9 Operation Smart (Girls Incorporated)

Operation Smart is part of a larger program known as *Girls Incorporated*, and was specifically designed to develop girls' enthusiasm for, and skills in, STEM through hands-on activities that allow them to explore STEM, ask questions, problem-solve, and persevere. The program has served over 617,000 girls ages 6 to 18 since it was founded in the early-1980s. *Operation Smart* includes a variety of afterschool and summer programs across more than 1,000 *Girls Incorporated* sites around the United States and Canada.

Girls in the program are typically partnered with a STEM professional whom they work with to gain experience in STEM. For example, some girls work with their mentors to build robots or make archeological discoveries. All students, no matter what specific experience they have or who their mentor may be, engage in hands-on, inquiry-based STEM projects.^{76,77}

⁷⁶ Girls Incorporated 2010

⁷⁷ Operation SMART n.d.

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| Benchmark Profile: Operation Smart | |
|---|---|
| Location | A subset from the over 1,000 <i>Girls Incorporated</i> sites around the United States and Canada |
| Vision | <i>Operation Smart</i> is designed to develop girls' enthusiasm for and skills in STEM through hands-on activities that allow girls to explore STEM, ask questions, problem-solve, and persevere. |
| Founded | Early-1980s |
| Target Audience | Girls ages 6 to 18 |
| Student Reach | 617,000 girls since the early 1980s |
| OST Program Type | The program is used as part of various afterschool and summer programs through the larger organization, <i>Girls Incorporated</i> |
| Program Duration | Varies by program |
| STEM Content Incorporation | The program focuses solely on STEM and engages girls in inquiry-based, hands-on learning activities, such working alongside archaeologists to make discoveries or with engineers in building robots |
| Type of Educators Delivering Content | Girls are paired with women in STEM who serve as mentors |
| Major Sources of Funding | Corporations, foundations, government grants, and individuals |
| Professional Development | No evidence of professional development was available |
| Evaluation | Studies conducted at the <i>Girls Inc.</i> of Rapid City, MN showed that girls who participate in <i>Operation SMART</i> hold less stereotypical views of female scientists than those who do not. A preliminary program evaluation also showed that participating in the program improved participants' attitudes toward STEM. |

III.2.10 Project Exploration

Project Exploration was founded in 1999 in Chicago, IL to give underserved and underrepresented students and girls personalized science experiences with real professional scientists. The program operates year-round and serves over 250 students each year through a variety of experiences, such as the Junior Paleontologist program, which is a three-week immersion camp for students to work alongside paleontologists.

The program prioritizes the involvement of career scientists so that students will have authentic experiences in the field. The main focus is to provide students with authentic experiences that are exciting enough to sustain their participation in the program and promote an enduring interest in science. *Project Exploration* conducted a 10-year retrospective study that revealed its students had a 95 percent graduation rate and 50 percent rate of entering a four-year college or university. Additionally, 60 percent of the program alumni who enter college pursue degrees in STEM, and many stories from alumni credit their passion for science to their involvement with *Project Exploration*. The program works to maintain contact with its alumni via phone and email in order to gather longitudinal statistics.^{78,79,80}

⁷⁸ Project Exploration 2010

⁷⁹ St. Louis 2011

NASA SoI Excellence in Summer Learning Benchmarking Study

| Benchmark Profile: Project Exploration | |
|---|---|
| Location | Chicago, IL |
| Vision | <i>Project Exploration</i> was designed to give minority youth and girls access to personalized experiences in science |
| Founded | 1999 |
| Target Audience | Underserved and underrepresented youth and girls |
| Student Reach | 250+ students each year |
| OST Program Type | Year-round activities for students |
| Program Duration | Varies by participant and particular program |
| STEM Content Incorporation | The focus of the entire program is science |
| Type of Educators Delivering Content | Professional scientists and certified teachers act as coordinators |
| Major Sources of Funding | Most funding comes from corporations, foundations, and individuals; Two major funders are the Motorola Foundation and the Whitten-Newman Foundation |
| Professional Development | While the program only uses professional scientists to work with students, <i>Project Exploration</i> does offer professional development to teachers at local schools on how to bring science into the classroom |
| Evaluation | A 10-year retrospective study showed that 50% of program participants enrolled in four-year colleges after graduating high school, and 60% of those participants pursued a STEM degree while in college. |

III.2.11 Summer Advantage

Summer Advantage was founded in 2009 and serves various school districts around Indiana. The goal of the program is to provide education opportunities during the summer for K-8 students in order to raise academic achievement. The program partners with school districts, and the districts provide funding, transportation, and meals for students in return for receiving programming. Earl Phalen, the founder and former Executive Director of *BELL*, also founded *Summer Advantage*, and his experience in building and scaling an OST program led to a rapid development of *Summer Advantage*. The program served 1,000 students in its first summer, 3,000 in its second summer, 5,000 in its third summer, and is planning to serve 10,000 in 2012, its fourth summer.

Students receive academic instruction for three hours in the mornings and participate in enrichment activities, such as art classes and hands-on activities and experiments. Students attend the program 6.5 hours per day, 5 days per week, for 5 weeks during the summer. Students engage in roughly 1.5 hours of mathematics instruction in the morning, and many of the enrichment activities expose students to STEM, such as an activity that involved building and racing solar-powered cars.

Program staff are devoted to evaluation and administer the Iowa Skills Test to students at the beginning and end of the program in order to measure academic growth. Students in past summers have

⁸⁰ Project Exploration 2010

NASA SoI Excellence in Summer Learning Benchmarking Study

averaged a two-month academic gain during the program, according to this assessment.⁸¹ In addition, *Summer Advantage* reports that their students improved an average of 16 points in language arts on state assessments and 12 points in mathematics.^{82,83}

| Benchmark Profile: Summer Advantage | |
|--------------------------------------|--|
| Location | Various school districts around Indiana |
| Vision | <i>Summer Advantage</i> aims to raise the educational achievement of all students by providing summer learning opportunities. |
| Founded | 2009 |
| Target Audience | K-8 students at partner schools in Indiana school districts; partner schools that receive Title I funds |
| Student Reach | Served 5,000 students in 2011 and plans to serve 10,000 in 2012 |
| OST Program Type | Summer learning program |
| Program Duration | 6.5 hours/day, 5 days/week, 5 weeks |
| STEM Content Incorporation | Students participate in mathematics classes for 1.5 hours/day and the program also offers enriching STEM experiences, such as building and racing solar-powered cars |
| Type of Educators Delivering Content | Each classroom of 24 “scholars” is led by a certified teacher and a college-age teacher’s assistant |
| Major Sources of Funding | Funding primarily comes from federal programs, such as the Title I program and school districts; school districts are required to provide food, facilities, and transportation in order to have the program |
| Professional Development | Educators participate in online professional development known as “The Professional Advantage” |
| Evaluation | Administers pre- and post-skills assessments to determine student growth during the program; State test scores of Indiana third grade students who participated in <i>Summer Advantage</i> increased by almost 16 points in language arts and 12 points in mathematics ⁸⁴ |

III.2.12 Techbridge

Techbridge was founded in 2000 and is an afterschool and summer program in Northern California designed to promote girls’ interests and skills in STEM. The program serves 500 girls in the 5th to 12th grades each year and provides professional teachers with a variety of STEM resources to engage students in hands-on learning activities. Students participate in modules on topics such as Crime Scene Investigation, Chemical Engineering, Computer Science, Digital Media, and Environmental Engineering. Each module contains a hands-on activity that gives students a chance to investigate their hypotheses and to experiment.

⁸¹ Magallanes 2011

⁸² Phalen 2011

⁸³ Summer Advantage USA n.d.

⁸⁴ Ibid

NASA SoI Excellence in Summer Learning Benchmarking Study

Techbridge focuses on professional development in order to ensure teachers are delivering STEM content in an effective manner. Teachers attend monthly training sessions on how to effectively deliver STEM curriculum in an engaging way and to also share lessons learned, ideas, curriculum plans, and learn new skills. Participating teachers are also invited to a summer institute to learn how to develop a STEM curriculum and how to incorporate volunteers and corporate partners into their program.⁸⁵

| Benchmark Profile: Techbridge | |
|---|---|
| Location | 16 schools in Northern California |
| Vision | <i>Techbridge</i> aims to promote girls' interest and skills in science, technology, and engineering through multi-faceted programs, as well as to develop resources for teachers, role models, families and partners |
| Founded | 2000 |
| Target Audience | 5 th -12 th grade girls |
| Student Reach | 500 girls/year |
| OST Program Type | Afterschool programs and Summer Programs |
| Program Duration | Varies with each program |
| STEM Content Incorporation | The focus of the entire program is on STEM, and examples of modules that students participate in include Crime Scene Investigation, Chemical Engineering, Computer Science, Digital Media, Environmental Engineering, and Electrical Engineering. Students participate in hands-on activities in each of these modules that show girls what a career in these fields would entail. |
| Type of Educators Delivering Content | Professional teachers at the program's school sites lead the program |
| Major Sources of Funding | The National Science Foundation (NSF), the Noyce Foundation, Chevron, and the Gordon and Betty Moore Foundation |
| Professional Development | Monthly trainings at school sites teach educators how to effectively deliver STEM curriculum in a way that will engage students in the material. Educators share lessons learned, ideas, curriculum plans, and new skills during the monthly meetings. Also offers a summer institute for educators for professional development in designing a program model, curriculum, working with role models and corporate partners, and creating an action plan. ⁸⁶ |
| Evaluation | The Gordon and Betty Moore Foundation sponsored a three-year longitudinal study of <i>Techbridge</i> that evaluated the long-term impact of the program of the program. The study relied on pre- and post-surveys and showed results such as 95% of participants knew more about how devices like simple machines work after participating in the program, 89% felt more confident, 89% planned to study harder after the program so that they could go to college, and 82% saw themselves working in a STEM field. |

⁸⁵ Techbridge n.d.

⁸⁶ Ibid

NASA SoI Excellence in Summer Learning Benchmarking Study

III.2.13 TechREACH

TechREACH was established in 2003 to increase the interest in STEM among underserved and underrepresented middle school students from low-income communities. The program has expanded to 40 clubs in Washington state and serves 1400 students in 6th through 8th grades each year through afterschool and summer programs. Each program incorporates hands-on activities, and each unit last 30 to 40 hours. Some of the units in the program include robotics, renewable energy, building design, 3D modeling, animation, and arcade game design. For example, students designed their own version of the popular video game, *Dance Dance Revolution*, during one program.

In addition to providing engaging curriculum for students, the program incorporates “role models,” who are STEM professionals who volunteer to share their experiences from their careers with students in the program. These guest speakers give students the opportunity to hear about different careers in STEM and to gain ideas about what kinds of careers they may be interested in for their futures^{87,88}

| Benchmark Profile: TechREACH | |
|--------------------------------------|---|
| Location | 40 clubs in Washington state |
| Vision | <i>TechREACH</i> was established to increase underserved and underrepresented, low-income middle school students’ interest in STEM through hands-on, high-quality curriculum, role models, and instruction. |
| Founded | 2003 |
| Target Audience | Underrepresented and underserved middle school students from low-income families |
| Student Reach | 1400 students |
| OST Program Type | Afterschool and Summer |
| Program Duration | Each unit is designed to last 30-40 hours |
| STEM Content Incorporation | The program focuses entirely on STEM, with topics such as robotics, renewable energy, building design, 3D modeling, animation, and arcade game creation |
| Type of Educators Delivering Content | Certified teachers |
| Major Sources of Funding | Bill & Melinda Gates Foundation, NSF, Microsoft, Google, and other grants |
| Professional Development | <i>TechREACH</i> equips teachers with proven curriculum and training to get their students excited about STEM |

⁸⁷ Enman 2011

⁸⁸ TechREACH n.d.

NASA SoI Excellence in Summer Learning Benchmarking Study

| | |
|-------------------|--|
| Evaluation | <i>TechREACH</i> is part of the EdLab group, which has extensively researched STEM education and created research-proven curriculum. The curriculum has been pilot tested, evaluated, and adjusted to ensure quality. <i>TechREACH</i> evaluates their own students' interest by conducting surveys to measure student engagement in STEM. |
|-------------------|--|

IV. Best Practices in Summer and Out-of-School Time STEM Programs

IV.1 Program Planning and Development

Careful program planning and development is the root of success for OST STEM programming, equipping them to overcome the challenges faced during implementation. Successful OST STEM programs incorporate many of the following program planning and development best practices.

IV.1.1 Best Practices for Setting and Reaching Achievable Goals

- ***Establish a Vision for Meeting Community Needs***
- ***Define Clear, Realistic, and Measurable Goals***
- ***Create a Detailed Strategic Plan for Accomplishing Goals***

IV.1.1.1 Best Practice: Establish a Vision for Meeting Community Needs

Best Practice Description:

Establishing a clear vision provides an organization with the foundation for building a successful OST STEM program.⁸⁹ Settling upon a focused vision for an OST program is often challenging, as students and educators within a community may have seemingly endless needs that an organization could choose to target. Ultimately, successful OST STEM programs pinpoint specific needs and design programming to focus on impacting these selected areas of improvement.⁹⁰ In fact, programs that cast too broad of a vision or that attempt to be “everything to everyone” often fail because the vision is unrealistic and spreads programs’ resources too thin to be effective.⁹¹

While it may be tempting for community organizations to simply replicate an existing OST STEM model that has proven successful in another environment, successful OST organizations tend to craft their vision to address the specific needs of the local community.⁹² Each community is its own “organism,” meaning that communities may respond differently to external providers.⁹³ In order to establish a vision that can meaningfully impact the local community and align to its needs, program developers should familiarize themselves with the work of existing local organizations to determine which concerns are

⁸⁹ Zastrow 2011

⁹⁰ Martinez 2011

⁹¹ Ibid

⁹² National Summer Learning Association 2009

⁹³ Hudgins 2011

NASA SoI Excellence in Summer Learning Benchmarking Study

already being met.⁹⁴ Armed with this knowledge, program developers can design a vision that positions their program to target identified unmet local needs⁹⁵ while enabling the program to add unique value to the community.⁹⁶

Best Practice in Action:

- *Higher Achievement* is in the midst of expanding nationally, and currently has centers in Washington, DC; Alexandria, VA; Baltimore, MD, and Richmond, VA. Each of these cities is different, but *Higher Achievement* selected them after investigating the OST landscape of each city and determining that they were in need of additional afterschool and summer academic programs for low-income middle school students. Further, they identified local schools in these cities that aligned with and would support their organization's mission, indicating that the program would be likely to receive a great deal of support in these communities.⁹⁷
- *Breakthrough Collaborative* has established 25 sites around the nation, but each program is its own independent 501c3. Each program is required to find their own funding, facilities, and personnel, but the national office helps in their development by providing PD, recruiting participants, and providing grant-writing structures. With this support system, programs can easily receive help from the national office but can also tailor their programs to meet the specific needs of the community they are serving. This system is particularly appropriate for *Breakthrough Collaborative* because the organization has expanded all over the United States and internationally to Hong Kong (which is not eligible for U.S. federal funding and is not part of the U.S. school system), which makes it essential for each site to have the freedom to adapt programming to their own community.⁹⁸
- *21st Century Community Learning Centers* is funded by the U.S. Department of Education, but each state receives its own pool of money from which to award grants. Individual programs are able to cast their visions for the community and develop a plan to serve their students, and then apply for a *21st CCLC* grant to support their program. This system ensures that each community learning center is tailored to its own unique community, and its vision is true to the needs of its community.⁹⁹
- *Aim High* was founded when two teachers in San Francisco recognized the need for urban middle school students from low-income backgrounds to have positive, enriching learning experiences during the summer in order to support their success in life and in school. *Aim High* recently reevaluated their vision and developed "Vision 2015," which includes plans to expand and strengthen the program. More specifically, *Aim High* recognizes that they currently only serve four percent of the 25,000 students in the area who qualify for free and reduced-price lunches, so they plan to expand to five more sites and serve 700 more students during the summer by 2015. In addition to expanding, *Aim High* is committed to deepening the quality of

⁹⁴ Jefferies 2011

⁹⁵ C.S. Mott Foundation Committee on After-School Research and Practice 2005

⁹⁶ Change the Equation 2011

⁹⁷ Jefferies 2011

⁹⁸ Martinez 2011

⁹⁹ Afterschool Alliance n.d. d

NASA SoI Excellence in Summer Learning Benchmarking Study

their program by providing more professional development for teachers, conducting external and longitudinal evaluations, increasing student academic gains and graduation rates, and raising \$15 million by 2015 in order to accomplish these goals.^{100,101}

Assessment of Importance to Sol:

This best practice is *highly important* to Sol. Sol is a national program that works to improve the capacity of OST STEM programs for middle school students and educators on a local level. While the vision is broad, the project's objectives specifically outline goals for successfully integrating STEM in OST to meet local needs. Sol's tiered implementation model gives organizations across the country flexibility in designing strategies for meeting requirements, allowing organizations to take into account important local needs and conditions.

- After 2010, the Sol project team created a more focused vision, mission, and set of objectives so that the project could better define and measure success without losing sight of its purpose.
- Sol supports its vision by providing the same selection of content to all National Awardees, then leveraging Curriculum Development Specialists to provide PD training to Awardees' educators to help tailor the content to meet local needs.
- Sol allows NASA Centers significant flexibility in partnering with local organizations to reach their student and teacher participation requirements. Centers have diverse existing relationships, resources, and funding vehicles, leading each Center to creatively design a partnership strategy that will allow that particular Center to succeed.
- Because Mini-Grant Award requirements are so flexible and because Awardees have an opportunity to request funding across many different components of programming, smaller local programs are able to apply for funds to help them meet specific local needs.

IV.1.1.2 Best Practice: Define Clear, Realistic, and Measureable Goals

Best Practice Description:

After establishing its vision, an OST STEM organization should focus on setting goals that are both ambitious and realistic given the program's available resources.¹⁰² Without prioritizing its goals based on the available resources, an organization may be in danger of overextending itself and failing to accomplish any of its goals successfully. Therefore, programs should strategically establish a small set of STEM goals that are directly related to the vision.¹⁰³

Organizations should also define their program goals to be measureable, enabling organizations to ensure quality by monitoring and evaluating progress toward the desired outcomes over time.¹⁰⁴ In addition to being measurable, STEM goals must be designed with an understanding of feasible ways to

¹⁰⁰ Aim High n.d. b

¹⁰¹ Capobres 2011

¹⁰² Change the Equation 2011

¹⁰³ Metz, Goldsmith and Arbretton 2008

¹⁰⁴ Chun and Harris 2011

NASA SoI Excellence in Summer Learning Benchmarking Study

collect data on each goal.¹⁰⁵ This data enables programs to monitor their progress and provides clear direction on what needs to be improved.

Best Practice in Action:

- *Project Exploration* established a program scorecard to track and assess its progress toward each specific goal. This tool drives accountability and ensures that every program team member is working toward the same goal, prioritizing the correct activities, and aware of the program's successes.¹⁰⁶
- *Higher Achievement* recently established a specific goal to expand to ten cities by 2017. They are currently in the process of identifying communities that would make feasible candidates for expansion: mid-sized cities with large achievement gaps and large volunteer pools. So far they have programs in Washington, DC; Baltimore, MD; Richmond, VA; and Alexandria, VA. Currently, they are focusing their efforts on working toward their 2017 goal by launching two achievement centers in Pittsburgh, PA in 2012.¹⁰⁷
- *Citizen Schools* strives to impact middle school students from low-income backgrounds at schools that are performing below their state's averages on standardized tests by sending them on a path to success in high school and college. Their specific goals are to build academic and 21st Century skills through their programming, to provide access to educational experiences for students that connect them with the community and future possibilities, and to inform students' beliefs, work ethic, and future success. One element they have implemented to meet these goals is their apprentice program that connects students with a professional who can teach them not only the skills, but also about the specific career and the academic and training path the student can pursue to reach that career. In addition, Citizen School's apprentice program gives students a chance to connect with community members, to collaborate in the completion of a final project, and to envision a practical path towards a successful future in that career. All of these outcomes are correlated with the specific goals that the program established.^{108,109}
- *21st CCLC* set forth the goal of creating community learning centers around the United States that provide students in high-poverty areas and in low-performing schools the opportunity to receive academic enrichment. More specifically, the program was established with the goal of helping students achieve their state and local student standards in core subjects, such as mathematics and reading. In order to meet that goal, *21st CCLC* devised a strategy to outsource funding decisions to individual states so that the states could award grants, allowing them input to select programs that are best positioned to meet their state's needs.^{110,111}

¹⁰⁵ Krishnamurthi 2011

¹⁰⁶ St. Louis 2011

¹⁰⁷ Jefferies 2011

¹⁰⁸ Cohen and Alfaro 2011

¹⁰⁹ Citizen Schools n.d.

¹¹⁰ Parker 2011

¹¹¹ 21st Century Community Learning Centers - U.S. Department of Education n.d.

NASA SoI Excellence in Summer Learning Benchmarking Study

- *Aim High's* 2015 vision to expand, deepen, and measure the impact of the program, has established a series of performance targets metrics that will enable them to assess their progress towards and success at meeting those 2015 goals. For example, by 2015, *Aim High* plans to expand to five new sites, to serve 1,700 students each summer, to show academic gains of at least 15 percent on students' mathematics pre- and post-tests, to increase the number of students with at least a 3.0 GPA by 15 percent, and to inspire at least 90 percent of students to report that they plan to attend college. In addition, *Aim High* included a goal to have 95 percent of their students graduate from high school by 2015, and they have already surpassed this goal with a graduation rate of 97 percent in 2010.¹¹²

Assessment of Importance to Sol:

The best practice is *highly important* to Sol. As a federal program, Sol must be able to prove its success at meeting its goals and show the potential for a return on the investment of public funds. Sol has set out clear requirements for student and teacher participation and has placed a high priority on improving outcome measures for evaluating the effects of Sol programming on participants.

- Sol has clear student and teacher participation targets and content hour requirements for its 2011 awards, giving the project preliminary baselines for success at reaching its target demographics. Sol can continually measure its progress toward its goals throughout the summer and extended learning implementations, providing opportunities for more real-time Awardee support, course corrections, and project improvement.
- The Sol project team has taken steps for improving the outcome measures of Sol student and teacher programming, including organizing a panel of evaluation experts to present recommendations on evaluation design and feasibility moving forward.

IV.1.1.3 Best Practice: Create a Detailed Strategic Plan for Accomplishing Goals

Best Practice Description:

Once leading organizations have established a vision and defined clear STEM goals, their next step is often to develop a strategic plan as a roadmap towards accomplishing those goals.¹¹³ An effective strategic plan includes methods for measuring and monitoring the progress of the program and sets up a realistic timeline to guide the evaluation process.¹¹⁴ High-quality programs also outline students' anticipated activities, which are specifically designed to accomplish programs' intended outcomes.¹¹⁵ This strategic planning aligns with research from the University of Connecticut, which revealed that the best OST programs intentionally design their programming and activities to accomplish their established goals.¹¹⁶

¹¹² Aim High n.d. b

¹¹³ National Summer Learning Association 2009

¹¹⁴ Change the Equation 2011

¹¹⁵ National Summer Learning Association 2009

¹¹⁶ Afterschool Alliance 2011a

NASA SoI Excellence in Summer Learning Benchmarking Study

Best Practice in Action:

- In 2010, *Aim High* created a strategic plan to guide them through 2015. The first part of their strategic plan involves expanding their program from serving 1,000 students at 12 sites in 4 regions of California to serving over 1,700 students at 17 sites in 5 regions of California, and also raising \$15 million by 2015 in order to support this expansion. Another piece of their strategic plan includes focusing on increasing students' GPAs by providing a higher quality program and better instruction. More specifically, they are aiming for 70 percent of their students to have a middle school GPA of 3.0 or above by 2015, which is 15 percent higher than in 2010.^{117,118}
- Over the next four years, *Citizen Schools* plans to partner with 20-25 new schools that serve 10,000 to 12,500 students in 8 to 10 districts around the United States, to contract with an external evaluator to prove that their program produces statistically significant and positive results in turning around low-performing schools, to model the cost-effectiveness of extended learning time while providing high-quality programming, and to support the incorporation of extended learning time into education reform.¹¹⁹

Assessment of Importance to Sol:

This best practice is *highly important* to Sol. The Sol project team requires detailed information from each National Awardee in order to have visibility into Awardee activities. On a higher level, the internal Sol team is working to better formalize its schedule, roles and responsibilities, and performance management using key performance indicators to ensure that it can best support a successful procurement and project implementation.

- Sol's current evaluation design requires a detailed implementation schedule from each National Awardee in order to effectively understand and monitor Awardee success. Unfortunately, many of the 2011 Awardees were slow to develop or send their master schedules, delaying the delivery of data collection tools and hindering evaluation success.
- NASA's Awardee Technical Representatives would also benefit by receiving timely strategic plans from Awardees. If Technical Representatives had increased visibility into Awardee activities, the Technical Representative team would be able to more effectively and proactively support implementers.
- The Sol project team is currently outlining and refining overall roles and responsibilities for all team members so that project work is efficiently delegated. Sol also has a project scheduler so that leadership can clearly communicate future milestones. In addition, Sol will place renewed emphasis on its set of key performance indicators to more closely monitor the health of the project over time.
- Future National Awardees and the internal project team will be better able to effectively outline project plans moving forward because of the additional planning time afforded by the National Award procurement time-out in 2012.

¹¹⁷ Aim High n.d. b

¹¹⁸ Capobres 2011

¹¹⁹ Citizen Schools n.d.

NASA SoI Excellence in Summer Learning Benchmarking Study

IV.1.2 Best Practices for OST STEM Program Planning

- ***Prioritize Strong Leadership***
- ***Hire a STEM Specialist***
- ***Secure a Safe and Accessible Program Location***
- ***Begin Targeted Recruitment of Students and Staff Early***

IV.1.2.1 Best Practice: Begin Program Planning Early

Best Practice Description:

In order to run a successful summer program, an organization should begin planning far in advance of a program's start date. According to the National Summer Learning Association's Quality Standards, a list of recommendations for designing and delivering high-quality OST programs, programs should be proactive in planning and should have a plan and structure for the entire program established before the initial summer programming even begins.¹²⁰ Ideally, summer program planning should commence early in the fall, and January is the latest possible month to begin planning.¹²¹ In order to conduct this early planning, organizations should invest in qualified year-round staffs that are motivated and responsible for accomplishing program goals.¹²² This early planning period provides an opportunity for organizations to establish trust with potential partner organizations and school districts, giving organizations time to prove that they can use funds and services wisely and develop a quality summer program.¹²³

Best Practice in Action:

- Every program selected as a benchmark has hired more than one staff member for year-round planning and development of the program. Some organizations, such as *Citizen Schools*, even have over 25 members on their leadership staff that support the organization in planning and development year round.¹²⁴
- Programs that have multiple locations, such as *Breakthrough Collaborative*, *Aim High*, *Citizen Schools*, *Higher Achievement*, *BELL*, and others typically have year-round staff members for each specific geographic location, as well as year-round national and administrative staff. For example, *Breakthrough Collaborative* has a team of staff members who manage program operations and development on a national scale while directors and front-line staff manage the individual program's local operations.¹²⁵

Assessment of Importance to Sol:

This best practice is *highly important* to Sol. The internal Sol team has previously planned the project under significant timing constraints, impacting implementers' ability to plan programming early. Both

¹²⁰ National Summer Learning Association 2009

¹²¹ Enman 2011

¹²² McCombs, et al. 2011

¹²³ Ibid

¹²⁴ Citizen Schools n.d.

¹²⁵ Breakthrough Collaborative n.d.

NASA SoI Excellence in Summer Learning Benchmarking Study

implementers and the project team report that the compressed planning time in both 2010 and 2011 limited the project's ability to meet its ambitious goals.

- Following SoI 2011's summer implementation, SoI project leadership decided to take a National Awards procurement time-out instead of rushing the procurement to make awards for implementation in summer 2012. SoI will take the time to analyze the results of the 2011 implementation, draft a solicitation with requirements that incorporates the lessons learned from 2011, release the solicitation with sufficient time for prospective offerors to craft thoughtful and realistic proposals, and support innovative Awardees as they plan for a summer 2013 implementation during the preceding school year.
- SoI is also planning to release the Center Award solicitation in an earlier timeframe, which will give NASA centers more time to secure mutually beneficial partnerships and plan for effective programming.
- With more generous timelines, SoI will be able to assess the effectiveness of the SoI model, rather than the effectiveness of the SoI model given timing duress.

IV.1.2.2 Best Practice: Prioritize Strong Leadership

Best Practice Description:

Strong leadership is critical for sustaining a high-quality program.¹²⁶ As the nation faces economic distress, deep budget cuts for federal, state, and local government education efforts are putting many programs at risk, and budgetary challenges have historically plagued non-profit and community efforts as well. Therefore, program leaders must be aggressive and creative in securing the funding and resources their programs need to continue to serve their participants.¹²⁷ Research shows that strong leaders who display a deep and active commitment to their programs and that have experience in leading OST programs are more likely to find innovative ways to fund programs and to overcome challenges¹²⁸. These leaders should also be skilled at building relationships with funders and districts to ensure program financial sustainability.¹²⁹

Best Practice in Action:

- *Building Educated Leaders for Life (BELL)* was founded by Earl Phalen in 1990, and the organization has grown from serving 50 students in Boston to serving over 15,000 students in Georgia, Maryland, Massachusetts, Michigan, and New York each year. Phalen recently broke off from *BELL* to start *Summer Advantage*, another OST program in Indiana. His experience in developing a business model, recruiting students, and building a successful organization has enabled him to launch a program that served 1,000 students in its first summer, 5,000 students in its third summer, and is projected to serve 10,000 in its fourth summer, a growth rate that was exponentially faster than *BELL* experienced. He has successfully launched and expanded

¹²⁶ Jefferies 2011

¹²⁷ McCombs, et al. 2011

¹²⁸ Ibid

¹²⁹ Ibid

NASA SoI Excellence in Summer Learning Benchmarking Study

this thriving OST program despite one of the worst economic times in U.S. history - a testament to the importance of knowledge, experience, and strong leadership in OST.¹³⁰

- *Higher Achievement* was at risk of failure in 1998 when poor performance caused them to run out of money. After accruing a debt of \$50,000, many board members decided that the program had run its course and proposed sunseting the program, but three of board members decided to persevere and change directions. They hired a new executive director, Maureen Holla, who was a mentor in the program at that time. Holla made changes in the operating staff, fortified the board with new members, and spent six months planning a rigorous programming curriculum that was mapped to standards and focused on desired outcomes. She rebuilt trust in the funding community, opened centers around Washington, DC, and continued to steward relationships with funders. Holla was described as an incredibly persuasive “go-getter” who saved *Higher Achievement* and put it on the path to success.¹³¹

Assessment of Importance to Sol:

This best practice is *moderately important* to Sol. Sol’s success hinges on its ability to work with strong leaders and programs through mutually beneficial partnerships. The National Awards have a four-year period of performance with declining Sol-provided funds each year. Ideally, the leaders of Sol’s Awardees would use their OST knowledge and experience to leverage new and existing partnerships to fill the anticipated resource gaps, thereby increasing program sustainability. But if Sol is working with an organization with a strong leader that does not believe in Sol’s vision or goals, the Awardee may not fulfill all of the requirements, preventing Sol from meeting its objectives.

- Strong National Awardee leadership had an impact on Awardees’ ability to meet requirements in 2011. When faced with a challenge, such as losing an implementing partner shortly before programming was set to begin, strong leaders could leverage their networks, knowledge of the OST field, and experience leading a program to find creative solutions and course correct in real time.
- Leaders that were nonresponsive to Awardee Technical Representatives and/or did not work with their Curriculum Development Specialists when planning content and PD were less likely to meet Sol targets.

IV.1.2.3 Best Practice: Hire a STEM Specialist

Best Practice Description:

Many OST providers already juggle multiple programmatic responsibilities, so adding additional program demands is often a challenge. If existing programs lack a significant and engaging STEM component, it often takes a more senior administrative staff member to champion the cause of including STEM in the program and to catalyze the addition of a STEM curriculum.¹³² The team member can act as an advocate for the inclusion of a significant STEM component in OST programming.¹³³ A dedicated STEM specialist can also bolster the STEM component by creating a more comprehensive STEM curriculum that aligns to

¹³⁰ Phalen 2011

¹³¹ Jefferies 2011

¹³² Sacco 2011

¹³³ Ibid

NASA SoI Excellence in Summer Learning Benchmarking Study

state standards, incorporates high-quality, age-appropriate STEM activities, and develop a mentorship program with students and volunteer STEM professionals.¹³⁴

Best Practice in Action:

- *Higher Achievement* hired a former science teacher as dedicated, year-round STEM specialist. She is charged with creating an in-depth STEM curriculum and with providing support to educators who are teaching the material and facilitating activities.¹³⁵
- *Techbridge* hired a variety of year-round staff members, including their assistant director and various program directors and managers, who have backgrounds in teaching mathematics and science at low-performing schools and experience providing professional development to science and mathematics teachers.¹³⁶

Assessment of Importance to Sol:

This best practice is *not important* to Sol. The project, in its current form, largely partners with organizations that are working with Sol because they are already inspired to add a STEM component to their program. In addition, the Sol project team provides National Awardees with Curriculum Development Specialists and Technical Representatives to support Awardees in content and PD selection and implementation and integration of NASA STEM resources, largely negating the need for additional STEM program specialists.

- Once Sol educators receive PD in OST STEM content and pedagogy, they could leverage that knowledge in any OST program they engage with in the future. While this extended impact would be difficult to measure for Sol evaluators longitudinally, NASA STEM knowledge has immense potential to be scalable and sustainable.
- If Sol decides to prioritize increasing STEM specialization with OST programs, Sol could incorporate a “train-the-trainer” model of PD in National or Center Awards and teach a small number of personnel in an organization to train educators in OST STEM content and pedagogy. These trainers would be relative STEM experts within the partnering organization.
- The Sol project team can engage their implementers in discussions to understand what prompted these organizations to prioritize STEM enough to work with Sol.

IV.1.2.4 Best Practice: Secure a Safe and Accessible Program Location

Best Practice Description:

Finding a space to hold an OST program can be challenging for many organizations.¹³⁷ In order to maximize enrollment, programs should conduct their activities at a well-known location, ensuring that parents feel secure in allowing their children to participate.¹³⁸ Organizations can partner with local schools that provide office and classroom space, allowing these organizations to conduct their programming at a locations where parents already feel familiar and comfortable.^{139,140} Many OST

¹³⁴ Jefferies 2011

¹³⁵ Ibid

¹³⁶ Techbridge n.d.

¹³⁷ Sacco 2011

¹³⁸ Hudgins 2011

¹³⁹ Martinez 2011

NASA SoI Excellence in Summer Learning Benchmarking Study

programs look to local community based organizations (CBO), such as the local Boys & Girls Club or YMCA, to provide facilities. These CBOs have access to a large number of students who spend time at their facilities regularly, which may increase the likelihood that students from the target audience will enroll in the program.¹⁴¹ Finally, while it is rare, some programs are able to secure the funding to buy their own building. In such cases, organizations should prioritize finding a safe and familiar location for their program.¹⁴²

Best Practice in Action:

- *Breakthrough Collaborative* partners with local independent schools who provide facilities, so parents are familiar with the facilities and feel safe sending their students there.¹⁴³
- *Girlstart* owns their own building in Austin, TX, and the Executive Director, Tamara Hudgins, stated that the location and safe area of this building have been important to their program's ability to attract students. When conducting off-site programs, *Girlstart* partners with local Boys & Girls Clubs in order to attract students because students are already used to the location and their parents feel safe sending them to camp.¹⁴⁴
- *Citizen Schools* serves students at their home schools by simply extending the learning day. Students do not have to travel anywhere beyond where they would normally go and they already spend their days there, making the location completely accessible for students.¹⁴⁵
- *Aim High's* program campuses are held at local schools with which parents are already familiar and where they are already comfortable sending their students.¹⁴⁶

Assessment of Importance to Sol:

This best practice is *highly important* to Sol. In order to reach its target audience, Sol partners with school districts, national and local non-profit organizations, and other federal programs that are trusted in the community and already have access to students and facilities.

- National Awardees are required to partner with school districts, many of which can provide facilities for programming and cover overhead costs.
- Because most Centers have limited funds to offer potential implementers during the summer, they have extensive experience with finding and partnering with preexisting programs that have access to facilities and students, but are looking to strengthen their STEM curriculum. When partnering with these programs, funding directly supports STEM content integration, rather than being diverted to recruiting, start-up, and facilities costs.

¹⁴⁰ Hudgins 2011

¹⁴¹ Ibid

¹⁴² Ibid

¹⁴³ Martinez 2011

¹⁴⁴ Hudgins 2011

¹⁴⁵ Citizen Schools n.d.

¹⁴⁶ Aim High n.d. a

NASA SoI Excellence in Summer Learning Benchmarking Study

IV.1.2.5 Best Practice: Begin Targeted Recruitment of Students and Staff Early

Best Practice Description:

Many OST STEM programs fail to meet their stated goals to impact students' academic success because they are unable to effectively recruit and enroll student participants, particularly students from demographic groups that are traditionally underrepresented and underserved in STEM. Because many families solidify their summer plans by February, successful summer programs tend to mitigate these recruiting and enrollment risks through continuous outreach – often in efforts that are well-underway for the next summer as soon as the current summer program end.¹⁴⁷

Early recruiting is particularly important for newer organizations that have not yet established themselves in the community or that are not linked to a school district.¹⁴⁸ Programs that can leverage existing partnerships with districts are able to recruit students year-round. If programs do not currently partner with local schools or districts, they should begin cultivating relationships with principals, teachers, and staff early in the year, laying the groundwork for eventually recruiting participants by delivering program presentations to students and school staff.^{149 150}

Just as students and their families make their summer plans early in the year, teachers and youth development professionals often secure their own summer plans long before summer begins. In order to ensure a high-quality program delivery, OST programs should seek to employ the best possible teachers and staff; therefore, they must recruit educators before they make other plans. Early recruitment maximizes the potential for teacher hiring, increasing the likelihood that a program will be fully staffed by qualified program providers.¹⁵¹

Best Practice in Action:

- *Girlstart* relies on local CBO partners such as Boys & Girls Clubs to recruit students when they conduct camps outside of their home site, Austin, TX. They also conduct presentations at local schools, send representatives to local camp fairs, and place flyers at local CBOs and businesses.¹⁵²
- *TechREACH* recruits students by visiting schools where the programs are conducted to give information presentations to students. They also creatively structure and tailor their presentations to appeal to students by doing things such as inviting them to bring a friend to enjoy an ice cream sundae while they learn about the program. Additionally, *TechREACH* describes its program using student friendly terms. For example, the program tells students that they will build a robot rather than describing the intricacies of computer coding. This is a particularly important and effective strategy for *TechREACH* because the organization is committed to recruiting students who would not traditionally be interested in STEM.¹⁵³
- *Breakthrough Collaborative* sends local program directors to community middle schools and to elementary schools with rising 6th graders to build relationships with the school administration

¹⁴⁷ McCombs, et al. 2011

¹⁴⁸ Hudgins 2011

¹⁴⁹ Martinez 2011

¹⁵⁰ McCombs, et al. 2011

¹⁵¹ Ibid

¹⁵² Hudgins 2011

¹⁵³ Enman 2011

NASA SoI Excellence in Summer Learning Benchmarking Study

and faculty. After they have cultivated these relationships, *Breakthrough Collaborative* conducts presentations to the students and teachers to introduce the programs. The program's application process is rigorous and entails essays, transcripts, recommendation letters, and interviews, and these presentations are critical to sparking students', parents', and teachers' interest in the program and to encourage students to apply.¹⁵⁴

- *Citizen School's* teacher recruitment is so successful that they have to initiate selective screening processes to narrow their potential candidate pools. Some of the strategies they use to recruit candidates are to send representatives to job fairs, to post flyers on college campuses, to speak with career counselors, to advertise in local newspapers, to sponsor radio advertisements, to list opportunities on nonprofit and volunteer recruitment websites, and to actively leverage staff and volunteers to share their experiences with others who would make good candidates. After initial recruitment, candidates go through a formal hiring process that includes an application, resume screening, phone interview, and interview process with campus.¹⁵⁵
- *Breakthrough Collaborative* sends campus recruiters to more than 30 of the highest-ranked colleges in U.S. to recruit educators for their program's teaching internship, which is ranked as one of the top ten internships in America by the Princeton Review.¹⁵⁶ *Breakthrough Collaborative* recruiters especially target males, underrepresented minorities, and science and mathematics majors for these teaching internships, and they also have some program alumni return as teaching interns. *Breakthrough Collaborative* has been extremely successful with recruiting educators: receiving over 2,000 teaching internship applications each year for roughly 700 positions.¹⁵⁷

Assessment of Importance to Sol:

This best practice is *highly important* to Sol. While Centers were successful overall at meeting their student targets, none of the National Awardees engaged their required 2500 students in the summer and very few reached 150 certified teachers. Even though each Awardee provided a strategy for reaching the student and teacher participation target in their proposals, the delayed Awardee selection and the shortened planning schedule significantly limited the efficacy of recruitment efforts.

- With the National Award time-out in 2012, Sol will make awards in summer 2012 for implementation in summer 2013. During the full school year between selection and implementation, Awardees can solidify their partnerships and execute recruitment strategies for securing the targeted number of students and certified teachers in summer 2013. Because the Sol project team will be supporting the new Awardees during this planning period, NASA can assist Awardees with recruitment planning when setbacks occur.
- Part of the reason that the Centers were more successful than National Awards at recruiting students was that they were aware of the 2011 summer opportunity in summer 2010. Therefore, they were able to begin planning and partnership efforts a year before implementation. In addition, Centers could leverage their existing relationships with trusted partners from the Pilot for 2011 student recruitment. Similarly, the 2011 National Awardees will be able to leverage increased planning time and existing relationships to improve their student and teacher reach between summer 2011 and summer 2012.

¹⁵⁴ Martinez 2011

¹⁵⁵ Policy Studies Associates 2005

¹⁵⁶ Breakthrough Collaborative n.d.

¹⁵⁷ Ibid

NASA SoI Excellence in Summer Learning Benchmarking Study

IV.1.3 Best Practices for Leveraging Partnerships

- ***Leverage Mutually Beneficial Partnerships to Increase Program Resources***
- ***Find Partners with Shared Goals and Priorities***

IV.1.3.1 Best Practice: Leverage Mutually Beneficial Partnerships to Increase Program Resources

Best Practice Description:

Building partnerships with local schools, school districts, government agencies, or CBOs can help programs with recruiting students and teachers, obtaining facilities for programming, providing transportation and meals for students, and securing funding.¹⁵⁸ According to Matthew Boulay, the Interim CEO of the National Summer Learning Association, working hand-in-hand with a partner organization can increase program quality because it enables the partners to combine their strengths and resources to build greater collective capacity.¹⁵⁹

Schools and school districts are often particularly well positioned to offer access to a number of resources because many of their buildings remain open for year-round staff during the summers and they often already provide reduced-price or free lunches to low-income communities through summer feeding programs.¹⁶⁰ School districts can also often offer access to transportation, central office management services, curriculum experts, teachers, and sometimes even student data.¹⁶¹ Together, these resources typically account for a large percentage of an OST STEM program's operating costs, so receiving these resources for free can dramatically deflate an individual program's costs and increase the likelihood of program sustainability.^{162, 163, 164}

CBOs also tend to offer a pool of helpful resources for STEM programs. Existing OST and other student CBOs, for example, typically have established relationships with a large population of students. Partnerships with these types of organizations can help OST STEM programs recruit students, potentially eliminating the need to conduct additional recruiting.¹⁶⁵ Moreover, programs sometimes receive funding from CBOs and can also learn from those CBOs' experiences in building, executing, and sustaining an OST program in the local community.¹⁶⁶ New programs can benefit from access to a partner organization's experience and expertise, greatly easing the burden of launching a new program from scratch.¹⁶⁷

Finally, partnering with a science, engineering, technology, or research company can also be an option for OST STEM programs, and many OST STEM programs have been successful at recruiting STEM

¹⁵⁸ McCombs, et al. 2011

¹⁵⁹ Boulay 2011

¹⁶⁰ Phalen 2011

¹⁶¹ McCombs, et al. 2011

¹⁶² Ibid

¹⁶³ Hudgins 2011

¹⁶⁴ Phalen 2011

¹⁶⁵ McCombs, et al. 2011

¹⁶⁶ Ibid

¹⁶⁷ Hudgins 2011

NASA SoI Excellence in Summer Learning Benchmarking Study

professionals from these companies as volunteer educators or mentors. These companies are also often willing to donate supplies or money for OST STEM programs because they are invested in the mission of these programs to engage students in STEM, to recruit students into the STEM career pipeline, and to improve STEM education overall.¹⁶⁸

Best Practice in Action:

- *Aim High* partners with a number of independent and charter schools and with the five school districts it serves. These schools cover the operating costs and provide the facilities for programming. *Aim High* also partners with various community organizations including the Exploratorium, the San Francisco Zoo, the California Academy of Sciences, Upward Bound, Summer Search, San Mateo County Parks, and the College Bound Network.¹⁶⁹
- *BELL* partners with school districts looking to improve their low-performing schools and relies on the districts to identify the students most in need of additional academic support, eliminating the need for *BELL* to spend a substantial amount of time recruiting students. The school districts are able to access government funding set aside for students from low-income areas, such as Title I funding, which helps defray program costs. Also, *BELL* uses this partnership to identify and hire the top performing one to five percent of teachers in the school system to serve in their program.¹⁷⁰
- *Summer Advantage* has benefitted tremendously from a partnership with a local engineering firm in Indiana that provides students with volunteer mentors and which funds field trips for students.¹⁷¹
- *Girlstart* collaborates with the Boys & Girls Club and provides STEM programming while the clubs contribute to the program by recruiting students within *Girlstart*'s target audience of underrepresented middle school girls.¹⁷²
- Almost every benchmark program holds their programming at local schools or community centers, such as schools, YMCAs, or Boys & Girls Club, and they use the facilities and electricity of these buildings in order to provide programming for students.

Assessment of Importance to Sol:

This best practice is *highly important* to Sol because the project relies on partners to implement programming. If Sol selects ineffective partners, Sol will not meet its objectives.

- Sol National and Mini-Grant Awardees and Center implementers represent a variety of different types of organizations, including non-profits, CBOs, federal programs, museums, science centers, universities, schools, and school districts.
- Awardees and implementers have their own partnership networks that provide resources such as facilities, food, funding, program support, evaluation, materials, and more.

¹⁶⁸ Phalen 2011

¹⁶⁹ Aim High n.d a

¹⁷⁰ Building Educated Leaders for Life n.d

¹⁷¹ Phalen 2011

¹⁷² Hudgins 2011

NASA Sol Excellence in Summer Learning Benchmarking Study

- National Awardees were better able to meet Sol goals if they received funding and other resources from partners outside of NASA Sol. For example, Awardees with additional PD support from other partners had a far easier time meeting certified teacher requirements. Receiving additional support allowed National Awards to focus Sol's resources on meeting the project objectives, rather than managing program overhead or paying for start-up costs.

IV.1.3.2 Best Practice: Find Partners with Shared Goals and Priorities

Best Practice Description:

While pursuing partnerships to build the capacity and maximize program quality is important, OST programs should be careful to only partner with other parties that align with their own program's mission.^{173,174,175} Dr. Anita Krishnamurthi of the Afterschool Alliance stated that partnerships between organizations can break down if the partners get very territorial or fail to delineate roles and responsibilities effectively.¹⁷⁶ Similarly, sources agreed that it is critical to gain support from the school principal in order to successfully partner with a school, its teachers, or leverage other facilities.¹⁷⁷ Ultimately, it is imperative for programs and their partners to share a singular educational vision.

Best Practice in Action:

- *Citizen Schools* initially partnered with the YMCA and the Boys and Girls Club because these organizations were also serving middle school students, but they ended these partnerships because these programs were not committed to evaluation, which *Citizen Schools* knew was necessary in order to improve their program's quality.¹⁷⁸
- *Aim High* is selective when choosing school partners, and turns down schools that do not have the same mission as the program. Michelle Capobres, Director of Academics and Program Evaluation at *Aim High*, emphasized the criticality of choosing the right partners because the program must be able to work hand-in-hand with the school staff, and the school must support the program's mission enough to be willing to donate the facilities and operating costs.¹⁷⁹

Assessment of Importance to Sol:

This best practice is *highly important* to Sol because the project relies on partners to implement programming. If Sol selects partners that do not share and pursue the projects' interests, Sol will not meet its objectives.

- Some National Awardees had concerns with Sol's project model and reacted by limiting conversations with the Technical Representatives and neglecting to pursue certain aspects of

¹⁷³ Hudgins 2011

¹⁷⁴ Cohen and Alfaro 2011

¹⁷⁵ Capobres 2011

¹⁷⁶ Krishnamurthi 2011

¹⁷⁷ Hudgins 2011

¹⁷⁸ Cohen and Alfaro 2011

¹⁷⁹ Capobres 2011

NASA SoI Excellence in Summer Learning Benchmarking Study

the project. These Awardees had worse outcomes overall than the Awardees that supported Sol's objectives.

- Some Center summer implementers do not share the project's commitment to extended learning. After their summer programming ended, they cut ties with the Center POCs, thereby hindering Centers' ability to meet the extended learning requirements.
- Most of the National Awardees and Center implementers do not come from a government background, meaning that they are inexperienced with the significant evaluation component and stringent evaluation requirements of federally funded programs. In order for the implementers to understand and to fully share Sol's commitment to thorough data collection, and in order for Sol's evaluation to be successful, the project should communicate the importance of Sol's evaluation component to all stakeholders.

IV.1.4 Best Practices for Reaching Underrepresented and Underserved Students

- ***Eliminate Cost Barriers to Student Participation***
- ***Provide Students with Transportation to Program***
- ***Provide Meals to Participating Students During Programming***
- ***Advertise and Recruit Strategically to Attract Underrepresented and Underserved Students***

IV.1.4.1 Best Practice: Eliminate Cost Barriers to Student Participation

Best Practice Description:

Programs that aim to reach students who are underrepresented and underserved in STEM, particularly those who come from low-income backgrounds, should do everything possible to mitigate program expenses for their students. Any program fee can be a barrier to participation for low-income students, so eliminating cost barriers enables more students to attend and benefit from the program. Ideally, programming should be free for all students in order to maximize enrollment and minimize the financial burden on families, particularly given today's struggling economy.¹⁸⁰ Unfortunately, most OST programs largely cater to wealthier students whose parents can afford to send them to enrichment programs. A study by the Afterschool Alliance revealed that even parents from low-income families are paying over \$1700 per year for afterschool and summer programs, despite the reality that some parents simply cannot afford these fees.¹⁸¹ Though a large portion of OST programs do require fees, many programs, especially those that target low-income students, have successfully prioritized funding and raised enough financial support to serve their students for free.

Best Practice in Action:

- Programs benchmarked in this report offer programming free of charge to all student participants. Girlstart charges nominal fees for a few of its summer camps, but the majority of its programs are provided to students for free.^{182,183}

¹⁸⁰ Earle 2009

¹⁸¹ Ibid

¹⁸² Hudgins 2011

¹⁸³ Girlstart n.d.

NASA SoI Excellence in Summer Learning Benchmarking Study

Assessment of Importance to Sol:

This best practice is *highly important* to Sol. To help reach the target audience of underrepresented and underserved students, many of which may not be able to afford traditional OST camps and afterschool programs, Sol partners with implementing organizations that provide free OST STEM programming to all participating students.

- Sol leverages National, Center, and Mini-Grant Awards to build the STEM capacity of free OST programs of all sizes and maturities to engage middle school students from demographics that are underrepresented and underserved in STEM.
- To help further lower the cost of participation, Curriculum Development Specialists helped National Awardees adapt the Sol content so that it incorporated the least expensive possible materials. By conducting student activities using inexpensive materials that are highly accessible to the target demographics, students are more able to see the connection between STEM and their daily lives and may even be able to recreate activities using the same materials at home with their families and friends. Moving forward, Sol is looking to include information on alternative, cost-saving materials alongside the content on the website.

IV.1.4.2 Best Practice: Provide Students with Transportation to Program

Best Practice Description:

Providing transportation for students is another key component for running a successful OST program that targets students who are underrepresented and underserved in STEM.¹⁸⁴ Research shows that not offering transportation to students is often a barrier for programs because it prevents students who cannot find their own transportation from attending.^{185,186} Parents are often unable to transport their students to and from OST programs if it conflicts with their work schedule or if they do not have access to a car, particularly in low-income communities. Without parental transportation, many students do not have a safe and reliable alternative.¹⁸⁷ Therefore, providing transportation is one of the most effective ways to improve access to programs.¹⁸⁸

Many schools and school districts already have buses that run later than the school day to accommodate athletes and students who stay for tutoring, so afterschool STEM programs should investigate the possibility of sharing these buses with schools. If sharing buses is not possible, another option is to fundraise in order to purchase or lease a van or activity bus. Programs can also form partnerships with other programs to spread transportation expenses. If providing transportation to students is not feasible, taking the program to students' neighborhoods where they can easily walk or bike to the programming location is sometimes an option.¹⁸⁹

¹⁸⁴ Zastrow 2011

¹⁸⁵ Enman 2011

¹⁸⁶ McCombs, et al. 2011

¹⁸⁷ Enman 2011

¹⁸⁸ Zastrow 2011

¹⁸⁹ McElvain, Diedrich and Kaufman 2005

NASA SoI Excellence in Summer Learning Benchmarking Study

Best Practice in Action:

- *Summer Advantage* requires the districts they partner with to provide free transportation for students.¹⁹⁰
- *Aim High* is unable to provide transportation to students, but the organization does plan for its programs to be accessible by public transportation in order to ease the burden of parents having to drive their students to daily activities.¹⁹¹
- *BELL*'s partnership with the Detroit Public School District enables them to provide transportation home for students.¹⁹²

Assessment of Importance to Sol:

This best practice is *moderately important to Sol*. While providing transportation to programs may be an effective way of increasing the attendance of underrepresented and underserved students at Sol programming, it can also be very costly. National Awardees, Center implementers, and Mini-Grant Awardees must meet their requirements with limited funds and they may not decide to prioritize transportation.

- In summer 2011, some National and Center Awardees provided daily transportation to participating students. One transportation strategy is leveraging partnerships with school districts, some of which provide bus transportation during the summer. Implementers can also cut transportation costs by picking up students at a few centralized bus stops, such as the local school.
- National and Center Awardees can save their transportation budgets for special events, such as a field trip or a centralized competition for all participants. This way, Sol can prioritize the subsidization of transportation to events with particularly daunting transportation hurdles.

IV.1.4.3 Best Practice: Provide Meals to Participating Students During Programming

Best Practice Description:

OST programs can also increase enrollment among underrepresented and underserved students by providing participants with meals during programming.¹⁹³ Many successful programs provide meals by partnering with a district, as many public schools provide lunches to low-income communities through summer feeding programs.¹⁹⁴ In communities where schools do not provide summer meals to students, some OST programs partner with child nutrition programs that reimburse afterschool and summer programs for snacks and, in some cases, meals.¹⁹⁵ Accessing these federal and state meal programs, while also seeking in-kind donations from local businesses, organizations, and individuals can provide programs with the resources to meet their students' nutritional needs during programming.

¹⁹⁰ Phalen 2011

¹⁹¹ Aim High n.d. a

¹⁹² Williams 2010

¹⁹³ Zastrow 2011

¹⁹⁴ Phalen 2011

¹⁹⁵ Afterschool Alliance n.d. a

NASA SoI Excellence in Summer Learning Benchmarking Study

Best Practice in Action:

- *Citizen Schools* provides a free snack for students every day.¹⁹⁶
- *Summer Advantage* partners with school districts and required the districts to provide meals for their students during the summer days free-of-charge through their summer feeding program.¹⁹⁷
- Delaware, Illinois, Michigan, Missouri, New York, Oregon, and Pennsylvania reimburse or provide up to \$2.32/day on meal costs for OST and summer programs.¹⁹⁸
- *Aim High* solicits donations to pay for snacks for their students, and \$100 is enough to purchase snacks for one *Aim High* campus for an entire week.¹⁹⁹

Assessment of Importance to Sol:

This best practice is *highly important* to Sol because the majority of participants were eligible for free or and reduced lunch, so many may not have been otherwise able to afford nutritious meals during programming. Many National, Center, and Mini-Grant implementers used funding or strategic partnerships to provide food to students.

- Free meals may be particularly important for the National Awards because programs reported delivering up to 8 hours of STEM content to students per day to meet their summer hourly content requirements. If students lack proper nourishment, they may lack the energy required to focus for a whole day.
- Center and National Awardees leveraged partnerships to provide free food to students. For example, because the vast majority of participating students qualified for free or reduced price lunch, USDA could provide free meals for participants. Some Centers reported only worked with implementers that partnered with the USDA to provide free meals to participants.

IV.1.4.4 Best Practice: Advertise and Recruit Strategically to Attract Underrepresented and Underserved Students

Best Practice Description:

Reaching target students is often a challenge for many programs; therefore, leading organizations are often very strategic in their recruitment and outreach.²⁰⁰ In order to maximize enrollment among students from underrepresented and underserved communities and to have the greatest possible impact, programs should design advertising to be visible to and appealing to students and parents from low-income communities.²⁰¹ One particularly effective way to do this is to focus advertising and recruiting efforts on students at CBOs that target the same demographic. For example, many programs post flyers and conduct presentations at Boys & Girls Clubs in an effort to reach participating students

¹⁹⁶ Citizen Schools n.d.

¹⁹⁷ Phalen 2011

¹⁹⁸ Afterschool Alliance n.d. a

¹⁹⁹ Aim High n.d. a

²⁰⁰ Zastrow 2011

²⁰¹ McCombs, et al. 2011

NASA SoI Excellence in Summer Learning Benchmarking Study

from low-income communities.²⁰² Similarly, programs can focus school recruiting efforts on schools that primarily serve students of the targeted demographic group. Most importantly, programs should establish a connection with those students and inspire them to join. Programs can achieve this connection by describing activities to students in ways that will appeal to them. For example, telling students that they are going design a video game is more descriptive and enticing to middle school students than telling them that they will learn about computer coding because it relates to their own lives and gets them excited about the final product of the program.²⁰³

Best Practice in Action:

- *Girlstart* partners with the Boys & Girls Club to recruit participants because the Boys & Girls Club already has a large number of underserved and underrepresented students who attend their program and *Girlstart* can simply recruit these same students for their camps. Also, *Girlstart* relies on principals at partner schools to personally select students for the afterschool programs, eliminating the need to do much advertising.²⁰⁴
- *Breakthrough Collaborative* sends representatives to local schools that have a high percentage of 6th grade students or rising 6th grade students who are underserved and underrepresented. Their recruitment efforts, such as delivering presentations to students and teachers at these schools, have been very successful and the program now has more students apply for admission than it has spaces to fill.²⁰⁵

Assessment of Importance to Sol:

This best practice is *highly important* to Sol. Sol was unable to meet its National Award student participation target in summer 2011. Awardees reported that participating students were universally enthralled with the content, and determining effective ways to attract more students to programming will help Awardees meet their requirements and give even more students the opportunity to have an exciting STEM experience.

- Several National Awardees and Centers strategically partnered with organizations with preexisting programs or student networks, such as school districts, *21st Century Community Learning Centers*, and 4H clubs. Sol relied on these partners to recruit students rather than starting wholly new recruitment efforts.
- National and Center Awardees also relied on additional outreach methods for student recruitment, including holding large community events, distributing fliers in schools, and leveraging partnerships with television or radio networks that reach the target audience to run Sol commercials.

IV.2 Engaging Students in OST STEM

Programs should aim to provide an exciting and engaging STEM experience for students to spark their interest in STEM and to motivate and empower them to pursue STEM throughout their education and

²⁰² Hudgins 2011

²⁰³ Enman 2011

²⁰⁴ Hudgins 2011

²⁰⁵ Martinez 2011

NASA SoI Excellence in Summer Learning Benchmarking Study

into their careers. Providing an engaging STEM experience for students can be accomplished by incorporating the following best practices into programming.

IV.2.1 Best Practices for Designing an OST STEM Curriculum

- ***Design STEM Curriculum that Expands In-Class Learning***
- ***Prioritize STEM Learning Activities in OST Programming***
- ***Create a Supportive STEM Learning Environment with High Expectations for Students***

IV.2.1.1 Best Practice: Design STEM Curriculum that Expands In-Class Learning

Best Practice Description:

Many leading OST STEM programs deliberately align their programming with the school day in order to expand on and support students' formal, in-school experience.^{206, 207} One way for OST STEM programs to expand on in-school learning is to use fun and innovative learning methods to help students who are behind in STEM catch-up to their peers. Because of their emphasis on exciting hands-on activities, Informal learning environments can teach science content using more engaging and interactive methods, which research shows helps students retain information.²⁰⁸

Despite the potential for impacting STEM learning in OST, programs that choose to align their programming and activities with state and national STEM education standards should avoid purely duplicating the in-school environment.²⁰⁹ Informal education provides students with an opportunity for students to learn in ways different from those used to in the classroom, so leading OST STEM providers actively differentiate their programming from that offered during traditional school day.²¹⁰ OST programs provide a space for students to engage in fun activities without the pressure of grades or tests. Instead of listening to a lecture, students are building things, doing projects, and going on field trips.²¹¹ In other words, they can experience science in ways that they cannot in the classroom.²¹² Science can come alive in these programs, allowing students to care more about science as the process of discovery than about rote learning for a test.²¹³

Best Practice in Action:

- *TechREACH* has aligned its content to Washington state standards and is currently trying to broaden that to incorporate national standards, but all of their activities are hands-on opportunities to problem-solve and collaborate with peers to solve scientific questions and focus on experimentation and group work rather than lectures and tests. For example, in one of their curriculum units, students design and build an arcade game similar to *Dance Dance Revolution*, a popular video game.²¹⁴

²⁰⁶ Zastrow 2011

²⁰⁷ Krishnamurthi 2011

²⁰⁸ Afterschool Alliance 2011a

²⁰⁹ Krishnamurthi 2011

²¹⁰ Enman 2011

²¹¹ Krishnamurthi 2011

²¹² Sacco 2011

²¹³ Enman 2011

²¹⁴ Ibid

NASA SoI Excellence in Summer Learning Benchmarking Study

- *Project Exploration* communicates with students' school year teachers to inform them about what students are learning in OST and to coordinate learning opportunities while building links between the formal and informal education sectors.²¹⁵

Assessment of Importance to Sol:

This best practice is *highly important* to Sol. Sol's objectives specifically state that Sol's programming should align with that of the formal education community. In addition to supporting student learning, content that is aligned to academic standards is extremely valuable for the project's teacher PD. Teachers are required to teach toward academic standards in their classrooms, so they will be most likely to use STEM content that they can easily align to standards.

- Some Curriculum Development Specialists connected content to the specific state standards of the Awardees that they were supporting. This made the content even more valuable to teachers, as they are often required to demonstrate how content that they deliver to students in the classroom supports students' progress toward the standards outlined by their states. Some participating teachers that did not know the connection between Sol content and their state standards were hesitant to abandon their current, state standard-based STEM curricula.
- During the Sol PD, Curriculum Development Specialists teach educators the basics of STEM, how to deliver the content, and pedagogy for effectively delivering OST. They also describe the ways in which the content connects to NASA's actual missions so that educators can explain the relevance of the content to students. With this training, educators can effectively lead students through fun, hands-on learning and demonstrate the exciting real world applications of STEM while reinforcing the STEM material that students learn during the school day.

IV.2.1.2 Best Practice: Prioritize STEM Learning Activities in OST Programming

Best Practice Description:

In OST programs that are not traditionally also STEM programs, STEM must compete for time against a variety of other program components.²¹⁶ Programs that intend to add a STEM component must be very intentional about devoting time to STEM, engaging students by deliberately weaving a substantial number of STEM activities into their program.²¹⁷ Interviewed programs stated that isolated STEM activities, such as a short-term project or special STEM day, are insufficient for significantly impacting student STEM outcomes, so students need to be engaged in STEM for a prolonged period of time to sustain interest in STEM even after an OST program ends.²¹⁸ In contrast to STEM classroom learning, during which student activities are often graded or tested, extended OST STEM activities provide students with the opportunity to persevere through STEM challenges and earn the rewards of their discoveries without the fear of failure.²¹⁹ In fact, research by McLaughlin and Pitcock in 2009 linked the amount of STEM exposure students receive to improved academic outcomes, suggesting that program curriculums that are longer and more saturated with STEM are more likely to increase student achievement in STEM in the years following the program.²²⁰ Therefore, programs should prioritize

²¹⁵ St. Louis 2011

²¹⁶ Chun and Harris 2011

²¹⁷ Krishnamurthi 2011

²¹⁸ Zastrow 2011

²¹⁹ Ibid

²²⁰ McCombs, et al. 2011

NASA SoI Excellence in Summer Learning Benchmarking Study

substantial and prolonged engagement in STEM to prevent students' interest in STEM from fading after programming concludes.²²¹

Best Practice in Action:

- *Techbridge* provides afterschool programs that give over 500 middle and high school girls opportunities to participate in hands-on science projects over the course of the school year. For example, girls at Arroyo High School solve mock crimes by using forensic science methods, such as fingerprinting analysis, powder analysis, and chromatography to analyze DNA. Also, students at Madison Middle School began the 2011-2012 school year by using mechanical engineering techniques to build their own gumball machines. Then, during the summer, these same girls will be invited to engage in *Techbridge's* summer programs to incorporate similar hands-on projects with career exploration. The students will learn about careers in food science while making root beer and gummies. The students are encouraged to keep journals and reflect on these activities and to write about the related careers.²²²
- *Project Exploration* provides students an authentic STEM experience participating in fieldwork alongside professional archeologists.²²³
- *Aim High* devotes two class periods each morning to STEM, and students participate in a variety of projects and experiments. Each summer is devoted to learning about a different field of science, such as Environmental Science, Human Anatomy and Nutrition, and Earth Science.²²⁴

Assessment of Importance to Sol:

This best practice is *highly important* to Sol. In order to have a meaningful impact on student interest in STEM, Sol is designed to provide substantial NASA STEM experiences over an extended period of time in OST.

- For National Awards, Sol 2011 required that programs provide students with 40 hours of hands-on STEM learning in the summer, followed by 25 hours of extended STEM learning during the school year. Forty hours of was selected in the summer because research suggests that a minimum of approximately 40 hours of STEM engagement and instruction is often deemed necessary to begin realizing gains in student academic outcomes.^{225, 226, 227} Sol requires 25 hours of follow-on STEM instruction during the school year to maintain students' excitement for STEM even after the summer ends.
- For Center Awards, Sol 2011 required 25 hours of summer engagement, followed by two follow-on events during the school year. While these requirements are lower than the National Award requirements, Center programming engages students in substantial STEM experiences for much

²²¹ Zastrow 2011

²²² Techbridge n.d.

²²³ St. Louis 2011

²²⁴ Capobres 2011

²²⁵ Lauer, et al. 2004

²²⁶ Meier and Invernizzi 2001

²²⁷ Black, et al. 2008

NASA SoI Excellence in Summer Learning Benchmarking Study

longer period than many implementing partners would be able to support without working with NASA's Centers.

IV.2.1.3 Best Practice: Create a Supportive STEM Learning Environment with High Expectations for Students

Best Practice Description:

Programs should challenge their students to excel by pushing participants academically and setting high expectations for what they will learn and accomplish.^{228,229} Those high expectations, however, should be coupled with a supportive and encouraging environment. Successful OST STEM programs do not demand success or hard work from students without committing to support them throughout the effort.²³⁰ The OST environment should reduce intimidation and free students from the constraints of a normal school day by providing them with the comfort of knowing that they do not have to get everything right the first time because learning, especially experiential learning that reinforces the scientific method as so much of STEM does, is a process that often depends on trial and error.²³¹ To that end, effective programs structure STEM activities to encourage students to work together to seek solutions and to engage in the discovery process. This builds interpersonal and critical thinking skills that will serve students well in future STEM career pursuits.²³²

Best Practice in Action:

- *Operation Smart (Girls Incorporated)* has designed what they call a formula for success, which entails letting students in the program make “big, interesting mistakes” so that they can act on their intellectual curiosity and learn how to take risks in problem-solving. At the same time, the formula includes pushing students to succeed because creating this expectation helps communicate to girls that they perfectly capable of pursuing STEM throughout their education and careers. This formula for success sets up a learning environment that is both supportive and nurturing yet sets the bar high for girls in order to encourage them to succeed.²³³
- *BELL* aims to create an environment of high expectations for their students, and one way they do this is by referring to their students as “scholars” instead of kids or students. The program believes that this word communicates their belief that all students have an innate ability to learn. Scholars are supported in their attempts to excel by program staff, educators, and community mentors.²³⁴

Assessment of Importance to Sol:

This best practice is *highly important* to Sol. Sol engages students in hands-on, inquiry-based activities that allow students to creatively overcome STEM challenges. The content supports the actual scientific process of trial and discovery, making failure a temporary and necessary step in the process.

²²⁸ Enman 2011

²²⁹ Martinez 2011

²³⁰ Enman 2011

²³¹ Krishnamurthi 2011

²³² Enman 2011

²³³ Operation SMART n.d.

²³⁴ Building Educated Leaders for Life n.d

NASA SoI Excellence in Summer Learning Benchmarking Study

- Sol content was specifically selected for its quality and appropriateness for the out-of-school time environment. The content was universally praised by National, Center, and Mini-Grant Awardees, reporting that students loved every second of the activities. Students were often given the independence to complete activities based on their own ideas.
- Many of the educators that lead students in Sol's OST STEM activities lack strong backgrounds in STEM. While the educators may be relatively unfamiliar with the content, their lack of STEM expertise can actually positively impact students' STEM experience. When educators and students work to understand the content together, this collaboration can lead to supportive learning environment.
- The Curriculum Development Specialists trained educators to facilitate student group work as a part of effective OST teaching pedagogy. This practice creates a community of Sol learners that can work together on an activity to find solutions to STEM challenges.

IV.2.2 Best Practices for Structuring Student-Educator Interaction in OST

- ***Minimize Class Sizes***
- ***Differentiate Instruction Based on Student Needs***
- ***Connect Students with Mentors***

IV.2.2.1 Best Practice: Minimize Class Sizes

Best Practice Description:

Research indicates that OST programs should minimize class sizes in order to support student learning outcomes.²³⁵ Small classes create a more supportive learning environment because they give teachers more time to work with each individual student and the chance to tailor instruction to each student's needs. Further research links smaller class sizes to greater academic gains amongst students, indicating that there is value in reducing the student-to-teacher ratio.^{236,237} Ideally, many OST experts recommend that programs should aim for a student-to-teacher ratio near 5:1, which does not necessarily require a class size of 5 students but could instead be achieved through class size of 10-15 students with a lead teacher and an assistant.²³⁸

Best Practice in Action:

- *Aim High* puts 2-3 teachers in each classroom with ~17 students. The program teams one certified teacher leading the classroom, with a college-aged intern and a high school-age teaching assistant.²³⁹
- *Breakthrough Collaborative* prioritizes small class sizes and maintains a 3:1 student to educator ratio.²⁴⁰
- *BELL* maintains a student-to-teacher ratio of no more than 10:1.²⁴¹

²³⁵ McCombs, et al. 2011

²³⁶ Ibid

²³⁷ Cooper, et al. 2000

²³⁸ Terzian, Moore and Hamilton 2009

²³⁹ Capobres 2011

²⁴⁰ Breakthrough Collaborative n.d.

²⁴¹ Building Educated Leaders for Life n.d

NASA SoI Excellence in Summer Learning Benchmarking Study

Assessment of Importance to Sol:

This best practice is *moderately important* to Sol. Sol requires National Award programs to leverage at least 150 certified teachers to deliver STEM content to students in OST, and most programs augment their instructor corps with informal OST educators. Requiring certified teachers may, however, be too expensive and unsustainable for many implementers to maintain an extremely low student-to-teacher ratio.

- Evidence from Centers in summer 2011 shows that programs with the lower student-to-teacher ratio also typically had higher costs per student. Therefore, to maximize sustainability, the benefits of so much student-teacher interaction should be weighed against the drawbacks of spending so many resources on teacher pay.
- Informal educators may be less experienced in teaching, but they command a lower salary and may therefore be a better option in programs with limited resources for augmenting program teacher staff and providing extra personalized time to students.

IV.2.2.2 Best Practice: Differentiate Instruction Based on Student Needs

Best Practice Description:

High quality OST programs capitalize on small student-to-teacher ratios to accommodate diverse learning needs and provide individual attention to cater to each individual student's unique learning style.²⁴² OST programs provide an ideal opportunity for individualized instruction because the small classes allow teachers to tailor instruction according to each student's individual needs.²⁴³ In fact, one of the greatest assets of an OST program is the extra attention from teachers, creating a more nurturing learning environment and an ideal setting for a young science student to learn. Teachers can offer more opportunities for students to explore their own individual interests in STEM and can provide the support and encouragement that students need to face STEM challenges but that they are often unable to receive in large environments.²⁴⁴

Best Practice in Action:

- *TechREACH* provides their teachers with a lot of flexibility and creativity so that they can tailor their curriculum to their own students' interests and needs. Also, much of *TechREACH* curriculum is in the form of self-guided tutorials or open exploration work on the computers, so students can drive the pace of their own learning and teachers can primarily serve as a support.²⁴⁵
- *BELL* conducts a pre-test at the beginning of its programs, which serve as a diagnostic assessment that shows their students' teachers the level at which each student is entering. This enables teachers to know each student's strengths and weaknesses and provides them with the knowledge they need to tailor their instruction for individual student needs. For example, if a student in the class did not demonstrate mastery of one-step algebraic equations on their pre-

²⁴² Change the Equation 2011

²⁴³ McCombs, et al. 2011

²⁴⁴ Afterschool Alliance 2010a

²⁴⁵ Enman 2011

NASA SoI Excellence in Summer Learning Benchmarking Study

test, the teacher knows they will need to spend extra time reviewing this with students before moving onto multi-step equations.²⁴⁶

Assessment of Importance to Sol:

This best practice is *highly important* to Sol. Sol is designed to provide OST STEM programming to meet student and teacher needs by increasing interest in, and comfort with, STEM.

- For National Awardees. Curriculum Development Specialists help Awardees modify PD, content, and program design to best meet student and teacher needs. For example, in 2011, Curriculum Development Specialists translated lessons to Spanish, created new PD sequences and augmented lessons with additional pedagogical training, and provided PD in-person and through various online capabilities to communicate effectively with educators.
- In addition to meeting student and teacher needs at an Awardee level, Curriculum Development Specialists work with Sol to help train educators to modify content to meet individual student needs.

IV.2.2.3 Best Practice: Connect Students with Mentors

Best Practice Description:

Almost two-thirds of teenagers interested in pursuing a STEM career report being discouraged because they do not personally know any STEM professionals or do not have a good understanding of what a career in those fields would entail.²⁴⁷ This issue particularly affects girls and underrepresented and underserved students, as it is critical for them to see people that they can relate to in STEM fields and to understand the careers and career paths of those professionals.²⁴⁸ OST STEM programs can facilitate opportunities for underrepresented and underserved students to visualize themselves as STEM professionals by incorporating an apprenticeship or mentorship component into their programming. This component would involve connecting students with STEM professionals, preferably mentors with whom they have something in common, and giving them the opportunity to learn about that mentor's profession.²⁴⁹ These mentorships or apprenticeships should ideally complement students' in-school curriculum, providing contextualization for classroom learning and connecting STEM to the real world.²⁵⁰

Research shows that mentoring relationships also help students understand the path and requirements for pursuing a STEM career, and that mentorship relationships help to sustain student engagement over time rather than simply sparking an initial interest that may quickly fade.²⁵¹ Many OST STEM programs that implement a strong mentorship component have shown a correlation between participation in the program and increased interest and confidence in STEM based on enrollment in advanced STEM classes in school and continued participation in OST STEM programs.²⁵²

²⁴⁶ Lemelson-MIT 2009

²⁴⁷ Citizen Schools n.d.

²⁴⁸ Krishnamurthi 2011

²⁴⁹ Ibid

²⁵⁰ Cohen and Alfaro 2011

²⁵¹ Chun and Harris 2011

²⁵² Afterschool Alliance 2011b

NASA SoI Excellence in Summer Learning Benchmarking Study

Best Practice in Action:

- *Techbridge* recruits professionals from companies such as Cisco Systems, Chevron, Clorox, eBay, Google, Lockheed Martin, Pixar Animation, Yahoo!, and UC Berkeley, to serve as role models for their students. Students select academic and career interests and then travel on field trips to the respective role models' work sites to learn more about what these professionals do and how they reached their goals. The role models share their backgrounds and speak with students about opportunities for summer internships, financial aid, and programs to prepare them for college. *Techbridge* encourages role models to speak honestly about their experiences and the challenges they faced so that the students can learn more about obstacles they may have to overcome and how they can do so. This is particularly important for *Techbridge* students because many of them will be first generation college students.²⁵³
- *BELL* pairs students with young adult mentor from students' communities. Mentors cultivate relationships with students to support them throughout the program and aim to inspire them to work hard, achieve, and set ambitious goals for their lives.²⁵⁴
- *Citizen Schools* places students in an apprenticeship that introduces students to what a career in that particular field would entail. The volunteer professionals who sponsor these apprenticeships serve as a career mentors and educators for students in the apprenticeship program.²⁵⁵

Assessment of Importance to Sol:

This best practice is *moderately important* to Sol. While Sol does not require a mentorship component, NASA can support student STEM mentorships through a variety of unique resources. Implementers can leverage these resources if they decide that mentorships will help their programs meet local needs.

- Technical Representatives are working with some National Awardees to create a formalized mentorship program leveraging the NASA's Speakers Bureau. NASA professionals that participate in the Speakers Bureau are available to meet with students in teachers in person or through several communications tools.
- In addition to the Speakers Bureau, National and Center Awards connect students to potential mentors through astronaut visits and SMEs using visits and field trips to NASA Centers, where students can see the exciting activities that STEM professionals do at work every day.

IV.2.3 Best Practices for Teaching STEM in OST

- ***Engage Students in Hands-On Activities***
- ***Relate OST STEM Content to the Real World***
- ***Facilitate Opportunities for Students to Work in Groups***
- ***Personalize Students' OST STEM Learning Experiences***
- ***Leverage Inquiry-Based Learning Methods***
- ***Emphasize the Fun of Learning in STEM***

²⁵³ Techbridge n.d.

²⁵⁴ Building Educated Leaders for Life n.d

²⁵⁵ Cohen and Alfaro 2011

NASA SoI Excellence in Summer Learning Benchmarking Study

IV.2.3.1 Best Practice: Engage Students in Hands-On Activities

Best Practice Description:

Hands-on activities are a hallmark of OST STEM programs and create a student-centered learning environment that sparks and sustains students' interest in STEM.²⁵⁶ According to the Afterschool Alliance, high-quality OST STEM programs should include hands-on, student-centered activities in order to give students a more engaging STEM experience.²⁵⁷ These activities immediately connect students to the activity and provide them with a platform to engage quickly, which is important to capturing their interest in STEM.²⁵⁸ Through hands-on learning, the projects students produce enable them to see the end product of their efforts.²⁵⁹ For example, students in the *TechREACH* program work hard to learn to code computers and ultimately see that coding enacted by robots that they create as a final product.²⁶⁰

One of the reasons that hands-on activities immediately engage students is because they enable the student to physically interact with the subject by doing an activity or creating a project, and these interactive, tactile, and practical activities help students find meaning in what they are learning.²⁶¹ A number of programs (e.g. *Operation Smart* and *TechREACH*) that emphasize hands-on learning have also documented increased student interest in STEM, suggesting a likely correlation between the completion of hands-on activities and student interest gains.²⁶²

Best Practice in Action:

- *Citizen Schools* students participate in an eleven-week apprenticeship that requires them to produce a final product, which is a hands-on learning experience. For example, some students have taken what they learned about computer programming to design their own website. Others have written their own computer game or conducted a case study in which they analyzed a chromosome, diagnosed it with Down Syndrome, and shared their findings with professional scientists.²⁶³
- *Techbridge* students complete hands-on projects such as building a board game to learn about simple circuits, parallel circuits, polarity, or prosthetic hands.²⁶⁴
- *Girl Scouts* provides an opportunity for girls to earn a badge by participating in FIRST LEGO League's building competitions, which involve designing and programming a robot.²⁶⁵
- *Girlstart* students build a multi-level video game from start to finish during their summer program, giving them the opportunity to apply what they are learning about technology and to design and build a project of their own.²⁶⁶

²⁵⁶ Sacco 2011

²⁵⁷ Afterschool Alliance 2010a

²⁵⁸ Cohen and Alfaro 2011

²⁵⁹ Krishnamurthi 2011

²⁶⁰ Enman 2011

²⁶¹ The After-School Corporation 2010

²⁶² Afterschool Alliance 2011b

²⁶³ Citizen Schools n.d.

²⁶⁴ Techbridge n.d.

²⁶⁵ Girl Scouts of the USA 2011

²⁶⁶ Hudgins 2011

NASA SoI Excellence in Summer Learning Benchmarking Study

Assessment of Importance to Sol:

This best practice is *highly important* to Sol. Sol content involves only hands-on activities, allowing students to truly experience NASA-based science.

- Sol provides National, Center, and Mini-Grant Awardees with hands-on content that was specifically selected because of its quality and appropriateness for the OST environment. Awardees at all levels reported that the content was a huge success, as both students and educators highly enjoyed the hands-on activities.
- All of the Sol content is based on actual NASA missions. Because the content is hands-on, students are performing actual NASA-related science themselves, potentially sparking their own interest in NASA, its missions, and STEM more generally.

IV.2.3.2 Best Practice: Relate OST STEM Content to the Real World

Best Practice Description:

Students in OST STEM programs should feel that what they are learning is authentic and that it is applicable to their lives. Therefore, it is critical for OST programs to relate all STEM content to real world scenarios to show students how STEM can be applied to their life experiences.^{267,268} One way to do this is to show students how the material can be applied in future careers and to give them the chance to interact with professionals in these careers. Another way is to give them the opportunity to learn about how science was used to create their favorite foods or how technology was used to design their favorite video games. These real world applications are particularly important for middle school students because they are naturally curious about the world and are learning to think more independently.²⁶⁹ Relating content to the real world intrigues them and offers them the opportunity to be more actively engaged in their own education.²⁷⁰ Ultimately, relating the content to the real world gives students a chance to see the purpose of learning STEM.²⁷¹ Research even shows that failing to show students an authentic application of what they are learning can deter them from fully applying themselves in school, which can negatively impact their academic performance.²⁷²

One of the best ways to authenticate the learning experience is to implement project-based learning that gives students the opportunity to explore how they could use what they learn during the school day in their current or future lives.²⁷³ These STEM projects also give students the opportunity to create something, to have a final product, and to see the fruits of their hard work. This is important because it gives students a tangible outcome that they can be proud of and symbolizes the importance of their experience.²⁷⁴

²⁶⁷ Capobres 2011

²⁶⁸ Enman 2011

²⁶⁹ Breakthrough Collaborative 2010

²⁷⁰ Ibid

²⁷¹ Maday 2008

²⁷² Central Valley Afterschool Foundation n.d.

²⁷³ Krishnamurthi 2011

²⁷⁴ Ibid

NASA SoI Excellence in Summer Learning Benchmarking Study

Best Practice in Action:

- *Techbridge* incorporates lessons and projects on career exploration, during which students learn about what STEM professionals do, such as Apple software programmers designing the iPod or civil engineers creating bridges to structurally survive earthquakes. During this unit, the students complete activities to link what they are learning to their real-life career aspirations, such as designing a board game to map their future career journeys or developing advertising campaigns for college STEM majors. These activities enable them to see how they can connect what they are learning during the program to their future professional lives.²⁷⁵
- *Operation Smart (Girls Incorporated)* and *Project Exploration* students accompany archaeologists to discover artifacts and interpret the history that they reveal. They learn firsthand about what archaeologists do on a daily basis and how archaeology has revealed the history of their own communities.^{276, 277}
- *Aim High* students spend their final summer in the program learning about Environmental Science every day, and the program takes them on a week-long leadership and education retreat to an outdoor education center at the Headlands Environmental Home. This retreat gives students hands-on experiences that help them understand the applications of what they have been learning while taking part in park restoration projects, such as maintaining trails and removing invasive plants. Students also spend the week hiking, camping, journaling, working in teams, and learning about the history of the region from experts at the park.²⁷⁸

Assessment of Importance to Sol:

This best practice is *highly important* to Sol. All of Sol's content reflects real NASA STEM work, creating an easy connection between activities and professional STEM experiences.

- All of the Sol content is mission-based. For National Awardees, Curriculum Development Specialists train educators to link the content back to the NASA mission that it is based on. By showing students these connections, students gain a better understanding of how the STEM that they are learning in and outside of school is used in the real world.
- National Awardees can augment students' NASA STEM activities by leveraging additional NASA Sol resources, including SMEs that study STEM topics professionally or by taking trips to NASA Centers to see NASA STEM in action.

IV.2.3.3 Best Practice: Facilitate Opportunities for Students to Work in Groups

Best Practice Description:

A high-quality OST program should encourage students to interact with their peers.²⁷⁹ Middle school students are particularly concerned with being part of a group, and programs can capitalize on this by encouraging students to work together and to collaborate on science projects to problem solve.^{280,281}

²⁷⁵ Techbridge n.d.

²⁷⁶ Operation SMART n.d.

²⁷⁷ Project Exploration 2010

²⁷⁸ Aim High n.d. a

²⁷⁹ National Summer Learning Association n.d.

²⁸⁰ Maday 2008

²⁸¹ Afterschool Alliance 2010a

NASA SoI Excellence in Summer Learning Benchmarking Study

Unfortunately, students often receive social encouragement from their peers for skipping class or behaving poorly in school.²⁸² Group work, however, gives students a positive, alternative way to interact with their peers, providing them with an opportunity to collaborate on projects and solve problems together.²⁸³ Group work also hones students' collaboration skills, which are critical for students in the 21st century because STEM jobs typically entail collaborating with colleagues to design and problem solve.²⁸⁴ In addition, group work teaches students to reach out to others for help, which is an important skill for all students and particularly critical for underserved students because they are often the first children in their family to pursue higher education and need to know how to find information and opportunities that are not as easily accessible for them as they are for their wealthier peers.²⁸⁵ In addition, many programs have successfully documented that teamwork often results in "increased interest, self-confidence or positive attitudes towards STEM fields."²⁸⁶

Best Practice in Action:

- *TechREACH* prioritizes group work to give students a chance to interact with their peers, learn how to share resources, collaborate, and reach out for help. *TechREACH* believes this experience is important for underrepresented students who will likely need to know how to reach out for help in accomplishing their goals since there are often more obstacles for them in the path to higher education.²⁸⁷
- *Techbridge* encourages girls to work together with peers outside of the friends they already know well. *Techbridge* incorporates icebreakers into the program to facilitate socializing amongst the students, and they gather the girls in groups for "circle time," during which they discuss career aspirations, recent achievements, and more. The students also work in teams on every project they complete in order to learn how to communicate their ideas to others. The group work is designed to build their interpersonal skills and to teach them how to work as part of a team.²⁸⁸

Assessment of Importance to SoI:

This best practice is *highly important* to SoI. SoI builds STEM capacity of OST programs for middle school students; the programming of which is designed to be different from the school day. Group work is one activity that often differentiates OST from the classroom, and NASA STEM content provides opportunities for students to work together to solve problems and make discoveries.

- Much of the SoI content is designed for a group of students to work on together. Even if students are working on individual projects, the relaxed atmosphere of OST gives students an opportunity to share their ideas and collaborate. Because there is no right answer and students do not receive a grade, it is impossible for students to cheat during SoI activities. Instead, when students exchange the secrets of how they responded to a project prompt, they can actually learn from each other.

²⁸² Balfanz 2009

²⁸³ Ibid

²⁸⁴ Enman 2011

²⁸⁵ Ibid

²⁸⁶ Afterschool Alliance 2011b

²⁸⁷ Enman 2011

²⁸⁸ Techbridge n.d.

NASA SoI Excellence in Summer Learning Benchmarking Study

- To help educators become more comfortable in the classroom and even those educators perhaps lacking any formal teaching experiences, Curriculum Development Specialists train educators on the pedagogy for facilitating group work. This allows educators to effectively manage groups in OST and to help students receive the greatest possible benefit from their activities.

IV.2.3.4 *Best Practice: Personalize Students' OST STEM Learning Experiences*

Best Practice Description:

Leading OST programs distinguish students' OST STEM experiences from the regular school day to give students choices and creative freedom in what activities they engage in, allowing them to tailor the experience to best meet their own personal interests.²⁸⁹ Research by Fred Newmann, the director of the Center on Organization and Restructuring of Schools, indicates that one criterion for providing authentic learning experiences, meaning the experiences engage students and contribute to significant and meaningful achievement gains, is to provide learning that students can find value in beyond needing to know it for a test. His research shows that teachers can connect the curriculum to personal and public issues to tailor the program to individual students' interests and experiences.²⁹⁰ For example, students interested in the outdoors could augment that interest by "greening" their school.²⁹¹ In addition, programs that target a specific gender can customize activities to appeal to those particular students, which may be particularly appropriate when engaging girls in STEM because of the false stereotype that careers in STEM are for men.²⁹²

Furthermore, research on adolescent development suggests that students in middle school should be challenged and given increasing independence.²⁹³ Allowing them to select topics to learn about and projects to do based on their own interests can help facilitate intellectual and personal development.²⁹⁴

Best Practice in Action:

- *TechREACH* strives to provide a personalized experience for all students and gives teachers the creative freedom to design projects that meet their individual students' interests. Students are assigned single-gender classrooms because *TechREACH* believes that boys and girls learn differently and the gender separation creates a more effective, more accepting environment, particularly for girls who too often believe they are inferior to boys when it comes to STEM. Working with students of the same gender gives the girls the chance to interact with other girls who are interested in STEM and allows them the opportunity to overcome inhibitions they may have had about STEM.²⁹⁵
- *Citizen Schools'* students have the opportunity to participate in two apprenticeships each semester during the program, giving students unique opportunities and personalizing their experiences by allotting them time to explore a topic or career and by connecting students with a mentor in the field. The apprenticeship opportunity culminates with students working with a

²⁸⁹ Enman 2011

²⁹⁰ Maday 2008

²⁹¹ The After-School Corporation 2010

²⁹² Chun and Harris 2011

²⁹³ Deschenes, et al. 2010

²⁹⁴ Ibid

²⁹⁵ Enman 2011

NASA SoI Excellence in Summer Learning Benchmarking Study

small group of peers to design final projects to share what they learned during the experience.²⁹⁶

Assessment of Importance to SoI:

This best practice is *moderately important* to SoI. There is no best or only way to solve the problems posed in the SoI content, giving students the freedom to choose which methods to utilize. In the current model, educators are almost always required to leverage NASA SoI content and activities to engage students in STEM, meaning that they do not have very much flexibility in terms of designing projects from scratch that meet student interests.

- While SoI usually requires that Awardees and Implementers to use the preselected NASA STEM content provided on the SoI website, SoI allows programs to use other STEM curricula against project hour requirements if Awardees can justify the change.
- Several National and Mini-Grant Award programs specifically target specific types of students, such as female or Hispanic students. Awardees can work with the Curriculum Development Specialists to select SoI content that they think would particularly interest the specific students in their programs based on the Curriculum Development Specialists knowledge of content implementation in 2011.

IV.2.3.5 Best Practice: Leverage Inquiry-Based Learning Methods

Best Practice Description:

Prioritizing an inquiry-based teaching method is critical for OST programs when engaging students in STEM.²⁹⁷ According to The After-School Coalition's Science Afterschool Guidebook, an inquiry-based learning approach gives students the opportunity to explore the natural and material world by asking questions, making discoveries, and experimenting with these discoveries to find new scientific meaning.²⁹⁸ Inquiry is widely recognized as a critical component of science education, and the National Science Education Standards even include inquiry as "fundamental to the STEM learning process."²⁹⁹ In addition, Fred Newmann designed three criteria for identifying "authentic instructional practices" that produce significant and meaningful achievement gains. In these criteria, he included inquiry-based teaching methods as imperative to student academic development because inquiry teaches students to seek meaning in what they are learning.³⁰⁰

Program leaders interviewed for this report also spoke to the importance of inquiry-based teaching methods. Inquiry helps capture students' attention and interest immediately, which motivates them to delve further into the content and to continue engaging in learning activities.³⁰¹ According to Ben Martinez of *Breakthrough Collaborative*, lecture styles are not effective at giving students an in-depth understanding of the content or at sparking their interest in the content. Instead students need to actively engage the material, and inquiry-based teaching methods are an effective way for students to

²⁹⁶ Cohen and Alfaro 2011

²⁹⁷ Afterschool Alliance 2010

²⁹⁸ The After-School Corporation 2010

²⁹⁹ Ibid

³⁰⁰ Maday 2008

³⁰¹ Capobres 2011

NASA SoI Excellence in Summer Learning Benchmarking Study

do so.³⁰² Therefore, rather than giving students the answers to STEM-based problems, teachers should drive students to ask more questions, experiment, and use trial-and-error to discover.³⁰³

Best Practice in Action:

- *TechREACH* focuses on inquiry-based learning rather than simply providing students with answers or procedures to follow. Even though students interact with a lot of technology in the program, they do not allow students to use the internet to find answers. Instead, *TechREACH* encourages students to ask questions and to experiment to find answers. For example, students might experiment in the development of a robot until the function they are trying to create works properly. Encouraging this discovery-focused learning leads students to take charge of their own learning and education.³⁰⁴
- *Operation Smart* considers encouraging girls to ask questions, investigate answers, and explore through hands-on activities part of what they call their “formula for success.” Girls in this program learn through a model of discovery that involves coming up with questions, problem-solving, taking risks, and making mistakes in order to learn because that is part of the scientific process.³⁰⁵

Assessment of Importance to Sol:

This best practice is *highly important* to Sol. Sol involves only inquiry-based activities.

- All of the Sol content is inquiry-based, allowing students to come up with creative solutions to challenges without worrying about finding a correct answer.
- Many of the educators delivering STEM content to students in Sol lack a STEM background. Inquiry-based teaching methods can be beneficial to educators that are inexperienced in a subject, as these methods allow educators to help students come to their own answer rather than being responsible for knowing the “correct” solution.

IV.2.3.6 Best Practice: Emphasize the Fun of Learning STEM

Best Practice Description:

Many STEM experts agree that students begin disengaging in STEM as early as the 6th grade, so OST programs should find ways to spark greater middle school student interest in STEM to prevent them from disengaging.³⁰⁶ STEM disciplines have great potential to be fun and engaging to kids, especially because effective STEM programs offer opportunities for active hands-on activities.³⁰⁷ In addition, summer and informal learning environments are well-positioned to combat this loss of interest because they are designed to be fun and hands-on for students.³⁰⁸ Leading OST STEM programs usually refrain from providing instruction through lectures, seating students in rows of desks that prevent collaboration, and using other typical school day structures that keep students from exploring their

³⁰² Martinez 2011

³⁰³ Enman 2011

³⁰⁴ Ibid

³⁰⁵ Operation SMART n.d.

³⁰⁶ Zastrow 2011

³⁰⁷ Afterschool Alliance 2010a

³⁰⁸ Capobres 2011

NASA Sol Excellence in Summer Learning Benchmarking Study

individual interests and interacting with the material in fun, hands-on ways. Instead, effective OST STEM programs ensure that students are engaging in scientific activities, such as designing experiments and building technology.³⁰⁹

While summer and informal STEM programs should certainly prioritize fun activities, education should remain the focus. Some of the most effective OST programs design their STEM activities to serve an academic purpose: for example, *Aim High*, a summer and afterschool program in the San Francisco Bay area of California encourages students to play educational video games and to go on camping trips. Even though these activities are fun, exciting, and different from in-school lessons, they also teach students the laws of physics and environmental science, respectively. *Aim High* provides students with a uniquely out-of-school experience while keeping learning as the central focus.³¹⁰

Best Practice in Action:

- *Aim High* was featured in the *San Francisco Chronicle* for its success in providing a fun learning experience for students over the summer. Mathematics teachers in the program compare inverse operations to a wizard in Harry Potter reversing a magical spell. An eleven-year-old student from the program, Danny Ferrar, was quoted in the article saying: “Summer school is more like school. Here it’s more fun.”³¹¹
- *Summer Advantage* invited a team of local engineers to teach the students in the program about engineering by giving them the chance to build solar cars that they raced against each other. Earl Phalen, the director of the program, said the reaction to this experience was very positive from the students. They loved it and seemed very interested in pursuing STEM further and investigating engineering careers.³¹²
- *Project Exploration*’s Senior Director of Programs, Kathleen St. Louis, considers the “fun” and “cool” experiences that students have in their program to be a primary reason they continue to return. For example, she spoke about a week-long forensics program that received a positive reaction from students who thought it was “cool.” The students were very invested in the program and seemed excited to come back every day to continue learning about and how to experiment with forensics methods by solving mock crimes.³¹³

Assessment of Importance to Sol:

This best practice is *highly important* to Sol. Sol is designed to increase student in STEM by providing OST organizations with fun NASA content. To have a chance of sparking a lifelong interest in STEM, Sol needs to ensure that its activities are enjoyable and exciting for students.

- National, Center, and Mini-Grant Awardees reported that students and teachers universally believe that Sol content and activities are fun.
- The Curriculum Development Specialists are currently working to improve the NASA Sol content even further, suggesting that the content will only become more engaging for students.

³⁰⁹ Krishnamurthi 2011

³¹⁰ Capobres 2011

³¹¹ Tucker 2010

³¹² Phalen 2011

³¹³ St. Louis 2011

NASA SoI Excellence in Summer Learning Benchmarking Study

IV.2.4 Best Practices for OST STEM Educator Professional Development

- **Select Type of Educator Based on Program Needs and Objectives**
- **Provide Professional Development Training for Educators Delivering STEM Content in OST**
- **Make Training and PD Highly Accessible to Educators**
- **Provide OST Educators with Ongoing Support**

IV.2.4.1 Best Practice: Select Type of Educator Based on Program Needs and Objectives

Best Practice Description:

Leaders of the organizations interviewed for this report differed in their opinions of the type of educator best suited to lead OST programs. Some emphasized the benefits of hiring certified teachers to deliver STEM content, while others highlighted the OST expertise of informal educators. There are advantages and disadvantages to each kind of provider. According to Matthew Boulay, interim CEO of the National Summer Learning Association, characteristics of an ideal OST educator vary based on the specifics of the program.³¹⁴ One-third of staff in afterschool programs are certified teachers.³¹⁵ These teachers often bring deep content knowledge. Unfortunately, they also have a tendency to replicate a traditional classroom environment in the OST program, causing students to reject the OST program if they perceive it as a mere extension of their potentially boring school day.³¹⁶ On the other hand, program staff members who have backgrounds in youth development, rather than certified teaching, often have significant experience working with youth in the OST environment, helping them connect well with students. At the same time, however, they may lack STEM content knowledge and feel uncomfortable leading science activities.³¹⁷ OST programs can also hire late high school or college students who are interested in pursuing teaching as a profession, and these pre-service teachers bring many of the benefits of informal educators. In addition, programs may choose to hire these education students to further spark their interest in the teaching profession while giving them valuable teaching experience. Organizations can train and support these future teachers by pairing them with more experienced mentor teachers.^{318,319,320}

Programs are usually not limited to hiring one type of educator, and many programs have been successful at blending informal educators with certified teachers and college and high school students so that each educator can bring their own strengths. Hiring multiple types of educators builds a staff with a variety of strengths that often complement each other, while also giving educators a chance to learn from each other.³²¹ Ultimately, organizations must tailor the decision regarding what type of educators to hire based on their own program's needs, goals, and budget.

³¹⁴ Boulay 2011

³¹⁵ Krishnamurthi 2011

³¹⁶ Ibid

³¹⁷ The After-School Corporation 2010

³¹⁸ Jefferies 2011

³¹⁹ Hudgins 2011

³²⁰ Martinez 2011

³²¹ Ibid

NASA SoI Excellence in Summer Learning Benchmarking Study

Best Practice in Action:

- *Aim High* hires a variety of educator types, including certified teachers, college-aged interns, and high school-aged teaching assistance. Certified teachers serve as the lead educators of each classroom, and they are supported by one to two interns and assistants. *Aim High* has selected this structure because the professional educators ensure quality instruction while giving the high school and college students a chance to gain experience educating students. The goal is to inspire these interns and assistants to pursue careers in education, and so far this effort seems fairly successful, as 67 percent of interns and teaching assistants report that the experience has motivated them to consider a career or degree in education. The other benefit of this structure is that it enables program alumni to become more involved as teaching assistants and interns. In fact, 54 percent of teaching assistants and interns at sites that have been established for at least four years are program alumni.^{322,323}
- *BELL* consults with school administrators to select and hire top certified teachers in the districts it serves, and these certified teachers serve as the lead educators of the program. The program also hires college-students and community members to support and assist these certified teachers and provide students with additional tutoring.³²⁴

Assessment of Importance to Sol:

This best practice is *highly important* to Sol. If Sol wants to meet its goal of increasing student interest in STEM, the project should ensure that it selects the right people to deliver content.

- Sol requires National Awardees to use certified teachers to deliver a portion of students' OST STEM content because evidence shows that better educated OST providers generally lead to better educational student outcomes.³²⁵ In addition, teacher PD is a priority for NASA. Sol certified teachers may receive as much as 40 hours of STEM PD. By allowing participating teachers the opportunity to leverage their newfound knowledge of hands-on STEM activities with students during OST, Sol also gives teachers more of an opportunity to increase their comfort with STEM.
- Most National Awardees and Centers rely on informal educators to deliver some OST STEM content. While informal educators may not have a background in STEM or classroom teaching, many bring other benefits, often including a deep connection with the community they are serving and an ability to differentiate OST learning from in-school learning.
- National Awardees reported that informal educators felt somewhat undervalued during the summer 2011 implementation, despite the fact that they delivered a significant amount of content.

³²² Aim High n.d. a

³²³ Capobres 2011

³²⁴ Building Educated Leaders for Life n.d

³²⁵ National Institute on Out-of-School Time 2007

NASA SoI Excellence in Summer Learning Benchmarking Study

IV.2.4.2 Best Practice: Provide Professional Development Training for Educators Delivering STEM Content in OST

Best Practice Description:

The best OST STEM programs offer STEM experiences that are often more engaging for students than their formal school day lessons. OST STEM often ensure that students have these engaging experiences by training educators to use appropriate OST teaching methods.³²⁶ Research shows that the quality of instruction in OST programs is directly correlated to greater student achievement, just like during the school year.³²⁷ Because of the varying strengths and weaknesses that different types of educators bring to OST STEM programs, it is critical for programs to not only offer, but require educators to undergo some type of formal training. While programs can and should grant educators some creative freedom in their classrooms, it is important for them to train educators to conduct programming using research-based methods that will encourage the programs' intended student outcomes.³²⁸ All programs interviewed for this study required their staff to undergo some type of training and professional development. Some programs conducted training for as long as two weeks for both new and returning educators.

In the ideal OST STEM program, program providers would have STEM backgrounds and still be able to relate to students.³²⁹ Finding and retaining teachers with STEM backgrounds, however, is often a challenge for OST programs.³³⁰ In fact, research shows that many after-school providers have minimal science training and many of them even report negative experiences with science and mathematics when they were in school.³³¹ These staff members without STEM backgrounds often feel uncomfortable leading STEM activities.³³² Fortunately, if programs offer frequent and effective training, program leaders who lack existing STEM knowledge but have experience with youth development can learn to be effective STEM teachers.³³³ These trainings should introduce staff to useful resources, such as ideas for activities to use in their classrooms and websites where they can find more information about the content and videos of activities being implemented in classrooms. The resources can also familiarize educators with the program curriculum and content they will be teaching. In addition, leading programs teach staff the importance of STEM education and show them the real-life application of what they are teaching. Having a deeper understanding of the content enables educators to better communicate the material to their students because they have more comprehensive knowledge about what they are teaching and are better prepared to answer students' questions.³³⁴ Also, training educators on any technology that they are expected to leverage in the classroom ensures that they feel comfortable using that technology with students.³³⁵ Perhaps most importantly, setting clear expectations about what instructional methods should be used and being very prescriptive when providing feedback helps educators know how to improve their instruction.³³⁶

³²⁶ Enman 2011

³²⁷ McCombs, et al. 2011

³²⁸ Capobres 2011

³²⁹ Zastrow 2011

³³⁰ Capobres 2011

³³¹ The After-School Corporation 2010

³³² Chun and Harris 2011

³³³ Ibid

³³⁴ The After-School Corporation 2010

³³⁵ Ibid

³³⁶ Ibid

NASA SoI Excellence in Summer Learning Benchmarking Study

Dr. Anita Krishnamurthi, Director of STEM Policy at Afterschool Alliance, emphasized the importance of training classroom teachers to use these appropriate OST teaching methods because certified teachers are more likely to replicate the (often dull) school day experience in OST programs.³³⁷ Adjusting to new teaching methods often takes time, even, and perhaps especially, for certified teachers, and one program reported that they often see their teachers start “loosening up” and becoming more comfortable with the informal learning environment about halfway through the program.³³⁸ To prepare these certified teachers or other providers for the OST environment, leading programs equip their teachers with teaching techniques and training for providing an engaging experience for students. For example, programs may train teachers to lead inquiry-based activities and facilitate student-driven experiments instead of lecturing or using other traditional methods that may cause students to disengage from the learning environment.³³⁹ PD trainers can model appropriate teaching methods so that teachers can experience the correct way to conduct activities with their students.³⁴⁰

Best Practice in Action:

- *Aim High* requires its mathematics teachers to participate in an additional week of professional development beyond the week that is required of all of its program educators to train them in the “Math Navigator” curriculum. Additionally, the program hires dedicated mathematics coaches to support teachers by facilitating department meetings, leading professional development throughout the summer, observing classrooms, providing feedback to teachers, and reviewing lesson plans.^{341,342}
- *BELL* partnered with the C.S. Mott Foundation to develop an online portal filled with professional development opportunities specifically designed to train OST educators. *BELL* even markets this tool for other programs to purchase and use to train their teachers. The online PD portal allows educators to work through self-paced courses on best practices for educators in OST settings. Courses include Mentoring & Student Efficacy, Classroom & Behavior Management, Differentiating Instruction, Youth Development & Learning, Interactive Read Aloud, and Professionalism.^{343, 344}
- *Breakthrough Collaborative* educators meet with a team of teachers in their content areas throughout the summer, and they are coached by a certified teacher in that same content area. The teaching coach provides them with implementation methods and provides feedback on their progress.³⁴⁵
- *21st CCLC* has developed an online portal for teachers to receive training in providing OST programming, and they recently incorporated an entire PD course on delivering STEM content in OST programs.³⁴⁶

³³⁷ Krishnamurthi 2011

³³⁸ Enman 2011

³³⁹ Krishnamurthi 2011

³⁴⁰ Enman 2011

³⁴¹ Capobres 2011

³⁴² Aim High n.d. a

³⁴³ Building Educated Leaders for Life n.d

³⁴⁴ The B.E.L.L. Foundation n.d.

³⁴⁵ Martinez 2011

³⁴⁶ Parker 2011

NASA SoI Excellence in Summer Learning Benchmarking Study

Assessment of Importance to Sol:

This best practice is *highly important* to Sol. Sol content was delivered by educators with a wide range in backgrounds: from college students without any STEM knowledge to experienced certified teachers that specialize in STEM. Many of the participating educators were uncomfortable with STEM before the PD began. Because the PD provided by the Curriculum Development Specialists was tailored to the needs of each Awardee, Sol was able to overcome this challenge, and the PD was considered an overwhelming success by the National Awardees.

- PD is a massive component of the National Award model, with a 40 hour expectation for certified teachers over the course of the year. Unsurprisingly, most National Awards provided a significant amount of PD before the programming began so that educators could leverage what they had learned in the summer. The Curriculum Development Specialists trained many educators that had very little experience in STEM, teaching pedagogy, and/or OST pedagogy, tailoring the PD to address each of these issues. The Curriculum Development Specialists provided PD in several forums. When possible, they delivered PD in-person to create a connection with the educators. They also provided PD over the internet using various web-based technologies, including Skype and NASA's DLN. In addition, Curriculum Development Specialists developed on-demand videos for explaining the use the NASA content that could be accessed by teachers at their convenience.
- The current Sol 2011 PD model is incredibly time and resource intensive, rendering it difficult to scale-up without significant investments

IV.2.4.3 Best Practice: Make Training and PD Highly Accessible to Educators

Best Practice Description:

One way leading OST programs have found to maximize educator participation in, and commitment to, professional development is to make it more accessible to teachers. Programs can increase accessibility by offering PD sessions as online modules or as webinars that educators can access when it best fits their schedule.³⁴⁷ 21st CCLC, for example, has an online professional development website for providers with modules such as "Strategies to Align After-School Programs with State Standards."³⁴⁸ These online training modules can be particularly effective when they provide teachers with videos showing how to implement activities in effective ways.³⁴⁹ When providing in-person PD to educators, programs can maximize accessibility by scheduling the PD at convenient times. For example, programs that hire certified teachers should avoid scheduling PD during regular school days, when certified teachers would need to arrange substitutes, and should avoid major vacation breaks, such as spring break, when teachers will likely already have plans. Similarly, programs that hire college students as educators, interns, or assistants should schedule PD when it will not conflict with students' class schedules, such as at night. They should also avoid scheduling PD during school breaks when these students may be traveling.³⁵⁰ In general, each program will have to tailor their PD offerings and schedules to the particular type of teachers they rely on.

³⁴⁷ Sacco 2011

³⁴⁸ Phalen 2011

³⁴⁹ Sacco 2011

³⁵⁰ Enman 2011

NASA SoI Excellence in Summer Learning Benchmarking Study

Best Practice in Action:

- *Aim High* provides all of their mandatory professional development during the week before the program begins (two weeks for mathematics teachers). Since many of their educators are professional teachers, the timing of *Aim High*'s PD is scheduled so that teachers are already finished with the school year and are available to attend the training. The PD offering is also convenient for the high school and college interns and assistants who have also completed their school years.^{351, 352}
- *BELL*'s online PD program, *BELL Success!*, is a collection of self-paced courses that enable educators to review the training convenient for their schedule. This always-on availability eliminates scheduling conflicts while still providing educators with the PD they need to effectively deliver programming.³⁵³

Assessment of Importance to Sol:

This best practice is *highly important* to Sol. The Curriculum Development Specialists were selected because of their qualifications as master STEM teachers, rather than for their proximity to Awardees. Therefore, many often lived far away from the Awardees they were assigned to assist. Specialists relied on several forms of communications technology to provide educators with the PD they needed.

- Because of the massive geographical reach of Sol, Curriculum Development Specialists leverage technology for training, offering e-training and webinars through Skype and Adobe Connect. Many teachers also signed up for NASA Educator Online Network (NEON) and received PD help through that channel.
- In order to better meet the timing and content needs of the Sol's teachers, some of this training was live while other training was on-demand.

IV.2.4.4 Best Practice: Provide OST Educators with Ongoing Support

Best Practice Description:

In addition to offering training at the beginning of a program, some leading OST STEM programs improve program quality by offering ongoing support to OST educators. Strategies for providing ongoing support include providing webinars, conferences and work groups, facilitating professional learning communities, and hiring certified teachers to serve as instructional coaches. The National Summer Learning Association reports that programs that meet their standards for high quality offer "extensive opportunities for staff development and advancement before, during and after the session."³⁵⁴ These opportunities are important because educators need to feel that they can reach out for help and get answers to their questions at any point during the program, particularly if educators are inexperienced.³⁵⁵ These strategies for providing educators with ongoing support give educators a variety of opportunities to find answers to their questions and to find support in delivering content, planning activities, or managing their classrooms, any and all of which ultimately improves the learning experience for students.

³⁵¹ Capobres 2011

³⁵² Aim High n.d. a

³⁵³ The B.E.L.L. Foundation n.d.

³⁵⁴ National Summer Learning Association 2009

³⁵⁵ Krishnamurthi 2011

NASA SoI Excellence in Summer Learning Benchmarking Study

Best Practice in Action:

- *Breakthrough Collaborative* hires high school and college educators, provides a week-long intensive training at the beginning of the summer. They also hire experienced teachers to coach and provide ongoing one-on-one and group support to the younger educators through the summer of teaching. This enables the educators to reach out for help and to continue to improve their instruction throughout the summer.³⁵⁶
- *Aim High* hires high school and college students as teacher's assistants and interns and they work in a classroom with a certified teacher who leads and supports them throughout the duration of the program. In addition, the program hires experienced certified mathematics teachers as "coaches" to provide ongoing support to all educators in delivering the mathematics curriculum.³⁵⁷

Assessment of Importance to Sol:

This best practice is *highly important* to Sol. Sol must provide National Award teachers with at least 40 hours of PD. For many 2011 Awardees, this PD was designed to take place over a long period of time, making regular, ongoing communication with educators a crucial component of Awardees' success at meeting their requirements.

- Curriculum Development Specialists developed trusting relationships with teachers during the initial, largely face-to-face PD sessions. For ongoing support, Curriculum Development Specialists leveraged technology.
- Sol educators also signed up for NEON, allowing them to communicate with Curriculum Development Specialists and other teachers.

IV.2.5 Best Practices for Supporting Students' Long-Term STEM Outcomes

- ***Help Students Plan for Futures in STEM***
- ***Design Program Duration to Accomplish Predetermined STEM Goals***
- ***Engage Parents to Create a Supportive STEM Culture***
- ***Maximize Student Attendance***

IV.2.5.1 Best Practice: Help Students Plan for Futures in STEM

Best Practice Description:

Research shows that students who are interested in STEM often lack information about the classes to complete and/or the requirements for pursuing future STEM education opportunities and careers, creating a roadblock to further STEM pursuits. A 2007 poll of over 1800 middle school students conducted by the National Association of Secondary School Principals and Phi Delta Kappa International found that 83 percent of students indicated that they know "nothing or very little about the high school courses that are required to graduate," and that 23 percent had "no information about selecting the

³⁵⁶ Martinez 2011

³⁵⁷ Capobres 2011

NASA SoI Excellence in Summer Learning Benchmarking Study

right high school courses at all.”³⁵⁸ To ensure that this information gap does not prevent students from succeeding in STEM, OST STEM programs should prioritize educating students and their families on the prerequisites, experiences, and knowledge required for high school- and college-level STEM courses and future STEM careers.³⁵⁹

In addition, top OST programs help students plan for futures in STEM by ensuring that the students’ excitement about STEM does not fade once programs end. As research shows that OST STEM programs are particularly effective in increasing student interest in STEM, programs can mitigate waning interest by helping students chart a pathway for staying involved in fun STEM activities beyond their own program’s duration.^{360,361}

Best Practice in Action:

- *Breakthrough Collaborative* aims to help students gain acceptance into high-performing college-preparatory schools that will increase their students’ chances of continuing on to college. In 2010, the organization reported that 75 percent of their students were accepted to these high school programs, which is well above the national 28 percent average for students from the same SES background. Also, after students graduate from the *Breakthrough Collaborative* program and enter college-preparatory high schools, the organization continues to support them on their path to college by partnering with local organizations to provide ongoing college preparation and assistance, tutoring, grade monitoring, college test preparation, admissions counseling, campus tours, financial aid workshops, scholarship opportunities, and internship placements.^{362,363}
- *Breakthrough Collaborative* also sets up partnerships with other organizations, such as the Jack Kent Cooke Young Scholars, so that their alumni will continue to have additional academic opportunities to thrive after they graduate from the Breakthrough program.³⁶⁴
- *Aim High* hires experienced certified mathematics teachers to serve as “math coaches” for the program’s mathematics educators throughout the summer. The coaches facilitate professional development opportunities, review lesson plans, mentor teachers, observe teachers, and provide feedback.³⁶⁵

Assessment of Importance to Sol:

This best practice is *moderately important* to Sol. As the project is currently designed, Sol is intended to increase student interest in STEM and teacher comfort with STEM, so programming focuses on providing fun and engaging STEM experiences. The intensive summer STEM programming and extended learning over the school year will ideally spark and sustain excitement that could grow into a lifelong dedication to STEM. There is, however, currently very little focus on providing information on the courses or preparation necessary to pursue STEM.

³⁵⁸ NASSP and PDK 2007

³⁵⁹ Breakthrough Collaborative 2010a

³⁶⁰ McCombs, et al. 2011

³⁶¹ Zastrow 2011

³⁶² Breakthrough Collaborative n.d.

³⁶³ Martinez 2011

³⁶⁴ Breakthrough Collaborative n.d.

³⁶⁵ Aim High n.d. a

NASA SoI Excellence in Summer Learning Benchmarking Study

- Sol content was specifically selected to be exciting in the OST environment. It was designed to align to real life NASA missions, giving students an opportunity to see the exciting ways that STEM is used in the real world. National Award educators are trained during their PD to explain these connections to students, potentially inspiring some students to aspire to these NASA STEM careers.
- National and Center Awardees can arrange access to NASA SMEs and facilities, further demonstrating connections between student and educator STEM content and the real world. Students may find inspiration from understanding these connections and could learn more about the path to STEM careers from NASA STEM professionals.

IV.2.5.2 Best Practice: Design Program Duration to Accomplish Predetermined STEM Goals

Best Practice Description:

Research shows that time spent participating in educational OST STEM programs is correlated to academic gains.³⁶⁶ The number of student engagement hours required for achieving academic gains, however, is not an exact science and may fluctuate based on a number of variables including age, prior exposure, teaching environment, etc.^{367,368} A study by McLaughlin and Pitcock (2009) suggested that OST programs need to engage students for at least 80 hours to show academic gains, while a study by Winship (2005) indicated that programs should offer at least 360 hours of instruction over a course of eight weeks to see gains in academic achievement.³⁶⁹

Dr. Claus van Zastrow, the Chief Operating Officer and Director of Research for Change the Equation and former Executive Director of the Learning First Alliance, believes that while recommendations differ, one conclusion is clear—engaging students in STEM is a “long-term affair.”³⁷⁰ Students who are not engaged in ongoing OST STEM programs may be initially excited by the program, but that excitement can fade out once they no longer have that outlet to pursue their interest.³⁷¹ Matthew Boulay, Interim CEO of the National Summer Learning Association, even recommends that summer programs must engage students in STEM activities for multiple consecutive years to see sustained STEM interest.³⁷²

Best Practice in Action:

- *Aim High* focuses on recruiting students to attend for three to four consecutive years in order to provide them with educational opportunities and support throughout the entirety of their middle school years. Each summer the students attend five weeks of programming for seven hours a day and five days a week, giving them an intensive learning experience to combat the summer slide. In addition, the program follows-up with students throughout the school year with further afterschool and weekend learning opportunities that encourage the students’ continued involvement in the program.^{373,374}

³⁶⁶ Zastrow 2011

³⁶⁷ McCombs, et al. 2011

³⁶⁸ Zastrow 2011

³⁶⁹ McCombs, et al. 2011

³⁷⁰ Zastrow 2011

³⁷¹ Ibid

³⁷² Boulay 2011

³⁷³ Capobres 2011

NASA SoI Excellence in Summer Learning Benchmarking Study

- *Higher Achievement* provides its students with 650 hours of academic enrichment each year for three to four years. Students attend the program for 4.5 hours after school three days each week during the school year and for 40 hours per week for six weeks during the summer. This deep exposure maximizes the students' time in an enriching academic setting and provides them with the intensive support they need to improve their academic performance and gain acceptance into a top college-preparatory high school - the goal of the program. *Higher Achievement's* extensive commitment is evidently working given that the program recently released a \$3 million longitudinal study indicating that participation in their program leads to statistically significant gains in students' standardized test scores.^{375,376}

Assessment of Importance to SoI:

This best practice is *highly important* to SoI. In moving from the 2010 Pilot to the 2011 model, SoI was designed to provide an intensive and extensive experience in STEM that could ultimately support STEM interest, rather than simply provide independent, shorter NASA-related summer activities. The duration of the summer programming, at 40 hours, was designed to provide enough STEM contact to potentially manifest as student academic gains, though academic achievement measures are not an explicit measure of the program's formal evaluation.

- While the 40 hours of STEM content was selected to potentially support academic gains, it is on the low end of estimates for increases in student achievement. In addition, because of the incredible difficulty and expense of obtaining longitudinal academic data for students, academic achievement is not an explicit goal of the project and SoI has not been tracking or measuring data that would measure academic impact.
- The extended learning aspect of the SoI was specifically designed to extend NASA's engagement with students and sustain student interest over the course of the year. Unfortunately, by the end of summer 2011, National and Center Awardees expressed that they were unaware of effective ways for tracking students after the summer programming ended. Without being able to track participants over the school year, SoI will likely be unable to determine whether the same students participated in the program in both summer and during the school year.

IV.2.5.3 Best Practice: Engage Parents to Create a Supportive STEM Culture

Best Practice Description:

Increasing parental involvement in OST STEM programming is considered a best practice for sustaining students' attendance, interest, and participation in educational programming.^{377,378,379} Including parents in programming is powerful in sustaining students' participation and interest in the program and in STEM more broadly because parents are of the most influential figures in the lives of most students regardless of age.^{380,381} Research shows that parental involvement is linked to increased attendance

³⁷⁴ Aim High n.d. a

³⁷⁵ Higher Achievement n.d.

³⁷⁶ Jefferies 2011

³⁷⁷ McCombs, et al. 2011

³⁷⁸ Capobres 2011

³⁷⁹ Jefferies 2011

³⁸⁰ Capobres 2011

³⁸¹ Zastrow 2011

NASA SoI Excellence in Summer Learning Benchmarking Study

rates and more support for learning at home.³⁸² Many leading OST programs recognize the importance of parental involvement and are seeking ways to elevate that involvement in their program. For example, *Aim High*, a well-established OST program in California, recently set a specific goal to increase parental involvement because they believe the parents can be influential in capturing students' attention and keeping them interested in the program. In order to meet this goal, *Aim High* incorporated various opportunities for parents to participate, such as family nights, high school and college application information sessions, and volunteer opportunities for family members.³⁸³

One of the most common ways OST programs involve parents in programming is to invite them to visit the program and observe or participate in a class or activity.³⁸⁴ A big advantage to parents visiting and observing the program is that it helps facilitate conversation in students' homes about what they are learning and also that it immerses parents in the experience and provides them a reference point from which to ask questions about their child's daily experiences. In addition, some OST programs have found that calling parents or visiting their homes to talk about students' progress and experiences helps many parents feel included in the educational experience and involves them in their student's education.³⁸⁵

Best Practice in Action:

- *Girlstart* conducts monthly parent association meetings at the schools where the programs are held and brings in a bilingual meeting facilitator to reach out to parents of Spanish-speaking students. This is particularly important for their program because they serve areas in Texas with large Latino populations.³⁸⁶
- *Higher Achievement* prioritizes parental support before students are even accepted to the program by requiring parents to participate in an admission interview. The interview is not to identify the families' merit to participate in the program, but rather the interviews are to give parents a chance to speak with program staff and express the reasons why the program is important for their child's education. These one-on-one sessions also give *Higher Achievement* the opportunity to reiterate the time and effort demands of the program and to ensure that the parents understand the commitment they are making to the program and to their child's education. This commitment is particularly important to *Higher Achievement* because they have more applicants than space, so they aim to maximize their impact by selecting students who will be present and active participants in the curriculum and who will benefit the most from the program.³⁸⁷
- *TechREACH* considers parental involvement to be a critical element of their program, so they set up parent showcases for students to have the opportunity to share with parents what their children are learning and their accomplishments. *TechREACH* also frequently sends information home to parents to demonstrate the value of the program for their children.³⁸⁸
- *Aim High* incorporates parent participation by holding family orientation nights, back to school nights, a "future night," which educates families about high school and college choices, weekly

³⁸² McCombs, et al. 2011

³⁸³ Capobres 2011

³⁸⁴ McCombs, et al. 2011

³⁸⁵ Ibid

³⁸⁶ Hudgins 2011

³⁸⁷ Jefferies 2011

³⁸⁸ Enman 2011

NASA SoI Excellence in Summer Learning Benchmarking Study

cultural days, and volunteer opportunities for parents. Staff also communicates with parents throughout the course of the program and asks for feedback from parents to better serve their program's students.³⁸⁹

- *Techbridge* supports families in encouraging their girls' interests in STEM. The program produced a family science guide for families in the Bay Area in 2010, which included information on activities parents can do with their children, such as keeping a family science journal of what they learn about science, and lists of local museums and discovery centers to which parents can take their children to fuel their passion for STEM.³⁹⁰

Assessment of Importance to Sol:

This best practice is *moderately important* to Sol. Parent and family participation was not a requirement of Sol in 2011. Many Awardees, however, created opportunities for engaging with parents as a way to help meet local needs. In addition, engaging parents and families can help create a home environment that is supportive of students' STEM pursuits, potentially increasing the likelihood that students continue with the program through the sustained engagement component.

- Several National and Center Awardees provided opportunities for parental engagement, including family science nights and a reception for parents celebrating students' completion of summer programming.
- National Awardees can leverage Curriculum Development Specialists to assist with planning content for family events. As master educators, the Curriculum Development Specialists can ensure that the programming is fun and exciting for learners of all ages.

IV.2.5.4 Best Practice: Maximize Student Attendance

Best Practice Description:

Because students must be present in order to benefit from an OST STEM program, it is critical for organizations to find ways to maximize attendance.³⁹¹ Maximizing attendance is a particularly daunting challenge for programs serving low-performing students because these participants, according to research, have lower attendance rates than their higher performing peers.³⁹² Many programs try to preempt low attendance by instituting a screening process for students. For example, through an interview process, programs can determine that students selected for the program, as well as their parents, are fully invested in their education and understand both the demands of the program and the time commitment required to participate.^{393,394} Regardless of whether interviews are conducted, programs should set clear expectations for student attendance and commitment before students enroll.³⁹⁵

³⁸⁹ Aim High n.d. a

³⁹⁰ Techbridge n.d.

³⁹¹ McCombs, et al. 2011

³⁹² Ibid

³⁹³ Jefferies 2011

³⁹⁴ Martinez 2011

³⁹⁵ Jefferies 2011

NASA SoI Excellence in Summer Learning Benchmarking Study

Some leading OST programs have had success maximizing attendance by creating an incentive program. Possible incentive strategies include providing students who attend with free transportation passes, incorporating more “fun” activities such as sports or kayaking, and providing tangible rewards, such as a free bus pass, food, or Girl Scout badges.³⁹⁶ Many programs have entertained the idea of mandating participation, but this approach has not proven effective because OST programs typically lack effective enforcement mechanisms and are really more interested in sparking a passion for learning.³⁹⁷ Therefore, perhaps the most important strategy for maximizing attendance should be designing and managing a OST STEM program that students actually enjoy attending.³⁹⁸

Best Practice in Action:

- *Higher Achievement* requires both students and parents to participate in an admissions interview to ensure that students are invested in the program and are not being forced into it by parents. These interviews also ensure that the parents understand the demands of the program on the family’s time. *Higher Achievement* typically has more students apply than they have slots for participants, so these interviews are used to screen for students who are fully committed to the program, which also increases the likelihood that they will actively participate and attend.³⁹⁹
- *Breakthrough Collaborative* is another OST program that conducts a rigorous evaluation process for students that includes transcripts, letters of recommendation, and interviews of the student. This program also receives more applicants than they have space to accommodate, so the rigor of the application process weeds out students who are not committed and would not likely attend on a regular basis.⁴⁰⁰
- *Summer Advantage* provides food and transportation for students so that these issues do not serve as barriers for students and do not prevent them from attending.⁴⁰¹

Assessment of Importance to Sol:

This best practice is *highly important* to Sol. National, Center, and Mini-Grant Awardees have defined hour requirements for engaging students in summer and extended learning OST STEM activities. If students do not attend each program for its entirety, the total attendance numbers will be misleading and interest outcomes could be impacted.

- National and Center Awardees did not report problems with student attendance over the course of summer programming, perhaps partially stemming from the fact that students overwhelming enjoyed the fun Sol content.
- Looking toward the school year, many National and Center Awardees are concerned that they will be unable to prove that summer students receive the required amount of follow-on

³⁹⁶ McCombs, et al. 2011

³⁹⁷ Ibid

³⁹⁸ Ibid

³⁹⁹ Jefferies 2011

⁴⁰⁰ Martinez 2011

⁴⁰¹ Phalen 2011

NASA SoI Excellence in Summer Learning Benchmarking Study

learning, suggesting that the project could benefit from implementing an attendance strategy that extends beyond the summer

IV.3 Evaluating Program Impact

Program evaluation reveals whether an OST STEM program is meeting its goals and measures the impact of the program. Program evaluation critical because it provides programs with the information they need to shift course and create strategic improvement plans if they are not prioritizing the right elements or are weak in certain areas. In addition, program evaluation is important because it provides programs with the information that they are required to report to funders, and positive evaluation results reassure funders that their money is being well-spent and is making an impact.⁴⁰²

IV.3.1 Best Practices for Evaluation Strategy

- ***Align Evaluation Design and Communication with Funding and Stakeholder Needs***
- ***Continually Evaluate Progress toward Each Goal and Implement Changes Based on Evaluation Results***
- ***Avoid Allowing Testing and Evaluation to Become the Sole Program Focus***

IV.3.1.1 Best Practice: Align Evaluation Design and Communication with Funding and Stakeholder Needs

Best Practice Description:

Effective organizations find ways to communicate the progress they have made toward their goals to funders. Programs that receive grants are often required to develop an annual report for stakeholders, giving them a chance to highlight their successes and share the impact of their program in a way that reassures stakeholders that their money is being well-spent and making a difference.^{403,404} 21st CCLC, for example, requires all of its grantees to produce annual reports documenting the program's impact and accounting for program expenditures.⁴⁰⁵ An annual report typically describes the program's impact, provides an overview and history of the program and organization, lists principal partners, staff, funders, and volunteers, and provides a financial accounting of the past year of programming. In addition, many OST programs incorporate pictures and stories that lend anecdotal evidence of program impact – allowing their annual report to often also serve as an outreach or marketing tool.^{406, 407, 408} This communication typically increases an organization's chances for receiving continued support and funding.⁴⁰⁹

Funding is almost always dependent on data, so effective OST STEM programs ensure that they measure and report data documenting the program's progress toward meeting its goals. Because of the importance of assessment for receiving funding, programs should prioritize evaluation and data

⁴⁰² Enman 2011

⁴⁰³ Ibid

⁴⁰⁴ Citizen Schools n.d.

⁴⁰⁵ Parker 2011

⁴⁰⁶ Capobres 2011

⁴⁰⁷ Citizen Schools n.d.

⁴⁰⁸ Enman 2011

⁴⁰⁹ National summer Learning Association 2009

NASA SoI Excellence in Summer Learning Benchmarking Study

collection to ensure eligibility and suitability for continued funding.⁴¹⁰ OST programs reported that funders often choose to support programs based on that program's stated goals and its potential to impact students, so it is reasonable for these funders to require data and reports to prove the program is progressing toward these goals. Also, it is reasonable for stakeholders and funders to leverage their support to ensure that OST programs follow through on their commitment to data collection and effective evaluation.^{411,412} Many stakeholders require very specific data to be collected such as attendance rates, number of certified teachers, and a detailed financial statement, so OST programs should plan ahead and make efforts to align their evaluation design and data collection to meet their stakeholders' needs.^{413,414}

Best Practice in Action:

- *Girls Scouts* generates an extensive annual report each year that includes pictures and stories along with the data and financial summaries that are typically expected in an annual report. In 2010 they produced a 44-page annual report that included a message from the founder and CEO, evaluation outcomes, membership records, extensive financial records, and personal anecdotes from current *Girl Scouts* sharing their experiences with the program.⁴¹⁵
- *TechREACH* incorporates pictures and stories in their annual report to provide a glimpse into the successes of the program that numbers often do not fully explain, reassuring funders and stakeholders that their money is being well-spent and that the project is producing a positive impact.⁴¹⁶
- *Project Exploration* displays an extensive annual report on their website, filled with pictures and stories, a letter from the co-founders, program highlights, lists of program donors grouped according to how much they donated, lists of partner organizations, and a detailed budget from the fiscal year.⁴¹⁷
- *Citizen Schools* has established specific metrics that align with funders' requirements and continuously monitors those metrics to make sure their program is on track to succeed in meeting those requirements. They then make sure to include the progress on these metrics for funders in annual reports. For example, one of *Citizen School's* primary funders, the National Science Foundation (NSF), requires them to produce a very specific progress report, and *Citizen Schools* takes great care to do so. Some of the requirements of the NSF grant include that at least 50% of students taking computing internships will report aspirations for a STEM career and 85% of volunteer mentors will report being satisfied or highly satisfied with the apprenticeship program.⁴¹⁸ *Citizen Schools* prioritizes these goals and is very diligent in collecting data to measure their progress so that they will be able to receive continuous funding from NSF in future years.⁴¹⁹

⁴¹⁰ Krishnamurthi 2011

⁴¹¹ Phalen 2011

⁴¹² Krishnamurthi 2011

⁴¹³ Boulay 2011

⁴¹⁴ Phalen 2011

⁴¹⁵ Girl Scouts of the USA 2010

⁴¹⁶ Enman 2011

⁴¹⁷ Capobres 2011

⁴¹⁸ Cohen and Alfaro 2011

⁴¹⁹ Ibid

NASA SoI Excellence in Summer Learning Benchmarking Study

Assessment of Importance to Sol:

This best practice is *highly important* to Sol. The Sol project team worked with OMB and leadership at NASA to determine a set of outcomes for Sol in 2011, and then designed its evaluation to demonstrate Sol's progress toward these outcomes.

- The project team communicates with OMB, NASA's Office of Education, and NASA's Education Coordinating Committee (ECC) through reports and presentations throughout the year.
- Sol requires National Awardees to present annual reports and continuous improvement plans. National Awardees have opportunities to formally present their plans, results, and lessons learned at kickoff and project review meetings. Aside from these presentations, NASA project leadership has little insight into many of the National Awardees' activities, limiting the project team's ability to proactively assist Awardees in responding to implementation issues. This lack of visibility may negatively impact Awardee ability to meet requirements and thus puts Awardees at risk for losing funding the following year.
- Sol can leverage the Awardee Technical Representative team to support Awardees through the annual report process and to remind Awardees of the related deadlines and requirements. In addition, Technical Representatives will begin holding two monthly, required group calls with four Awardees each to improve communication and give Awardees an opportunity to learn from each other.

IV.3.1.2 Best Practice: Continually Evaluate Progress toward Each Goal and Implement Changes Based on Evaluation Results

Best Practice Description:

Continuous program evaluation alerts leaders to weaknesses and problems as they arise, giving program staff the information they need to immediately revise efforts as necessary to meet program goals.⁴²⁰ Successful programs should establish performance metrics that enable them to measure their progress toward each individual program goal to both highlight particular areas of success and pinpoint areas of risk.⁴²¹

In addition to ensuring program quality, ongoing assessment is also critical to programs' relationships with funders and stakeholders. Lynsey Jeffries, the Executive Director of the Washington, D.C. branch of *Higher Achievement*, emphasizes the importance of prioritizing continuous assessment because it shows funders that the program is committed to program quality. Data from continuous evaluation can also reassure funders that their investment is impactful and well-spent, and sharing continuous improvement data with funders typically induces funders to be more likely to continue supporting the program in subsequent years.^{422, 423, 424}

Leading OST programs engage in a continuous cycle of program improvement in order to ensure they are delivering the highest quality program possible.^{425, 426} This continuous process of improvement

⁴²⁰ McCombs, et al. 2011

⁴²¹ Jefferies 2011

⁴²² Enman 2011

⁴²³ Jefferies 2011

⁴²⁴ Cohen and Alfaro 2011

⁴²⁵ McCombs, et al. 2011

NASA SoI Excellence in Summer Learning Benchmarking Study

should be guided by the findings of ongoing data collection, performance monitoring, and program evaluation.⁴²⁷ Programs should use information to make data-driven decisions and to pinpoint areas of concern, then develop improvement strategies.⁴²⁸ Engaging in this ongoing improvement cycle not only improves program quality, but it also keeps the staff focused on the goals of the program.⁴²⁹

Best Practice in Action:

- *Higher Achievement* developed a dashboard of metrics that allows for monitoring of the program on a national level. The dashboard measures everything from attendance and student grades to mentor feedback and survey completion. This tool serves as an indicator of program quality and affords insight into whether or not the program is making progress and reaching its goals. *Higher Achievement* uses its performance dashboard to identify and diagnose challenges and to revise programming to address those specific weaknesses.⁴³⁰
- *Citizen Schools* uses an internal program scorecard that defines key outcomes and indicators. This online tool is used to track outcomes, which allows the organization to monitor program progress in real time and adjust programming when the program falls short of its goals.⁴³¹
- *Project Exploration* established a system of metrics and a scorecard to measure its progress toward goals, allowing the project to continuously improve programming. The scorecard and metrics system highlight areas that need improvement and provide *Project Exploration* leadership and staff with the data they need to make mid-course corrections, as needed. One program improvement *Project Exploration* has made based on this data was to reduce administrative staff and disburse administrative duties amongst other staff members in order to save money to expand the number of students it served. This shift in administrative structure is an example of how OST STEM programs can improve and advance their impact through constantly evaluating their needs, challenges, and weaknesses and regularly strategizing to overcome these weak areas.⁴³²

Assessment of Importance to Sol:

This best practice is *highly important* to Sol. Sol must work with Office of Management and Budget (OMB) to show its importance to national interest while also meeting NASA needs. As a federal project, Sol needs to be able to prove that it can meet its goals and thereby justify its use of taxpayer funding. By continually monitoring its progress toward goals, the project can gauge its strengths and weaknesses in real time and make mid-course improvements, as necessary.

- While many non-federal programs may be able to maintain a donation base without a rigorous evaluation, Sol must collect evaluation data from Awardees, implementers, students, and educators to show its progress toward its goals and justify support from NASA and the American taxpayer. The necessity of intensive evaluation as a federal program should be thoroughly and

⁴²⁶ Improving Programs, James Irvine

⁴²⁷ Sheldon 2008

⁴²⁸ Ibid

⁴²⁹ Ibid

⁴³⁰ Jefferies 2011

⁴³¹ Citizen Schools n.d.

⁴³² St. Louis 2011

NASA SoI Excellence in Summer Learning Benchmarking Study

effectively communicated to Awardees, as the evaluation criteria of federal programs is significantly more stringent than most requirements in the nonprofit community.

- Federal programs also have a duty to effectively evaluate programming so that it can contribute to the public good by adding to the overall knowledge of effective OST programming. Therefore, a successful and rigorous evaluation can serve as a future resource for other education programs.
- SoI measures its progress toward its goals in a number of ways. The external evaluator officially evaluates the effectiveness of the project after the completion of the summer and extended learning program phases. Based on the findings of the evaluation report, the SoI project team can make informed changes to the model for the subsequent year. SoI can also leverage its set of key performance indicators as a monthly pulse check to assess how well SoI is performing compared to its short term targets. If SoI is missing its targets, the project team can investigate root cause of the underperformance and address any issues.
- The SoI project team works to continuously improve evaluation effectiveness. Thanks to input from National and Center Awardees, internal SoI personnel, NASA leadership, the OMB, and a panel of evaluation experts, SoI can make crucial changes to its data collection and evaluation so that it can prove its effectiveness toward its goals.

IV.3.1.3 Best Practice: Avoid Allowing Testing and Evaluation to Become the Sole Program Focus

Best Practice Description:

While leading OST STEM programs ensure that students are learning and growing from their programs, they also strive to avoid allowing testing and the achievement culture that often dominates the traditional school day to become the sole focus of their program. Testing culture often deflates academically weaker students' self-esteem in science and because testing typically evaluates memorization of facts and the ability to recall scientific processes rather than deeper intellectual understandings and scientific aptitudes.^{433,434} Instead of focusing on testing, these OST STEM programs should provide a time for students to have new and exciting experiences that bring the scientific process to life and make students feel comfortable enough to fail because the trial-and-error process is central to STEM.^{435,436} Dr. Anita Krishnamurthi, the Director of STEM Policy for the Afterschool Alliance and the former Education and Public Outreach Program Planning Specialist at NASA-HQ, emphasized the importance of creating a friendly and low-pressure environment where students can take risks without feeling deflated by failure.⁴³⁷ In addition, focusing on more holistic, project-based evaluation may provide a more comprehensive analysis of student gains than does the usual high-pressure standardized testing.⁴³⁸ Dr. Kevin J. Crowley, Director of the University of Pittsburgh's Center for Learning in Out-of-School Environments and Associate Professor of Education and Psychology, stated: "If we allow the things that are easy to measure in school districts as the only definitions of learning we're going to consider, we are leaving off the table an awful lot of things."⁴³⁹

⁴³³ Robelen n.d.

⁴³⁴ Krishnamurthi 2011

⁴³⁵ Ibid

⁴³⁶ Sacco 2011

⁴³⁷ Krishnamurthi 2011

⁴³⁸ Ibid

⁴³⁹ Robelen n.d.

NASA SoI Excellence in Summer Learning Benchmarking Study

Best Practice in Action:

- *TechREACH* has created an environment that measures student learning and experimentation outcomes instead of standardized test scores. *TechREACH* focuses on project-based learning rather than testing and requires students to turn their learning into a final product, such as a coded computer game, a robot, a 3D design, a podcast, or an arcade game.^{440,441} The learning is evident in these final products because students need to take the knowledge they have acquired during the program and apply it towards the development of a functional product. For example, it is clear that a student who knew nothing about computer coding at the beginning of their *TechREACH* experience has learned and acquired new skills if they are able to produce a coded functional robot by the end of the program.⁴⁴²
- *Operation Smart (Girls Incorporated)* engages girls in STEM through hands-on activities and problem solving rather than through memorization and testing. Students are linked to professional women in STEM careers, also known as “SMART Partners,” who help to facilitate the program and guide students in learning how to problem solve in science. Students can also get involved in the “Girls Dig It” program, where they work with archeologists to uncover historical artifacts. Ultimately, *Operation Smart* focuses on encouraging students to experiment, make mistakes, and investigate what they are curious about without always worrying about getting the right answer.⁴⁴³

Assessment of Importance to Sol:

This best practice is *highly important* to Sol. Sol is designed to be a fun program that increases student interest in STEM and teacher comfort with STEM through the unique structure of OST programming. If the evaluation requirements become too burdensome or testing begins to feel too much like the regular school day, the evaluation runs the risk of negatively impacting program effectiveness.

- Sol’s 2011 National and Center Awardees reported that students, educators, and implementers were overburdened by the current evaluation requirements.
- Sol is working toward a simpler, more feasible, and more cohesive data collection strategy that balances the data needs of all stakeholders.

IV.3.2 Best Practices for Evaluation Execution

- ***Contract with an External Evaluator***
- ***Evaluate Pre- and Post-Programming Data***
- ***Measure Interest, Attitude, and Skill***
- ***Conduct Longitudinal Studies***
- ***Collaborate with School Districts to Access Year-Round Academic Data***

⁴⁴⁰ Afterschool Alliance 2011b

⁴⁴¹ Enman 2011

⁴⁴² Ibid

⁴⁴³ Operation SMART n.d.

NASA SoI Excellence in Summer Learning Benchmarking Study

IV.3.2.1 Best Practice: Contract with an External Evaluator

Best Practice Description:

Programs interviewed for this study expressed that contracting with an external evaluator is essential in determining the effectiveness of an OST STEM program, its impact on student interest and achievement, and its progress towards accomplishing programmatic goals.^{444, 445, 446, 447} Interviewees noted that external evaluation is important because allows programs to bring in an expert to lead evaluation.^{448, 449, 450} A respected external evaluator can add value to a program because the analyses is often deemed to be expert, impartial, and objective - likely increasing the credibility of results and enabling an organization to answer skeptical stakeholders questioning the program's claimed impact.⁴⁵¹ Interviewed programs noted that external evaluators can also add value to OST STEM programs if they know the landscape of the OST field and know how to execute a successful OST evaluation based on their familiarity with other programs.⁴⁵²

Best Practice in Action:

- *Project Exploration* leveraged from the Center for Research, Evaluation, and Assessment (REA) (at the Lawrence Hall of Science, University of California, Berkeley to conduct a 10-year retrospective study of the program. The study revealed that students who participate in their program are more likely to graduate from high school, go to college, and major in science than their peers who do not participate. In addition, students surveyed attributed their further science pursuits and decision to attend college to their experiences with *Project Exploration*. Results from the study showed that 95 percent of *Project Exploration* alumni graduated or were on track to graduate, 50 percent of these alumni were enrolled or had already graduated from a four-year institution, 60 percent were pursuing or had received a STEM degree, and 32 percent were employed in a career related to science.⁴⁵³
- *Girlstart* director Tamara Hudgins expressed that external evaluation has been invaluable to her program because it has given them credibility and enabled them to prove to investors that they are worth funding.⁴⁵⁴
- *Higher Achievement* contracted with Public/Private Ventures (P/PV) to conduct one of the first program evaluations that investigated if their program has had an impact on their students' standardized test score.⁴⁵⁵
- *Citizen Schools* recently contracted with Abt Associates to investigate the impact the program has had on students' academic performance, behavior, and future aspirations. The evaluation compares one school that is a *Citizen Schools* site to four carefully selected peer comparison

⁴⁴⁴ Sacco 2011

⁴⁴⁵ Enman 2011

⁴⁴⁶ Hudgins 2011

⁴⁴⁷ Jefferies 2011

⁴⁴⁸ Enman 2011

⁴⁴⁹ Hudgins 2011

⁴⁵⁰ Citizen Schools n.d.

⁴⁵¹ Jefferies 2011

⁴⁵² Ibid

⁴⁵³ Project Exploration 2010

⁴⁵⁴ Hudgins 2011

⁴⁵⁵ Jefferies 2011

NASA SoI Excellence in Summer Learning Benchmarking Study

schools and synthesizes data from pre- and post-program student performance, student and teacher surveys, and interviews with key informants at both the *Citizen Schools* site and at the four peer schools.⁴⁵⁶

Assessment of Importance to Sol:

This best practice is *highly important* to Sol. To show its value to OMB and to NASA leadership, Sol must credibly demonstrate the project can achieve its goals. The external evaluator is responsible for showing the project's progress toward objectives in a statistically sound, reliable, and feasible manner.

- Sol leverages an external evaluator to measure the effectiveness of programming.
- The external evaluator is bringing together a panel of OST education evaluation experts to help improve the design and effectiveness of the Sol evaluation.

IV.3.2.2 Best Practice: Evaluate Pre- and Post-Programming Data

Best Practice Description:

Conducting pre- and post-surveys to gather program feedback from students, staff, and parents is a strong launching point for program evaluation because these surveys enable programs to assess factors of program success, such as students' level of interest in STEM, students' future career aspirations, educators' instructional needs, and parental satisfaction.⁴⁵⁷ These findings can be used to identify weak areas and to inform the creation of strategic improvement plans.^{458,459} Many leading programs also incorporate more regular evaluation or assessment tools to measure the program's progress, alerting program directors if they need to revise programming and institute reforms in the middle of a session.^{460,461}

Ensuring a high survey response rate improves the validity of its findings by increasing the final sample size. Programs can mandate survey participation for students, educators, and administrative staff by incorporating time into the program for survey completion rather than relying on participants to complete surveys at home and then return them. Earl Phalen, founder of both *Building Educated Leaders for Life (BELL)* and *Summer Advantage*, stated that there is absolutely no reason not to receive at least 90% of surveys back if a program implements the survey within the hours of the program.⁴⁶² This practice ensures that the primary challenge in the response rate is attendance, and identifying absent participants on survey days gives programs opportunity to collect survey responses from these students upon their return.⁴⁶³

Some leading programs make surveys more accessible to educators, administrators, and parents by utilizing technology. Collecting surveys online not only makes them more convenient for those being surveyed, but it also organizes and simplifies the findings for evaluators. Organizing, tracking, and

⁴⁵⁶ Abt Associates 2011

⁴⁵⁷ Capobres 2011

⁴⁵⁸ Ibid

⁴⁵⁹ Phalen 2011

⁴⁶⁰ Capobres 2011

⁴⁶¹ Enman 2011

⁴⁶² Phalen 2011

⁴⁶³ Ibid

NASA SoI Excellence in Summer Learning Benchmarking Study

reading through hundreds or thousands of paper-based surveys is tedious and inefficient (and raises the cost of survey administration), so programs with even limited computer access may wish to investigate the potential of utilizing computer-based surveys to simplify the evaluation process.⁴⁶⁴ Programs can also use computer-based survey tools to target different surveys for each type of participant—students, educators, administrators, and parents. For example, Survey Monkey, a popular and free online survey tool, compiles all responses into an accessible format so that evaluators are able to easily retrieve needed information without sifting through hundreds of papers. Creating accessible and easily administered surveys makes participation requirements simpler and may ultimately increase survey participation rates, producing more credible survey results.⁴⁶⁵

In addition to pre- and post-tests, OST STEM programs can use other means to quantify the programs' impact on student learning and growth.^{466, 467, 468, 469} According to interviewed programs, some STEM programs may be better evaluated using more qualitative data collection methods, such as having students' give presentations on a product they have developed during the course of the program and requiring them to explain to their audience the scientific background of that project. It is important for programs to align data requirements to specific competencies in order to effectively measure the knowledge they have gained.⁴⁷⁰

Best Practice in Action:

- Every organization interviewed spoke to the importance of conducting pre- and post-program surveys and included them as part of their program evaluation.
- *Aim High*, an OST program in California, puts a particular emphasis on the importance of surveys in their program evaluation and requires students, teachers, parents, and site directors to all complete a survey about their experience at the beginning, middle, and end of the program. In addition, they require site directors to complete a reflective evaluation of their site at the end of the program. They also go beyond the time constraints of the program and strive to survey alumni four years after they graduate from *Aim High*. In those surveys, *Aim High* asks questions about whether or not students have graduated high school, if they are pursuing higher education, and how their career plans have developed. The program uses these results to evaluate the program's impact on students' academic paths.⁴⁷¹ They also implement a pre- and post-assessment for mathematics. According to Michelle Capobres, the Director of Program Evaluation, *Aim High's* pre- and post-tests align with the program's goals and strive for a 15% improvement in mathematical competency.
- *Summer Advantage* utilizes the online tool "Survey Monkey" to survey staff members.⁴⁷² This tool enables *Summer Advantage* to set up a series of questions with answer choices, true/false questions, ratings, and open-ended responses, so that the organization can customize questions to meet discrete program needs.⁴⁷³

⁴⁶⁴ Phalen 2011

⁴⁶⁵ Ibid

⁴⁶⁶ Boulay 2011

⁴⁶⁷ Phalen 2011

⁴⁶⁸ Martinez 2011

⁴⁶⁹ Krishnamurthi 2011

⁴⁷⁰ Ibid

⁴⁷¹ Capobres 2011

⁴⁷² Phalen 2011

⁴⁷³ Ibid

NASA SoI Excellence in Summer Learning Benchmarking Study

- *Citizen Schools* has prioritized measuring student learning by evaluating the scientific projects that students develop during their apprenticeships. Students participate in apprenticeships for 11 weeks and are expected to produce a culminating “WOW! Project” that demonstrates what they have learned during the program. For example, during an engineering design apprenticeship in 2010, students competed to produce the most functional and fastest solar car. After the students completed their cars, *Citizen Schools’* program evaluators assessed student knowledge gains based on students’ ability to explain the science behind their solar car designs. In other words, the evaluators judged the students’ ability to apply what they learned rather than students’ test scores.^{474, 475}
- *BELL* and *Summer Advantage* administer pre- and post-tests to measure student knowledge gains. When interviewed, founder Earl Phalen emphasized this method of assessment as a critical component of program evaluation because he felt it was the only way to feasibly gauge student achievement gains.⁴⁷⁶

Assessment of Importance to Sol:

This best practice is *highly important* to Sol. Sol implements pre- and post- programming surveys for student and certified teacher participants to test the impact of the program on student interest in STEM and teacher comfort with STEM. The effectiveness of these surveys at evaluating impacts is crucial for measuring the success of the program at meeting its goals. To help understand the impact of Sol, OMB is expecting student and teacher survey response rates of at least 80%. Unfortunately, the response rates for Sol in summer 2011 fell significantly short of this goal. If Sol can improve its survey response rates and show increases in student interest in STEM and teacher comfort with STEM, Sol would be able to show whether the project meets some of its most important and challenging objectives.

- Sol is working to improve its evaluation processes, including its survey instruments, based on feedback from OMB, a panel of evaluation experts, and feedback from the National and Center Awardees. With clearer and shorter data collection tools and requirements, response rates would likely improve.
- Awardees have noted that Sol would benefit from providing survey materials in multiple ways. With online materials, the Awardees, implementers, or participants could access survey materials at any time without needing to coordinate with the evaluator. In addition, the evaluator could include survey and data collection instructions on the website, allowing users to clarify the process as needed on their own time. As long as survey takers have access to a computer that connects to the internet, the simplicity of receiving, taking, and sending an online survey could help increase response rates. While online forms would be a useful addition to the evaluation protocol and could potentially help increase response rates, students from Sol’s targeted population may not have access to computers during Sol programming or at home.

⁴⁷⁴ Citizen Schools n.d.

⁴⁷⁵ Cohen and Alfaro 2011

⁴⁷⁶ Phalen 2011

NASA SoI Excellence in Summer Learning Benchmarking Study

IV.3.2.3 Best Practice: Measure Interest, Attitude, and Skill

Best Practice Description:

OST STEM programs should conduct a comprehensive evaluation of students' interest in, attitude toward, and learning in STEM in order to get the fullest picture of the program's impact on participants.^{477,478,479} Most of the interviewed OST programs have interest, attitude, and learning goals in addition to or in place of goals to increase school year academic achievement, so they need to measure these outcomes in order to determine program success.

Best Practice in Action:

- *Aim High* conducts a pre- and post-assessment in the mathematics component of their program and targets at least a 15% increase in scores to determine whether students have developed a better understanding of the curriculum over the summer.⁴⁸⁰
- *Breakthrough Collaborative* administered the Mathematics Diagnostic Testing Project (MDTP) at various pilot sites in 2010. The MDTP is a set of pre- and post-assessments to measure students' growth in mathematics and their progress toward being ready for Pre-Algebra, Algebra, and Geometry, and the test has been used for more than 20 years to determine whether or not students are ready for advanced-level mathematics. These tests enabled *Breakthrough Collaborative* to measure the academic impact of their program, and the tests results indicated that every site achieved academic growth in mathematics.⁴⁸¹
- *Higher Achievement* conducts what they call a "360 analysis of scholars," which entails measuring students' confidence, skills, attitudes, and behaviors in addition to their grades, attendance, and test scores. This enables *Higher Achievement* to have a more comprehensive picture of how their program impacts their students' academic interests and achievement.⁴⁸²

Assessment of Importance to Sol:

This best practice is *highly important* to Sol. After the Pilot in 2010, Sol shifted away from attempting to measure academic outcomes and instead began measuring attitudinal impacts that are also more realistic outcomes given the intensity and duration of Sol. Because Sol's goals include increasing student interest in STEM and teacher comfort with STEM, it is crucial that Sol can effectively measure these non-academic outcomes. Sol is not currently designed to measure impacts on specific STEM skills.

- Sol is taking steps to improve its evaluation processes, including organizing a panel of experts to provide recommendations. Sol can also leverage other organizations' expertise in testing student STEM knowledge and skills as they develop feasible and appropriate outcome measures.
- If the Sol project team decides that Sol should also create a measurable impact on student or teacher skills, the project team would need to change some of the existing program model. For

⁴⁷⁷ Sacco 2011

⁴⁷⁸ Jefferies 2011

⁴⁷⁹ Krishnamurthi 2011

⁴⁸⁰ Capobres 2011

⁴⁸¹ Breakthrough Collaborative 2010a

⁴⁸² Jefferies 2011

NASA SoI Excellence in Summer Learning Benchmarking Study

example, instead of selecting content based on its appropriateness for the OST environment, the content team may instead need to identify content that is best designed to produce increased knowledge of desired topics. This content might not be as fun as the current SoI content, which has been hailed by Awardees because students find it so enjoyable.

IV.3.2.4 *Best Practice: Conduct Longitudinal Studies*

Best Practice Description:

Longitudinal studies afford a more comprehensive and detailed analysis of the impact of OST STEM programs because they collect data over a number of years and explore the long-term impact of a program. These studies can investigate long-term program outcomes such as students' academic success, graduation rates, postsecondary enrollment rates, and decisions to pursue postsecondary STEM degrees.^{483, 484, 485}

So far, few OST STEM programs have been able to conduct longitudinal studies because they are often too expensive for OST programs to justify and because it is difficult to collect enough information on a sufficient number of students over a long enough time to perform an effective longitudinal analysis. In the years following an OST experience, students' contact information can change, some contacts are lost, or programs are not able to collect the necessary test score and grade information on students because of privacy concerns, making it difficult to track students for reliable longitudinal studies. Collecting student data and information is particularly difficult in underserved and underrepresented populations because parents are not always available to return extra evaluation paperwork due to work schedules.^{486, 487} Further complicating the reliability of longitudinal studies are the myriad of potential factors that may impact student academic performance over an extended period of time. Isolating an individual OST program as the primary variable that caused an increase in student achievement can be a dubious, at best, reading of causation versus correlation.⁴⁸⁸

Best Practice in Action:

- *Higher Achievement* released one of the most extensive longitudinal OST evaluations ever conducted in October 2011. The study was a \$3 million undertaking over the course of two years that found that the program significantly increased participants' standardized test scores in reading and mathematics, and also increased student interest in attending more academically rigorous high schools.⁴⁸⁹
- *Project Exploration* conducted a 10-year longitudinal study that suggested that the program increases students' science capacity and interest in future STEM careers. The study also revealed that participation in the program results in positive youth development, meaning students actively engage in a community of relationships with students from whom they learn.⁴⁹⁰

⁴⁸³ Jefferies 2011

⁴⁸⁴ St. Louis 2011

⁴⁸⁵ Capobres 2011

⁴⁸⁶ Enman 2011

⁴⁸⁷ Jefferies 2011

⁴⁸⁸ Sparks n.d.

⁴⁸⁹ Herrera, et al. 2011

⁴⁹⁰ Project Exploration 2010

NASA SoI Excellence in Summer Learning Benchmarking Study

- *Breakthrough Collaborative* partnered with Stanford University and the American Institutes for Research in 1999 to conduct a longitudinal study of the impact the program had on students. They collected data on students for 10 years and found that 92% of Breakthrough students went to college, 57 percent of Breakthrough students took algebra or geometry in the 8th grade (twice the 25 percent national average), and 74 percent of the 9th grade students and 92 percent of the 10th grade students were enrolled in biology or an advanced science course.⁴⁹¹

Assessment of Importance to Sol:

This best practice is *moderately important* to Sol. Longitudinal studies are the gold standard for demonstrating the lasting impact of a project. If the goals of a program include long-term impacts on participant outcomes, longitudinal tracking of students is the best way to measure success. Unfortunately, tracking students over long periods of time is very expensive and resource intensive. Because Sol is not currently designed to measure students' long-term outcomes, longitudinal tracking is not necessary for measuring project success at this time.

- The current model of Sol does not require longitudinal tracking because none of the project outcomes extend past students' participation in the program. In addition, if the Sol outcomes changed to include long-term impacts, Sol would likely need to make significant changes to the project model and its evaluation design.
- Based on the traditional expense of conducting a longitudinal study, longitudinal tracking may be too expensive and resource intensive for Sol's partners without a significant financial investment from Sol or another partner. The benefits of tracking students and teachers longitudinally would need to be balanced with the drawbacks of using so many financial resources to execute the study.

IV.3.2.5 Best Practice: Collaborate with School Districts to Access Year-Round Academic Data

Best Practice Description:

A program should collaborate with a school district to access year-round student grades and standardized test scores if it is attempting to prove that the program correlates with, or effects increases in, academic achievement.^{492,493,494} Accessing this data is typically a substantial barrier to overcome in program evaluation for multiple reasons. OST programs typically work with students from multiple schools and schools districts and to get comprehensive performance data. Programs would need to build strong relationships with not just one school but with multiples schools – all while addressing privacy concerns, incompatible data systems, and other logistical issues. These schools also do not always have the data readily accessible from programs to retrieve.⁴⁹⁵ In addition, sharing student data often raises privacy concerns and may require release forms from parents, which can be problematic because parents do not always return these forms.⁴⁹⁶ For many programs, the inability to collect this type of student performance data prevents them from conducting reliable studies investigating academic gains.

⁴⁹¹ Breakthrough Collaborative 2008

⁴⁹² Capobres 2011

⁴⁹³ Jefferies 2011

⁴⁹⁴ Krishnamurthi 2011

⁴⁹⁵ Jefferies 2011

⁴⁹⁶ Krishnamurthi 2011

NASA SoI Excellence in Summer Learning Benchmarking Study

Best Practice in Action:

- *Higher Achievement* has been successful in collecting student data, though they still expressed that they have not perfected the process. Lynsey Jeffries, the executive director of the D.C. branch of *Higher Achievement*, expressed that data collection hinges upon developing strong relationships with both schools and students' parents in order to get authorization from all necessary authorities. Once access of the data has been authorized, successful data collection then depends on schools being sufficiently organized to have the data readily accessible to pass on to the program, which Jeffries expressed has still been a significant challenge.⁴⁹⁷
- *Girlstart* recently began leveraging their partnerships with schools to collect standardized test score data on the 20 to 30 girls at each school who participate in the afterschool program. They are working on a 5-year basis with these schools to show that participating in the program boosts students' scores, and Tamara Hudgins, Executive Director, indicated that *Girlstart* has been successful at collecting data to date because they prioritize selecting schools to partner with that are open to this collaboration. *Girlstart* also invests time in stewarding relationships with these partner schools to ensure they are willing to assist in data collection.⁴⁹⁸

Assessment of Importance to Sol:

This best practice is *not important* to Sol. Sol does not attempt to show increases in students' STEM academic achievement and therefore does not need to leverage relationships with school districts to collect academic data.

- Sol requires National Awardees to partner with school districts, potentially giving Sol easier access to students' school district data. Unfortunately, it may be very difficult to gain access to the data across the whole project, as different schools and school districts have varied policies on data.
- It may also be difficult compare results across or even within Awardee programs, as school districts do not all collect the same data in the same way. Some Awardees may partner with several school districts that each have different data policies and incompatible data sets. The time and expense required to gain access to all Awardee school data and to effectively compare different data sets may outweigh the potential evaluation benefits.

IV.4 Sustainability and Scalability

A strong financial foundation and support network are critical components of developing an OST STEM program that is sustainable and will impact students for years to come. In addition, effective programs that are financially sound will ideally take their programs to scale in order to impact a greater number of students at multiple sites for a lower cost per student. The following best practices position an organization to be both sustainable and scalable.

⁴⁹⁷ Jefferies 2011

⁴⁹⁸ Hudgins 2011

NASA SoI Excellence in Summer Learning Benchmarking Study

IV.4.1 Best Practices for Sustaining an OST STEM Program

- ***Pursue Sustainability through Diverse Partnerships***
- ***Seek In-Kind Donations***
- ***Cultivate Strong Stakeholder Dialogues***
- ***Secure Funding Early in the Year***
- ***Find Creative Ways to Save Money on Staff and Materials***

IV.4.1.1 Best Practice: Pursue Sustainability through Diverse Partnerships

Best Practice Description:

Funding is typically a primary concern of most OST STEM programs, as it is critical to the development of a program and yet often difficult to secure.^{499, 500} OST STEM programs are often costly, and research by the Rand Corporation estimates that an effective five-week summer program may spend over \$2,800 per student to provide programming. This means that programs that want to offer free programming for students – generally a hallmark of programs targeting underserved and underrepresented, have to spend a great deal of time and effort fundraising to cover this expense.⁵⁰¹ Funding is of particular importance during difficult economic times like the present. Even a well-regarded OST provider like *Aim High* was forced to unexpectedly close two of its sites, but through a renewed focus on fundraising efforts and by pursuing new sources of funding, the organization was able to reopen those sites the next year and will continue to expand.⁵⁰² Given the criticality of funding, OST STEM organizations need to prioritize fundraising from the very inception of their program and maintain that level of focus through their operating periods.

One of the most important funding strategies for OST STEM programs is to cast a wide fundraising net because relying too heavily on one or a few sources of funding puts the program at risk of collapsing if those sources experience a financial crisis or decide not to continue funding the program.^{503,504} Pooling together financial resources from a variety of sources increases the chances that a program will be able to sustain if one of their funders is no longer able to contribute financially.⁵⁰⁵ Diversifying funding is particularly important during tumultuous economic times like the present.⁵⁰⁶

Diversifying funding sources is particularly difficult for newer organizations that have yet to find a variety of supporters or are unable to point to a long track record of performance. These organizations should cast a wide net and explore several avenues of funding starting at the very beginning of program planning in order to increase their chances of success. Over time, as these programs generate a positive track record and can prove through evaluation that they are a worthy of investment, these programs will increasingly be able to leverage their reputation to expand their fundraising.⁵⁰⁷

⁴⁹⁹ McCombs, et al. 2011

⁵⁰⁰ Capobres 2011

⁵⁰¹ McCombs, et al. 2011

⁵⁰² Capobres 2011

⁵⁰³ Afterschool Alliance n.d. a

⁵⁰⁴ Jefferies 2011

⁵⁰⁵ Afterschool Alliance n.d. a

⁵⁰⁶ Jefferies 2011

⁵⁰⁷ Ibid

NASA SoI Excellence in Summer Learning Benchmarking Study

In order to maximize funding and other, OST STEM programs should reach out to potential donors from a variety of arenas, such as the federal, state, and local governments, corporate sponsors, school districts, independent schools, other nonprofit organizations, individual donors, universities, museums, fellow OST enrichment organizations, and foundations. Each of these sources has the potential to donate money, services, materials or advertising that can greatly contribute to the success of an OST STEM program. For example, universities, museums, nonprofit organizations, STEM companies, and schools can often offer deep STEM content knowledge to improve the delivery of the curriculum. Foundations, federal, state, and local governments, individual donors, and corporate sponsors, on the other hand, often have the financial resources to support the development and sustainment of OST STEM programs. Local CBOs, such as the Boys & Girls Club, can often offer access to facilities, program staff, advertising, additional enrichment opportunities for students, utilities, transportation, and more.⁵⁰⁸ By tapping into the variety of these resources, programs can expand their base of funders and ensure that they have enough funding to sustain and scale their program.

Of the potential partners listed above, schools and school districts are considered one of the most valuable partners an OST STEM program can develop. These partners have access to so many of the resources a program needs, leading to dramatically lower costs for OST organizations.⁵⁰⁹ For example, a school or school district can often offer facilities, staff, teachers, recruiting services, transportation, meals, technology, internet, utilities, and curricula – typically some of the most important and expensive parts of providing OST STEM programs.⁵¹⁰ For this reason, the majority of OST STEM programs benchmarked in this report have developed partnerships with schools and school districts.

Best Practice in Action:

- *Higher Achievement* devotes a great deal of their efforts to fundraising and, as a result, the program was able to secure \$3 million to conduct a longitudinal study of its OST program to investigate if their program produces statistically significant academic gains for their students. Securing this funding was easy. The program applied for a Wallace Foundation grant four times before they were eventually successful in winning the funding necessary to conduct the evaluation.⁵¹¹ In addition, the program has been able to find funding through local law enforcement agencies, appealing to these agencies' interest in keeping students supervised, off the streets, and occupied in order to reduce crime rates.⁵¹²
- *Project Exploration* spent \$1,620,741 in the fiscal year ending August 31, 2010. Its two largest sources of revenue were corporations and foundations, which constituted 49 percent of all donations; individual donors contributed 22 percent of the remaining revenue. Only one percent of funding came from government awards. Overall, *Project Exploration* has over 200 donors that make their program possible.⁵¹³
- *21st Century Community Learning Centers* funds the Cooperative for After-School Enrichment (CASE), which was formed by the Harris County Department of Education in 1999 to provide afterschool programs for all students in Harris County, Texas. The partnership with *21st CCLC*

⁵⁰⁸ McCombs, et al. 2011

⁵⁰⁹ Boulay 2011

⁵¹⁰ McCombs, et al. 2011

⁵¹¹ Jefferies 2011

⁵¹² Ibid

⁵¹³ Project Exploration 2010

NASA SoI Excellence in Summer Learning Benchmarking Study

enables CASE to provide technical assistance, professional development, budget management, and site observation visits to support staff at 39 centers in the Houston area.⁵¹⁴

- *Aim High* has extensively sought local and community funding, and now city and community foundations are among the largest supporters of the program. In fact, its mathematics curriculum in the Silicon Valley is entirely funded through the Silicon Valley Community Foundation.⁵¹⁵
- *Higher Achievement* was once 80 percent funded by foundations, but they chose to pursue more federal funding in order to expand the organization. This ambitious search for additional funding sources ultimately provided *Higher Achievement* with a much broader financial grounding. They now rely on foundations to provide only 50 percent of their funding, federal funding now accounts for 15 percent, and individuals and corporations provide the remaining 35 percent.⁵¹⁶ Currently, there are 12 funders donating over \$100,000 to *Higher Achievement* each year. Some of these supporters include the Atlantic Philanthropies, Baltimore City Public Schools, Family League of Baltimore City, the Freddie Mac Foundation, and The William T. Grant Foundation, among others.
- *Techbridge* currently receives annual contributions of over \$100,000 from the National Science Foundation, the Noyce Foundation, the Gordon and Berry Moore Foundation, and Chevron, among others. In addition, they partner with a variety of other funding sources, such as school districts, Apple, Kaiser Permanente, the Massachusetts Institute of Technology (MIT), a variety of other Universities, and Google, among many others.⁵¹⁷
- *Breakthrough Collaboration's* national headquarters has developed a training program to teach frontline staff and local directors how to diversify their fundraising efforts.⁵¹⁸
- *Girlstart* builds partnerships with local schools and relies on those partners to recruit students and provide facilities. Tamara Hudgins, Executive Director, always visits a school before formalizing a partnership to get a sense of whether or not the principal will be collaborative and she will turn down a potential partnership if she has any question about whether or not that school will be open to fully supporting *Girlstart*.⁵¹⁹

Assessment of Importance to Sol:

This best practice is *highly important* to Sol. National Awardee funding is delivered in a phased approach, with funding levels decreasing each year during the period of performance despite expectations for continued success at meeting project requirements. Therefore, Awardees' Sol programs will only be sustainable if they partner with additional funders. Sol was designed to build capacity of OST programs so that they would subsequently be able to provide middle school students with high-quality STEM activities, but additional partnerships are crucial for maintaining this capacity over the long term. Sol can leverage partnerships with other organizations, including national nonprofits and other federal programs, to link Sol's Awardees and implementers with additional funding and resources.

⁵¹⁴ Afterschoolzone n.d.

⁵¹⁵ Capobres 2011

⁵¹⁶ Jefferies 2011

⁵¹⁷ Techbridge n.d.

⁵¹⁸ Martinez 2011

⁵¹⁹ Hudgins 2011

NASA SoI Excellence in Summer Learning Benchmarking Study

- Overall, National Awardees' with additional partners beyond NASA were better able to meet requirements. For example, Awardees with partnerships with a PD organization exceeded teacher PD requirements. In contrast, Awardees without additional partners may not be able to continue STEM programming at Sol levels after the Sol period of performance ends.
- Many Centers partnered with organizations that already had funding from other sources and only required NASA Sol content. Because this type of partnership does not rely on Center funds, implementers will likely be able to sustain the Sol programming by continuing to use the free NASA STEM content and by leveraging their additional partnerships.
- Sol can pursue partnerships with many other organizations to increase implementers' sustainability, including 21st Century Community Learning Centers.

IV.4.1.2 Best Practice: Seek In-Kind Donations

Best Practice Description:

One way for OST STEM programs to save money or to expand operations is to seek in-kind donations from businesses, other organizations, or individuals.⁵²⁰ These in-kind donations often provide for a significant portion of a program's budget through donated staff time and services, facilities, equipment, photocopying, utilities, internet access, accounting, website development, classroom supplies, technology, and more.^{521,522} While these individual donations may not constitute a large contribution by themselves, collectively these donations often add up to a substantial expense. In fact, research shows that securing in-kind donations for these resources might be stitched together to save up to 15% of the average summer program's budget.⁵²³

The Afterschool Alliance suggests that programs begin seeking in-kind donations by mapping their community's resources and analyzing how those resources may be used by the program to identify savings opportunities. Local schools are often some of the greatest resources because they can provide classroom space, technology, and staff, but programs should be also creative in reaching out to other potential resources. For example, a local nonprofit may be able to help with grant writing, or a health care agency could provide public relations or even supplies.⁵²⁴ Programs should research companies from whom they are requesting donations so that they can tailor their proposals to the individual corporate sponsors to be clear about what services or goods they are requesting. In addition, programs should seek a personal contact when seeking donations from businesses because requesting donations from an already established contact is more likely to be fruitful.⁵²⁵

Best Practice in Action:

- *Project Exploration* has creatively pursued in-kind donations and has focused on targeting corporate or retail organizations with dedicated foundations willing to give in-kind donations – even if direct funding might not be available. For example, the outdoor sportswear clothing company REI could

⁵²⁰ McCombs, et al. 2011

⁵²¹ Ibid

⁵²² Afterschool Alliance n.d. b

⁵²³ McCombs, et al. 2011

⁵²⁴ Afterschool Alliance n.d. b

⁵²⁵ Ibid

NASA SoI Excellence in Summer Learning Benchmarking Study

not provide money, but they did donate backpacks to students and space for a program leadership retreat.⁵²⁶

- *Aim High* partners with four independent schools, and each of these schools provides an in-kind donation to cover operating costs. *Aim High* prioritizes a commitment to seeking in-kind donations when choosing partner schools because securing these types of donations is an attainable goal and significantly helps alleviate the program's expenses.⁵²⁷
- *Girl Scouts* received \$6,831,000 in donated television, radio, and print advertising from a variety of sources during October 1, 2009 to September 30, 2010.⁵²⁸
- *Girls Incorporated (Operation Smart)* received \$2,217,115 worth of in-kind contributions from its partners in the year that ended March 31, 2010.⁵²⁹
- *Citizen Schools* receives in-kind contributions from a number of large corporate sponsors, including Accenture, IBM, Microsoft, Hewlett Packard, and Time Warner Cable.⁵³⁰
- *Aim High* keeps a list on their website of program needs for which they solicit donor support. Some of the in-kind donations they request include food, digital cameras, photography, videography, transportation for field trips, laptop computers, outdoor education gear, school supplies, athletic gear, tickets to museums, sporting events, and movies, books, web site development services, and advertising services.⁵³¹
- *Breakthrough Collaborative* received \$574,645 worth of in-kind contributions in the 2010 fiscal year, which accounted for 20% of its annual costs. Some of the major in-kind donors were The Fairmont San Francisco, Gap Inc. Legal Team Volunteers, The Morehead-Cain Scholars Program, Orange Photography, National Public Radio, PH7 Design, The Robertson Scholars Program, Organizations and Transactions Clinic of Stanford Law School, and Winton duPont Films.⁵³²

Assessment of Importance to Sol:

This best practice is *moderately important* to Sol. In-kind donations represent one of many ways that National Awardee organizations, Center implementing partners, or Mini-Grant Awardees can increase capacity and sustainability of their STEM programming.

- In summer 2011, National, Center, and Mini-Grant Awardees leveraged many types of in-kind donations, including mentors from universities and STEM businesses, STEM materials from universities, ad space from radio stations and television networks, and food provision.
- Centers leveraged additional resources unique to their Center, including personnel that were paid by other NASA projects, Center education materials, and facilities.

IV.4.1.3 Best Practice: Cultivate Strong Stakeholder Dialogues

Best Practice Description:

Leading OST STEM programs cultivate strong relationships with stakeholders and assiduously steward these relationships to enable them to cultivate sufficient resources to provide free programming for

⁵²⁶ St. Louis 2011

⁵²⁷ Capobres 2011

⁵²⁸ Girl Scouts of the USA 2010

⁵²⁹ Girls Incorporated 2010

⁵³⁰ Citizen Schools n.d.

⁵³¹ Aim High n.d. a

⁵³² Breakthrough Collaborative 2010a

NASA SoI Excellence in Summer Learning Benchmarking Study

students. Strong stakeholder relationships improve programs' chances of receiving continued or increased financial support in subsequent years, making the program more sustainable.⁵³³ Proactive programs prioritize regularly communicating their progress and impact to stakeholders and maintain an open line of more informal communication with these stakeholders.⁵³⁴ Regular communication, both formal and informal, fosters a strong relationship with stakeholders, increasing the likelihood of continued funding, the provision of more resources, and securing of in-kind contributions because it invests partners in the program's mission and success and helps these stakeholders understand the impact their donation is making.⁵³⁵

One common way of communicating with funders is by developing an appealing and detailed annual report and frequently communicating progress across regularized channels. Organizations can go above and beyond financial reports to include stories, student testimonies, and pictures - all are powerful ways to steward relationships with funders, helping them to visualize and to understand their impact on a more personal level.⁵³⁶ Also, periodic phone calls to update stakeholders is an effective personal touch to developing these relationships, particularly if a program can establish contact with an individual who is actively involved in the allocation of funding.⁵³⁷ Ultimately, the goal should be for programs to find ways to connect with stakeholders in a way that deepens their personal investment and commitment to the program, communicates the difference partners are making and importance of their investment, and motivates their partners to continue investing in the organization in future years.^{538,539,540}

Best Practice in Action:

- *Operation Smart (Girls Incorporated)* displays videos of their financial supporters sharing why they choose to invest in the program. This public showcasing gives funders a platform to share why they chose to support *Operation Smart* and having their video on the site makes these supporters feel personally invested in the program. In addition, *Operation Smart* pays tribute to all of its funders by promoting a list of all donors and thanking them for their support.⁵⁴¹
- *TechREACH* maintains strong and regular communication with their stakeholders and funders. *TechREACH* promotes an open line of communication that makes funders feel like they can reach out to the program, and sends pictures, quotes, videos, and stories to stakeholders so that they see anecdotal evidence of an impact, which sometimes speaks more powerfully to them than the typical data reports that most programs issue.⁵⁴²
- *Citizen Schools* recruits its corporate sponsors to engage in volunteering with students and to provide apprenticeships for students. *Citizen Schools* then highlights these companies' stories on their website and in their newsletter. For example, *Citizen Schools* recently released an article detailing the impact that Wells Fargo has made by offering financial literacy workshops and

⁵³³ Jefferies 2011

⁵³⁴ Ibid

⁵³⁵ Sandel, et al. 2007

⁵³⁶ Enman 2011

⁵³⁷ Sandel, et al. 2007

⁵³⁸ Enman 2011

⁵³⁹ Citizen Schools n.d.

⁵⁴⁰ Sandel, et al. 2007

⁵⁴¹ Operation SMART n.d.

⁵⁴² Enman 2011

NASA SoI Excellence in Summer Learning Benchmarking Study

financial and volunteer support to the program. This type of promotion honors the contributions of funders and increases their personal investment in the program.⁵⁴³

- *Girl Scouts* creates a polished annual report that was 44 pages long in 2010. They fill their reports with student testimonies, pictures, stories, and data indicating the success and impact of the organization. In addition, they thank all of their donors and reiterate the mission and vision of the organization. It gives funders a more comprehensive understanding of why their investment was valuable.⁵⁴⁴

Assessment of Importance to Sol:

This best practice is *highly important* to Sol. In 2011, Sol had little insight into National Awardee activities during implementation. Sol was subsequently unable to proactively assist Awardees with overcoming obstacles, which negatively impacted Awardees' ability to meet their requirements and which may ultimately prevent some Awardees from receiving follow-on funding. Sol communicated project successes to OMB and NASA leadership to ensure their continued support of the project and to comply with Agency reporting requirements.

- Sol is taking steps to improve communication with National Awardees. Awardees that had more communication with their Sol Technical Representative were generally more successful than those that did not have regular contact with Sol personnel. By increasing communication with Awardees, Sol can help them troubleshoot any obstacles in real time and hopefully increase confidence in Awardees' program implementation.
- At the 2011 project review meeting following summer implementation, each of the National and Center Awardees were able to present updates on their programming in summer 2011. This gave Awardees the opportunity to share pictures, videos, and student and teacher participation data, as well as anecdotal evidence of promising practices and lessons learned.
- Over the past year, Sol has leveraged several reports and presentations to communicate the project's design and progress toward objectives to internal stakeholders within the NASA Office of Education and to external stakeholders at OMB.

IV.4.1.4 Best Practice: Secure Funding Early in the Year

Best Practice Description:

OST STEM programs should secure funding several months in advance of the beginning of a program in order to plan accordingly and avoid exceeding their budget. Leaders of summer STEM programs who were interviewed agreed that it is *ideal* to secure funding by the September or October before the summer program, *important* to secure it by January, and *critical* by the end of February.^{545,546} Securing funding well in advance of programming allows programs to assess how many students they can serve, how many teachers they need to hire, what activities they can incorporate, how much space they will need, and how much food and transportation they will need to secure. These advanced timelines also allow programs time to plan requirements for reporting, performance data, curriculum, and program structure and to align these outputs with needs set forth by funders and stakeholders, which can be

⁵⁴³ Citizen Schools n.d.

⁵⁴⁴ Girl Scouts of the USA 2010

⁵⁴⁵ Phalen 2011

⁵⁴⁶ Enman 2011

NASA SoI Excellence in Summer Learning Benchmarking Study

complicated in terms of satisfying and balancing against the needs from other stakeholders and funders.^{547,548}

One strategy for programs to ensure stable funding is to seek multi-year grants. These grants guarantee that programs will have funding over several years, which is particularly important in times of economic downturns. The securing of multi-year grants alleviates the uncertainty of where the next year's money will come from and whether the program will be able to continue and, perhaps just as importantly, allows programs to focus more of their attention to improving program quality or increasing the number of students reached. These multi-year grants also benefit funders, because it enables them to hold programs accountable to funding requirements, such as turning in data on time and accurately reporting progress. If the program does not meet the requirements, the donor can discontinue funding in subsequent years. Ultimately, multi-year funding commitments represent a winning situation for both parties involved.^{549, 550}

Best Practice in Action:

- Earl Phalen expressed that both of the programs he founded, *BELL* and *Summer Advantage*, have prioritized securing funding early in the year, well in advance of programming. Phalen stated that it has been critical for his programs to secure funding by January, though it is very helpful to secure it by September or October.⁵⁵¹
- *Higher Achievement* seeks multi-year grants and donation pledges in order to ensure their sustainability for more than one year at a time. Lynsey Jeffries, Executive Director of the D.C. location, stated that this has been particularly important during struggling economic times and when expanding to new locations.⁵⁵²

Assessment of Importance to Sol:

This best practice is *highly important* to Sol. Late or delayed National and Center Award solicitation releases, awards, and fund transfers severely limited the ability of many Awardees and implementers to effectively plan for programming.

- The National Award procurement time-out will help alleviate some of the planning pressure for the Sol project team and for future Awardees.
- Sol is planning to release the 2012 Center Award solicitation months earlier than the 2011 solicitation, allowing the Centers to solidify relationships with future collaborators well before the summer.

⁵⁴⁷ McCombs, et al. 2011

⁵⁴⁸ Phalen 2011

⁵⁴⁹ Ibid

⁵⁵⁰ Jefferies 2011

⁵⁵¹ Phalen 2011

⁵⁵² Jefferies 2011

NASA SoI Excellence in Summer Learning Benchmarking Study

IV.4.1.5 Best Practice: Find Creative Ways to Save Money on Staff and Materials

Best Practice Description:

Paying staff and purchasing enough classroom materials for every child are significant expenses for most OST STEM programs, so sustainable organizations typically explore creative ways of saving money on these expenses. One of the primary ways that they trim operating costs is to recruit volunteer staff members and educators. For example, some programs hire AmeriCorps volunteers because they are cheaper than hiring a certified teacher.^{553, 554, 555, 556} Many programs also recruit university students pursuing education degrees to volunteer as unpaid teaching interns in return for teaching experience.^{557, 558, 559}

In addition to recruiting volunteer staff, leading programs often focus on using reusable resources to avoid having a constant outflow of money for materials. While the expense of these materials is not initially high, when purchased in bulk for hundreds or thousands of students, even small individual costs can be magnified.⁵⁶⁰ For example, marshmallows for an experiment may not cost much for one class of students, but those costs do add up when buying for thousands of students. Using a reusable resource instead, such as cotton balls, can end up saving significant amounts of money. Ultimately, finding creative ways to cut costs, as long as they does not sacrifice program quality, can help programs balance their budgets, sustain their organizations, and expand to new sites.

Best Practice in Action:

- *Higher Achievement* recruits teachers who are working toward their education degrees because these pre-service teachers need experience but are also somewhat familiar with effective instructional methods and are typically used to working with students. This practice has enabled the organization to save money, contribute to the development of the next generation of teachers, and provide quality teaching at the same time.⁵⁶¹
- *Girlstart* hires Texas's UTEACH interns and pre-service teachers for their programs. *Girlstart* provides curriculum and PD to the UTEACH staffers throughout the summer. Some of these educators used to be participants in the *Girlstart* program, which is of great benefit to the program because they have firsthand insight into what students need in order to get the most out of the program. Also, hiring young teachers currently at a university often means these UTEACH recruits have more flexible schedules and are often more available to lead *Girlstart's* new mobile program because their schedules allow for travel.⁵⁶²
- *Citizen Schools* has created a two-year national teaching fellow program that begins with summer training. The summer training provides extensive coaching and evaluation of teachers, and *Citizen Schools* focuses on ensuring that their educators become comfortable and

⁵⁵³ Sacco 2011

⁵⁵⁴ Hudgins 2011

⁵⁵⁵ Martinez 2011

⁵⁵⁶ Capobres 2011

⁵⁵⁷ Jefferies 2011

⁵⁵⁸ Capobres 2011

⁵⁵⁹ McCombs, et al. 2011

⁵⁶⁰ Sacco 2011

⁵⁶¹ Jefferies 2011

⁵⁶² Hudgins 2011

NASA SoI Excellence in Summer Learning Benchmarking Study

knowledgeable about working with middle school students. *Citizen School* educators are AmeriCorps volunteers, reducing the cost to *Citizen Schools* because they are relatively inexpensive and AmeriCorps is federally subsidized. *Citizen Schools* also relies on professional volunteers and corporations to offer apprenticeships, again reducing the cost of hiring staff.⁵⁶³

- *TechREACH* tries to use reusable materials whenever possible to mitigate costs, and they also try to substitute low-cost materials, such as cardboard, for more expensive materials whenever possible. In addition, they ask partner organizations to provide the technology needed to run the program.⁵⁶⁴

Assessment of Importance to Sol:

This best practice is *highly important* to Sol. Most Sol program implementers have limited funds for providing STEM activities, so strategies for saving money during implementation are crucial for program effectiveness.

- Over summer 2011, Curriculum Development Specialists collected ideas for cheaper materials for many of the activities. The Sol website team can post this information on the Sol content section of the website.
- Some Awardees found ways to save money on staff by leveraging interns as educators or support staff.

IV.4.2 Best Practices for Scaling Up

- ***Assess Current Program to Determine Readiness to Scale-Up***
- ***Identify Communities with Strong Potential for Program Success***
- ***Build Capacity to Manage Multiple Sites***

IV.4.2.1 Best Practice: Assess Current Program to Determine Readiness to Scale-Up

Best Practice Description:

Before an organization takes its program to scale, it should first evaluate its existing program to determine whether it is an effective model that is ready for and worthy of expansion. If the current program is not already making significant progress towards its goals and accomplishing its vision, the program should use feedback from its evaluation to make changes to the program before expanding.⁵⁶⁵ Once a program has been deemed successful and worthy of scaling up, the organization should analyze and map out the elements of the program that made it successful and determine how those elements can be adapted to new program sites. This analysis is critical to the development of a strategic plan for new program sites to ensure successful implementation.⁵⁶⁶

⁵⁶³ Cohen and Alfaro 2011

⁵⁶⁴ Enman 2011

⁵⁶⁵ Ibid

⁵⁶⁶ Harris 2010

NASA SoI Excellence in Summer Learning Benchmarking Study

Best Practice in Action:

- *Citizen Schools* piloted its program in Boston and originally partnered with the YMCA and the Boys & Girls Club of Boston because they were serving middle school students. *Citizen Schools* soon discovered that these organizations did not have the same commitment to evaluation as *Citizen Schools* did, so they broke away from these partnerships and developed their own nonprofit organization. *Citizen Schools* then decided to only focus on extending the regular school day to improve failing schools, so they designed ways to evaluate schools for potential relationships and then developed deep school partnerships. Through a measure of trial and error, *Citizen Schools* eventually established a program that proved successful through evaluation and began to scale up. Currently they have established partnerships with schools at 31 sites around the United States as a result of this successful scaling process.⁵⁶⁷
- *Girlstart* piloted its mobile lab in 2010, which is a new programming facet that enables their organization to travel to locations outside of Austin for a week or more to provide camps for students in those areas. They tested the mobile lab at the Boys & Girls Club in Killeen, TX, and they discovered that it was a very successful and meaningful experience for the girls in the program. One discovery the program staff made was that it is very important for the leader of a mobile camp to be someone who is already an employee of *Girlstart* so that they know how the camp should run and how the activities should be implemented. This experience within the organization ensures programmatic fidelity as the staff member already knows what the projects entail and how to facilitate the activities. Now that the program has identified a successful model for providing a mobile camp, the organization is planning to scale-up for the 2012 summer by implementing five mobile camps.⁵⁶⁸

Assessment of Importance to Sol:

This best practice is *moderately important* to Sol. Currently, Sol does not have any plans for independently scaling up the operations of existing Awardees, but there is potential to bring Awardee best practices to scale.

- Sol will reach more students in summer 2013 than in 2011, but the majority of this scaling up will likely come from onboarding new Awardees, rather than from scaling up existing Awardee programs.
- Sol should take the time to learn from its 2011 implementers to determine which aspects of the model it should scale up within the program moving forward. Sol can use this knowledge to help select Awardees with models that are likely to be successful at helping Sol reach its objectives.

⁵⁶⁷ Cohen and Alfaro 2011

⁵⁶⁸ Hudgins 2011

NASA SoI Excellence in Summer Learning Benchmarking Study

IV.4.2.2 Best Practice: Identify Communities with Strong Potential for Program Success

Best Practice Description:

When deciding on new program sites during the process of scaling-up, organizations should be careful to select communities where the program has a good chance of succeeding. Programs should begin by ensuring that the potential site actually has a need for the program and that the new community will welcome and support the endeavor. Expanding to an area without generating local buy-in for the program or expanding to an area already saturated with OST programs will likely be challenging and will not position a program well to recruit participants and sustain the program for years to come.^{569,570}

After ensuring local need and buy-in for the program, organizations should move forward with logistical and human capital concerns, such as identifying potential program leaders who can build and sustain the project, cultivating partnerships with local organizations and schools that can provide facilities and resources, and securing the grants and donations necessary to support the program. Each community is a different organism, so it is important for programs to ensure that they will be able to secure all of these needs before moving forward with implementation.^{571, 572} These planning steps ensure that a program is selecting the best possible locations to which they can expand and should increase the likelihood of a successful implementation.

Best Practice in Action:

- *Techbridge* created a Girls Go Techbridge program-in-a-box that includes user-friendly science experiments and activities that Girl Scout troops can use to gain experience in STEM. The kits also include career information, a leader guide, and a list of resources for students to take to their families. While commodification of STEM activities is an untraditional way of scaling up, *Techbridge* was creative in finding a way to expand its impact while staying within its financial means and contributing to other programs, such as *Girl Scouts*, that were also looking for ways to increase students' interest in STEM.⁵⁷³
- *Citizen Schools* has a detailed formula to select schools with which to partner in order to ensure success. They require that school partners have a demonstrated track record of working with outside partners, a strong principal with a data-driven approach to success, a school improvement strategy that focuses on teacher engagement, and a commitment to the *Citizen Schools* program as the center of their schools' improvement plan. They also require that schools be committed to providing space, staff, time, and funding necessary to ensure a successful program implementation. Focusing on these criteria ensures that *Citizen Schools* will

⁵⁶⁹ Change the Equation 2011

⁵⁷⁰ Harris 2010

⁵⁷¹ Ibid

⁵⁷² Jefferies 2011

⁵⁷³ Techbridge n.d.

NASA SoI Excellence in Summer Learning Benchmarking Study

be able to succeed in new communities and that it is selecting the best possible locations for scaling up.⁵⁷⁴

Assessment of Importance to Sol:

This best practice is *moderately important* to Sol. Sol has been hugely successful with its geographic reach in 2011. Because Sol increases OST programs' STEM capacity in a variety of ways, most communities would be able to partner with at least one type of Sol award.

- Sol can reflect on its Award types to see commonalities between communities that successfully implemented programming with different Award requirements. Based on this knowledge, Sol can help steward potential implementers toward an award type that fits with their local needs.
- If the Sol project team or NASA leadership decides that Sol should increase its focus on a certain type of community, Sol can strategically leverage Mini-Grants to support local programming for a minimal cost.

IV.4.2.3 Best Practice: Build Capacity to Manage Multiple Sites

Best Practice Description:

Organizations should ensure that they have developed the organizational capacity to manage multiple sites before they begin the scaling process. Expanding to new sites necessitates the development of a management system capable of coordinating and overseeing a larger staff, managing more daily operations, collecting a larger set of data, raising more money, and recruiting and educating more students across multiple geographic locations.^{575, 576} Successful expansion also involves securing the resources and structures necessary to ensure that the organization will be able to thrive in its new setting. Examples of these necessary resources and structures include local program leadership staff, funding, educators, and facilities.⁵⁷⁷ Finally, building capacity to manage multiple sites requires programs to investigate and leverage the local resources of the new community and also to identify and plan to overcome challenges that they will likely face at the new site.⁵⁷⁸ Each location is sure to have its own resources and challenges based on its unique community, so ultimately it is important to the success of the program at-large for the organization to strategically plan to adapt programming to each site.

Best Practice in Action:

- *Citizen Schools* has three levels of leadership that enables them to effectively manage their 31 program sites across the United States. They have 19 members on the leadership team at the program's headquarters who manage program logistics on a national level. There are also state offices for each state where the program exists, and each state has its own Executive Director.

⁵⁷⁴ Citizen Schools n.d.

⁵⁷⁵ Jefferies 2011

⁵⁷⁶ Martinez 2011

⁵⁷⁷ Jefferies 2011

⁵⁷⁸ Harris 2010

NASA SoI Excellence in Summer Learning Benchmarking Study

Local staff manages the day-to-day logistics of each program site and ensure that the sites' programming runs smoothly. Each of these teams works together to improve program quality and to deliver an effective OST program.⁵⁷⁹

- *Higher Achievement*, which currently operates programs in three geographic locations, plans to expand to Pittsburgh, PA in 2012, and plans to continue expanding to a total of 10 cities by 2017. In addition to growing its staff, the program has created a dashboard of metrics that enables the national office to easily monitor the data and progress of each program location, making it possible for the program to maintain its commitment to evaluation while scaling up.⁵⁸⁰

Assessment of Importance to Sol:

This best practice is *highly important* to Sol. National Awardees and Centers must manage several sites in order to meet teacher and student participation requirements, so coordination across sites is crucial for achieving requirements.

- National and Center Awardees had little insight into implementer activities, sometimes leading to lower than expected participation numbers and data collection form response rates.
- Some National Awardees and Centers developed platforms for managing implementers. The project manager could use this platform or dashboard to monitor implementer data and progress toward objectives.

⁵⁷⁹ Citizen Schools n.d.

⁵⁸⁰ Jefferies 2011

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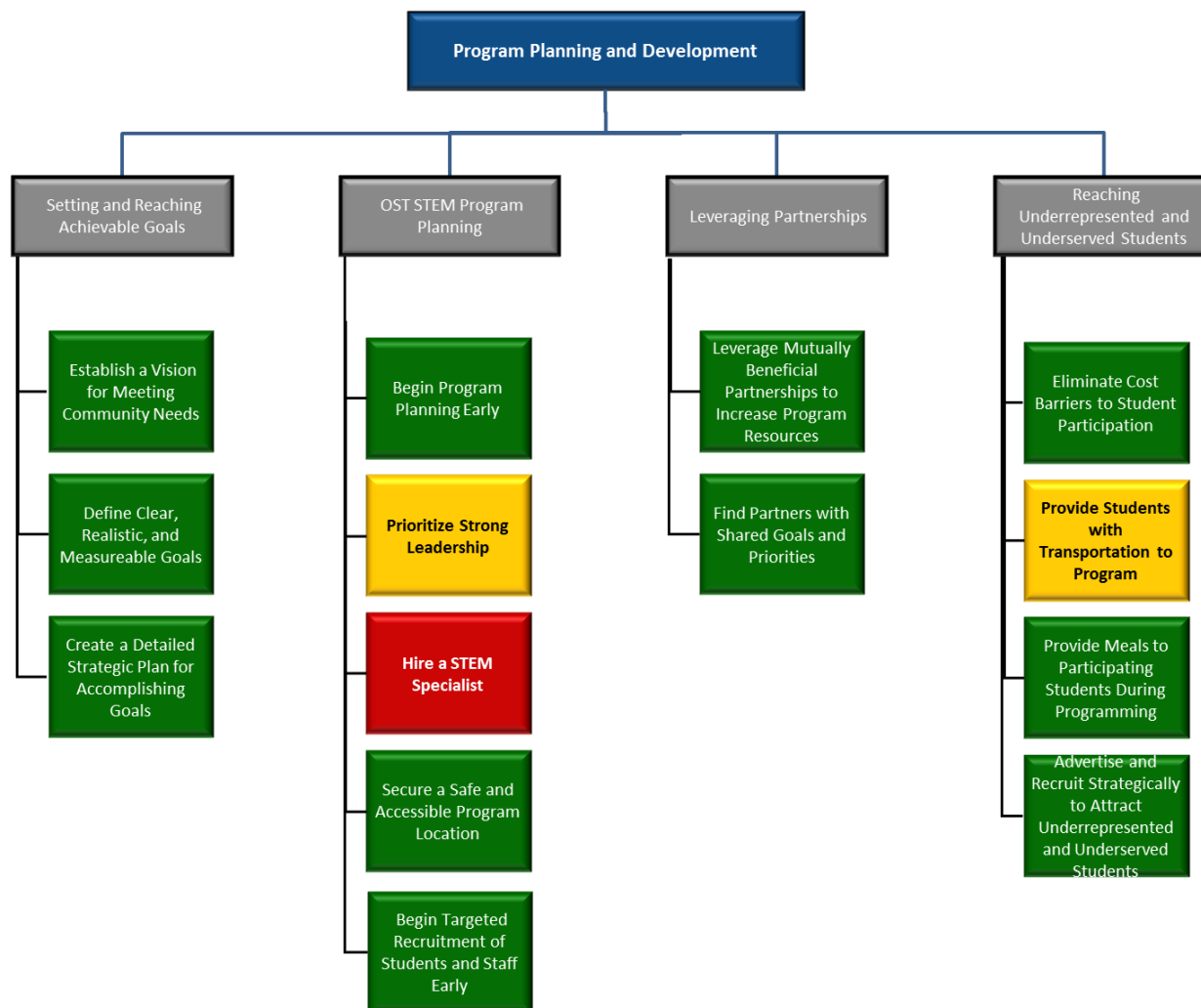
VI. Appendix A – Best Practices by Category and Importance to SoI

The following charts show all of the best practices categories, best practice sub-categories, and best practices featured in this report, as well as the importance of each BP to the success of the SoI project.

-  This best practice is *highly important* to SoI
-  This best practice is *moderately important* to SoI
-  This best practice is *not important* to SoI

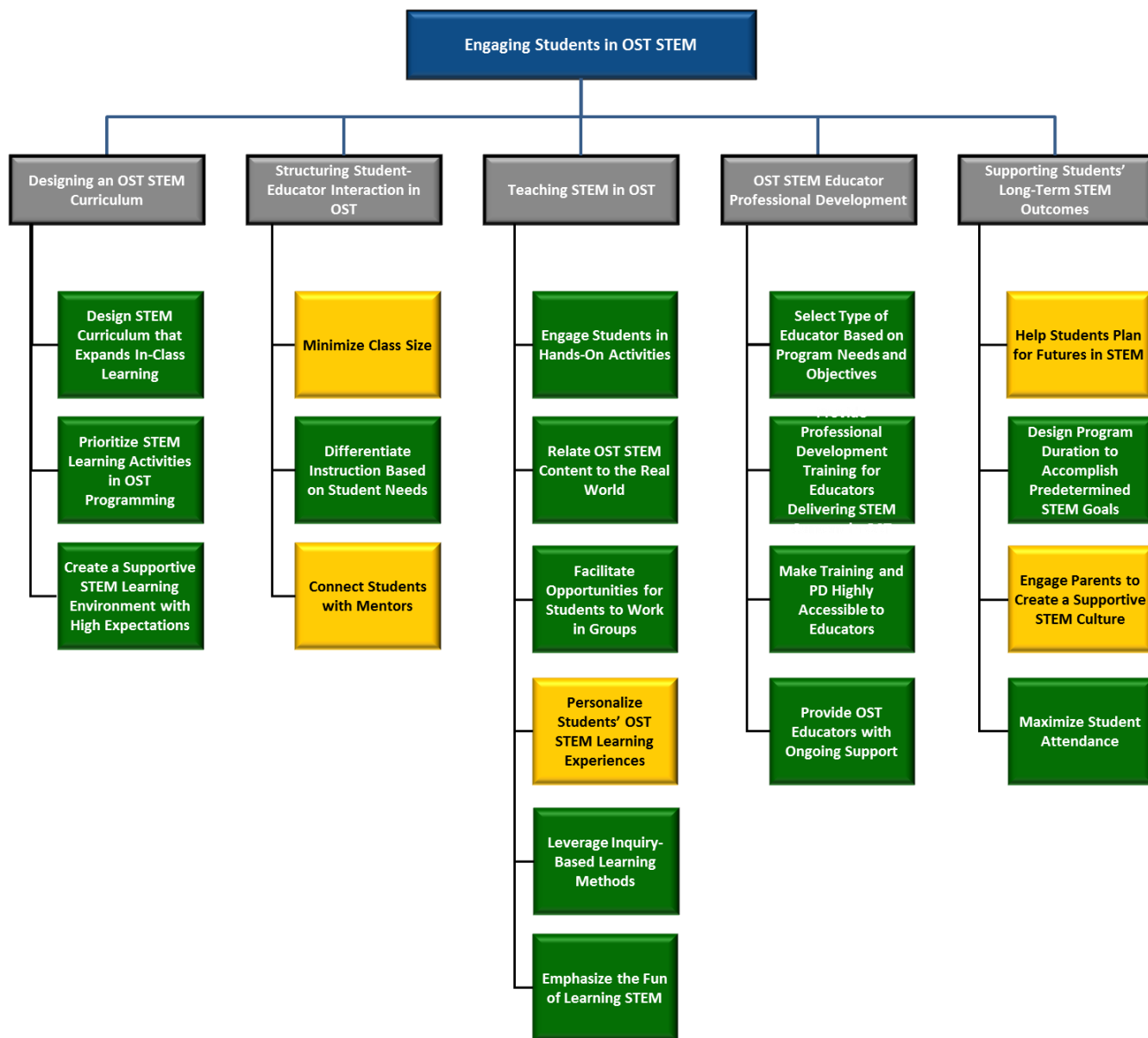
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Best Practices by Category and Importance to SoI – Program Planning and Development

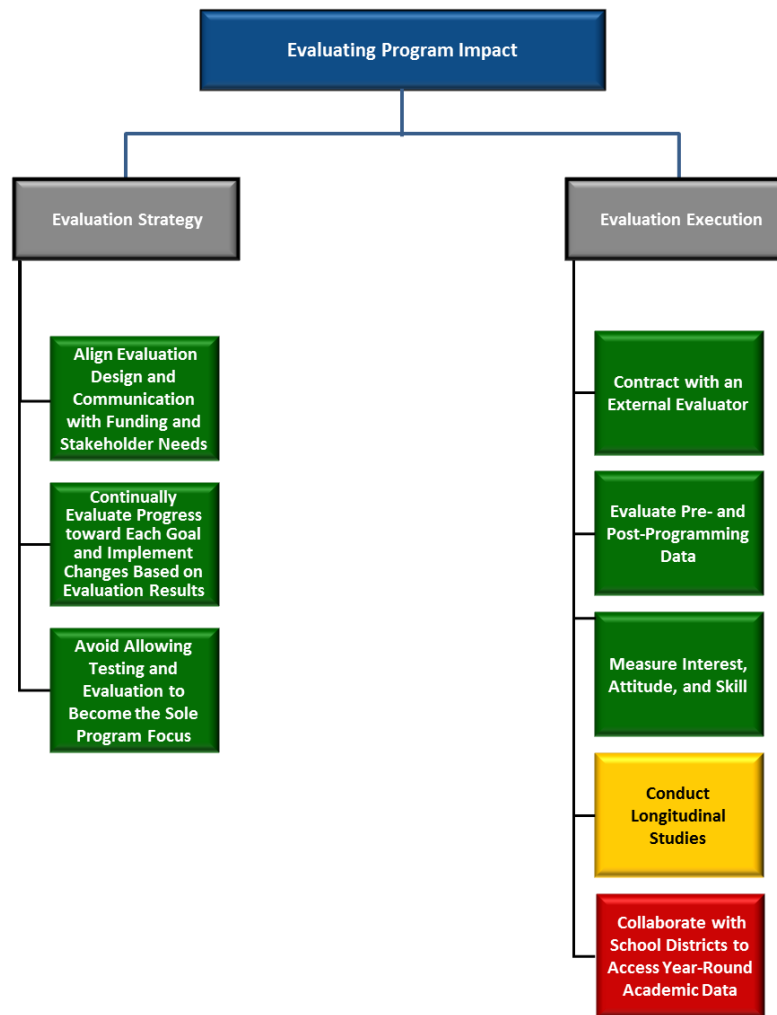


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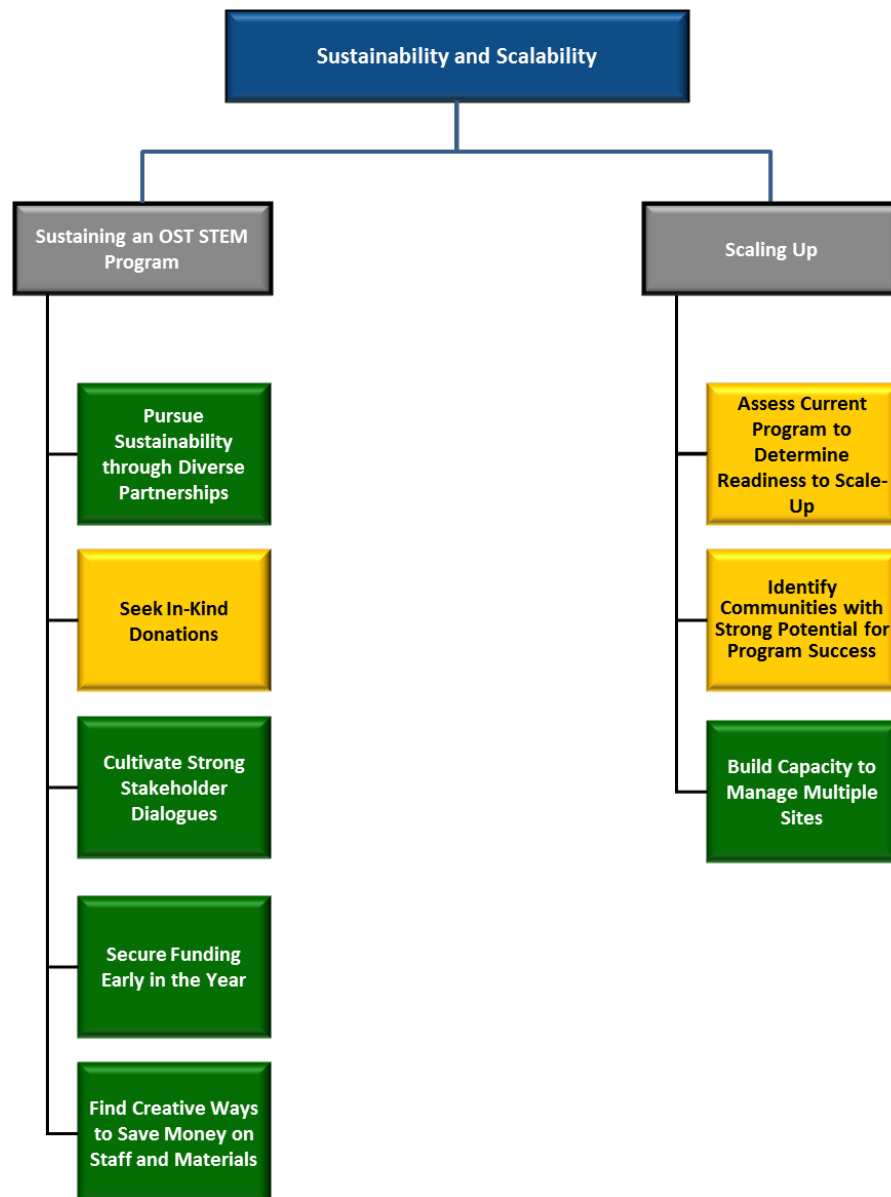
Best Practices by Category and Importance to SoI – Engaging Students in OST STEM



Best Practices by Category and Importance to SoI – Evaluating Program Impact

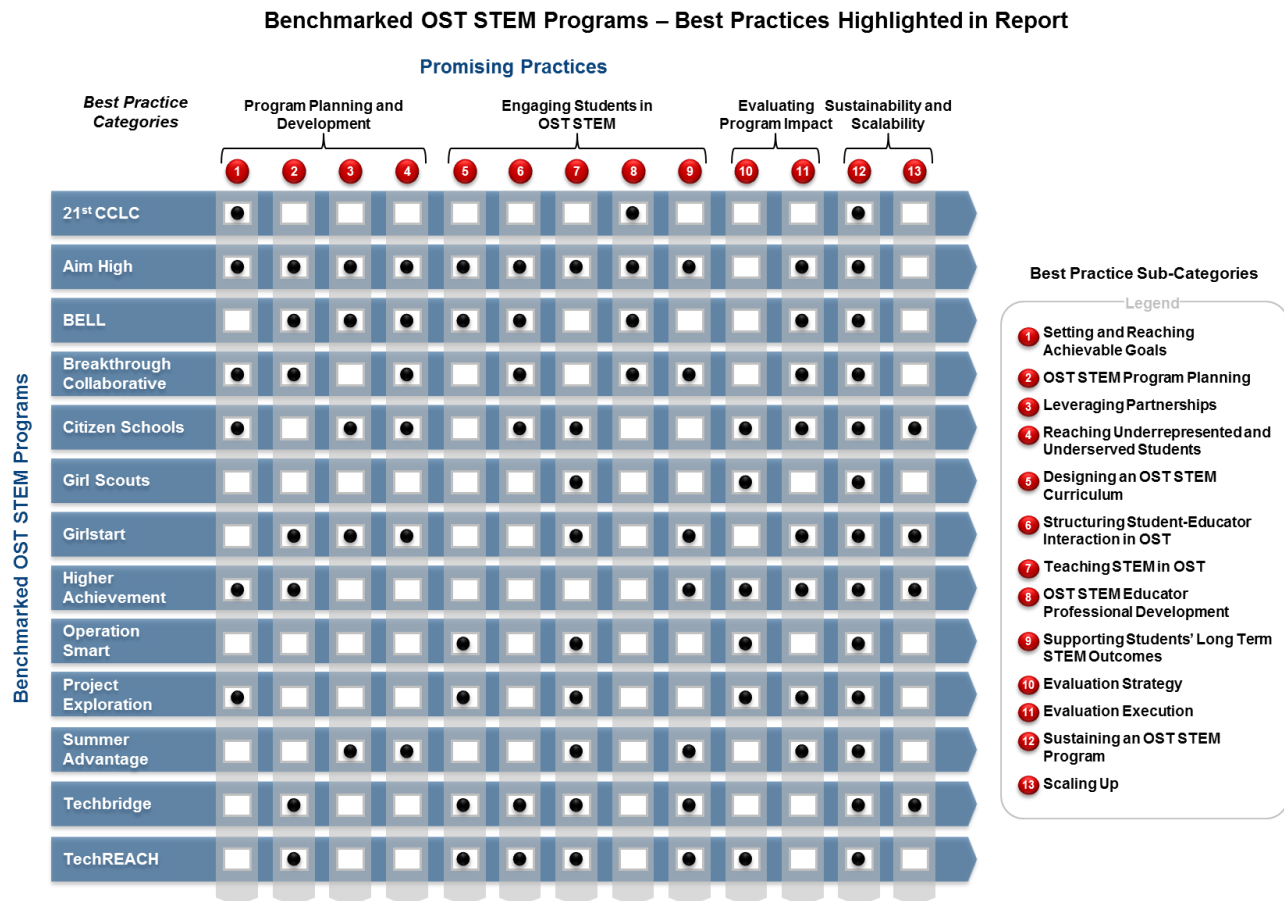


Best Practices by Category and Importance to SoI – Sustainability and Scalability



VII. Appendix B – Benchmarked Program Best Practices Highlighted in Report

The following matrix illustrates the OST programs represented in the best practice in action sections of each best practice sub-category. The rows represent each of the 13 benchmarked organizations, and the columns represent each of the 13 best practice sub-categories. The dots indicate that a benchmarked program was used as a practical example in the best practice in action section of the best practice sub-category. The sub-categories are listed in the legend to the right of the matrix.



VIII. Appendix C – Acronyms and Abbreviations

| | |
|-----------------------|---|
| 21 st CCLC | 21 st Century Community Learning Centers |
| BELL | Building Educated Leaders for Life |
| CASE | Cooperative for After-School Enrichment |
| CBO | Community Based Organization |
| ECC | Education Coordinating Committee |
| MDTP | Mathematics Diagnostic Testing Project |
| NEON | NASA Educator Online Network |
| NSF | National Science Foundation |
| NSLA | National Summer Learning Association |
| OMB | Office of Management and Budget |
| OST | Out-of-School Time |
| PD | Professional Development |
| PISA | Programme for International Student Assessment |
| P/PV | Public/Private Ventures |
| REA | Center for Research, Evaluation, and Assessment |
| SES | Socioeconomic Status |
| SoI | Summer of Innovation |
| STEM | Science, Technology, Engineering, and Math |
| TWG | Technical Working Groups |